DEVELOPMENT OF BIOTECHNOLOGY TEACHING MATERIALS BASED ON HYDROPONICS *RESEARCH SYSTEM WICK* TO INCREASE CREATIVITY AND TECHNOLOGICAL LITERACY IN CLASS IX LEARNERS AT SMP NEGERI 2 MAJALENGKA

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Abstract: The purpose of this research is to develop teaching materials so that they can be utilized and implemented to students to increase creativity and technological literacy. The method used in development is Research and Development (R & D) with stages of conducting analysis, design (design), development (development), revision, implementation. The sample in this study was class IX G learners as many as 10 people and class IX J consisting of 30 people. The results of validation of LKPD Biotechnology based on Hydroponics Research System Wick is very good and very feasible to use. The student's response to LKPD Biotechnology based on Hydroponics Research System Wick obtained an excellent category. The results of student creativity obtained a very high category, with a significant increase. Meanwhile, the results and analysis of Technological Literacy with IBM SPSS 25 showed significant results between the average pretest and posttest values of the experimental group and the control group through the independent t sample test. The test result of the experimental class's N-Gain score resulted in the high category, meanwhile N-Gain score in the control class gained medium category. Thus, it can be concluded that the use of teaching materials in the form of LKPD based on hydroponics research system wick is very effective to improve technological literacy in conventional biotechnology materials utilizing modern agricultural fields in class IX students of State Junior High School 2 Majalengka for the 2021/2022 semester 2.
Keywords: *teaching materials; Biotechnology; Hydroponics System Wick; creativity; technological literacy*.

INTRODUCTION

Teaching materials are a form of diverse materials used to assist teachers in carrying out teaching and learning activities in schools consisting of written or unwritten materials. Teaching materials can be interpreted as a set of materials from learning materials (*teaching materials*) that are arranged systematically, based on competencies that will be mastered by students in learning activities. In essence, whatever teaching materials we use must be in accordance with the demands or references of the curriculum, the material presented must be in accordance with basic competencies (KD) to be achieved by students, can provide motivation to students to learn, as positive feedback so that it will provide reinforcement to the understanding of learners and the evaluation of learning outcomes that have been achieved by using learning resources / teaching materials so that they can enrich the material in a learning (Kurniawati, 2020). The role of teachers as educators is clearly seen to always be creative, innovate in choosing and developing

teaching materials so that the learning atmosphere is created well, does not burden students and facilitates us as teachers in the learning process in the classroom.

The development of teaching materials in this research is tailored to the characteristics of learners as a target in learning to overcome difficulties in the learning process, for example, learners have difficulty understanding the material or the possibility of teachers having difficulty explaining the material to be delivered. These difficulties can occur because the material presented is complicated, abstract, foreign and so on. To overcome these difficulties requires the development of appropriate teaching materials. If the learning material is abstract, then the teaching material must be able to describe something abstract to help learners, for example containing images, photos, charts, schemes, etc., while for complex materials can be explained in a simple way, according to the level of thinking of students, so that it becomes easier to understand by students (Emtha, 2011).

This is in line with the research of Harahap, M., Harahap, F., & Gultom, T. (2017) that the development of teaching books based on hydroponics research is needed because of the lack of knowledge of students in understanding conventional biotechnology concepts, especially about hydroponics and teachers who do not understand hydroponics making so that a teaching material is needed so that students better understand the concepts conveyed and how to make simple hydroponics.

Biotechnology is the process of utilizing scientific principles of using living things to produce products and services that are useful for human interests. Based on research Mulasari S. A. (2018) that Hydroponics is a method of farming without using soil media, but by using a solution of nutritious minerals or other materials containing nutrients such as coconut coir, mineral fibers, sand, brick fragments, sawdust, and others as a substitute for media. Goal: The purpose of this activity is to reduce the problem of waste and add insight to the surrounding residents about how to use used goods using hydroponics. The method used in this activity is to give lectures on hydroponics, conduct discussions and questions and answers, practice hydroponic farming activities. The impact obtained is to increase citizens' knowledge about hydroponics, and can increase public awareness to utilize used goods as an effort to reduce the presence of plastic waste in people's lives.

Creativity is the ability of individuals to use imagination and various possibilities obtained due to interaction with ideas or ideas, other people and the environment, to make connections, new results and have meaning. On the other hand, the existence of creativity is something that can be amazed, so that brilliant ideas can be realized that may not have been thought of before. Even creativity is said to be an advantage that helps a person to solve a game or problem at hand.

The concept of independent learning carries literacy ability to be one of the components of assessment. As a teacher, it is required to develop technological literacy in students. The use of technology in teaching and learning is a valuable practice to support learner learning and engagement. "In the world of technology literacy education can be interpreted as an ability consisting of aspects of science, critical thinking skills, and decision making in an effort to use technology or innovation of human works effectively." (Yudik_23, n.d).

At the level of Education in Junior High School (SMP) on Hydroponics is studied in conventional Biotechnology concept materials in class IX semester 2 on Basic Competencies 3.7 Understanding the concept of biotechnology and its role in human life and 4.7 Making one of the conventional biotechnology products in the surrounding environment, for example planting hydroponics. Learning activities on hydroponic materials are present at the 2nd - 3rd meeting of biotechnology and food production materials. Based on the observations of researchers in several schools, such as in SMP Negeri 2 Majalengka, SMP Negeri 2 Maja and SMP Negeri 6 Majalengka, that the problem that occurs in schools is the lack of knowledge of students in understanding the concept of conventional biotechnology utilization in the field of modern agriculture, especially regarding hydroponics and teachers who do not understand hydroponics making so that a teaching material in the form of LKPD is needed so that students better understand the concepts conveyed. by practicum way of making simple hydroponics from used bottles of mineral water.

In addition, in Class IX students at SMP Negeri 2 Majalengka has not appeared creativity and

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technological literacy, this is evidenced by the majority of creativity and technological literacy is still below the average value of minimum completion criteria (KKM) where the average value achieved by students is 50, while the value of KKM must reach 70. One of the causes is because the development of hydroponic research-based biotechnological teaching materials has not been used in the learning process. So far researchers in the learning process are still using teaching materials with books, LKPD and sober learning media.

From the above background, researchers feel interested in conducting research with the title "Development of Bioengineering Materials Based on Hydroponics System Wick Research to Increase Creativity and Technological Literacy in Class IX Learners at SMP Negeri 2 Majalengka".

METHOD

This research is R&D (*Research and Development*) research, which is a research method used to produce certain products and test the effectiveness of these products (Nur Sa'adah & Wahyu, 2020). The subjects in this study are class IX learners at SMP Negeri 2 Majalengka for the 2021/2022 school year.

In this study, which will be carried out with the needs analysis stage and collecting information using computers and internet access to collect materials related to research. After obtaining an overview of biotechnology teaching materials based on hydroponics research system wick to be developed, then further develop the design of biotechnology teaching materials based on hydroponic research in the form of LKPD by utilizing access to technology so that students can access LKPD in print and digital files.

The procedures/stages of research that is carried out in this study are as follows:

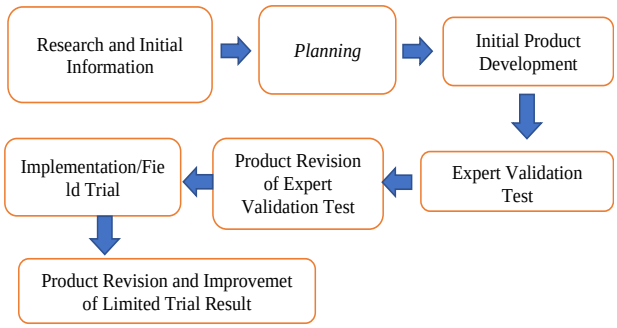

Figure 1. *Steps to resesarch R&D methods*1

The next step is the preparation of LKPD by conducting curriculum analysis (Basic Competencies), simple sampling of hydroponic planting *of wick system* method or also called axis system.

The types and sources of data in this teaching material development research consist of 2, namely quantitative data in the form of taking data from observations on the implementation of teaching and learning activities (KBM) in schools, student creativity observation data and writing test results data in the form of pretests and posttests of technological literacy. Qualitative data in the form of data retrieval from observations of the implementation of teaching and learning activities (KBM) in schools, student creativity observation data and writing test results data in the form of pretests and posttests of technological literacy.

The population used in this study is the IPA / Biology Teacher and the students of SMP Negeri 2 Majalengka as users.

Table 1. *Data collecting techniques*

No	Data Type	Subjects	Collection Techniques
1.	Needs Survey	Teachers	Interview
2.	Validation of Teaching Materials / LKPD	Lecturers, Principals, Junior High School IPA Supervisors, Teachers and learners	Validation Sheet
3.	Learning Implementation	Observer/ Fellow Teacher	Observation sheet
4.	Learner creativity	Teachers, Lecturers and Learners	Observation sheet
5.	Teacher's response to LKPD	Teachers	Questionnaire
6.	Student's Response to LKPD Admission	Learners	Questionnaire
7.	Technological literacy	Learners	Pretest and Posttest

Data analysis in this study using quantitative descriptive analysis techniques is data obtained in the form of input from validators at the validation stage and the student's response to the acceptance of teaching material products, namely input from material experts, media experts, IPA teachers and student responses and qualitative descriptive is data that explains the results of teacher responses about product development in the form of teaching materials based on hydroponics system wick

research to improve creativity and technological literacy whether it can be used as a source of learning or additional biology learning in the classroom or not. Convert the average score obtained into qualitative values that match the assessment criteria

RESULTS AND DISCUSSION

From the results of the needs analysis interview, the researcher drew the conclusion that in the delivery of basic materials biotechnology teachers still use package books, internet (rarely) and LKPD print from publishers. The learning approaches and methods used also still do not involve learners in terms of skills so that no projects are carried out by learners. So researchers develop teaching materials in the form of biotechnology LKPD to provide opportunities for creativity of students in stimulating technological literacy in the procedure of learning activities.

The results of the evaluation of the analysis stage show that the needs analysis and curriculum analysis in class IX of SMP Negeri 2 Majalengka requires a renewal in the learning process. For this reason, it is necessary to design an interesting LKPD in accordance with the learning criteria applied in the school. Based on the information obtained, the researcher will proceed to the design stage.

In a small group trial designed to test product product validity, learners in this small group trial saw the LKPD given, at the end of the product trial involving 10 learners who were selected heterogeneously based on ability in the classroom and gender then the learners will be given questionnaires to assess the efficacy of LKPD. The small group test was carried out at SMP Negeri 2 Majalengka to get the results of the student response questionnaire of 91.2% very interesting criteria, seen in the following graph:

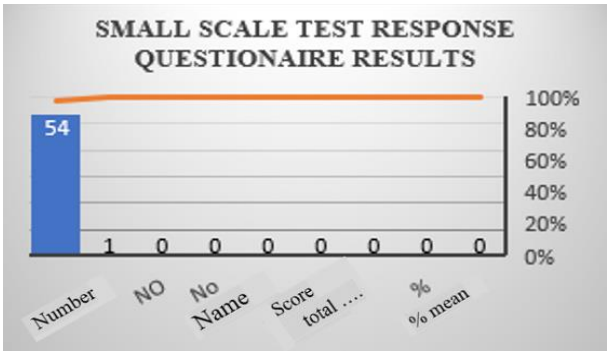

Figure 2. *Small-scale test response questionnaire results*

The results of the student's response to the LKPD IPA based on *hydroponics wick system* research on biotechnological materials received an average score of 91% with the interpretation criteria achieved, namely "Very good" meaning that the LKPD developed by the researcher has interesting criteria to be used as a tool in teaching and learning activities in IPA materials based on hydroponics wick system research on biotechnological materials for class IX, seen in the following graph:

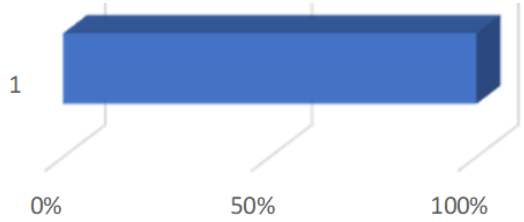

Figure 3. Results of participants' responses to LKPD (percentage of students' response mean towards LKPD)

Quantative descriptive data research results of students' creativity consisted of:

The Average Value of Learners Towards Mastery of Concepts consists of indicators remembering, understanding, applying, analyzing, evaluating and making conclusions showing a total average value of 88.9% so that it falls into a very high category with the highest percentage found in the indicator understands the concept of hydroponic practicum and evaluates the success or failure of practicum results with a value of 90.3%.

Kall of the students' response to the hydroponics system wick practicum in increasing creativity in biotechnological materials consisting of indicators of innovation, creativity and discovery shows an average total value of 91.8% so that it has a very high category with the highest percentage contained in the discovery creativity indicator in the application of hydroponic biotechnology system wick increased by 93.5%.

Increased creativity of learners can be seen in the following figure:

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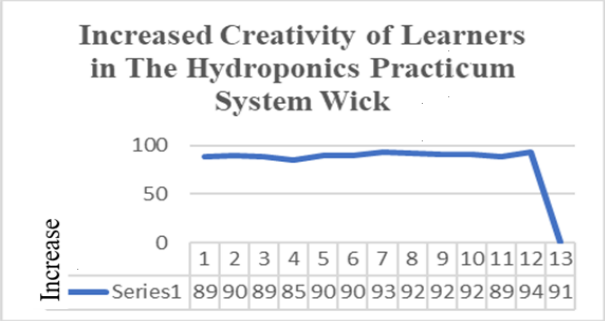

Figure 3. *Increased creativity of learners in practicum Hydroponic System Wick*

Technological literacy is carried out in control classes and experimental classes by pretesting and posttesting students analyzed using IBM SPSS 25 that the N-Gain score test can be used when there is a significant difference between the average pretest and posttest scores of the experimental group and the control group through the independent t-test sample test, so that the following results are obtained:

Based on the results of the N-Gain score test calculation, showing that the average N-gain score for the hydroponic system wick research-based experimental class is 83.4008 or 83% belongs to the high category meaning very effective.

While the average N-Gain score in the control class is 61.5024 or equal to 61.50% belongs to the medium or effective category. With a minimum N-Gain score of -20% and a maximum of 88.89%.

Then it can be concluded that the use of teaching materials in the form of LKPD based on hydroponics research system wick is very effective to improve technological literacy in conventional biotechnology materials for the use of modern agricultural fields in class IX students of SMP Negeri 2 Majalengka for the 2021/2022 semester 2.

While in the use of conventional methods of learning is also said to be effect-tif.

CONCLUSION

Based on the results of research, final product studies and discussions on the development of class IX junior high school biotechnology teaching materials based on hydroponic *system wick* research, it can be concluded that:

The development of class IX junior high school biotechnology teaching materials based on hydroponics research *system wick* developed by following 5 stages only, namely the potential and problem stages, the information gathering stage, the product design stage, the design validation stage and the design improvement stage. Thus, researchers design teaching materials with the subject matter of biotechnology materials for junior high school class IX based on hydroponics system wick research in the form of student worksheets.

Based on the results of validation of LKPD biotechnology materials based on *hydroponics research system wick* reviewed from the components of Content, Presentation and Language by Material Experts, Media Experts, IPA Teachers as well as small-scale readability tests by 10 learners declared in the category of "excellent" and "very feasible" and limited trials by 30 students of class IX J SMP Negeri 2 Majalengka were declared to be included in the category of "Excellent" and "Very worthy" to be tested in limited scope.

Increased creativity in learners showed a result of 91.8% with a very high category.

The improvement of learners' technological literacy with ibm SPSS 25 calculations showed that the average N-gain score for the hydroponics system wick research-based experimental class was 83.4008 or 83% belonged to the high category meaning it was very effective and in the control class was 61.5024 or equal to 61.50% belonged to the medium or effective category with a minimum N-Gain score of -20% and a maximum of 88.89%.

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