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Development of Physics Modules Based on the REACT Learning Model of Sound Wave Material to improve the ability to Understand Concepts

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Abstract: The goal of this study is to create a physics learning module for grade XI high school students based on the REACT learning model of sound wave content. The ADDIE model is being used in this research as part of a research and development project. The first step is to conduct a needs analysis and curriculum to see the problems in the field and then find a solution to overcome these problems, namely by developing a physics module based on the REACT learning model. The second step is designing, and the third is developing modules following the designed design. The produced physics modules have been approved by professionals and experts. The validation results show that the physics module based on the REACT learning model of sound wave material is declared valid. Before the product is applied to the field, the product is tested in small groups first on practitioners and students in small group trials. According to the answers from teachers and students, the physics module has a very good category, making it possible to use it in schools for the teaching process. The fourth phase entails putting the physics modules into practice or applying them to Class XI Science 1 students as an experimental class and Class XI Science 2 students as a control class that has already been evaluated for normalcy and homogeneity. It may be deduced that the data are normally distributed and that the control and experimental classes have homogeneous variance because the significant value for the control class was 0.200 and for the experimental class was 0.071. In the t-test, the average understanding ability of experimental class concepts was 76.30, and the standard deviation was 10.43, while the average understanding ability of control class concepts was 57.80, and the standard deviation was 11.44. Meanwhile, in the equality Means test, df and sig values were obtained. (2-tailed) or p-value, or H0 is rejected. The data thus confirm the proposed hypothesis, leading to the conclusion that the experimental class has a higher conceptual understanding than the control group.t=5.608, df=42, and sig. (2-tailed) or p-value = 0.000<0.005.

Keywords: Development Module; Concept Understanding; REACT learning

Introduction

Today's 21st-century education demands that students learn the skills to innovate and understand the use of information media and technology (Rasyid et al., 2022). According to the 2013 curriculum, knowledge cannot simply be transferred from teachers to learners. Students should actively seek, process, construct and apply information independently (Ibrahim & Yusuf, 2019; Yosi, 2023). Interactions between teachers and students in the learning process and learning resources are organized and managed within the learning environment (Simeru et al., 2023). This ensures that learning activities are aligned with educational goals that help students reach their full potential, skills, and humanity. ability. Therefore, every teacher must know how to organize, conduct, and evaluate the learning process (Ibrahim & Yusuf, 2019).

Learning in the 2013 curriculum through a scientific approach includes investigating, formulating questions,

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collecting data using techniques, processing, drawing conclusions, and presenting results, including the nature of acquiring knowledge, skills, and behavior (Sulastri et al., 2021). Physics is an important subject in high school. Because, physics learning material is not only expected as a conveyance of information, but also a place to develop effective thinking skills to find all oddities and phenomena in the universe (Chen & Techawitthayachinda, 2021; Herwinda et al., 2022). Students should be able to demonstrate concepts and theories learned through experimental activities as part of physics lessons. In addition, studying physics requires the ability to understand the concept of everyday physical events (Arifuddin et al., 2022).

A study by Tomy Suherly (2023) found that students rate their conceptual understanding as low. This is reflected in test results for several question indicators, including concept, but the results obtained are still low. Therefore, it is very important to design learning in a way that stimulates and motivates students so that they have a holistic understanding of physics concepts. One of the least understood concepts of physical matter is sound waves. Students have been found to have misconceptions about the use of observer speed signs and sound source velocities, the relationship between distance and number of sound sources at sound intensity levels, and the relationship between sound intensity (Bajongga, 2014).

Materials are components that teachers need to create. This is due to the widespread use of printed books by students in schools, a decline in interest in reading, and low student autonomy in learning. As a result, students have difficulty understanding the content contained in the book (Nikita et al., 2018; Bajongga, 2014). A module is one of the teaching materials containing a set of learning content that is compiled and used to support student learning so that they can achieve their learning objectives (Ramadhani & Fitria, 2021).

The 2013 curriculum wants direct, student-centered learning (Student Center). Teachers are expected to choose a learning model that allows students to participate directly in the learning process. To overcome this, a learning model is needed that can motivate students to participate actively and directly in the learning process and increase their understanding. A learning model that supports active students, is directly involved in the learning process, and increases student understanding is the REACT model (Amsikan et al., 2023; R. A. Putri et al., 2023; Silaban & Jumadi, 2022).

REACT was introduced by the Center of Occupational Research and Development (CORD) which consists of five processes, namely: Relating; experiencing; applying; cooperating; and transferring (Dwijayani, 2019; Nurzannah et al., 2021). The REACT stage can empower students' problem-solving performance and can provide opportunities for students to learn to "experience" rather than just memorize, apply concepts, and train students' thinking skills optimally. That is, students are not only passive recipients of teacher instruction but are engaged in the construction of their knowledge (Crawford, 2001; Sari & Iza, 2020).

With this in mind, we need to develop a physics module for sound wave teaching materials that teachers can use in their learning process. Therefore, in this study, a physics module based on the REACT sound wave learning model was proposed for class XI. Classes developed.

Method

This research is Research and Development (R&D) according to the ADDIE model. The ADDIE model consists of his five phases of design, development, implementation, and evaluation (Cahyadi, 2019; Damarwan & Khairudin, 2017). Research to develop a physics module based on the REACT learning model focuses on sound wave teaching materials for XI High School students. class. The ADDIE study design is shown in Figure 1.

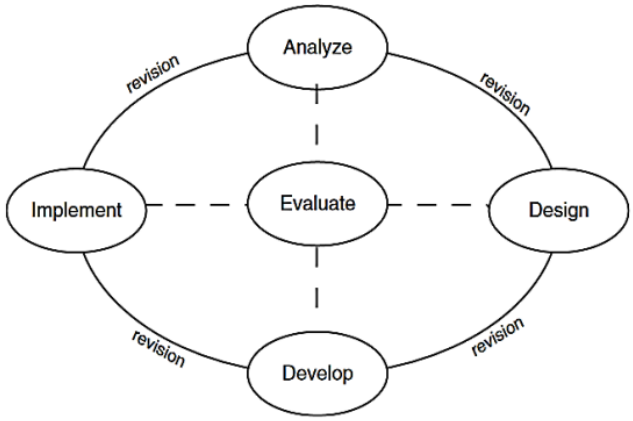

Figure 1. ADDIE development model

The first step is the analysis phase. The purpose of this phase is to analyze needs by identifying problems, expectations, and solutions to be pursued. A needs analysis that was performed is relevant to physics learning difficulties and allows researchers to know learning needs and identify problems. Next, analyze the curriculum to see the curriculum currently used in schools and the subjects that will be studied in schools in the future.

The second step is the design *stage which is the design of modules that will be developed* with several activities including the preparation of teaching materials by reviewing the REACT learning model to determine

learning materials based on facts, concepts, principles, and procedures; designing learning scenarios; selecting teaching material competencies; designing learning materials and learning evaluation tools (Anggiani, 2023; Lestari et al., 2021).

The third step is to create and modify teaching materials based on the designs created. Completed modules are validated by validators using validation tools. The developed learning modules will be used by professionals, practitioners, and her 12 students of XI. A class dealing with sonic material has been validated.

Data obtained from validation and feasibility instruments are expressed on a Likert scale, with scoring criteria indicating conformity with the evaluation point. The Likert scale criteria used are listed in Table 1.

Table 1. Likert Scale Assessment Categories

Value	Criteria
1	Strongly disapproving
2	Disagree
3	Agree
4	Very Agree

Source: (Sugiyono, 2010)

An assessment item is valid if all experts give a minimum score of 3. On the other hand, a draft module is considered valid if all items are declared valid by all reviewers or if each item has a value of 3.00 or higher. The criterion of module draft validity can be expressed by the overall average of the items. The criteria for the validity of the module draft can be stated in Table 2;

Table 2. Module Validity Categories

Value	Criterion
≥ 3.00	Valid
< 3.00	Invalid

Source: (Sugiyono, 2010)

After a module effectiveness score has been obtained and verified, a wave sound materials module based on the REACT learning model can be tested with a small group of teachers and students to find out information about the module's feasibility for users (Budiana, 2019). increase. Analyze questionnaire data for the development of physics modules based on the REACT learning model based on teacher and student questionnaires with the following steps: provide a score for each item, add up the total score of each validator for all indicators, and score responses using the Formula 1.

$$M = \frac{\sum FX}{N} \quad (1)$$

Note:
M = Average score
FX = Score obtained
N = Number of response components

In addition, the teacher-student rate of response questionnaire results are converted to quantitative values as shown in Table 3.

Table 3. Criteria for Teacher and Student Response Questionnaire

Average Response Score	Criteria
3.25 > x ≤ 4	Excellent
2.5 > x ≤ 3.25	Good
1.75 >x ≤ 2.5	Good enough
1 > x ≤ 1.75	Not Good

Source : (Adaptation Yennita et al., 2019)

Based on Table 3, the product developed is said to be practical in use for teachers and students if the minimum criteria achieved are good. The fourth stage is *implementation* which is the stage to implement the design of teaching materials that have been developed through field trials. Field exams are conducted to determine the level of feasibility and effectiveness of modules designed to improve students' understanding of concepts. The experiment was conducted in Class XI of SMA Negeri 2 Kelayang with an experimental class of 22 students and a control class of 22 students. In the experimental class, learning using a sound wave module based on the REACT learning model was applied, and in the control class, the Erlangga book was used. The classification of categories resulting from the students' concept comprehension results is shown in Table 4.

Table 4. Classification of Concept Understanding Assessment Categories

Average rating	Criteria
x ≥ 75.6	Good
59.4 ≤ x < 75.6	Good enough
x < 59.4	Less

Source: (Arikunto, 2013)

Furthermore, the posttest data on concept understanding and learning motivation were analyzed to see the impact of learning using modules based on the REACT learning model in the form of increasing understanding of concepts and learning motivation of students.

The last stage is an *evaluation* which contains the final improvement of the developed module. The evaluation stage has also been carried out in the previous stage. Every improvement made at the analysis, design, development, and implementation stages is included in the evaluation stage.

Result and Discussion

Result

Analyze

The needs analysis phase is designed to provide information on the need to develop physics modules based on the REACT learning model to improve the conceptual understanding and motivation of high school students. This phase considers how the materials are used in schools, what potential weaknesses there are in the materials, and what weaknesses there are in the implemented learning process. increase. At this stage, it is obtained that in the learning process learning activities still use the lecture method and rarely use experimental activities, so that learning activities are still teacher-centered. In addition, the teaching materials used are still dominated by using printed books and never teachers develop a learning module.

Design

Module designs are developed using Microsoft PowerPoint software with the working page set to A4 paper size. The modules developed are designed to contain a start part, a content part, and an end part. The opening section contains several pages, namely the cover, preface, table of contents, module position map, glossary, concept map, and introduction (module identity, basic competencies, module brief description, and module usage instructions). The content section contains pages of learning activities 1, 2, 3, and 4. Each lesson contains learning materials, and student worksheets. Each worksheets contains a section of work instructions, activity objectives, and learning activity steps that are following the REACT learning model activity steps.

The steps of the REACT learning model activities in the module are related containing problem orientation, experiencing and cooperating containing experimental tools and materials, experimental work steps, collecting data, data analysis, and conclusions. Then the applying step contains a page on the application of learning materials that students will do through various activities, and the transferring step contains instructions for students to make presentations in front of the class. The closing section contains summary pages, evaluation questions, a bibliography, and module compiler history.

Develop

Learning modules that have been designed are then developed using power point software. The learning modules developed are designed in such a way that the appearance of the module becomes attractive. The developed physics module consists of 35 pages covering the entire module. Figure 2 shows some pages of the developed module.

A portion of the module pages displayed in Figure 2 has recently been fixed a few times by specialists and professionals. Before providing an assessment, experts and practitioners will review the module in various aspects such as aspects of the material contained in the module, aspects of media used in the module, and aspects of pedagogy. After upgrades are made, specialists and professionals will give evaluations in appraisal sheets that have been arranged by analysts. The aftereffects of the evaluation of the physical science module given the Respond learning model of sound wave material for grade XI secondary school understudies.

The physics module based on the REACT learning model of sound wave material for grade XI secondary school understudies was created and afterward surveyed and further developed by 3 specialists comprising material specialists, media specialists, and teaching method specialists.

The learning module is feasibility tested by 3 experts in the field of material before being used for research. The evaluation sheet in the material field approval contains 16 appraisal inquiries on 5 things of material congruity appraisal, 5 things of material recency evaluation, 3 things of easy-to-use evaluation, 2 marks of practicality evaluation, and 1 thing of versatile evaluation. The enhancements and appraisals given by validators are then reconsidered and again displayed to validators. Then, the validator will audit the better module and afterward reconsider it. The consequences of the approval appraisal by 3 material master validators are displayed in Table 5.

Table 5. Module Validation Results by Material Experts

Assessment Indicators	Average	Category
Material suitability	3.93	Valid
Material up-to-date	3.87	Valid
User-friendly	3.56	Valid
Benefits	3.17	Valid
Adaptive	3.67	Valid
Average	3.64	Valid

Considering the evaluation by 3 validators displayed in Table.5, the typical approval of physical science modules by material specialists got a score of 3.64. Because of the normal, the score shows the evaluation class in the substantial class.

In addition to conducting assessments in the field of material, 3 experts also conducted assessments in the field of pedagogy. The validation assessment sheet on the pedagogical aspect contains 26 assessment items including 5 presentation assessment items, 3 language assessment items, 7 contextual assessment items, 5

REACT learning model assessment items, and 6 concept understanding assessment items. The appraisal of every marker is then evened out and the consequences of the approval evaluation by 3 master teaching method validators are displayed in Table 6.

Table 6. Module Validation Results by Pedagogy Experts

Assessment Indicators	Average	Category
Serving	3.67	Valid
Language	3.44	Valid
Contextual	3.67	Valid
REACT learning model	3.73	Valid
Concept understanding	3.44	Valid
Average	3.59	Valid

Because of the evaluation of the field of teaching method by 3 validators displayed in Table.6, the typical approval of physical science modules by master specialists got a score of 3.59. Given the normal, the score shows the appraisal classification in the legitimate class.

Furthermore, 3 experts also assessed the physics module based on the REACT learning model of the sound wave material displayed by the media experts. The assessment sheet in the media aspect contains 18 questions, namely 2 points of format assessment, 5 points of organizational assessment, 2 points of attractiveness assessment, 3 points of typographic assessment, 2 points of consistency assessment, 2 points of language assessment, and 2 points of expediency assessment. The appraisal is then evened out on each scoring pointer for the 3 validators. The aftereffects of the evaluation by 3 specialists in the field of media are displayed in Table 7.

Table 7. Results of Module Validation by Media Experts

Assessment Indicators	Average	Category
Format	3.67	Valid
organization	3.93	Valid
Attraction	3.83	Valid
Typographers	4.00	Valid
Consistency	3.83	Valid
Language	3.67	Valid
Benefits	3.67	Valid
Average	3.86	Valid

Because of the appraisal of the media field by 3 validators displayed in Table 7, the typical approval of the material science module by master specialists got a score of 3.86. In light of the normal, the score shows the evaluation classification in the legitimate class.

The physical science module in light of the REACT learning model of sound wave material for grade XI secondary school understudies is tried for possibility by professionals (educators) before being utilized in learning. The assessment sheet contains five assessment indicators of which a total of 17 assessment items, namely 3 material assessment items, 3 presentation assessment items, 2 language assessment items, 3 design assessment items, and 6 useful assessment items. The assessment results are then leveled based on assessment indicators. The consequences of the appraisal by 3 specialists are displayed in Table 8.

Table 8. Consequences of approval by specialists

Assessment Indicators	Average	Category
Material	3.78	Excellent
Serving	4.00	Excellent
Language	3.83	Excellent
Design	3.78	Excellent
Benefit	3.50	Excellent
Average	3.78	Excellent

Because of the appraisal of the three specialist validators in Table 6, the normal educator reaction to the physical science module was 3.78. Because of these spans, it shows that the typical outcome score by professionals in the classification is awesome. In the meantime, understudies' reactions to physical science modules given learning models are displayed in Table 9.

Table 9. Student Response Results

Assessment Indicators	Average	Category
Facilities of Use	3.71	Excellent
Benefit	3.67	Excellent
Attraction	3.73	Excellent
Average	3.70	Excellent

Considering Table 9, the normal score of the preliminary outcomes on 12 understudies was 3.70. Referring to the questionnaire criteria for teacher and student responses presented in Table 3.9, the criteria for student trials are in the range $3{,}25 > x \geq 4$ with very good categories.

Implementation

This stage completed field execution preliminaries on 22 understudies of grade XI Science 1 and 22 understudies of grade XI Science 2 at SMA N 2 Kelayang. The exploratory class applied to master utilizing the physical science module because of the Respond learning model of sound wave matter, while the control class applied to get the hang of utilizing class XI printed physical science books of sound wave material.

Before the idea cognizance test was done, the two classes completed an ordinariness test and a homogeneity test first. Information on the consequences of ordinariness tests that have been done with SPSS programming is acquired qualities in Table 10.

Table 10. Normality by Kolmogorov-Smirnov of control classes and experiments

Class	Statistic	df	Sig.
Experiment	0.177	22	0.071
Control	0.124	22	0.200

Table 10 acquired huge qualities for the control class of 0.200 and for the exploratory class of 0.071, so it tends to be presumed that the information is regularly appropriated > 0.05. Test aftereffects of homogeneity of learning results of control classes and trials are displayed in Table 11.

From the outcomes in Table 11, In light of the Mean meaning of 0.713 which is more noteworthy than 0.05, then, at that point, the control class and the trial have a homogeneous difference. Because of the posttest variation ordinariness and homogeneity test, the two classes are typically dispersed and have homogeneous variations, so the distinction test between the two class midpoints should be visible in Table 12.

Besides, tests were completed with t-test measurements on the normal worth of idea understanding capacity in the exploratory class and control class. Table 13 shows the aftereffects of the Autonomous Examples Test.

Table 11. Homogeneity of variance

Class	Levene statistic	df1	df2	Sig.
Based on Mean	0.137	1	42	0.713
Based on Median	0.234	1	42	0.631
Based on the Median and with adjusted df	0.234	1	41.9	0.631
Based on trimmed mean	0.153	1	42	0.697

Because of Table 12, the normal comprehension capacity of exploratory class ideas is 76.30 and the standard deviation is 10.43, while the typical comprehension capacity of control class ideas is 57.80 and the standard deviation is 11.44. This implies that distinctly the capacity to comprehend the ideas of understudies instructed with physical science modules in light of the Respond learning model is higher than understudies who use Erlangga printed book educating materials.

Table 12. Group Statistic

	Class	N	Mean	Std. Deviation	Std.Error Mean
Posttest Concept comprehension	Experiment	22	76.30	10.43	2.22341
	Control	22	57.80	11.44	2.43802

Table 13. Independent Samples Test

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std.Error Difference
Posttest Concept comprehension	Equal variances assumed	0.137	0.713	5.608	42	0.000	18.50545	3.29962
	Equal variances not assumed			5.608	41.648	0.000	18.50545	3.29962

Considering Table 13, Levene's test of an incentive for Equivalent changes expected got F=0.137 with sig. or on the other hand p-esteem = 0.713>0.05, and that implies that the populace change of the two gatherings is equivalent and homogeneous. In the meantime, in the uniformity Means test, t=5.608, df=42, and sig. (2-tailed) or p-value =0.000<0.005, or H0 is dismissed. Consequently, the speculation proposed is tried by the information, so it is inferred that the capacity to comprehend the idea of the exploratory class is higher than that of the control class.

Discussion

This examination created a physical science module considering the Respond learning model of sound wave material for grade XI secondary school understudies to work on's how understudies might interpret ideas and learning inspiration. The development of this module uses the ADDIE development stage which begins with the analysis stage (Martin et al., 2019). The stages of analysis used are needs analysis and curriculum analysis. At the examination stage, it is realized that the issues exist in schools, particularly N 2 Kelayang Secondary School. These problems include learning activities that still use lecture activities, and the teaching materials used still use printed books without any development of teaching materials from teachers. In addition, students rarely conduct experiments in learning activities, and student's understanding of concepts and learning motivation at school is still low.

Overcome these problems, solutions are proposed to help students and teachers in overcoming these problems.

In this study, a physics module based on the REACT learning model was developed on sound wave material for grade XI high school students to overcome problems in the needs analysis. The use of planned and appropriate learning media can help students understand the learning message conveyed (Atapungkang, 2016; A. A. Putri & Ardi, 2021).

After a necessary investigation is completed, plan exercises are done and afterward, improvement is completed. The physical science module considering the Respond learning model of sound wave material to work on the comprehension of ideas and inspiration of grade XI secondary school understudies was then evaluated by 3 material specialists, clinical specialists, and teaching method specialists with a normal of 3.64, 3.59 and 3.86 separately. Because of the appraisal span, the evaluation class is in the Substantial class.

As well as being evaluated by specialists, the physical science module because of the Respond learning model of sound wave material to work on the comprehension of ideas of grade XI secondary school understudies was given an appraisal and reaction by professionals comprising of 3 educators. The typical score of reactions by professionals got was 3.78 with a generally excellent evaluation classification. In the meantime, the typical understudy reaction after utilizing the module was 3.70 with high classes. This shows that as per instructors and understudies, the material science module because of the Respond learning model for grade XI secondary school understudies is exceptionally fascinating and deserving of being utilized and applied to the growing experience.

In the meantime, the trial of understudies' idea appreciation tests in the exploratory class and control class showed that the typical score of the test class was higher than the control class. This shows that physical science modules given the Respond learning model can work on's how understudies might interpret ideas.

Conclusion

This exploration plans to foster a material science module given the Respond learning model as a physical science learning medium and test its practicality. The topic chosen in this module is sound waves. Material, pedagogy, and media experts validated the study to see its feasibility. The material science module created was then surveyed and answered by professionals comprising 3 physical science educators. The results of expert and practitioner assessments are obtained in the entire category of high assessment, which means that the physics modules developed are suitable for application in schools. Before the physics module was applied in schools, the module was tested on a small scale on grade XII students who had previously learned the subject of sound waves.

The consequences of the understudy reaction survey were gotten module appraisal with high evaluation classes. Later, it is trusted that the material science module considering the Respond learning model to work on the comprehension of ideas and inspiration of secondary school class XI understudies can be helpful for understudies in the educating and educational experience. Additionally, for educators, the physical science module is supposed to be utilized as an elective medium in homeroom learning

Author Contributions

This article was written by three authors, ie Januarti, Nur Islami, and Yennita. All authors together completed this paper at each stage.

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Conflicts of Interest

The authors declare no conflict of interest.

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