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Development of an Integrated Science and Health Education Module Based on Discovery Learning Theme Sports Healthy Heart

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Abstract: This research aims to analyze the validity, practicality and readability of the Integrated Science module based on discovery learning on the theme of healthy heart sports. This research is research and development. The development model used is the 4D model by Thiagarajan which contains three development stages, namely define, design and develop. The validity assessment included two science education experts and the practicality assessment included five science teachers at SMP Negeri 2 Bekasi. The test subjects for the Integrated Science module included ten students in class VIIIA of SMP Negeri 2 Bekasi Sukasada in the readability test. The data obtained consisted of qualitative data and quantitative data using observation guide grid instruments, interview guide grids and questionnaire assessment sheets. Data were analyzed descriptively. Research results The Integrated Science Module obtained a score of 1 with very valid qualifications based on the results of the Science Education Expert's assessment with a score of 1; The Integrated Science Module obtained a score of 4.35 with very practical qualifications based on the science teacher's assessment; The Integrated Science Module obtained a score of 4.14 with a reading qualification based on the results of student assessments with a score of 4.14. The conclusion of this research is that the Integrated Science module based on discovery learning with the theme of healthy heart sports has very valid qualifications, is very practical and readable, so it can be continued to effectiveness testing.

Keywords: Discovery Learning; Healthy Heart Exercise; Integrated Science; Modules

Introduction

Integrated Science Learning is an educational program that is oriented towards developing thinking skills, curiosity, developing a caring attitude, the ability to learn, be applicable and be responsible for the surrounding environment. Integrated Science Learning trains students to actively discover for themselves various principles, concepts, laws that are studied holistically, actively and meaningfully, so that students can gain direct experience in the learning process (Kemendikbud, 2014). Responding to the demands of Integrated Science learning, it is necessary to implement optimal Integrated Science learning. Implementing optimal Integrated Science learning requires the availability of teaching materials that can facilitate students to develop their potential.

Kuswanto's research (2019) states that teachers as educators are required to be able to create teaching materials creatively so that students can utilize these teaching materials as learning resources in the learning process independently. However, according to research by Khairani et al. (2017) stated that the Integrated Science teaching materials at SMP N 8 Bekasi, SMP N

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12 Bekasi and SMP N Bekasi contain material that is still separated between physics, chemistry and biology so that the teaching materials do not reflect Integrated science teaching materials.

Based on the results of interviews and distributing questionnaires with three class VIII science teachers at SMP Negeri 1 Bekasi, two class VIII science teachers at SMP Negeri 2 Bekasi and one class VIII science teacher at SMP Negeri 6 Bekasi on 22 October-26 October 2023, several problems were found, namely the availability of materials. There is still little Integrated Science teaching in the field. This is because most teachers have never created an Integrated Science module. Apart from that, the Integrated Science teaching materials currently used in the field have limitations. These limitations are viewed in terms of quality, which still has several weaknesses, such as: not having complete elements, namely only containing the main material; the material has not been integrated using a particular integration model; and it is not yet based on a learning model so that science learning cannot meet the demands of the applicable curriculum.

Another problem found was that science material was considered difficult by students. One of the science materials is material about the human circulatory system. This is in accordance with research by Miftahudin, (2019) which states that material on the human circulatory system is science material which is difficult for students. This is proven by only 40-50% of students who get a score above the KKM in daily tests on the circulatory system material. Therefore, we need integrated science teaching materials that can help students understand the material on the human circulatory system.

Based on the discovery of problems in the field and relevant research data, it is necessary to develop teaching materials that can support the Integrated Science learning process, namely the Integrated Science module. Developing an Integrated Science module requires an integration model. The integration model chosen is the webbed integration model. The choice of the webbed integration model is because learning is taught using a contextual theme. According to research Liu, (2007); and Priyambodo et al., (2012), the webbed integration model is very suitable for use in preparing Integrated Science modules because the themes developed can be integrated into all fields of science, making it easy for students to see the relationship between concepts. The theme formulated in the development of the Integrated Science module is heart-healthy exercise. The theme of healthy heart sports was formulated to overcome students' difficulties in understanding the circulatory system material. The theme of healthy heart sports consists of three fields of science so it uses a thematic approach in combining the material. The three fields of science are Biology, Physics and Chemistry. In the field of Biology, it contains material about blood, blood circulation, disorders of the circulatory system, efforts to prevent disorders of the circulatory system and physical fitness. In the field of Physics, it contains material on heart rate frequency, how to calculate heart rate, heart rate units, Pascal's law and blood pressure.

In the field of chemistry, it includes the composition of blood components, blood content, nutrition, hemoglobin binding reaction and cigarette content. On the other hand, it is very possible to study the circulatory system material using various learning models that require student activity (student center). Referring to the 2013 Curriculum directions, there are three recommended learning models, including discovery learning, inquiry learning and problem. The learning model applied in preparing the Integrated Science module is the discovery learning model. The discovery learning model was chosen because the characteristics of the circulatory system material consist of science concepts that can be proven again, such as the concept of heart rate frequency, how the heart works, the components that make up blood and so on. This is in accordance with Bruner's opinion in Siddiqui, (2008) that the discovery learning model is a model that emphasizes student activities to reorganize or transform evidence in such a way that students can go beyond the collected evidence back into new knowledge.

Applying the discovery learning model to material on the human circulatory system can help students understand concepts related to the human circulatory system and can provide real learning experiences. The discovery learning-based Integrated Science module developed has a category that is suitable for use in the learning process and can improve students' literacy skills (Ito & Kawazoe, 2015; Maclean & Pavlova, 2017; Riandari et al., 2018). The development of an Integrated Science module based on discovery learning was also carried out by research which received a very good category and can increase student motivation and learning outcomes (Gryczka et al., 2016; Yusuf et al., 2020).

The novelty of this research is that the module developed could be an alternative related to health learning. Modules are a very familiar medium to use in learning. The use of Health materials will have a good impact on improving learning (Budiarti et al., 2016; Fitria et al., 2019; Pulukadang et al., 2020; Suwono & Dewi, 2019).

The focus of the researcher's problem is the lack of Integrated Science teaching materials in the field. This

problem is also strengthened by the results of interviews and needs analysis which state that Integrated Science teaching materials in the field still have several weaknesses. Based on these problems, the development of an Integrated Science module is seen as the right solution to overcome the shortcomings and limitations of Integrated Science teaching materials. The Integrated Science Module was developed with complete module elements, using a webbed integration model and based on a discovery learning model as well as innovative Integrated Science teaching materials, namely using the contextual theme "healthy heart sports". In this way, the availability and quality of Integrated Science teaching materials used in the field can be addressed so that the implementation of science learning is in accordance with curriculum demands. The aim of this research is to develop an Integrated Science module based on discovery learning that has valid, practical and readable qualifications.

Method

This type of research is research and development. The development model used is the 4D development model by Thiagarajan which contains four development stages, namely define, design, develop and disseminate. However, in this research, the dissemination stage could not be carried out. This is due to limited research time making it difficult to carry out product distribution because the science material used in preparing the Integrated Science module is odd semester material. Therefore, this research was carried out at the readability test stage in small groups. Product testing was carried out in three stages, including a validity test by two science education experts, a practicality test by five science teachers at SMP Negeri 1 Bekasi and a readability test by ten class VIIIA students at SMP Negeri 1 Bekasi.

$$Content\ Validity\ (CV) = \frac{D}{A + B + C + D} \quad (1)$$

Information:
A = number of items that are less relevant according to both validators
B = number of relevant items according to validator 1 and less relevant according to validator 2
C = number of items that are less relevant according to validator 1 and relevant according to validator 2
D = number of relevant items according to both validators

Data collection in the research consisted of; define stage using interview, questionnaire and observation methods and develop stage using questionnaire method. The research instruments used were an observation guideline grid, an interview guideline grid and a product testing questionnaire sheet. The validity test results scores were analyzed using Gregory analysis using the following equation 1. These results are then qualified at the level of validity of the Gregory test in Table 1.

Table 1. Qualification Level of Validity of the Gregory Test

Value Interval	Qualification
0.80-1	Very High Validity
0.60-0.79	High Validity
0.40-0.59	Medium Validity
0.20-0.39	Low Validity
0.00-0.19	Very Low Validity

The product being developed must at least meet a validity test score of > 0.40 in order to have moderate validity qualifications. Next, the practicality test score is in the form of an average score which is then qualified at the practicality level qualification in Table 2.

Table 2. Practicality Level Qualifications

Value Internal	Qualification
$X \leq 1.8$	Impractical
$1.8 < X \leq 2.6$	Less Practical
$2.6 < X \leq 3.4$	Quite Practical
$3.4 < X \leq 4.2$	Practical

The product being developed must at least meet an average readability test score of > 3.40 in order to obtain readability qualifications.

Result and Discussion

Results

Define Stage

The define stage contains several stages, namely: initial analysis; curriculum analysis; student analysis; analysis of teaching materials; material analysis; and formulation of learning objectives. The results of the initial analysis revealed problems in the science learning process that occurred in the field, namely at SMP Negeri 1 Bekasi, SMP Negeri 2 Bekasi and SMP Negeri 6 Bekasi. These problems were obtained based on the results of interviews with science teachers. The results of the interview are the limitations of the Integrated Science teaching materials used in schools. These limitations, in terms of the quality of the Integrated Science teaching materials used in schools, still have several weaknesses, namely they do not contain complete module elements, do not use an integrated model and are not based on a learning

model.

The results of the curriculum analysis are the determination of KD in accordance with the theme of healthy heart sports, namely KD 3.70 and 3.80. The reason the researcher chose KD 3.70 and KD 3.80 was: it contains material that can be tied into the theme of healthy heart sports, based on the results of the initial analysis the material KD 3.70 and KD 3.80 has not been presented optimally in the K13 science book being developed, KD 3.70 and KD 3.80 contain science material that is difficult for students and KD 3.7 contains the operational verb 'analyze'. The results of the analysis of the characteristics of students at SMP Negeri 1 Bekasi are based on observations, namely that the students at SMP Negeri 1 Bekasi who are the research subjects are class VIII A with a minimum age of 13 years. Furthermore, the results of the analysis of student characteristics based on the results of distributing questionnaires are: students at SMP Negeri 1 Bekasi, specifically in science subjects, have heterogeneous cognitive abilities, students' ability to receive science material is good and interest and students' motivation in learning science is moderate.

The results of the analysis of teaching materials are: the K13 science book in terms of availability, all students have the book; appearance aspect, having an attractive sub-chapter appearance but the cover design still contains images that are not related to the material contained in the chapters; convenience aspect, equipped with instructions for use; and material aspects, the LKPD is not yet simple, it still uses laboratory equipment so it is difficult for students to carry it out independently, the LKPD steps are not yet based on a specific learning model and the delivery of material is not optimal on the topic of circulatory system disorders, prevention efforts disorders of the circulatory system and the application of the principles of Pascal's law to blood pressure.

The results of material analysis are the determination of the material discussed in the Integrated Science module. The main material in this module contains science material, namely the human circulatory system. Next, this is followed by supporting materials, namely science material, namely blood pressure and physical fitness. This material is taught to class VIII SMP/Mts students. Next, the learning objectives are formulated. The learning objectives contained in the product developed are 24 learning objectives.

Design Stage

The design stage contains several stages, including: media selection; making initial designs; and format selection. The media used is an Integrated Science module based on discovery learning which contains features that can help students understand the science material. This Integrated Science Module was developed in the form of a pdf file. This is based on the fact that 79% of students at SMP Negeri 1 Sukasada already have devices (cellphones, tablets, PCs/laptops) that can support the implementation of the science learning process. After determining the media, the initial design of the Integrated Science module is then carried out. The science module elements were then designed using Adobe Illustrator and Microsoft Word 2013 software. After selecting the format, a Draft Integrated Science Module I was produced.

Development Stage

In the development stage, product testing is carried out consisting of: validity test; practicality test and readability test). The validity test was carried out by distributing questionnaires to 2 science education experts. The validity test results are presented in Table 4.

Table 4. Cross Tabulation Results of Validity Assessment

2x2 Cross Tabulation			Judges I
		Weak	Strong
Judges 2	Weak	A (0)	B (0)
	Strong	C (0)	D (64)

Based on the validity test results presented in Table 4, the level of product validity can then be calculated using analysis.

$$Content\ Validity\ (CV) = \frac{D}{A + B + C + D} \quad (2)$$

Based on the results of content validity calculations using Gregory's analysis, the Integrated Science module based on discovery learning with the theme of healthy heart sports obtained a very valid qualification with a score of 1. The practicality test was carried out by distributing practicality questionnaires to five science teachers at SMP Negeri 1 Bekasi. The following is a summary of the practical test results by science teachers in Table 5.

Table 5. Summary of Practicality Test Results by Science Teachers

Practitioner	Score
Practitioner 1	4.83
Practitioner 2	4.26
Practitioner 3	4.57
Practitioner 4	3.96
Practitioner 5	4.13
Average	4.35

Based Based on Table 5, the Integrated Science module based on discovery learning with the theme of healthy heart sports obtained very practical qualifications with an average score of 4.35. The readability test was carried out by distributing a readability questionnaire to ten students in class VIII A of SMP Negeri 1 Bekasi. The following is a summary of the results of the readability test by students in Table 6.

Table 6. Summary of Readability Test Results by Students

No student	Final Score
Student 1	4.25
Student 2	4.08
Student 3	4.17
Student 4	4.17
Student 5	4.08
Student 6	4.08
Student 7	3.92
Student 8	4.17
Student 9	4.33
Student 10	4.17
Average	4.14

Based on Table 6, the Integrated Science module based on discovery learning with the theme of healthy heart sports obtained a reading qualification with an average score of 4.14.

Discussion

This research is an Integrated Science module based on discovery learning with the theme of healthy heart sports which was developed using a 4D model by Thiagarajan. The following is an explanation of each stage; At the define stage, the initial analysis found the problem that the majority of science teachers had never developed Integrated Science modules as supporting teaching materials in schools. In responding to these problems, teachers are required to develop additional Integrated Science teaching materials so that the formulated learning objectives can be achieved. This is in accordance with the opinion of Yuberti (2014) that the success of the learning process is determined by a teacher's ability to develop teaching materials. However, based on further observations, the Integrated Science teaching materials developed by science teachers in the field still have weaknesses. This is in line with the findings of research conducted by (Usmeldi et al., 2021) which stated that science teachers at SMP Negeri 2 Bekasi did not properly understand how to develop Integrated Science teaching materials and Integrated Science materials.

Thus, the Integrated Science teaching materials developed by teachers are not optimal due to the lack of teacher understanding of the concept of teaching materials and teacher experience in developing teaching materials. Another problem found is that the circulatory system material is one of the science materials that is considered difficult by students because the material requires students' understanding because it has complex material topics and cannot be observed directly by students. This is in line with research by Puspitasari, (2019) which states that material on the human circulatory system is difficult science material because the circulatory organs can be observed directly by students.

The results of the curriculum analysis showed that the Basic Competencies in the development of the Integrated Science module were KD 3.7 and 3.8 class VIII. The choice of KD was because based on initial analysis, KD 3.7 and KD 3.8 material had not been delivered optimally in the Ministry of Education and Culture's K13 Science book, containing science material that was difficult for students, namely the blood circulatory system. Apart from that, KD 3.7 and KD 3.8 contain material that can be tied into the theme of healthy heart sports and KD 3.7 contains the operational verb 'analyze' so that it can train students' critical thinking skills; The characteristics of students at SMP Negeri 1 Bekasi based on the results of distributing questionnaires to five science teachers are the average age of students who are research subjects is 12 years and over. This student is currently in class VIII.

According to Rahmat (2018), junior high school students are included in the formal and concrete operational development level and some are still in the transition phase from the concrete phase to the formal operational phase. At this stage, students can be trained to make observations, identify variables, formulate hypotheses and communicate experimental results both orally and in writing. Therefore, the Integrated Science module based on discovery learning is suitable for the development of these students. This is because discovery learning requires students to carry out proof of a concept using systematic steps; The main Integrated Science teaching material used is the K13 Science book. The Science K13 book has weaknesses, including the delivery of material that is not optimal in the circulatory system material, the topic of circulatory system disorders, as well as the material on substance pressure and its application, the topic of applying the principles of Pascal's law to blood pressure.

Teaching materials should contain optimal material to minimize student confusion during the independent learning process. Apart from that, a

teaching material, especially a module, is developed independently or does not depend on other learning media when used in the learning process, so that the material contained therein is required to be optimal. The material chosen for the preparation of the module is the circulatory system and blood pressure. There is also additional material, namely physical fitness. This physical fitness material was chosen due to consideration of the theme of healthy heart sports which must include sports material in maintaining blood circulation organs. Apart from that, the selection of physical fitness material aims to enable students to carry out real activities to prevent blood circulation disorders because the physical fitness material contains simple exercise steps that students can do independently. Based on the initial analysis and material analysis, learning objectives are then formulated.

The formulation of learning objectives is guided by Basic Competencies (KD 3.7 and KD 3.8) and Competency Achievement Indicators. The learning objectives formulated are 24 learning objectives. At the design stage, a Draft Integrated Science Module I was produced. The media chosen was an Integrated Science module because the problems found in the field were limited Integrated Science teaching materials, so an Integrated Science module was developed based on discovery learning on the theme of healthy heart sports. The Integrated Science Module is presented in pdf file format. This is based on the consideration that 79% of students at SMP Negeri 1 Bekasi already have devices to support the implementation of the learning process, while 21% of other students still do not have personal devices to support the implementation of the science learning process. Thus, most students will be able to access this Integrated Science module easily so that it can help students understand the concept of the human circulatory system.

After determining the media, the general structure of the Integrated Science module is then carried out to produce a grand design. This grand design contains the elements of the module that was developed. According to Prastowo (2011), a module contains at least seven elements: (1) title; (2) student learning instructions; (3) Basic Competencies; (4) supporting information; (5) exercises; (6) LKPD and (7) evaluation. The overall syntax of the discovery learning model is contained in the LKPD which in the Integrated Science module developed includes the let's prove it! However, there are several supporting features that are integrated with the discovery learning model syntax such as let's study, important term, why is it important? did you know? let's understand! let's answer! The next stage is format selection. Format selection is carried out by designing each element of the Integrated Science module. The software used at this format selection stage is Adobe Illustrator and Microsoft Word 2013 software. This software is used to design the Integrated Science module.

At the develop stage, product testing was carried out, namely the Integrated Science Module I. The results obtained from assessing the validity of the Integrated Science module were a score of 1. Based on the validity qualification level, this score obtained a very valid qualification level. This very valid qualification is because in developing the Integrated Science module, researchers are guided by the characteristics of a good and interesting module. These characteristics include self-instructional, self-contained, stand alone, adaptive and user friendly (Ministry of National Education, 2008). Very valid qualifications show that the Integrated Science module based on discovery learning is of good quality in terms of content. After carrying out the validity test, the Integrated Science I module was revised according to expert input. The results of the next revision are called the draft Integrated Science II module which can be tested to the next stage, namely the practicality test.

Based on the qualification level of practicality, the Integrated Science module based on discovery learning with the theme of healthy heart sports obtained a very practical qualification level. The results of distributing questionnaires to science teachers showed that students had heterogeneous cognitive abilities. The Integrated Science Module based on discovery learning with the theme of healthy heart sports that has been developed can adapt to all levels of student ability because students can learn to use the module at their own pace. This is in accordance with the opinion of Yulastri et al. (2017) that one of the functions of the module is that it can accommodate various levels of learning speed of students. A very practical qualification shows that the Integrated Science module developed is practical or easy to use in the learning process in terms of appearance, time allocation, material, presentation, discovery learning model, themes and integration as well as usefulness.

Next, readability testing is carried out. The results obtained in the readability assessment were a score of 4.14. Based on the readability level qualification, the discovery learning-based Integrated Science module obtained a readability qualification. The reading qualifications obtained in this research are based on the Integrated Science module based on

discovery learning with the theme of healthy heart sports and developed in accordance with the rules for developing teaching materials. The rules for developing teaching materials are that teaching materials are prepared so that they are adapted to the characteristics and needs of the students who will use them, contain detailed learning materials including student activities and practice questions, adjusted to the applicable curriculum and prepared with the hope of changing student behavior (Bahri et al., 2021; Bustami et al., 2018; Suryani et al., 2020). Therefore, the Integrated Science module that was developed obtained a legibility qualification.

The legibility qualification obtained proves that the content of the Integrated Science module that was developed can be understood by students. This is teaching materials that have a high level of readability can maintain students' reading habits because they find it easy to understand the teaching materials easily (Hartik et al., 2021; Jensen et al., 2014; Miftah, 2013). After carrying out the readability assessment, product improvements are then carried out so that the final product is formed, namely an Integrated Science module based on discovery learning with the theme of sports, a healthy heart who has very valid qualifications, is very practical and legible. Based on these qualifications, the Integrated Science module meets the requirements for large-scale trials by carrying out effectiveness tests.

Conclusion

Based on the research results, the conclusions of the research on developing an Integrated Science module based on discovery learning on the theme of healthy heart sports are as follows: The Integrated Science Module based on discovery learning with a sports theme, a healthy heart, was declared very valid based on the results of a validity test by two science education experts with a score of 1; The Integrated Science Module based on discovery learning with the theme of healthy heart sports was declared very practical based on the results of a practicality test by five science teachers with a score of 4.35; The Integrated Science Module based on discovery learning with the theme of healthy heart sports was declared legible based on the results of a readability test by ten students with a score of 4.14.

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Conceptualization; methodology; validation; formal analysis.; investigation.; resources; data curation: writing—original; draft preparation; writing—review and editing: visualization: A. M. All authors have read and agreed to the published version of the manuscript.

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The authors declare no conflict of interest.

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