

Development of Science Learning Modules on the Topic of Biotechnology for Differentiate Learning Independent Learning Curriculum for Students in Junior High School

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Abstract

This study aims to develop learning modules for science subjects to determine the feasibility, practicality, and effectiveness of using science learning modules for class IX in junior high school. This research is a type of research and development conducted at SMP Negeri 1 Paringin. The selected development model is the ADDIE model. The object of research is the development of science learning modules on the topic of biotechnology. Data collection using questionnaires and questions (pretest-posttest). The result of this research is the development of science learning modules. The modules that have been developed are declared good, based on material experts with an average score of 3.64 or 91.08 with the criteria "Very Valid", assessments from media experts with an average of 3.79 or 94.83% with the criteria "Very Valid". Modules that have been assessed as good are then tested for their effectiveness on students. Based on the results of research conducted by learning with the Science module that the effectiveness of student learning has increased in class IX B which can be seen in the N-Gain result of 0.73 with the "High" criterion. According to the data on student responses to the Science module as a whole it was stated "Very Practical", this can be seen from the results of the average score from the respondent's trial of 3.37 with a percentage of 84.21%. Based on the research results, the product in the form of a science learning module on the topic of biotechnology for differentiation learning is declared valid, effective, and practical and can be used as a support for learning in science lessons on the topic of biotechnology.

Keywords: Biotechnology, learning module, differentiated learning, development.

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INTRODUCTION

The development of the current learning model has advanced rapidly, from a model that focuses on teacher centered to student centered. Even so, not all schools can carry out a student-centered learning process. The student-centered learning system requires a paradigm shift for learning actors, both teachers and students. The teacher acts as a facilitator and motivator, while students act as active and independent learners. The practice of daily learning in schools is still experiencing problems with the teaching materials used in learning that do not demand student-centered. The teaching materials used are minimal and designed to be widely marketed, the writing style is narrative but not communicative, very dense, does not have a mechanism to collect feedback from buyers.

Based on the results of interviews with science teachers at SMPN 1 Paringin, information was obtained that 1) in the learning process in class, the teacher only used the lecture method during learning, 2) the teacher had never implemented differentiated learning so that students' learning needs had not been fully met, 3) students considered the lesson Science is difficult to understand and they cannot actively develop their interest in learning, 4) The teaching materials used are only books from the government.

One of the factors that causes problems in learning science is learning activities that are boring and still use conventional learning strategies. In addition, learning activities in the classroom do not pay attention to the needs of students in learning. In fact, the teacher teaches according to the learning style he wants without regard to students as learning subjects and indirectly

dictates the learning styles of students to suit the teacher's learning style. This problem indirectly causes the learning outcomes obtained by students to be low.

Based on the problems that have been described, the need for appropriate solutions. One suitable solution in responding to the needs of students as learning subjects is to design and implement learning activities that are able to answer the needs of diverse students, namely applying a differentiated learning strategy (Suwartiningsih, 2021).

Differentiated learning is learning that pays attention to the characteristics of students and their potential (Faiz, 2022). This approach takes into account the individual differences of children. Differentiated learning is very important to apply because each individual has its own uniqueness. We cannot generalize all students to achieve one competency, but the learning process will run optimally if we are able to optimize the potential that exists within students. So far, the diversity of students in the classroom is still a direct problem faced by teachers, while respect for diversity is very important to be taught in class. This is because the classroom is a place of preparation for the world of work (Astuti, 2021).

Students still find it difficult to understand the sentences in the teaching materials (handbooks) used. Indaryanti (in Puspita, 2014) states that currently student handbooks only contain content in the form of material that is not explained clearly and is not accompanied by pictures as explanations of learning material so that students cannot independently use handbooks or modules in learning. Therefore, the development of teaching materials is important to be carried out by educators so that learning is more effective, efficient, and does not deviate from the competencies to be achieved. The selection of teaching materials and their development is entirely up to the teacher as a professional (Wahyudi, 2022).

One of the teaching materials that can be developed by the teacher according to the characteristics of students is printed teaching materials in the form of modules. The advantages and advantages of modules are that modules have self- instruction which allows students to learn independently and the teacher is no longer the only source of learning for students. So the teacher is expected to be able to develop modules according to the needs of students. Based on the description above, the authors see that the importance of student needs assessment. If the needs of students are met and served effectively and efficiently, it is very likely that the learning process in the future will increase. Fulfilling the right needs will help students in carrying out various educational activities, especially in learning activities (Devianti, 2020).

The background problem of the title of developing science learning modules on the topic of Biotechnology for differentiated learning is the Independent Learning Curriculum for students in junior high school is the need for learning that can be adapted to the needs and abilities of students. The Independent Learning curriculum is a curriculum that promotes creativity, innovation, and student independence in the learning process (Fadhli, 2022). However, in its implementation in the classroom, there are often problems in learning that cannot be adapted to the different needs and abilities of students. Therefore, it is necessary to develop learning modules that can be used in differentiated learning for students in junior high schools.

RESEARCH METHODS

This research is a type of R&D (Research and Development) research which was developed using the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation) in the form of a one group pre- test post-test experimental design consisting of one predetermined sample. The main purpose of research and development methods is used to produce certain products and determine the feasibility of the products being developed (Sugiyono, 2021).

This research was conducted in the even semester of the 2022/2023 school year in May at Paringin 1 Middle School with the intended subjects being 29 students of class IX B. The data collection instruments used in this study included (1) materials and media validation sheets, (2) student response questionnaires, and (3) student learning outcomes test sheets.

The following is the formula for validating questionnaire data analysis for material experts, media experts and response questionnaires:

$$V = \frac{\text{Score obtained}}{\text{Highest total score}} \times 100\%$$

Table 1: Validity Interpretation Table

Value	Kriteria
85%-100%	Very Valid
70%-85%	Valid
50%-70%	Less Valid
0,01%-50%	Invalid

Table 2: Table of Student Response Percentage Criteria

Value	Criterion
81% - 100%	Very Pratical
61% - 80%	Practical
41% - 60%	Enough
21% - 40%	Less practical
0% - 20%	Impractical

Learning module can be said to be "Practical" if the percentage of student responses obtained is more than 60%.

The following is the formula to find out the increase in student learning outcomes before and after the use of learning media during the learning process:

$$\langle g \rangle = \frac{(\bar{x} \text{ score posttest} - \bar{x} \text{ score pretest})}{(100 - \bar{x} \text{ score pretest})} \times 100\%$$

Table 3: N-gain Level Criteria Table

Result	Criterion
$(g) \leq 0,30$	Low
$0,30 < (g) \leq 0,70$	Medium
$0,70 \leq (g)$	High

Learning media is said to be effective if it is in the medium to high criterion.

RESULTS AND DISCUSSION

The results of this research and development are science learning modules on the topic of biotechnology for differentiation learning. The resulting product aims to help students to be able to learn independently and creatively, and to meet students' learning needs based on learning styles. In conducting research on the development of science learning module media on the topic of biotechnology for this differentiation learning using the ADDIE model, namely 1) Analysis, 2) Design, 3) Development, 4) Implementation and 5) Evaluation.

The curriculum used today demands that learning activities are not teacher-centered but student-centered, in accordance with constructivist learning theory. Constructivistic learning theory according to Piaget is that knowledge is a human creation constructed from experience (Nasir, 2022). Based on this theory, teaching materials are needed that systematically help students learn independently to build their knowledge related to the material being studied. One of the teaching materials that can be used to facilitate this is the module.

The *first* step in developing science learning modules on the topic of biotechnology for differentiated learning is analysis, at this stage the researcher analyzes the needs of the existing problems. The results of this

analysis will become a reference in the development of science learning modules on the topic of biotechnology for differentiation learning. The results of observations made by researchers in class IX B students of SMPN 1 Paringin are as follows: a) The teacher has not implemented a method that allows students to process, develop products according to the style or interests of each student. b) There is no teaching material in the form of differentiated learning-based modules. c) Students feel bored with learning that only uses textbooks or worksheets. d) Student learning outcomes at school are not entirely good. e) Students are less enthusiastic and look less active in participating in science learning. f) There are students who have difficulty understanding the concept of biotechnology which is sometimes related to contextual problems or everyday life.

The *second* stage of the ADDIE development model is the design or planning stage. At this stage the researcher begins to design learning modules that will be developed.

Third is development. The development here is the product printing process which is then ready for the validation process. The product validation of science learning modules on the topic of biotechnology for differentiated learning for junior high school students was tested by 5 material and media experts consisting of 2 science education lecturers and 1 biology education lecturer from Lambung Mangkurat University. After conducting an assessment by the validator, the researcher revised according to the suggestions from the validators for development and improvement before trying it out.

Fourth is implementation. The implementation in question is testing the science learning module on students. Implementation is carried out to obtain data on the practicality and effectiveness of the developed modules.

Fifth, this evaluation step aims to analyze the practicality and effectiveness of the modules developed at the implementation stage and to revise the product based on evaluations during field trials. The following are the validation results from material experts:

Table 4: Material Expert Assessment Results

Assessment Aspects	Percentage (%)	Criteria
Content	90,25	Very Valid
Presentation	90,33	Very Valid
Language	92,67	Very Valid
Average	91,08	Very Valid

Based on the table above the results of the assessment of the material expert on the module above resulted in the eligibility of the module material with a percentage of 91.08% so that it is declared included in

the "Very Valid" criteria or can be used but needs a little revision according to the advice given by the material expert.

Suggestions and criticisms from the three material experts, namely a) Correct writing errors b) Update data tables, c) Complete the closing section, d)

Make assignments or learning activities balanced between students with visual, auditory and kinesthetic learning styles.

Table 5: Media Expert Assessment Results

Assessment Aspects	Percentage (%)	Criteria
Graphics	94,83	Very Valid

Based on the table above the results of the assessment of the material expert on the module above resulted in the eligibility of the module material with a percentage of 94.83% so that it is declared included in the "Very Valid" criteria or can be used but needs a little revision according to the advice given by media experts.

Suggestions and criticisms from the three media experts, namely a) If you still want to make 3 different modules, make different colors on the cover between the learning modules for students with visual,

auditory and kinesthetic learning styles, b) Some pictures and data are missing captions and sources The layout of the images is still inconsistent, c) It is better if the module does not need to be separated between visual, auditory and kinesthetic learning styles. It is enough to separate the location according to the differentiation chosen, d) There are still similarities between the differentiation of learning activities between visual and auditory, it is better to differentiate learning activities for visual and auditory students, e) Fix the supporting images on the cover.

Table 6: Student Response Questionnaire Assessment Results

No.	Indicator	Rating Score	Max Score	Presentage (%)
1	Ease of Use	3,35	4	83,87
2	The attractiveness of the dish	3,44	4	85,99
3	Benefit	3,31	4	82,76
Average		3,37	4	84,21

Based on the table above, the results of the student response questionnaire assessment in the module above obtained an average value of 3.37 with a

percentage of 84.21%. When converted to a Likert scale it is included in the "Very Practical" criteria.

Table 7: Pre-Test and Post-Test Result Data

Pre-Test	Post-Test	Gain	N-Gain	Interpretation N-Gain
41,03	84,31	43,28	0,73	High

Based on the results of research conducted learning with science learning modules on the topic of biotechnology for differentiation learning. That the effectiveness of student learning has increased in class IX B which can be seen in the N-Gain result of 0.73 with the "High" criterion. This is in line with the results of research conducted by Suwartiningsih (2021) and Laia *et al.*, (2022) which state that the application of differentiated learning can improve learning outcomes.

CONCLUSION

Based on research results obtained from material experts and media experts as well as students' responses to the science learning module on the topic of biotechnology for differentiated learning that was developed, it is included in the very valid category with a validity score of 91.08% from material experts, and 94.83% from material experts media. In addition, it was also declared effective which was obtained from the results of the pretest and posttest percentages based on the normalized gain (N-gain) value of 0.73 with high criteria. This is also supported by student responses which show that the science learning module on the

topic of biotechnology for differentiation learning is very interesting with a score of 84.21% with very practical criteria.

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