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Development of Teaching Module Based on Independent Learning to Optimize Students' Conceptual Knowledge on the Motion Topic

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Abstract: Teaching modules are independent curriculum bodies which replace learning plans. This study aims to development of teaching module based on independent learning to optimize students' conceptual knowledge on the motion topic. The development of teaching modules using the ADDIE model consists of five stages: analysis, design, development, and implementation. This research used 15 class VII students as teachers at SMP Negeri 3 Satap Tabongo. Based on the validation results from three validators, the average percentage for the teaching module was 81.25%, which was in the very valid category and suitable for use in learning the motion topic. Based on the practicality of the Independent Curriculum-Based Teaching Module to optimize students' conceptual knowledge, it meets the practicality criteria with a score of 93.18% for teachers and student activities of 91.67%.and the results of the student responses were very good. Based on the effectiveness of the Independent Curriculum Based Teaching Module to optimize students' conceptual knowledge, it meets the criteria for effectiveness.

Keywords: Conceptual knowledge; Independent learning; Teaching module

Introduction

The curriculum has been implemented at all educational unit levels to update the learning process, which is experiencing problems caused by the pandemic. The government provides solutions to implementing the independent curriculum in schools and madrasas: First, freedom to learn; second, freedom to share; third, freedom to change. Implementing the independent curriculum will undoubtedly bring significant changes to school teachers and teaching staff regarding learning approach strategies, learning administration and methods, and even the learning evaluation process (Sari et al., 2022; Wirawan et al., 2024).

Teaching modules are independent curriculum (*Kurikulum Merdeka*) bodies which replace learning plans. The independent curriculum teaching module replaces lesson plan, which has a varied format and includes learning content, learning methods, interpretation, and evaluation techniques, which are prepared systematically and impressively to achieve the expected indicators of success (Rahayu et al., 2024; Daulay & Asrizal, 2024; Husnadi et al., 2024). Before instructing in the classroom, teachers create lesson plans. Less work for teachers in presenting material is one of the purposes of teaching modules, which frees up more time for tutoring and assisting students in their learning (Nurhafidhah et al., 2024; Maulida, 2022; Maulisa et al., 2024). The primary role of teaching modules is to support teachers in designing learning.

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Teachers have an essential role in preparing learning tools. Teachers' thinking abilities continue to be sharpened to innovate in creating teaching modules (Silmi et al., 2024; Patel et al., 2024; Syakur et al., 2023).

Knowledge exists in everyone's mind, and each person has a different level of knowledge. Knowledge is the result of one's creation. Anderson & Krathwohl (2001) distinguish between types of knowledge, namely: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge (Yusuf & Prabowo, 2019; Walid et al., 2023; Abdelshiheed et al., 2024). This research chose conceptual knowledge as the primary focus because it is essential for students to overcome problems in science learning, especially physics.

Anderson & Krathwohl (2001) suggest that conceptual knowledge is a more complex and organized form. An example of conceptual knowledge is that objects move or stay still in physics, including motion or mechanics. Moving and stationary objects can be analyzed kinematically or dynamically. The next dimension of knowledge is procedural knowledge. This procedural knowledge is about the special skills needed to work in a field of science or the algorithms that must be used to solve a problem (Lesmono et al., 2023; Juanengsih et al., 2017; Vukić et al., 2020; Barak, 2013).

Conceptual is an understanding of definitions, rules, and principles in a field of knowledge (Sapitri et al., 2018). A person with conceptual knowledge can identify, describe, and comprehend the connections between concepts. Conceptual knowledge is interconnected information, a network whose connections are as significant as individual facts. Conceptual knowledge positively impacts learning achievement, and conceptual considerations are necessary to acquire procedural information (Flowers et al., 2023; Afgani et al., 2019). Children with strong conceptual knowledge can create problem-solving techniques, such as connecting ideas (Yurniwati & Yarmi, 2020; Whitebread & Cárdenas, 2012).

Science subjects are an important part of the independent curriculum. However, the fact is that changes to the curriculum and regulations that have been established may only sometimes be a solution to various problems in the world of education, especially in the learning process at school (Fathurohman et al., 2023; Amaliyah et al., 2021; Taali et al., 2023). Moreover, after the COVID-19 pandemic, the pandemic has become a significant challenge in delivering physics material (Khusaini, 2023). One of the challenges in learning science in junior high school is the topic of physics, which demands higher intellectual abilities than other science topic. This is based on Minister of National Education Regulation Number 22 of 2006, which states that science learning aims to develop knowledge and understanding of helpful science concepts that can be applied in everyday life.

Based on observations made by researchers at SMP Negeri 3 Satap Tabongo, problems were found in science learning. First, student activity during the learning process is low, and teachers are more active than students. Second, the teaching modules are still the 2013 curriculum, even though the school has implemented an independent curriculum. Third, class VII students are not very familiar with motion topic, their arithmetic skills are low, their basic mathematical skills are lacking, and they are weak in working on calculation problems. Fourth, students experience difficulty in understanding and differentiating the concepts in motion topic. Fifth, focus and motivation for learning decreases over time. Sixth, learning difficulties vary because each child's learning type or style differs.

The implementation of the independent curriculum teaching module provides several benefits, as explained by Ruangguru.id, that the teaching module's benefits are significant for students, including that it gives students the freedom to explore their own interests and talents. They can choose modules that suit their interests and abilities, increasing learning motivation and active involvement in the learning process. Second, teaching modules strengthen independent and problem-solving skills. In the teaching module, students will learn to manage time, gather resources, and manage their tasks. This allows them to develop important independence and management skills in their daily lives and future careers. Based on the description above, the author wants to conduct research about development of independent curriculum-based teaching modules to optimize science conceptual knowledge in motion topic."

Method

This research is included in Research and Development (R&D). It uses the ADDIE model developed by Reiser and Mollenda, whose aim is to develop teaching modules that are tested based on their quality and suitable for implementation. The development of teaching modules using the ADDIE model consists of five stages: analysis, design, development, and implementation. The stages of product development are depicted in the diagram Figure 1.

This research focuses on the learning process using science teaching modules based on the Independent Curriculum that has been developed. The validity of the teaching module is obtained from the validator's assessment. The practicality of this teaching module can be seen through its use in the learning process. Observation focuses on the implementation of the

teacher's learning process, student activities, and student responses to learning. First, the implementation of the learning process refers to the extent to which the teacher can implement the teaching module effectively and efficiently. Second, student activities planned in the teaching module can be fully implemented, students are involved in them, and learning objectives can be achieved. Third, Student responses are obtained by giving a questionnaire to see how they can receive, respond to, and be involved. The effectiveness of the teaching module can be seen in students' conceptual knowledge tests after taking the pre-test and post-test. Teaching modules based on the Merdeka curriculum will increase students' conceptual knowledge.

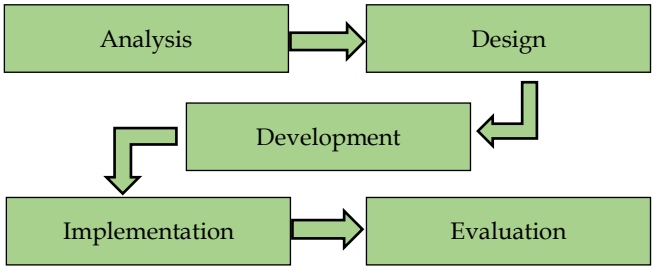

Figure 1. Flow chart of the ADDIE model

This research is development research or R & D using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The resulting product is validation, which is carried out by the validator by giving a score to each aspect of the assessment. To find practicality, observers observed teacher and student activities, including initial, core, and closing activities. Observers give scores for each aspect, which are assessed using the existing rubric. The results are then analyzed and studied to determine the level of practicality of the teaching module being developed. The effectiveness of the teaching module is obtained from the analysis of the conceptual knowledge test. Students are given pre-test questions, then go through the learning process and complete the post-test at the end of the lesson. This research used 15 class VII students as teachers at SMP Negeri 3 Satap Tabongo, the research school.

This research uses a validation sheet to see the validity of the teaching module. Validators also validate teaching materials, student worksheets, and students' conceptual knowledge tests—observation of the implementation of the learning process, student activity observation sheets, and student response questionnaires. The observation sheet on learning implementation is measured using 5 PBL phases with 23 observation sub-aspects. Orienting students to problems, structuring their learning, leading their investigations, producing and presenting work products, and assessing and evaluating the problem-solving process are all examples of how syntax is applied in the classroom. Student activity observation sheets are used to guide student activities during learning. Observers observed student activities during 3 x 40-minute lessons in 3 meetings. Observed activities include: answering apperception questions from the teacher, observing learning videos, identifying problems, collecting data, processing data by answering questions on the worksheet, and formulating conclusions. The test used conceptual knowledge indicators of classification, generalization, and theory knowledge.

Data from the validation results of the teaching modules provided by the three validators were analyzed descriptively quantitatively, where the average score from the validation results was adjusted to the criteria of 100 < very valid ≤ 81; 61 < valid ≤ 80; 41 < less valid ≤ 60; 21 < less valid ≤ 40; and 0 < less valid ≤ 20. The learning implementation sheet and student activities are analyzed by calculating the score on the learning implementation observation sheet that the observer filled in. Observations of learning implementation were carried out during three meetings. Learning implementation data and student response questionnaires in learning activities were also analyzed quantitatively descriptively, namely calculating the percentage of answers for each question asked. Meanwhile, learning outcomes are computed using the normalized gain formula for pre-test and post-test data, and the results are adjusted to the N-Gain criteria in Table 1.

Table 1. Normalized gain categorization criteria

Gain Value	Category
(g) ≥ 0.7	High
0.3 ≤ (g) < 0.7	Medium
< g > < 0.3	Low

Result and Discussion

This research is the development of an independent curriculum-based science teaching module for class VII. This research took place at SMP Negeri 3 Satap Tabongo. This research aims to produce quality teaching modules that fulfil three important aspects: validity, practicality and effectiveness.

Validation

Validation is carried out to assess whether a product is suitable for use by expert validators and practitioners. The expert validator consists of three experts. The results of the teaching module validation are presented in Table 2. Based on the Table 2, it can be seen that each aspect of

the component has a different score. Validator 1 gave the highest score on the readability indicator. Validator 2 gives the highest score on construction indicators, while Validator 3 gives the highest score on appearance indicators.

The overall average for the construction aspect obtained a score of 83, the same as for the readability and appearance aspects, while the content aspect received a score of 75. The overall results of the teaching module validation data obtained a score of 81. This score is 81-100, which can be categorized as very valid (Husna et al., 2021; Sari et al., 2021). Apart from teaching modules, validated research support instruments include teaching materials, student worksheet, assessment of conceptual knowledge learning outcomes tests, learning implementation observation sheets, student response questionnaire sheets and student activity observation sheets. Validation results contain comments and suggestions, which must then be revised so they can be used for research. The description of the results of the teaching module validation is described in Table 3.

Table 2. Teaching module validation results

Assessment Aspects	Validator 1	Validator 2	Validator 3	Average	Criteria
Construction	75	100	75	83.33	Very valid
Contents	75	75	75	75	Valid
Legibility	100	75	75	83.33	Very valid
Appearance	75	75	100	83.33	Very valid
Overall average				81.25	Very valid

Table 3. Results of the validation of the teach module

Component	Validator 1	Validator 2	Validator 3	Average	Criteria
Teaching Module	81	81	81	81	Very valid
Teaching materials	81	81	87	83	Very valid
Student worksheet	80	80	80	80	Valid
Learning Results Test	75	81	83	79	Valid
Learning Implementation Sheet	81	87	75	81	Very valid
Student Response Questionnaire	81	87	81	83	Very valid
Student Activity Observation Sheet	75	81	81	79	Valid

Table 3 shows the validation results of the supporting components of the teaching module. The average validation score for the teaching module reached 81, with the very valid category. Teaching materials and student response questionnaires also received an average score of 83, indicating high quality. Student worksheets, learning outcomes tests, and student activity observation sheets each have average scores of 80, 79, and 79 in the valid category. This assessment states that the validity of a learning media is determined by its suitability and effectiveness in supporting learning (Dianta et al., 2021; Mustami et al., 2019).

Additionally, feedback from teachers and students shows that the module is easy to use and relevant to students' needs. Teachers noted that the use of modules provided a clear structure to learning, while students felt more interested and motivated to learn. The module's conformity with the principles of the independent Curriculum, such as project-based learning and flexibility, is also a factor in its success.

The validated teaching module is then applied in learning to see the practicality of the learning tool. Tests of the practicality of teaching modules are obtained from assessing teacher activities in the learning process, student activities, and responses given by teachers and students after learning. This is a continuation of the fourth stage of ADDIE development, namely the implementation stage.

Practicality

Implementing teacher activities is very important in determining the level of practicality of the teaching modules created. The teacher's activities that were observed included preliminary, core, and concluding activities that were adapted to the objectives of the research itself. Two observers were present for this learning activity, who observed for three meetings. The results of the observers' observations are seen in Table 4.

Table 4 shows the assessment results of implementing teacher activities are very good. Both observers gave the highest assessment at the third meeting. The average rating for meetings 1 to 3 from

Observer 1 was 93.94% in the very good category, and Observer 2 gave an average score of 92.42% in the very good category. Overall, it is in very good criteria, namely with a score of 93.18 (Wahyuni et al., 2022; Hamid et al., 2023). This shows that the teacher's learning activities are well implemented in class VII at SMP Negeri 3 Satap Tabongo.

Table 4. Results of teacher activity implementation assessment

Meetings	Observer 1 (%)	Criteria	Observer 2 (%)	Criteria
1	90.91	Very good	86.36	Very good
2	90.91	Very good	90.91	Very good
3	100	Very good	100	Very good
Average each observer	93.94	Very good	92.42	Very good
Average for observer 1 and observer 2			93.18	Very good

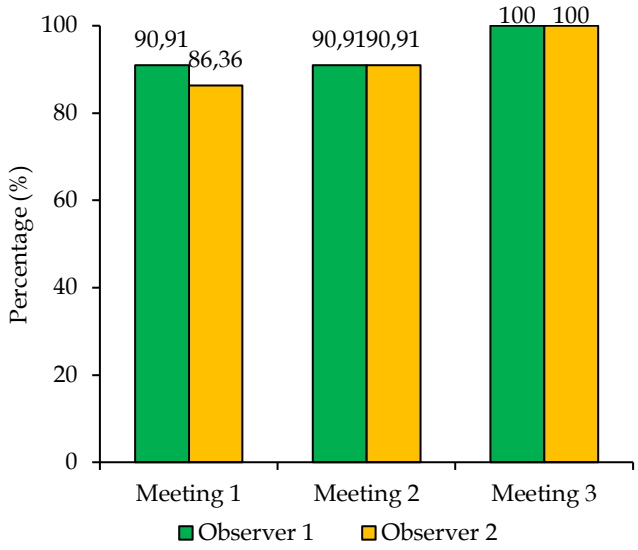

Figure 2. Average results of assessing the implementation of teacher activities

Figure 2 shows that the average results of the assessment of the implementation of teacher activities are in the very good category, with the highest average score at meeting 3. This shows that the teacher's learning activities are very good and can be implemented in class VII of SMP Negeri 3 Satap Tabongo. This conclusion was obtained from the observed teacher's ability to carry out learning consistently by the learning design in the form of planned teaching modules. This is in line with Lantowa et al. (2022), which states that learning implementation data is obtained through the implementation observation sheet, filled in by observers when researchers carry out the learning process in class.

The second practicality test was carried out through a student response questionnaire that was filled out after the learning activity. Student response questionnaires are given to obtain data on student responses during the learning process using teaching modules based on the Independent Curriculum. The results of the student response questionnaire obtained an average score of 92% in the very good category, which means that students' responses to learning using this science teaching module were very good. The recapitulation of student response results in Table 5 and Figure 3.

Table 5. Recapitulation of student response results

Indicators	Strongly agree	Agree	Do not agree	Strongly disagree	Total (%)
Students' opinions about learning using Independent Curriculum-Based Teaching Modules to Optimize Conceptual Knowledge (AA)	23.93	71.79	4.27	0.00	100
Students' impressions of learning using Independent Curriculum-Based Teaching Modules to Optimize Conceptual Knowledge (AB)	9.68	87.98	2.35	0.00	100
Students' feelings during learning using Independent Curriculum-Based Teaching Modules to Optimize Conceptual Knowledge (AC)	34.78	65.22	0.00	0.00	100
Student test results after participating in learning using Independent Curriculum-Based Teaching Modules to Optimize Conceptual Knowledge (AD)	11.07	71.63	15.22	2.08	100
Effectiveness of using student worksheet (AE)	39.18	45.31	14.69	0.82	100
Total Response	118.64	341.92	36.53	2.89	
Average Student Response	23.72	68.38	7.30	0.57	
Response Results	92.11		7.88		100

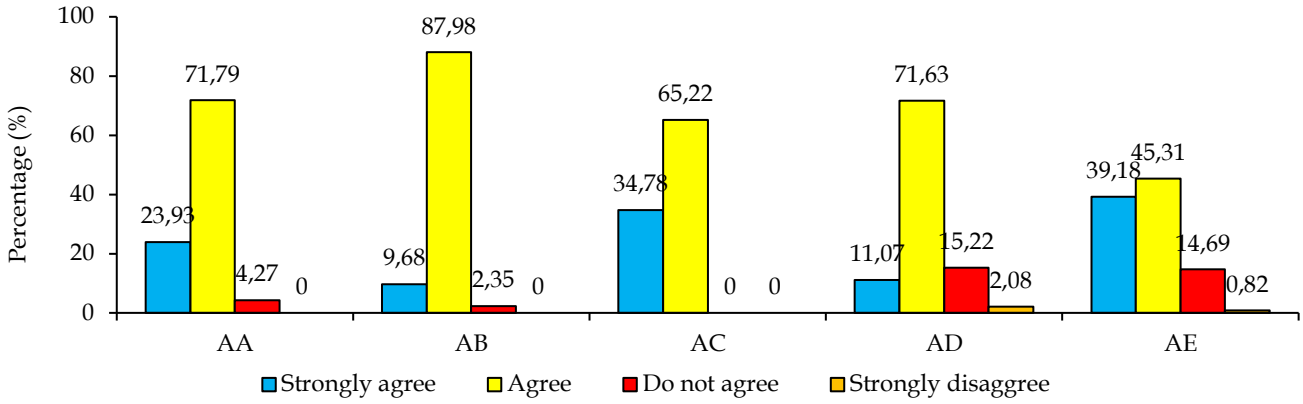

Figure 3. Average assessment of student responses

Based on Table 5 shows the results of students' responses after using the independent curriculum-based science teaching module. The research found that 100% of all indicators were positive responses, with 24% strongly agreeing and 68% agreeing. The results show that many students are interested in the learning being developed. Meanwhile, Figure 3 shows that the average response given to each question number is in the very good category. The highest response was obtained from indicator two regarding students' impressions of learning using the Independent Curriculum-Based Teaching Module to optimize conceptual knowledge, with 87.98% agreeing with the answers.

Effectiveness

Effectiveness is obtained from the results of observing student activities and the results of conceptual knowledge tests. Two observers observed student activities in learning activities using student activity observation sheets. The average results of observing student activities in this study are presented in Table 6 and Figure 4.

Table 6. Student activity assessment results

Meetings	Observer 1 (%)	Criteria	Observer 2 (%)	Criteria
1	88.64	Very good	86.36	Very good
2	90.91	Very good	90.91	Very good
3	96.59	Very good	96.59	Very good
Average each observer	92.05	Very good	91.29	Very good
Average for observer 1 and observer 2			91.67	Very good

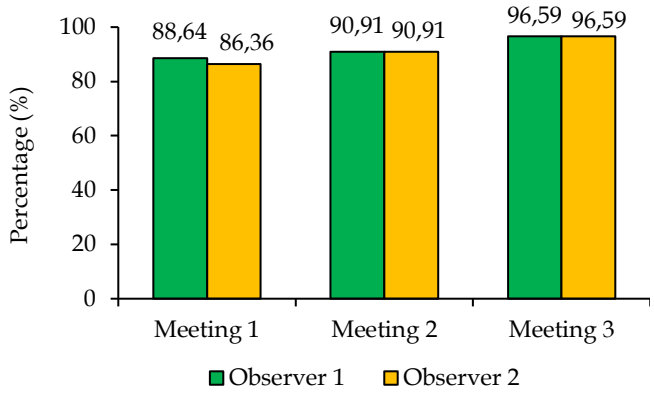

Figure 4. Average results of student activity assessments

Based on Table 6 shows that the student activity scores at meetings 1 to 3 are very good criteria. The observer gives a score that shows that all student activities are carried out, but some things still need improvement. Meanwhile, Figure 4, the average results of student activity assessments show that student activity is very good. These results show that the teaching module is very practical for learning in Class VII.

Conceptual Knowledge Test The effectiveness of the teaching module can be seen from the results of the analysis of student pre-test and post-test data presented in Table 7 and Figure 5.

Table 7. Average value of pre-test, post-test, difference, and N-gain

Respondents	Pre-test (%)	Post-test (%)	Difference (%)	N-gain	Criteria
15	38.89	83.33	44.44	0.71	High

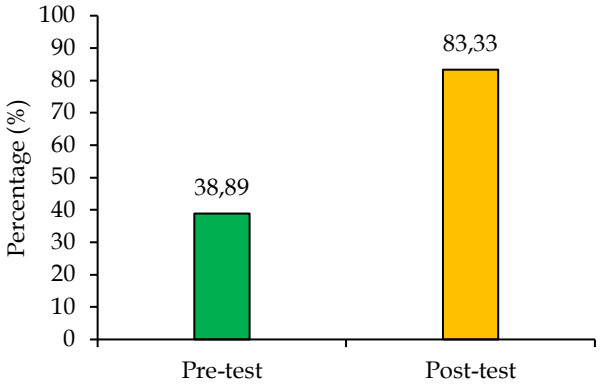

Figure 5. Comparison of pre-test and post-test

Based on the data in Table 7 shows that the pre-test results show that students' conceptual knowledge is still below the minimum completeness criteria is 75. After implementing independent curriculum-based learning, students' post-test scores show that their conceptual knowledge has reached the Minimum Completeness Criteria. Meanwhile, Figure 5 shows an increase in student learning outcomes in terms of students' conceptual knowledge after participating in learning in 3 meetings. This can be seen from the comparison between the average pre-test and post-test scores: the pre-test score is 38.889, and the post-test score is 83.333. with a difference of 44.44% with an increase in the N-gain value of 0.71 (<g> ≥ 0.7), including high N-gain criteria in Table 8.

Table 8. Increase in students' conceptual knowledge indicators

Indicators	Pre-test (%)	Post-test (%)	N-gain	Criteria
Classification	43.33	86.67	0.76	High
Generalization	33.33	88.33	0.82	High
Knowledge of Theory	40.00	75.00	0.58	Medium

Based on Table 8, there are differences in test results during the pre-test and post-test. The post-test results experienced a significant increase after the treatment was carried out. The results of the average percentage of conceptual knowledge in this study experienced a considerable boost. The average pre-test percentage value for classification indicators was 43.33%, and the post-test value increased by an average percentage of 86.67%, thus obtaining an N-gain of 0.76 on the high criteria. For generalization indicators, the average rate of pre-test scores was 33.33%, while the post-test percentage increased. Likewise, the Knowledge of Theory indicator experienced a significant increase but was in the medium category with an N-gain value of 0.583.

Conclusion

Development of Independent Curriculum Teaching Modules to optimize students' conceptual knowledge of motion topic using the ADDIE model developed, which includes five stages: Analysis, Design, Development, Implementation and Evaluation. Based on the validation results from three validators, the average percentage for the teaching module was 81.25%, which was in the very valid category and suitable for use in learning the motion topic. Based on the practicality of the Independent Curriculum-Based Teaching Module to optimize students' conceptual knowledge, it meets the practicality criteria with a score of 93.18% for teachers and student activities of 91.67%. It is used in the learning process of the motion topic. Based on the assessment of the implementation of learning in the very practical category, the results of the student responses were very good.

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Author Contributions
All authors contributed to writing this article.

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Conflicts of Interest
The authors declare no conflict of interest.

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