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DEVELOPMENT OF ONLINE STUDENT WORKSHEET BASED ON SCIENTIFIC APPROACH TO IMPROVE CRITICAL THINKING ABILITY IN JUNIOR HIGH SCHOOL

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Abstract: This research is based on learning activities in several junior high schools in Tangerang that have yet to be oriented to students' integration and critical thinking skills. The ability to think critically in learning can be done by growing it through electronic teaching materials like an electronic worksheet with a scientific approach. STUDENT WORKSHEET is compiled using a flip pdf builder application to support learning in the 21st century by utilizing technology. The purpose of this study was to design student worksheets in electronic form with a scientific approach to the theme of the role of biotechnology in food diversification to foster the critical thinking skills of class IX students. The research method used is Research and Development (R&D) development research with Thiagarajan development design through modifications that are tailored to the needs of researchers with being limited to the expert validation stage, which includes the following stages: Definition (Define), Design (Design), Development (Develop). The instrument used is a material expert validation questionnaire sheet, media expert, and science teacher. The results of this study indicate the validity of the student worksheet by obtaining an average percentage value of 79.92% with a valid category which includes material experts at 63.7% with a valid category, teaching media experts at 81.96% with very valid categories, and teachers IPA is 94.11% with a very valid category.

Keywords: *Student Worksheet, Critical Thinking Skills, The Role of Biotechnology, Scientific*

INTODUCTION

Based on the results of interviews with science teachers at schools, it was found that there are still obstacles to learning, including learning activities that are still teacher-centered, and students tend to be passive in learning. In addition, teachers have used online worksheets in learning, but not yet in an integrated manner because science learning is not yet integrated, so the discussion of concepts in the field of science studies is still separate, and students have difficulty linking the concepts. The student worksheets used as a collection of questions have yet to include critical thinking indicators. The assignments given are in the form of questions of mastery of the material, and the teacher has not involved students in solving a problem. It shows the need for more development of students' abilities in communicating and determining an action, so there is a lack of development of students' critical thinking skills in learning.

Critical thinking ability is an important ability to have in solving problems faced [1]. Although critical thinking skills are important, many students' critical thinking skills still fall into the low category. Because students are accustomed to receiving material directly from the teacher's explanation, learning is teacher-centered [2]. Other studies explain that students' passiveness in learning causes it, so there needs to be more interaction and ability to express arguments or questions [3].

Critical thinking is a process with skills in finding concepts, analyzing and evaluating based on experience, observations, considerations, communication, and determining actions [4]. Students with critical thinking skills can find concepts by looking for relevant resources and conclude and determine actions [5]. Critical thinking development is developing abilities such as observing, analyzing, reasoning, and making decisions [6]. Critical thinking skills developed in learning activities are expected to build the mindset of the future generation of young people to compete at the global level and be rational in choosing a good solution. In addition, it is necessary to build a habit for students in critical thinking to be able to observe various problems that occur in everyday life [7].

For this reason, in learning science, teachers can use student worksheet with a scientific approach to foster students' critical thinking. Learning by utilizing this technology is one of them in the form of student worksheet with a scientific approach that can help students understand the material and foster critical thinking skills [8]. The scientific approach is a learning activity that emphasizes students' activeness in thinking critically and systematically in learning [9]. The scientific approach provides direct experience to students through observation or experiments and observations [10]. The scientific approach includes observing, asking, trying, reasoning, and communicating [11]. The stages of the scientific approach can be integrated with indicators of critical thinking. That emphasizes student activity in understanding the material concept through the stages of observing with

indicators considering good and relevant learning resources, asking with indicators of critical thinking skills focusing questions, trying with indicators to make and determine the results of observations, reasoning with indicators considering the results deducing, and communicating with indicators of critical thinking ability to interact with others [12].

The online student worksheet, which was developed with a scientific approach, raised a theme with a webbed integration model. The model chosen is an integrated model that begins with determining the theme [13]. The theme of this research is the role of biotechnology in food diversification in KD 3.7, applying the concept of biotechnology and its role in life. 4.7 making one of the conventional biotechnology products that are often encountered and 3.3 explaining the concept of mixtures and single substances in the form of elements and compounds and physical and chemical changes in life. The theme raised relates to the application and impact of biotechnology in food manufacture that involves chemical reactions so that students can understand the concept of learning in an integrated and inseparable way. In connection with this background, the researcher aims to develop an student worksheet with a scientific approach to the role of biotechnology in food diversification to foster critical thinking skills for class IX students.

RESEARCH METHODS

This procedure uses research and development methods, or research and Development (R&D), to develop student worksheet with a scientific approach. The model used is the development of a 4-D model (Define, Design, Develop, Dissemination) proposed by Thiagarajan, which is limited to the Develop stage. or development to product revision [14]. The 4-D development model consists of stage I, namely: Define, Design, and Development.

The defining stage is done to determine the problems in learning activities. At this stage, interviews were conducted with science teachers to analyze the needs in learning. The second stage is the design of worksheet instruments and products with a scientific approach. The preparation of tests based on the assessment of teaching materials according to the BSNP, the selection of relevant media in the form of worksheets with a scientific approach using the flip pdf builder application, and the selection of formats adapted to the scientific approach. 15]. At the development stage, the instruments and e - LKPD that have been developed are validated and revised based on the validation results carried out by science experts and teachers [16]. Validation is carried out to obtain a valid worksheet to be used in learning.

The instruments used in this study were interview guidelines and validation sheets. The interview guide contains a collection of questions that are used as a guide in asking questions. During interviews with science teachers in junior high schools to analyze the integrity of making products in the form of student worksheet and validation sheets are used to determine the level of validity of student worksheet products with alternative Likert scale answers. Which consists of: very valid, valid, less valid, and very invalid [17]. Calculations to determine an average category of validation aspects with the formula [18]:

$$P= \frac{\Sigma X}{\Sigma Xi} x100\ \%$$

Information:
P = Percentage score
x = Total value of respondents' answers
xi = Total number of ideal scores

RESULTS AND DISCUSSION

Defining Phase

In the defining stage, a needs analysis is carried out, starting from an analysis of student characteristics, concept analysis by determining KD and indicators, and task analysis to the specification of learning objectives [19]. This stage aims to find out the problems in learning activities in junior high schools in Tangerang so that an student worksheet is produced with a scientific approach by raising a theme of the role of biotechnology in food diversification.

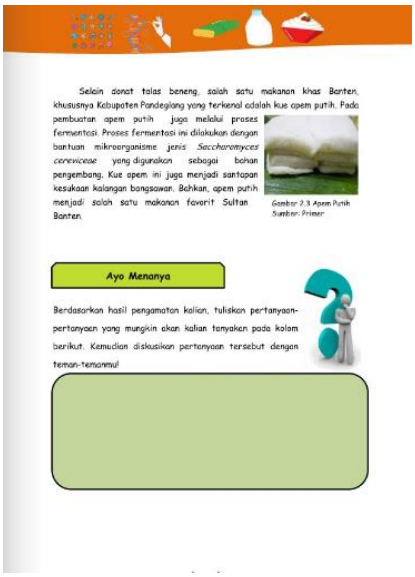
At the definition stage, information is obtained about the curriculum, media, methods, and learning resources used in schools. The curriculum used is the 2013 curriculum with a limited face-to-face learning method. The analysis of student characteristics aims to understand the characteristics of students from knowledge and learning abilities as well as observations of deficiencies in learning activities to suit the development of e- LKPD [20]. The concept analysis identifies the concepts that will be presented in the form of biological concepts related to the basic principles of biotechnology, the application of conventional and modern biotechnology, and biotechnology. Chemical concepts related to chemical changes in food manufacture, environmental concepts related to the impact of the application of biotechnology on the environment, and task analysis to determine the relationship of the material, namely the application and impact of biotechnology on food manufacture. The learning objectives are analyzed so that learning can run according to the expected achievements. The formulation of this goal is an expectation of behavior change after following the lesson.

Design Phase

This design stage aims to prepare media in the form of student worksheet. At this stage, the instrument used in the study was compiled as a validation sheet based on the BSNP teaching material assessment guide covering aspects of the feasibility of content, language, presentation, and graphics [21]. student worksheet with a scientific approach included media selection by identifying student worksheet. by the material being taught.

In student worksheet learning activities using a scientific approach integrated with critical thinking indicators and presenting images, audio and video using the Flip PDF builder and Kine Master applications. Apart from that, the selection of the student worksheet format is adjusted to design the learning content and determine the approach and learning resources, namely the scientific approach and relevant learning resources. The activity steps are adjusted to the scientific approach which includes 5M, namely observing, asking, trying, reasoning, and communicating [22]. The following are the components of student worksheet with a scientific approach which is integrated with the critical thinking indicators in table 1.

Table 1. student worksheet with a scientific approach integrated with critical thinking indicators.

Activity stages	Display of student worksheet
At the let's observe stage, it directs students to try to read the material by reading, to listen, and listening, which is integrated with indicators of critical thinking skills in the form of considering trusted sources.	 Kegiatan 1 Tujuan Pembelajaran: • Peserta didik dapat menjelaskan prinsip dasar bioteknologi dengan benar melalui studi literature • Peserta didik dapat mengamati produk bioteknologi dengan baik melalui pengamatan Ayo Amati Bioteknologi berasal dari kata "bio" yang artinya makhluk hidup dan "teknologi" yang artinya suatu cara. Bioteknologi dapat didefinisikan sebagai penggunaan organisme atau bagian dari organisme untuk membuat suatu produk atau jasa sehingga dapat mensejahterakan manusia. Bioteknologi banyak dimanfaatkan diantaranya yaitu bioteknologi pangan. Bioteknologi dapat digolongkan menjadi bioteknologi konvensional dan modern. Bioteknologi konvensional memanfaatkan secara langsung mikroorganisme dan melibatkan proses fermentasi. Contoh produk bioteknologi konvensional misalnya tapai, roti, keju sepeti pada gambar 1.1 berikut: Gambar 1.1 (a) keju; (b) roti; (c) tapai Sumber: Data Primer, 2022
At the let's ask stage, students are directed to ask questions related to information that has not been understood from the results of observations or in the form of additional information about what was observed and integrated with indicators of critical thinking skills in the form of focusing questions.	 Selain donat talas beneng, salah satu makanan khas Banten, khususnya Kabupaten Pandeglang yang terkenal adalah kue apem putih. Pada pembuatan apem putih juga melalui proses fermentasi. Proses fermentasi ini dilakukan dengan bantuan mikroorganisme jenis *Saccharomyces cerevisiae* yang digunakan sebagai bahan pengembang. Kue apem ini juga menjadi santapan kesukaan kalangan bangsawan. Bahkan, apem putih menjadi salah satu makanan favorit Sultan Banten. Gambar 2.3 Apem Putih Sumber: Primer Ayo Menanya Berdasarkan hasil pengamatan kalian, tuliskan pertanyaan-pertanyaan yang mungkin akan kalian tanyakan pada kolom berikut. Kemudian diskusikan pertanyaan tersebut dengan teman-temanmu!

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At the let's try stage, students carry out experiments, observe objects of observation, interview resource persons, and read related sources, integrated with critical thinking indicators in the form of making and determining the results of considerations.	
At the let's reasoning stage, students process the collected information resulting from previous activities, such as observing and gathering information, integrated with critical thinking indicators in the form of deducing and considering the results of deduction.	
At the let's communicate stage: Convey the results of observations in their delivery based on analysis both in writing and verbally or other media that are integrated with indicators of critical thinking skills in the form of interacting with other people	

Development Stage

At the development stage, the student worksheet is validated and revised. In the validation stage, the instruments that have been prepared are validated in advance by instrument experts. Validation was carried out by material experts, media, and science teachers to validate and provide suggestions or input to all research instruments and then make revisions based on validator input. The following are results of the validation in table 2 as follows:

Table 2. Results of Science Expert and Teacher Validation

No.	Assessment Aspect	Percentage (%)	Category
1.	Content Eligibility language	63.7%	Valid
2.	Presentation graphics	81.96%	Very Valid
3.	Content Eligibility language Presentation graphics	94.11%	Very Valid
	Average Percentage	79.92%	Valid

Source: (Primary Data, 2022)

Based on the data in table 3.2, it is known that the student worksheet, with a scientific approach to the role of biotechnology in food diversification, obtained a valid category with an average percentage value of 79.92%. It includes the results of material validation obtaining a value with a percentage of 63.7% with valid categories. It showed the results of validating the developed worksheet material of 60.59 % with valid categories [23]. The results of the validation of the material on the developed student worksheet have yet to be maximized in the display of the images presented. The arrangement of the sentences used contains writing errors that need to be adjusted to the Indonesian spelling. The results of the percentage of material expert validation in the aspect of content feasibility based on the average value of the five indicators obtained a value of 71.15% indicating that it was not maximal in conformity with SK & KD subjects, developments, and needs. The student worksheet is one of the supports to achieve the expected competencies, so it is necessary to prepare it must be prepared correctly, referring to KI and KD. In line with the explanation of the student worksheets, they can be defined as teaching materials that contain a summary of the material, and instructions for carrying out student assignments that refer to the basic competencies achieved [24]. There is a linguistic aspect based on the average value of the three indicators, which is 56.25% indicating not maximized in the preparation contained in the student worksheet and paying attention to the reading text**.** STUDENT WORKSHEET contains material that is packaged attractively and easy to understand [25].

The results of the media validation carried out obtained a value with a percentage of 81.96% with a very valid category. The validation has yet to be maximized in showing the unity of the material with the previous paragraph. The results of the percentage of media expert validation in the presentation aspect obtained a value of 71.42 %. The presentation of the worksheet is developed systematically starting from the introduction, including the introduction, instructions for using the worksheet, competencies, and objectives. Contents containing Activities I, II, and III (identity, objectives, working instructions, materials, tools and materials, working steps, practice questions or evaluations, assessments), and closing containing a bibliography and author's history. In line with the statement that part of the worksheet consists of three components, among others: a) Introduction, b) Contents, c) Closing [26]. In the graphic aspect, the score is 92.5 % based on the average value of the three indicators.

The results of the media validation carried out by the science teacher obtained an average score of 94.11% in the very valid category. The validation of the developed worksheet is not maximized in presenting material that does not display many images such as the process of adding yeast to food manufacture and does not only present a negative impact added to the positive impact of using microorganisms. Media validation in the developed student worksheet covers several aspects, namely in content feasibility obtaining an overall percentage value of 89.39%, indicating conformity in the formulation of achievement indicators and achievement of learning objectives, but not optimal in the preparation of learning activities. In the linguistic aspect, obtaining an overall percentage value of 95% indicates the use of language which does not cause multiple interpretations, according to the development of students [27]. In the presentation aspect, the overall percentage value is 94.79%. On the feasibility aspect of the content, it obtained an overall percentage value of 98.61% based on the average value of 3 indicators, namely the size/format of the student worksheet, the design of the skin section, and the design of the contents section.

E -LKPD with a scientific approach tested for validity is then subjected to product revisions in line with suggestions for improvement and input obtained from expert validators and science teachers. Based on the revision results from the validation of material experts, media and science

teachers, the material contained in the student worksheet is developed more coherently, starting from conventional biotechnology to the positive and negative impacts of using biotechnology. The images used are more varied to support students' understanding of the contents of the reading presented, and the table display presented is better as it is not cut off. The questions presented lead to students' ability to think critically to foster critical thinking skills in learning. Correction of errors in writing is adjusted to the correct Indonesian spelling and not multiple interpretations. The directions used are tailored to the target. Each image, video, and audio contained in the student worksheet is given a description. The writing of indicators is more adapted to the basic competencies used.

CONCLUSION

Based on the results of the discussion, this study shows that the development of student worksheet through the define stage is carried out to determine problems in learning activities. The second stage is the design of worksheet instruments and products with a scientific approach, and then the development stage of electronic student worksheets with a scientific approach integrated with indicators of critical thinking ability. Validation and revision are based on the validation results of experts and science teachers. Based on the validation results of the electronic student worksheet with a scientific approach on the theme of the role of biotechnology in food diversification, it obtained a percentage value of 79.92% with a valid category obtained from the assessment of experts and science teachers. It can be carried out for trials on learners. As for further research, it can develop a worksheet with a scientific approach that is integrated with other indicators of critical thinking skills and maximized so that it is more attractive in using student worksheet in learning.

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