Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

DEVELOPMENT OF NATURAL SCIENCE E-MODULE ON MOTION MATERIALS FOR JUNIOR HIGH SCHOOL STUDENTS

Lazaro Kumala Dewi[1)], Indri Astuti[2)], Aloysius Mering[3)]

[1)] *Universitas Tanjungpura, Pontianak, Indonesia*
E-mail: lazarokumaladewilala@student.untan.ac.id

[2)] *Universitas Tanjungpura, Pontianak, Indonesia*
E-mail: indri.astuti@fkip.untan.ac.id

[3)] *Universitas Tanjungpura, Pontianak, Indonesia*
E-mail: aloysius.mering@fkip.untan.ac.id

Abstract. The goals of this research are to produce an innovative, interactive, and practical Natural Science E-Module of Motion Materials, this learning can be more interesting, fun, and also the students can learn independently. This research using 4-D model (Four D-Models) with 4 steps they are define, design, develop, and disseminate/deploy. The subjects of this research were students of class VIII grade of SMP Negeri 1 Sungai Raya Pontianak and SMP Negeri 11 Pontianak. The data collecting of this research is using interview techniques, questionnaires, and tests. The assessment of E-Module by the experts obtained eligibility = 86,67% with "Excellent" qualification. The assessment of e-module by the design experts obtained = 79,17% with "Good" qualification. This e-module being assessment by media expert obtained = 82,5% with "Excellent" qualification. The student response which one to one class (individual) to the product obtained = 82,22% including the criteria "Very Interesting". Student response which small group class obtained = 90.07% including the criteria "Very Interesting". The effectiveness of the product is seen from the student's learning results using the effect size test. The effectiveness of Natural Science E-Module obtained = 1,748 which the criteria is "Large". This e-module using App Inventor which is very effective to the students to improve student's learning outcomes.

Keywords**:** *E-Module; 4-D Model (Four D-Models); App Inventor; Object Motion Materials; Learning Outcomes*

I. INTRODUCTION

Learning resources according to AECT in Daryanto (2010, pp. 60-62) are various or all sources in the form of data, people and certain forms that can be used by students in learning activities either separately or in combination so as to facilitate students in achieving their learning goals. The Ministry of Education and Culture publishes learning resources in the form of teacher and books students to support learning activities Natural Sciences in schools. The existence of science books for teachers and students plays an important role in learning in schools.

Science learning is still dominated by learning resources in the form of print media, namely textbooks and Student Worksheets (LKS). The provision of textbooks and worksheets is a good effort that teachers have made in providing learning media. However, having an unattractive appearance is not enough to motivate students to study science. The limitations of learning media make students less enthusiastic about being actively involved in the learning process, causing learning to be less effective. This causes students to have difficulty building knowledge, applying theories, and concepts in solving science problems in everyday life.

Based on the results of unstructured interviews with the Science Coordinator of Junior High School (*SMPN*) 11 Pontianak, namely Ibnu Kusdinarti, S.Pd., information was obtained that the provision of learning media that was less attractive and not interactive became a problem for students in learning science. The teacher has never used multimedia learning media in the form of an electronic module (e-module). Science learning is not always easily conveyed by the teacher and absorbed by students, especially in the Material of Motion of Objects.

In essence, students are very familiar with the Material of Motion of Objects, because without realizing it students have carried out internal movement activities of daily life. However, practice students still experience problems in studying on Motion Materials. This difficulty becomes a challenge for teachers in providing learning media that can make it easier for students to understand the material and be actively involved in the learning process. From the results of the interviews, it was concluded that the teaching materials used during the learning process were only in the form of

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

printed books, worksheets, and PowerPoint, as well as very necessary learning media that were practical and accessible anywhere, such as android.

In addition, based on a needs analysis questionnaire that the researchers distributed via google form in one of class VIII SMP Negeri 11 Pontianak obtained data from 30 students, namely 70% did not like science subjects, 63% said the science learning process had been boring, and 80% said want fun science learning. All students stated that the learning resources they had used from school to study science were student worksheets, textbooks, and PowerPoint. Only 17% of students stated that they liked the existing science course handbooks, and 37% stated that it depended on how they were presented. 40% of students stated that the handbook they had already provided an overview that made it easier to understand science subjects. All students stated that they wanted interactive learning media in the form of Science E-Module accompanied by learning videos and quizzes, but had never used them. 90% of students stated that it would be easier to understand science material with interactive media in the form of e-module.

Following up on this problem, researchers feel the need to develop learning media to help students build knowledge, apply theory, and discover science concepts in everyday life. Learning media can make a major contribution to the effectiveness of delivering material in the learning process. Learning media designed right for Overcoming the difficulties of students learning science can improve student learning outcomes, and allow learning to take place anywhere and anytime.

An electronic module (e-module) is a form of independent teaching material that is systematically arranged in easy-to-understand language into the smallest learning units, presented in an electronic format that includes animation, audio, video, which makes users more interactive with the program. (Sugianto, 2013, pp. 101-116). The learning process that involves more senses will provide direct and meaningful experience in building knowledge, applying theories, and concepts in science learning. According to Dale (in Arsyad, 1997, p.10) states "the acquisition of learning outcomes according to the sense of sight is around 75%, through the sense of hearing about 13% and through other senses about 12%)". Software that can be used to create learning media in the form of E-Module is App Inventor.

App Inventor is a programming that produces applications that can be used on the android. App Inventor was originally developed by Google, and is currently maintained by the Massachusetts Institute of Technology (MIT). App Inventor-based cloud access using an internet browser, has the advantage of ease of programming because users do not need to have basic programmer, understand code, or have experience in information technology. When building applications with App Inventor, what matters is how programmers use their own logic like when putting together a puzzle.

Development of Natural Science E-Module with App Inventor can be used as a practical and easy-to-store learning resource, as well as its dissemination by downloading software the E-Module on smartphones. E-Module Development this adapted to the needs analysis. Considering Android device mobile developed as a learning medium, because be is device that can flexible carried everywhere. In the era gadget, almost all students have Android .

Research by Ni Ketut Suci Artiniasih (2019) with the title "Electronic Development of Modules Based on Natural Science Subjects for Class VIII Junior High Schools" provides conclusions on the development of e-module very good and effectively improve science learning outcomes. A similar study by WS Sembiring (2021) with the title "Science E-Module to Facilitate Independent Learning for Senior High School Students" provides conclusions on the development of E-Module valid and feasible to be applied by the teacher in the learning process, so that it can help students in independent learning.

Based on the description of the needs review, researchers are interested in developing Android form of E-Module Science Material for Motion of Objects for Junior High School Students. Natural Science E-Module Motion of Objects is an innovation of teaching materials so that the learning process is more interesting and interactive, compiled by taking into account the characteristics of self-instructional, self-contained, stand-alone, adaptive, user friendly, consistent in the use of fonts, spacing, and layout, delivered using electronic media, utilizing various functions of electronic media, utilizing various features in the application used, and carefully designed.

Natural Science E-Module on Motion Materials is developed in accordance with the development of information and communication technology, attractively packaged with communicative language, provides challenges, and stimulates student curiosity to learn Objects Motion Materials, with sample questions equipped with discussions, learning videos that are relevant to the material, and evaluations are descriptive. interactive. Natural Science E-Module on Motion Materials motivates students to learn independently with teacher guidance or without teacher guidance, and allows learning to take place anywhere and anytime with android, so it is hoped that it can help improve student learning outcomes.

II. METHODS

A. Research Methods

Methods The method used in this research is research and development or Research and Development (R & D). According to Sugiyono (2012, p.297) research and development methods are research methods used to produce certain products and test the effectiveness of these products. The research and development (R & D) method is a process used to develop a product or improve an existing product and test the effectiveness of the product.

In research and development (R & D) methods there are several types of development models. The development model planned in this study uses the 4-D Model (Four D-Models). According to Thiagarajan in Reigeluth (2021, p.21) development is divided into four stages, namely: Define, Design, Develop, and Deploy. Research and development

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

that will be carried out by researchers is to develop products in the form of Natural Science E-Module Materials for Motion of Objects as a learning resource.

B. Development Procedure

Representation of the development stages carried out by researchers as follows:

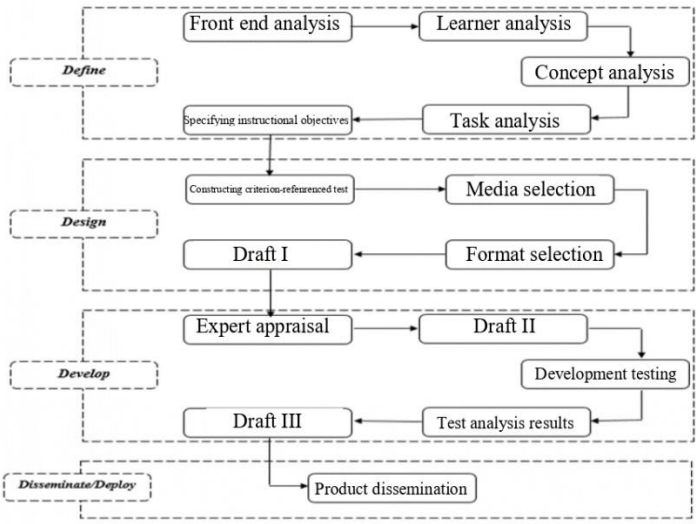


Figure 1 Stages of Development of Natural Science E-Module on Motion Materials

1. Define

a. Front end analysis

In the front-end analysis, researchers seek information about the problems that occur in science learning. Researchers conducted interviews with the science coordinator at SMP Negeri 11 Pontianak about the problems faced by teachers in the science learning process.

b. Learner analysis (student analysis)

In the learner analysis, researchers study the characteristics and needs of students in the science learning process. The researcher conducted a needs analysis on 30 eighth grade students at SMP Negeri 11 Pontianak through a needs analysis questionnaire that the researcher distributed via google form.

c. Concept analysis

In the concept analysis researcher analyzes important concepts that must be mastered by students. The concepts in KD that are interconnected are arranged into a concept map.

d. Task analysis

At the task analysis researcher determines the content and competencies that must be achieved in learning using Natural Sciences E-Module on Motion Materials.

e. Specifying instructional objectives

At the stage specifying instructional objectives, researchers determine learning objectives that are in accordance with the material to be studied and as a basis for determining the contents of the Natural Science E-Module.

2. Design

a. Constructing criterion-referenced test

In the constructing criterion-referenced test researcher developed instruments including validation of the assessment of learning outcomes, and product validation instruments. In addition to compiling the validation of learning outcomes and product tests, the researcher also developed an instrument for student responses to the product.

b. Media selection

At the media selection researcher selects media that is tailored to the needs and characteristics of students. Researchers choose to develop E-Module products Natural Sciences Materials for Motion of Objects based on the needs and characteristics of students at SMP Negeri 11 Pontianak.

c. Format selection

In the format selection researcher chooses the E-Module format Science that meets the criteria is interesting, makes it easier and helps in learning the Material of Motion of Objects. E-Module Design Science includes making storyboards, flowcharts, structuring materials in E-Module Science includes the layout (layout) used, the preparation of material and practice questions visualized using the App Inventor.

d. Initial design

At the initial design researcher designs the Natural Science E-Module (Draft I) includes: Cover and Title of E-Module Science, Instructions for Using Modules, Concept Maps, Learning, and Images and Videos.

3. Develop

a. Expert appraisal

At the expert appraisal, E-Module products The science developed was each validated by 2 lecturers as material experts, design experts and media experts before being tested in the field. Validation is done by using a questionnaire assessment sheet. Based on expert input, E-Module revised Natural Sciences produces Draft II so that it can be piloted.

b. Development testing

Product development trials were carried out including limited trials (one to one trials and small group) as well as large scale trials (field trials). The limited trial was conducted at SMP Negeri 1 Sungai Raya, while the broad trial was conducted at SMP Negeri 11 Pontianak. Researchers conducted trials in different schools so that the level of validity and reliability of the instrument was maintained.

1) One to One Trial

Individual trial implemented on 6 Class VIII students of SMP Negeri 1 Sungai Raya for the academic year 2021/2022. At this stage the researcher used a student response questionnaire instrument and a student learning outcome test instrument.

2) Small Group trial

Small group trials were conducted on 24 students of Class VIII SMP Negeri 1 Sungai Raya. Limited trial Small group using a student response questionnaire

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

instrument. In addition, researchers used student learning outcomes tests before conducting a large-scale trial. Natural Science E-Module that has been tested is analyzed, and revised again if necessary so that it produces (Draft III) and is ready to be disseminated.

3) Field Trial

Field trials were conducted to determine the effectiveness of the E-Module Science in improving student learning outcomes before and after using Natural Science E-Module. The instrument used is a test of student learning outcomes before and after using the Natural Science E-Module on Motion Materials.

The experimental design model in the field trial is shown in Table 1 as follows:

TABLE 1

PRETEST-POSTTEST CONTROL GROUP DESIGN

Class	*Pretest*	Treatment	*Posttest*
Experiment	O_1	X	O_2
Control	O_3	-	O_4

(Sugiyono, 2011, p.113)

Description: O1 = Pretest experimental class
O2 = Posttest experimental class
O3 = Pretest control class
O4 = Posttest control class
X = Treatment in the experimental class

In the field trial, the researchers tested two classes at SMP Negeri 11 Pontianak, namely class VIII C as the experimental class with 30 students and class VIII D as the control class with 29 students. Learning in the experimental class using Natural Science E-Module that researchers developed with App Inventor. While the control class learning uses learning resources from schools.

4. Disseminate/Deploy

Stage disseminate/deploy, researchers disseminate information by providing products Natural Science E-Module on Motion Materials to science teachers at SMP Negeri 11 Pontianak.

C. Time and Place of Research

The Research "Development of Natural Science E-Module on Motion Materials for Junior High School Students" is carried out in the odd semester of the 2021/2022 academic year. The research was held in July – October 2021. Researchers carried out research at SMP Negeri 1 Sungai Raya and SMP Negeri 11 Pontianak.

D. Research Subjects and Objects

The subjects of this development research were 30 students of Class VIII J SMP Negeri 1 Sungai Raya. There are 30 students of SMP Negeri 11 Pontianak Class VIII C and 29 students of VIII D. While the object of the research development is the Natural Sciences E-Module on Motion Materials for Junior High School Students.

E. Data Collection Techniques and Instruments

1. Techniques

According to Arikunto (2010, pp. 193-201) there are six data collection techniques, namely observation, questionnaires or questionnaires (quetonnaires), interviews, tests, rating scales, and documentation. In this development research used three types of data collection techniques as follows:

a. Interviews

In this development research, researchers used unstructured interview techniques, researchers did not develop and use interview guidelines. Interviews were conducted with the science coordinator at SMP Negeri 11 Pontianak to analyze the needs of learning media.

b. Questionnaire

In this development research, a questionnaire was given to material, design, and media experts to determine the feasibility of the Natural Science E-Module being developed, as a product validation process before the Natural Science E-Module was implemented. Then during the product trial, the researcher gave a questionnaire to the students to find out the student's response to the development of The Natural Science E-Module.

The form of the questionnaire provided by the researcher used a Likert Scale. According to Mulyatiningsih (2014, p.29) "The Likert scale is used to reveal respondents' opinions expressed in the form of a range of answers ranging from strongly disagree, agree to strongly agree."

c. Tests

In this development research, the test in question is student learning outcomes. Student learning outcomes tests were given to the experimental class and control class with the same type and number of questions. The researcher gave an objective test (multiple choice) with four alternative answers.

2. Data Collection Instruments

According to Arikunto (2010, p.203) "Research instruments are tools or facilities used by researchers in collecting data so that their work is easier and the results are better, in the sense of being more accurate, complete and systematic so that they are easier to process." In this development research, two types of data collection instruments were used as follows:

a. Questionnaire Sheet

Researchers provide questionnaire sheets for material, media, and design experts in the validation process, as well as students in the product testing process. Scale a Likert, and scoring guidelines with a score range of 1-4. Rating scale for E-Module The developed sciences are Strongly Agree (SS) = 4, Agree (S) = 3, Disagree = 2 (TS), and Strongly Disagree (STS) = 1.

The expert assessment questionnaires and student responses are explained as follows:

1) E-Module Assessment Questionnaire Science by Material Experts

E-Module Assessment Questionnaires Science by material experts assesses aspects of the feasibility of

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

content, language, and suitability of the material. Analysis of the data obtained by the researcher is used as a consideration in revising the E-Module developed Natural Science.

2) E-Module Assessment Questionnaire Natural Science by Design Experts

E-Module Assessment Questionnaire Natural Science by design experts assesses aspects of appearance, presentation of material, and attractiveness. E-Module assessment process Natural Science by design experts is done by trying to use E-Module developed Natural Science.

3) E-Module Assessment Questionnaire Natural Science by Media Experts

E-Module Assessment Questionnaire Natural Science by media experts assesses aspects of media and graphics efficiency. E-Module assessment process Natural Science by media experts is done by trying to use E-Module developed Natural Science. Media experts provide advice and feedback on the Natural Science E-Module that needs to be revised.

4) Student Response Questionnaire to E-Module Science

Questionnaire student responses to the E-Module Science is used to determine aspects of appearance, presentation of material, and attractiveness.

b. Test Sheet

Researchers provide test sheets to determine student learning outcomes in the form of pretest and posttest. Learning outcomes test is a form of assessment of students' cognitive abilities. The objective test (multiple choice) consists of 25 questions, with each question having four alternative answers, namely a, b, c, and d. The test sheet is made referring to the indicators of achievement of students' cognitive competencies. The pretest posttest and questions were validated before being tested first.

F. Data Analysis Techniques

1. Qualitative Analysis Qualitative

Data were obtained by researchers from expert assessment questionnaires and student response questionnaires. Researchers will get useful comments in the E-Module development stage Science is based on data from a questionnaire of experts, namely material, media, and design experts. Qualitative analysis was also carried out on the questionnaire response data for class VIII students at SMP Negeri 1 Sungai Raya as a limited trial school.

Qualitative analysis was carried out by researchers based on comments in the form of responses, criticisms and suggestions from expert assessment questionnaires in the validation process and student response questionnaires in the process of limited product trials. The results of the analysis are used by researchers as the basis for revising the Natural Science E-Module. Researchers also use the results of qualitative analysis to explain qualitative data.

2. Quantitative Analysis Quantitative

Data obtained by researchers based on the assessment of questionnaires and tests are described as follows:

a. Questionnaire

Researchers conducted a quantitative analysis of the E-Module assessment questionnaire Science by experts in the validation process, as well as students in the product testing process using a Likert according to Ridwan & Akdon (2015, p. 6) with the following criteria:

TABLE 2
LIKERT SCALE ASSESSMENT QUESTIONNAIRE NATURAL SCIENCE E-MODULE BY EXPERTS

No	Category	Score
1	Strongly Agree	4
2	Agree	3
3	Disagree	2
4	Strongly Disagree	1

The score obtained by the researcher was based on an assessment questionnaire by material, media, and design experts, as well as student response questionnaires, calculated as follows:

$$x = \frac{\sum x}{n} \quad (1)$$

Description:

x = Average score
n = Number of raters
$\sum x$ = Total score of each for each aspect

The score that the researcher obtained was converted according to Arikunto (2012: p.244) to determine the feasibility presentation as follows:

$$\text{Eligibility} = \frac{Score\ obtained}{Maximum\ score\ obtained} \times 100\% \quad (2)$$

Furthermore, the researchers identified the Natural Science E-Module into eligibility qualifications using a Likert scale according to Arikunto (2010: p.216) in accordance with Table 3 as follows:

TABLE 3
INTERPRETATION SCALE WITH LIKERT SCALE

No	Achievement Level (%)	Qualification	Remarks
1	81 – 100%	Very good	Very decent, not needs revision
2	61 – 80 %	Good	Decent, does not need revision
3	41 – 60 %	Good enough	Not feasible, needs revision
4	21 – 40 %	Not good	Not feasible, needs revision
5	< 20%	Very poor	Very not feasible,

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

needs revision

On the results of the calculation of student responses, the researchers identified the Natural Science E-Module into attractiveness criteria according to Atika Izzatul Jannah & Endang Listiyani (2017: p.60) according to TABLE 4 as follows:

TABLE 4
ATTRACTIVENESS CRITERIA

Percentage (%)	Attractiveness
81 – 100	Very attractive
61 – 80	Attractive
41 – 60	Less attractive
0 – 40	Very poor

b. Tests

Tests of students cognitive learning outcomes were validated first to find out whether it was feasible to be tested. Trial analysis was conducted to determine the validity, reliability, level of difficulty, and discriminatory power of the questions. Some of the testing steps are as follows:

1) The Validity Test

Calculation of the validity test is carried out with the Statistical Product and Service Solutions (SPSS) software version 26.00. To determine the validity of multiple choice questions, statistical tests with the Biserial Point as follows:

$$r_{pbis} = \frac{Mp - Mt}{SDt}\sqrt{\frac{p}{q}} \qquad (3)$$

(Sudijono Anas, 2014: 258)

Description:
rpbis correlation index number Point biserial
Mp = Mean (mean value) score achieved by test takers, which is being correlated with the overall test
Mt = Mean total score, achieved by all test takers
SDt = Total standard deviation (Standard Deviation from the total score)
P = Proportion of test takers who answered correctly to the item that is being searched for correlation with the test as a whole

Calculate the biserial index point as follows:

a) Finding the total mean (Mt) with the formula:

$$Mt = \frac{\sum x_t}{N} \qquad (4)$$

(Sudijono Anas, 2014: 259)

Description:
Mt = Mean total score, which was achieved by all test participants
$\sum x_t$ = Total score
N = Number of questions

b) Finding the total standard deviation with the formula:

$$St = \sqrt{\frac{\sum x_t^2}{N} - \frac{(\sum x_t^2)}{(N)}} \qquad (5)$$

(Sudijono Anas, 2014: 260)

Description:
$\sum x_t^2$ = Square of total score
$\sum x_t$ = Total score
N = Number of items
St = Total standard deviation

To determine the criteria for the existing validation values, the Nurgana criteria are used (in Jihad, 2013: p.180).

TABLE 5
VALIDATION CRITERIA

Validation	Criteria
0.80 < r_{xr} 1.00	Very High
0.60 < r_{xr} 0.80	High
0.40 < r_{xr} 0.60	Enough
0.20 < r_{xr} 0.40	Low
r_{xr} – 0.20	Very Low

2) Reliability Test

To calculate the reliability of multiple choice questions, SPSS version 26.00 was also used using Cronboach's Alpha. Then the data obtained were analyzed using the KR formula. 20 according to Arikunto (2013: p.188), namely:

$$r_{11} = \left[\frac{k}{k-1}\right]\left[\frac{Vt - \sum pq}{Vt}\right] \qquad (6)$$

Description:
r11 = Reability coefficient
k = Many questions
Vt = Total variance
p = $\frac{Propotion\ of\ subjects\ who\ received\ a\ score\ of\ 1}{N}$
q = $\frac{Propotion\ of\ subjects\ who\ received\ a\ score\ of\ 0}{(q=1-p)}$

Reliability criteria posttest and Pretest according to Ruseffendi (in Jihad, 2013: p.181) as follows:

TABLE 6
RELIABILITY CRITERIA

Reliability	Criteria
$r_{11} \leq 0{,}20$	Very Low
$0{,}20 < r_{11} \leq 0{,}40$	Low
$0{,}40 < r_{11} \leq 0{,}70$	Tall
$0{,}70 < r_{11} \leq 0{,}90$	High
$0{,}90 < r_{11} \leq 1{,}00$	Very High

3) Test Difficulty Level of Questions

In research in the form of multiple choice, according to Subana and Sudrajat (2011: p.133), to analyze the level of difficulty of each item the following formula is used:

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

$$P = \frac{B}{JS} \quad (7)$$

Description:
P = difficulty index
B = number of students who answered the question correctly
JS = total number of participating students test

To calculate the difficulty level of multiple choice questions, SPSS version 26.00 was used. The criteria for the level of difficulty according to Sudjana in Jihad (2013: p.182) are as follows:

TABLE 7
CRITERIA FOR THE LEVEL OF DIFFICULTY OF THE QUESTIONS

The level of difficulty of the questions	Criteria
0.00 - 0.30	Difficult
0.31 - 0.70	Medium
0.71 - 1 ,00	Easy

4) Distinguishing Power Test Distinguishing

Power is calculated using the DP formula for multiple choice tests according to Suharsimi Arikunto (2013: p.228) as follows:

$$DP = \frac{BA}{JA} - \frac{BB}{JB} = PA - PA \quad (8)$$

Description:
DP = Distinguishing power
JA = Number of participants in the upper group
JB = Number of participants in the lower group
BA = Number of participants in the upper group who answered the questions correctly
BB = The number of lower group participants who answered the questions correctly
PA = The proportion of the upper group participants who answered correctly
PB = The proportion of the lower group participants who answered correctly

To calculate the discriminating power of multiple choice questions using SPSS version 26.00. According to the classification of discriminating power according to Arikunto (2010: p.213) as follows:

TABLE 8
DISTINGUISHING POWER CRITERIA

Distinguishing Power	Criteria
Negative	Criteria
0.00 – 0.20	Poor
0.20 – 0.40	Enough
0.40 – 0.70	Good
0.70 – 1.00	Very Good

5) The Normality Test

Data used in the normality test are the results of the pretest and posttest. Normality test using Statistical Product and Service Solutions (SPSS) software version 26.00 with Kolmogorov-Smirnov technique (One Sample KS). According to Triton (2006: p.79) the data is said to be normal if the probability or (Sig.) > 0.05.

6) T-test

Normal distributed data will be continued with the Independent Sample t Test in the experimental class and control class using software SPSSThe level of significance on the t-test is 5%. The t-test was conducted to determine the difference in the average scores before (pretest) and after (posttest) using the E-Module Science in learning. The hypotheses used are:

H0 : There is no significant difference between the average pretest and the average posttest value.
H1 : There is a significant difference between the average pretest and the average posttest score.

Based on probability:
H0 is accepted if the significance > 0.05.
H0 is rejected if the significance is < 0.05.

7) Mann-Whitney

Test Mann used to analyze whether there is a difference between the mean of two independent data from each other. To determine whether a hypothesis is accepted or rejected, the Mann-Whitney can be considered from the following criteria:

If Zcount < Ztable or p > 0.05 then Ho is accepted and H1 is rejected.

If Zcount > Ztable or p < 0.05 then Ho is rejected and H1 is accepted.

8) The Homogeneity Test

Data used in the homogeneity test are the results of the posttest. The homogeneity test was analyzed using the Test of Homogeneity of Variance using software SPSS version 26.00 Homogeneity test using Levene's. Test was Levene's used to test the homogeneity of variance between data groups.

In the calculation of the homogeneity test used a significant level (Sig.) > 0.05. If (Sig.) Based on Mean > 0.05, then both groups have homogeneous variant groups.other hand, if Based on Mean < 0.05 then both groups have non-homogeneous variance groups.

9) Normalized Gain Test (N-Gain)

Data analysis to determine the increase in student learning outcomes using the N-Gain with software version 26.00. The comparison of the normalized gain value (N-Gain) between the experimental class and the control class is calculated using the following equation:

$$G = \frac{Spost - Spre}{Smaks - Spre} \quad (9)$$

Description:
$Spost$ = Score *Posttest*
$Spre$ = Score Pretest
$Smaks$ = Maximum Score

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

The high and low gains normalized by N-Gain are then categorized according to TABLE 9 as follows:

TABLE 9
CRITERIA FOR DISTINGUISHING POWER N-GAIN SCORE

Limitations	***Criteria***
N-Gain > 0,7	*High*
0,3 < N-Gain ≤ 0,7	*Medium*
N-Gain ≤ 0,3	*Low*

10) Test Effect Size

Data analysis to determine the effectiveness of the development of the Natural Science E-Module on Motion Materials on the learning outcomes of class VIII students of SMP Negeri 11 Pontianak using effect size. Effect size analyzed using the RStats Effect Size Calculator.

Effect size is calculated using the following equation:

$$d' = \frac{Xt - Xc}{S_{pooled}} \qquad (10)$$

Description:
d = Cohen's *effect size*
$\bar{X}t$ = *Mean treatment condition*
$\bar{X}c$ = *Mean control condition*
S_{pooled} = *Standard deviation*

For the equation Spooled or the combined standard deviation as follows:

$$S_{pooled} = \sqrt{\frac{(n_{t-1})S_t^2 + (n_{c-1})S_c^2}{n_t + n_c - 2}} \qquad (11)$$

Description:
S_{pooled} = Combined standard deviation
n_t = number of experimental class students
n_c = number of control class students
S_t^2 = standard deviation of experimental class
S_c^2 = standard deviation of control

The effect size is categorized according to Cohen's d (1988) interpretation criteria in TABLE 10 as follows:

TABLE 10
CRITERIA FOR INTERPRETATION OF COHEN'S D

Effect Size	**Criteria**
$0,8 \leq d \leq 2,0$	Large
$0,5 < d \leq 0,8$	Medium
$0,2 < d \leq 0,5$	Small

III. Results And Discussion

A. The Development of Prototype Product

Prototype of this research and development product is in the form of an E-Module in the Science of Motion Materials which was developed with the App Inventor to improve the learning outcomes of class VIII SMP students using the 4-D Model (Four D-Models). The research was carried out at SMP Negeri 1 Sungai Raya for the validation and limited trial phase, and SMP Negeri 11 Pontianak for the analysis phase and field trials. The stages of developing the Natural Science E-Module onMotion Materials are as follows:

1. Define

a. The Front End Analysis

Researcher is based on the analysis of pre-research results at SMP Negeri 11 Pontianak. The results of the initial and final analysis refer to the results of interviews with the IPA coordinator, namely Ibnu Kusdinarti.

Based on interviews conducted by researchers, information was obtained that the learning process, teachers use teaching materials in the form of printed books, namely teacher books and student books published by the Ministry of Education and Culture, the latest revision in 2017. Teachers also use Student Worksheets (LKS) as a source of student learning. In addition, teachers have also used electronic learning media, but they are still limited to PowerPoint learning media. The teacher has never used multimedia learning media in the form of an electronic module (E-Module).

In the material for motion of objects, the teacher has not used multimedia learning media, which should have been in the 2013 Curriculum for students to be introduced to the development of learning technology. So that the development of multimedia and interactive learning media in the form of Natural Science E-Module is needed to increase students interest in learning science, especially on motion materials which has a lot of applications in everyday life.

b. Learner Analysis

The analysis was carried out based on the results of a needs analysis questionnaire that the researchers distributed via google form in class VIII C of SMP Negeri 11 Pontianak at the time of the pre-research. The results obtained conclusions from 30 students, 70% did not like science subjects, 63% said the science learning process had been boring, and 80% said they wanted fun science learning. All students stated that the learning resources they had used from school to study science were worksheets, textbooks, and PowerPoint.

In addition, only 17% of students said they liked the existing science subject handbook, and 37% said it depended on how it was presented. 40% of students stated that their handbook already provides an overview that makes it easier to understand science subjects. All students also stated that they wanted interactive learning media in the form of Natural Science E-Modules accompanied by learning videos and quizzes, but had never used it. 90% of students stated that it would be easier to understand science material with interactive media in the form of E-Modules.

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

c. *Concept Analysis*

Analysis is carried out to identify the main concept that students will learn, namely Object Motion Material. The concepts to be taught are arranged systematically and relevantly in accordance with the Core Competencies (KI) and Basic Competencies (KD) contained in the syllabus. Object Motion Material contains the concept of motion can be in the form of straight motion (involving distance, displacement, speed, speed, acceleration, regular straight motion, and straight motion changes regularly), influenced by force (can be both touch force and non-touch force), and Newton's Law (consisting of Newton's Law I, Newton's Law II, and Newton's Law III).

d. Task Analysis

The analysis was carried out by researchers on basic competencies and then formulating indicators of learning material. Researchers analyzed the main tasks that must be mastered by students in order to achieve basic competencies in the Motion Materials, namely KD 3.1 Understanding straight motion, and the effect of force on motion based on Newton's Laws, as well as its application to the motion of living things and the motion of objects in everyday life. This stage will be very helpful at the stage of media selection and format selection that will be developed.

e. Specifying Instructional Objectives (Goal Spesifications)

Researchers determine learning objectives according to KD obtained in concept analysis and task analysis. Based on the results of the analysis, it is obtained that the learning objectives that will be achieved by students using the Natural Science E-Module on Motion Materials are to analyze the motion of objects, the effect of forces on the motion of objects, and Newton's Laws of motion.

2. Design

a. Constructing criterion-referenced test

Researchers compiled a grid of E-Module assessment of the Natural Science on Motion Materials by experts, namely material experts, design experts, and media experts. The researcher also made a grid of learning outcomes test questionnaires for material experts. The researcher also compiled a questionnaire grid for student responses to the product being developed. So that a validation questionnaire and a student response questionnaire were generated for the Natural Science E-Module.

TABLE 11
QUESTIONNAIRE FOR THE E-MODULE SCIENCE ASSESSMENT BY MATERIAL EXPERTS

Aspects of Assessment	Criteria	Items
Feasibility of Contents	Conformity of material with Basic Competencies (KD)	1, 2, 3
	Accuracy of material	4, 5, 6
Feasibility of Presentation Presentation	Technique	7
	Presentation of learning	8
	Straightforward	9, 10
Language Assessment	Communicative	11
	Appropriate to the developmental level of students	12, 13
	Use of terms, symbols, or icons	14, 15

TABLE 12
QUESTIONS OF SCIENCE E-MODULE ASSESSMENT QUESTIONNAIRE BY DESIGN EXPERTS

Assessment Aspects	Criteria	Items
Display	Text	1
	Clarity of images	2
	Suitability of images, videos with material	3, 4
Presentation of Materials	Ease of understanding the material	5
	Clarity of sentences	6
	Clarity of symbols and symbols	7
	Compatibility of examples with material	8
Interesting	Motivation	9, 10, 11
	Use of illustrations (pictures, videos)	12, 13
	Physical appearance	14, 15

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

TABLE 13
E-ASSESSMENT QUESTIONNAIRE GRID SCIENCE MODULE BY MEDIA EXPERT

Aspects of Assessment	Criteria	Items
Media Efficiency	Effectiveness and Efficiency	1, 2
	Reliability	3
	Maintainable	4
	Usability	5
	Accuracy in Media Selection	6
	Documentation	7
	Communicative	8
	Creative and Innovative	9
	Simple	10
Graphics	(Letters and Arrangements)	11, 12
	Figure	13
	Color	14
	Design	15

TABLE 14
STUDENT RESPONSE QUESTIONNAIRE

Aspects of	Item Assessment Questions
E-Module learning media Science is able to attract and focus students' attention.	1, 3
Delivery language used by Natural Science E-Module can be understood by students (not verbalistic).	2
Natural Science E-Module as a learning resource.	4, 10, 11
Continuation of TABLE 14	
Natural Science E-Module encourages students to carry out learning activities so that learning objectives are achieved.	5
Natural Science E-Module can increase student acceptance or acceptance of the lesson load to be studied.	6, 7, 8, 9
Natural Science E-Module builds effective communication between teachers and students.	12
Natural Science E-Module provides opportunities for students to learn independently.	13
Exercises contained in the Natural Science.	14
The content of learning according to student needs.	15

TABLE 15
STUDENT LEARNING OUTCOMES TEST

Statement	Item Assessment Questions
The material asked is in accordance with the level	1
The scope of the test is clear	2
The question indicators on the learning outcomes test can cover all basic competencies	3
The questions on the learning outcomes test are in accordance with the question indicators	4
Questions on the learning outcomes test it is clear (easy to understand)	5
The formulation of the questions does not show the answer key	6
Discourse or pictures really work	7
The use of language in the learning outcomes test is easy to understand	8
The sentences used in the learning outcomes test are precise and clear	9
Instruments can be used as research measuring instrument	10

b. Media Selection

Researchers determine the learning media to be developed, namely the Natural Science E-Module on Motion Materials using *App Inventor* which is practical make it easier for students to access learning media anywhere and anytime with *Android* .

c. Format Selection

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

Researchers identify the various components that will be created and used for the Natural Science E-Module using visual studio to be developed, including the typeface, *background*, images, *icons* and buttons used in this Natural Science E-Module.

d. Initial design

Researchers designed the initial Natural Science E-Module on Motion Materials using *App Inventor* containing a glossary, application of materials, summaries, learning videos, assessment of learning outcomes and equipped with instructions for using this Natural Science E-Module.

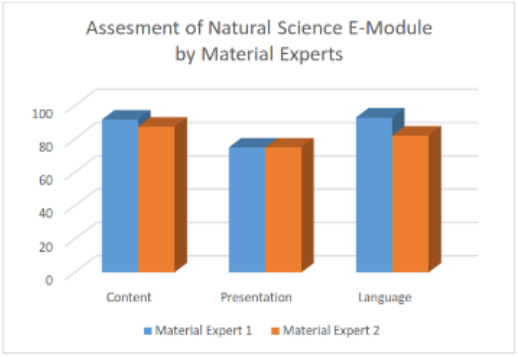
Figure 2 Prototype of Natural Science E-Module on Motion Materials

3. Develop

a. Expert Appraisal (Expert Assessment)

1) Assessment of the Natural Science E-Module by Material Expert

At the assessment stage of the IPA E-Module by a material expert, validation is carried out to test the feasibility of the material from the aspect of content, presentation, and language. Percentage of E-Module eligibility IPA by material experts is shown in the graph in Graph 1 as follows:



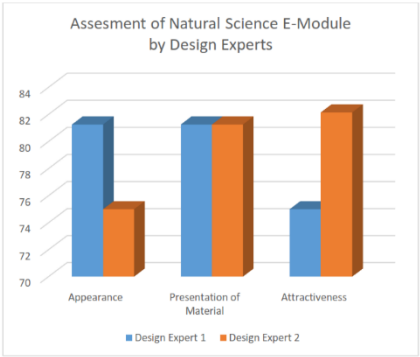
Graph 1 Assessment of Natural Science E-Module by Material Experts

Results of the material expert validation obtained an assessment of the feasibility aspect of the content obtaining an average score of 21.5 with a percentage of eligibility of 89.58% included in the qualification “Very Good”, i.e. very decent, no revision needed. The presentation feasibility aspect obtained an average score of 6 with a feasibility percentage of 75% included in the "Good" qualification, i.e. proper, no need for revision. The language assessment aspect obtained an average score of 24.5 with an eligibility percentage of 87.5% included in the "Very Good" qualification, which is very feasible, no need for revision.

The average value of the Natural Science E-Module from material experts is 52 with a feasibility percentage of 86.67% included in the "Very Good" qualification, which is very feasible, no need for revision. Material experts also provide comments and suggestions in the E-Module Science assessment stage. Comments and suggestions are used by researchers as a reference for revising the material on the product.

2) Assessment of the Natural Science E-Module by Design Experts

At the stage of evaluating the Natural Science E-Module by design experts, validation is carried out to test the feasibility of the design from the aspect of appearance, presentation of material, and attractiveness. Percentage of E-Module eligibility Natural Science by a material expert is shown in the graph in Graph 2 as follows:



Graph 2 Assessment of the Natural Science E-Module by a Design Expert.

The validation results by a design expert obtained an assessment of the feasibility of the design from the aspect of appearance, presentation of material, and attractiveness. The appearance aspect obtained an average score of 12.5 with a feasibility percentage of 78.13% included in the "Good" qualification, i.e. proper, no need for revision. The presentation aspect of the material obtained an average score of 13 with a feasibility percentage of 81.25% included in the "Very Good" qualification, which is very feasible, no need for revision. The attractiveness aspect obtained an average score of 22 with a feasibility percentage of 78.57% included in the "Good" qualification, i.e. eligible, no need for revision.

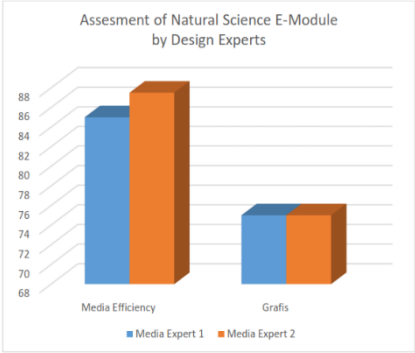
The average value of the Natural Science E-Module from the design experts is 47.5 with a feasibility percentage of 79.17% which is included in the "Good" qualification, that is, it is feasible, does not need revision. Design experts also provide comments and suggestions during the Natural Science E-Module assessment stage. Comments and suggestions are used

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

by researchers as a reference for revising the design of the product.

3) Assessment of the Natural Science E-Module by Media Experts

At the evaluation stage of the Natural Science E-Module by media experts, validation was carried out to test the feasibility of the media from the aspect of media efficiency, and graphics. Percentage of E-Module eligibility Natural Science by material experts is shown in the graph in Graph 3 as follows:



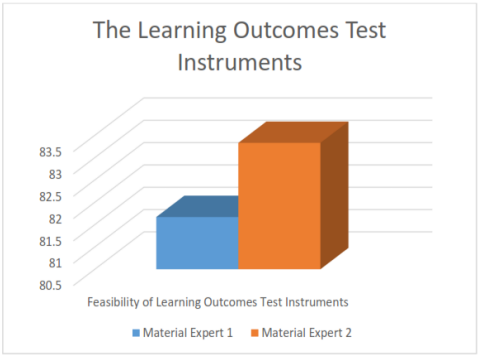
Graph 3 Assessment of the Natural Science E-Module by Media Experts

The validation results by media experts obtained an assessment of media feasibility from the aspect of media efficiency, and graphics. The media efficiency aspect obtained an average score of 34.5 with an eligibility percentage of 86.25% included in the "Very Good" qualification, which is very feasible, no revision is needed. The graphic aspect obtained an average score of 15 with an eligibility percentage of 75% included in the "Good" qualification, i.e. eligible, no revision needed.

The average value of the Natural Science E-Module from media experts is 49.5 with an eligibility percentage of 82.5% included in the "Very Good" qualification, which is very feasible, no need for revision. Media experts also provide comments and suggestions in the Natural Science E-Module assessment stage. Comments and suggestions are used by researchers as a reference for revising the media on the product.

4) The Learning Outcomes Test Instruments

Average score of the learning outcomes test instruments is 37 with a feasibility percentage of 92.5% included in the "Very Good" qualification, which is very feasible, no need for revision. The percentage of eligibility for the validation of student learning outcomes test instruments by material experts is shown in the graph in Graph 4 as follows:



Graph 4 Feasibility of Learning Outcomes Test Instruments

Material experts also provide comments and suggestions on test instruments in the Natural Science E-Module assessment stage. The researchers used comments and suggestions as a reference for revising the learning outcomes test instrument on the resulting product.

b. Development testing

1) One to One Trial

The results of the *one to one trial* can be seen in table 16 as follows:

TABLE 16
ONE TO ONE TRIAL RESULTS OF SMP NEGERI 1 SUNGAI RAYA

Analysis	Information
$\sum x$	296
$\bar{x}$	49.33
Eligibility	82.22%
Qualification	Very Attractive

The average value of student responses is 49.33 with a percentage of eligibility 82.22% included in the “Very Interesting” criteria . It shows E-Module The science of motion of objects developed using the *App Inventor* by researchers is appropriate to be used as a learning resource for junior high school students.

2) Small Group Trial

The result of the small group trial trial can be seen in table 17 as follows:

TABLE 17
SMALL GROUP RESULTS TRIAL SMP NEGERI 1 SUNGAI RAYA

Analysis	Information
$\sum x$	1297
$\bar{x}$	54.04
Eligibility	90.07
Qualification	Very Attractive

The average value of student responses was 54.04 with a percentage of eligibility 90.07% included in the

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

"Very Interesting" criteria. It shows The Natural Science E-Module on Motion Materials developed using the *App Inventor* by researchers is appropriate to be used as a learning resource for junior high school students.

The results of the validity, reliability, level of difficulty, and discriminating power are described as follows:

a) The Validity Test

Results of the validity test of the learning outcomes test instrument at SMP Negeri 1 Sungai Raya were tested with SPSS version 26.00. The validity used with a significance level of 5% on 30 students based on the values of r *product moment* is 0.36. The question is declared valid if the value of rCount is greater than rTable.

There are 18 valid questions, there are numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 15, 18, 19, 20, 21, 22, 23, and 25. There are 7 invalid questions, there are numbers 10, 11, 12, 14, 16, 17, and 24.

b) Reliability

The reliability test of the multiple-choice learning outcome test instrument was carried out with *Cronboach's Alpha* with the help of SPSS 26.00 and the result was 0.830. with a "High" level of reliability. The results of the reliability test of learning outcomes test instruments at SMP Negeri 1 Sungai Raya can be seen in Table 18 as follows:

TABLE 18
RELIABILITY TESTING OF LEARNING OUTCOMES TESTING INSTRUMENTS AT SMP NEGERI 1 SUNGAI RAYA

Reliability Statistics

Cronbach's Alpha	N of Items
.830	25

c) The Difficulty Level Test

Level of difficulty according to Sudjana in Jihad (2013: p.182) is divided into 3 criteria, namely, difficult, medium, and difficult. To calculate the level of difficulty of the test instrument for learning outcomes, SPSS version 26.00 is used. Based on the analysis, it is known that the questions with difficult criteria are 3 questions, there are 4, 17, and 24. The questions with moderate criteria are 15 questions, there are 2, 3, 7, 8, 9, 11, 13, 15, 18, 19, 20, 21, 22, 23, and 25. While the questions with easy criteria are 7 questions, located at numbers 1, 5, 6, 10, 12, 14, and 16.

d) Distinguishing Power Test Distinguishing

Power of the test results instrument learning was analyzed with SPSS version 26.00. The results of the analysis of the differentiating power of the learning outcomes test instrument at SMP Negeri 1 Sungai Raya contained questions that had bad, sufficient, good, and very good criteria. There are 3 questions with bad criteria, namely numbers 16, 17, and 24. There are 6 questions with sufficient criteria, namely 1, 10, 11, 12, 14, and 22. There are 15 questions with good criteria, namely numbers 3, 4, 5, 6 , 7, 8, 9, 13, 15, 18, 19, 20, 21, 23, and 25. And questions with very good criteria are 1, namely number 2.

Researchers choose to use questions number 1, 2, 3, 4, 5 , 6, 7, 8, 9, 11, 13, 15, 18, 19, 20, 21, 22, 23, 24, and 25. So that the questions used as test instruments for learning outcomes totaled 20 questions.

3) Field Trial

The field trial was conducted as a test of the effectiveness of the product that the researcher developed using a *pretest-posttest control group design* that used two test classes, namely the experimental class and the control class. The experimental class was given an the Natural Science E-Module on Motion Materials with *App Inventor* in the learning process, carried out in class VIII C totaling 30 students. The control class does not use the Natural Science E-Module on Motion Materials with *App Inventor* in the learning process, it is carried out in class VIII D totaling 29 students.

4. Disseminate/Deploy

Researchers provide *soft files* to the coordinator and the science teacher at the school. When the Natural Science E-Module deployment stage was carried out, the researchers got a positive response. The positive response in the form of appreciation of this learning media can be used as a learning resource so that students can learn independently and are practical, which allows students to learn anywhere and anytime. In addition, the positive response received was the interesting and varied the Natural Science E-Module on Motion Materials. In addition to distributing and providing *file*, the researcher also tells the steps for*installing*the IPA E-Module application to *Android*.

B. Profile of Natural Science E-Module on Motion Materials

The Natural Science E-Module on Motion Materials developed with *App Inventor* has the following profile:

1. Icon Natural Science E-Module on Motion Materials on Android

Icon Natural Science E-Module with pictures related to the Motion Materials, there is a material title.

Figure 3 *Icon* Natural Science E-Module on Motion Materials

2. Initial Display

The initial display contains the logo of the University of Tanjungpura Pontianak along with the words Master of Educational Technology, Tanjungpura University, Pontianak.

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

Figure 4 The initial display of Natural Science E-Module on Motion Materials

3. Main Menu

The main menu menu contains several menus, namely materials, videos, evaluations, profiles, and assistance.

Figure 5 Main Menu Natural Science E-Module on Motion Materials

a. Materials

On the material menu there are several menus, namely Instructions, KI namely Core Competencies, KD namely Basic Competencies, Indicators namely indicators of competency achievement, Concept Maps, and Module Contents. The content section of the E-Module is equipped with a cover, introduction, table of contents, glossary, learning materials, sample questions and discussion, evaluation, and bibliography.

Figure 6 Profile of Natural Science E-Module on Motion Materials

b. Video

There are 2 video menus of material discussed in the Material of Motion of Objects, namely Straight Motion and Force, and Newton's Laws. In the Straight Motion video there is an explanation of Distance, Displacement, Velocity, Speed, Acceleration, Uniform Motion (GLB), and Uniform Straight Motion (GLBB).

Figure 7 Natural Science E-Module Video Profile on Motion Materials

c. Evaluation

Evaluation in the form of multiple choice consists of 12 questions. Evaluations are made with *Google Forms.* Evaluation is interactive, students can immediately answer questions and find out the correct answer scores without the help of other applications.

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

Figure 8 E-Module Evaluation Profile IPA Material of Motion of Objects

d. Developer Profile

In addition to the identity of the product developer, there is also a *button* "chat" *the group WhatsApp* Material Motion Objects.

Figure 9 Natural Science E-Module Profile on Motion Materials

e. The Help

The help menu contains instructions for using the application technically in the form of *icons* and their functions.

Figure 10 E-Module Help Profile IPA Materials for Motion of Objects

C. Product Effectiveness

1. Normality Test Normality

Test data student learning outcomes of the experimental class and the control class of SMP Negeri 11 Pontianak can be seen in TABLE 18 as follows:

TABLE 18
TEST OF THE NORMALITY OF STUDENTS' LEARNING OUTCOMES IN EXPERIMENT CLASS AND CONTROL CLASS SMP NEGERI 11 PONTIANAK

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Class	Statistic	df	Sig.	Statistic	df	Sig.
Experimental Class Pretest	.133	30	.184	.948	30	.147
Continuation of TABLE 18						
Experimental Class Posttest	.240	30	.000	.865	30	.001
Control Class Pretest	.121	29	.200*	.961	29	.348
Control Class Posttest	.182	29	.015	.923	29	.037

Data *pretest* experimental class0.184 > 0.05 and the control class had a significance value (Sign.) 0.200 > 0.05, meaning that it was normally distributed. While the *posttest* the experimental class had a significance value (Sign.) 0.000 <0.05 and the control class had a significance value (Sign.) 0.015 <0.05, meaning that it was not normally distributed. With these results, the data on student learning outcomes of the experimental class and control class of SMP Negeri 11 Pontianak will be continued with non-parametric statistics (*Mann-Whitney*).

2. *Mann-Whitney*

Test Data for the *Mann-Whitney* of student learning outcomes in the experimental class and control class at SMP Negeri 11 Pontianak can be seen in TABLE 19 as follows:

TABLE 19
MANN-WHITNEY TEST LEARNING RESULTS OF STUDENTS' EXPERIMENT CLASS AND CONTROL CLASS STATE JUNIOR HIGH SCHOOL 11 PONTIANAK

Test Statistics[a]

	Student Learning Outcomes
Mann-Whitney U	170.000
Wilcoxon W	605.000
Z	-4.065
Asymp. Sig. (2-tailed)	.000

Based on Table 4.23, it can be seen that the learning outcomes data of experimental and control class students have a signfication value (Sign.) of 0.000 < 0.05, then H0 is rejected and H1 is accepted, meaning that there is a significant difference between the average pretest score and the average posttest score of the experimental class and the control class of SMP Negeri 11 Pontianak.

3. The Homogeneity Test

Data obtained are sig. 0.143. Thus H0 is rejected because of the value of sig. 0.146 > 0.05 means that the experimental class and control class data are homogeneous. Homogeneity test data Student learning outcomes of

Journal of Education, Teaching, and Learning
Volume 8 Number 2 September 2023. Page 202-218
p-ISSN: 2477-5924 e-ISSN: 2477-8478

experimental class and control class of SMP Negeri 11 Pontianak can be seen in TABLE 20 as follows:

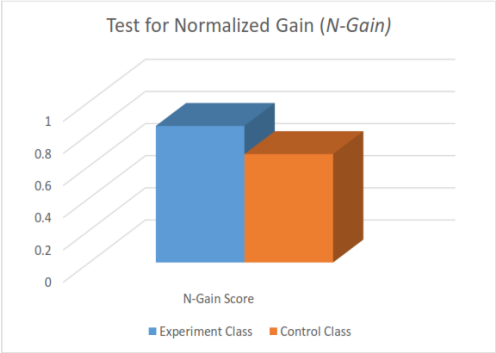
TABLE 20
TEST OF HOMOGENITY OF STUDENTS' LEARNING OUTCOMES IN EXPERIMENT AND CONTROL CLASS SMP NEGERI 11 PONTIANAK

Test of Homogeneity of Variance

	Levene Statistic	df1	df2	Sig.
Based on Mean	2.211	1	57	.143
Based on Median	.861	1	57	.357
Based on Median and with adjusted df	.861	1	42.137	.359
Based on trimmed mean	1.994	1	57	.163

4. Test for Normalized Gain (*N-Gain)*

Data results of the *N-Gain* learning outcomes of the experimental class and control class of SMP Negeri 11 Pontianak can be seen in Graph 5 as follows:



Graph 5 *N-Gain of* Student Learning Outcomes of Experiment Class and Control Class of SMP Negeri 11 Pontianak

Average *N-gain* of student learning outcomes SMP Negeri 11 Pontianak in the experimental class and control class has increased. This can be known through the *pretest* and *posttest* in both classes. The *N-gain* of student learning outcomes in the experimental class increased with an average *N-gain of* 0.8492 which was included in the "High" criteria. Meanwhile, *the N-gain* of student learning outcomes in the control class increased with an average *N-gain of* 0.6736 which was included in the "Medium" criteria.

Based on Graph 5, it can be concluded that the implementation of the Natural Science E-Module on Motion Materials in Learning can improve student learning outcomes. This can be due to the learning process with the Natural Science E-Module on Motion Materials attract students to be actively involved, and can learn independently and allow students to learn anywhere and anytime. The Natural Science E-Module makes students focus on viewing learning materials that are packaged in an attractive way, namely with *Android* , equipped with videos, text, images, and videos as well as practice questions that make students more interactive and can learn independently without or with teacher guidance.

5. Test *Effect Size*

Data analysis to determine the effectiveness of the Natural Science E-Module on Motion Materials on the learning outcomes of class VIII SMP Negeri 11 Pontianak using *effect size* according to *Cohen's d* (1988) the results of calculations with the *RStats Effect Size Calculator* are as follows:

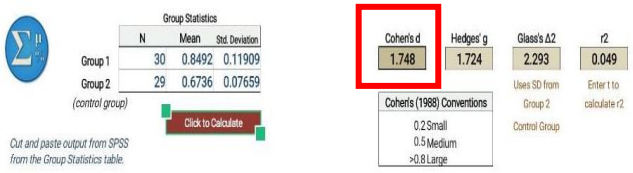


Figure 11 *Effect Size* Natural Science E-Module on Motion Materials on student learning outcomes SMP Negeri 11 Pontianak

Based on the calculation, the *effect size* 1.748 so it is included in the "*Large"* or "Large" criteria. Thus the development of E-Module The science of motion of objects has a great influence on the learning outcomes of class VIII students of SMP Negeri 11 Pontianak.

IV. Conclusions

Based on the results of the analysis of the data obtained, in general it can be concluded that the Development of the Natural Science E-Module on Motion Materials for class VIII SMP has an effect on student learning outcomes. The conclusions are specifically described as follows:

The Natural Science E-Module on Motion Materials was developed using a 4-D Model (*Four D-Models*) which has 4 stages, namely the define, design, develop, and disseminate/deploy. This learning media was validated by material experts, design experts, and media experts. Based on the assessment of the Natural Science E-Module on Motion Materials by media experts, the percentage of eligibility 86.67% is included in the "Very Good" qualification, which is very feasible, no need for revision. Based on the assessment of the Natural Science E-Module on Motion Materials by a design expert, the percentage of feasibility is 79.17% included in the "Good" qualification, that is, it is feasible, does not need revision. Based on the assessment of the Natural Science E-Module on Motion Materials by media experts, the percentage of eligibility of 82.5% is included in the "Very Good" qualification, which is very feasible, does not need revision. Researchers also conducted limited trials including *one to one trials* (individual trials) and *small groups trial* (small group trial). The average value of student responses in the *one to one trial* (individual trial) was 49.33 with a feasibility percentage of 82.22% included in the "Very Interesting" criteria. The average value of student responses in *the small group trial* (small group trial) was 54.04 with a percentage of 90.07% eligibility included in the "Very Interesting" criteria.

Natural Science E-Module on Motion Materials was developed with *App Inventor*. On the main menu there are materials, videos, evaluations, profiles, help, *buttons*. The material menu is equipped with instructions for use for teachers and students, there are Core Competencies, Basic Competencies and Competency Achievement Indicators,

Concept Maps, and Module Contents. The video menu contains videos about Straight Motion, Force, and Newton's Laws. The Natural Science E-Module Framework on Motion Materials is prepared based on the guidelines for the preparation of Modules and E-Module by the Ministry of Education and Culture. IPA E-Module The material for motion of objects is prepared by taking into account the characteristics of *self-instructional*, *self-contained*, *stand-alone*, *adaptive*, *user friendly*, consistent in the use of *fonts*, spacing, and layout, delivered using electronic media, utilizing various functions of electronic media, and various features in the application used, and carefully designed.

The effectiveness of the product is obtained based on the calculation of the *effect size* using *the RStats Effect Size Calculator*. The Natural Science E-Module Effectiveness on Motion Materials on the learning outcomes of class VIII students of SMP Negeri 11 Pontianak is 1,748 which is included in the *"big" criteria.* So that the E-Module Science Materials Motion of Objects is effectively implemented as a learning medium to improve student learning outcomes.

REFERENCES

Arikunto, Suharsimi. (2010). *Prosedur penelitian suatu pendekatan praktik*. Jakarta: Rineka Cipta.

Arsyad, Azhar. (2013). *Media pembelajaran*. Depok: PT Raja Grafindo Persada.

Artiniasih, Ni Ketut Suci., A.A. Gede Agung, dan I Gede Wawan Sudatha. (2019). Pengembangan elektronik modul berbasis proyek mata pelajaran Ilmu Pengetahuan Alam Kelas VIII Sekolah Menengah Pertama. *Jurnal EDUTECH Universitas Pendidikan Ganesha*, 7(1), 54-65, DOI: 10.23887/jeu.v7i1.20008.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed)*. Hillsdale, NJ: Erlbaum.

Daryanto. (2010). *Belajar dan mengajar*. Bandung: Yrama Media.

Jannah, Atika Izzatul, dan Endang Listyani. (2017). Pengembangan bahan ajar pada bahasan himpunan dengan pendekatan *problem solving* untuk siswa SMP Kelas VII. *Jurnal Pendidikan Matematika*, 6(3), 60. Diunduh di https://adoc.pub/pengembangan-bahan-ajar-pada-bahasan-himpunan-dengan-pendeka.html.

Jihad, Asep dan Abdul haris. (2013). *Evaluasi pembelajaran*. (Cetakan ke-1). Yogyakarta: Multi Presindo.

Mulyatiningsih, Endang. (2014). *Metode penelitian terapan bidang pendidikan*. Bandung: Alfabeta.

Sembiring, W.S., I.G.W. Sudatha, A.H. Simamora. (2021). E-Module ipa untuk memfasilitasi siswa menengah atas belajar mandiri. *Jurnal Teknologi Pendidikan Indonesia*, 11(1), DOI: 10.23887/jurnal_tp.v11i1.635.

Sugianto, Doni dkk. (2013). Modul virtual multimedia *flipbook* dasar teknologi digital. *Jurnal INVOTEC*, 9(2): 110-116, DOI: 10.17509/invotec.v9i2.4860.

Sugiyono. (2011). *Metode penelitian pendidikan*. Bandung: Alfabeta.

Sugiyono. (2012). *Metode penelitian kuantitatif kualitatif dan R&D*. Bandung: Alfabeta.

Thiagarajan, Sivasailam, dkk. (1974). *Instructional development for training teachers of exceptional children*. Washinton DC: National Center for Improvement Educational System.

Triton, Prawira Budi. (2006). *SPSS 13.0 Terapan; Riset Parametrik*. Yogyakarta: Andi Offset.