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# The Development of Connected Integrated Science Modules based on Differentiated Learning on Solar System Materials

**Kadek Ayu Astiti[1]*, Kompyang Selamet[2], Luh Devi Herliandry[1]**

[1] Universitas Nusa Cendana, Jl. Adisucipto Penfui Kupang-NTT, Indonesia

[2] Universitas Pendidikan Ganesha, Jl. Udayana No. 11 Singaraja-Bali, Indonesia

* *e-mail: kadekayuastiti88@yahoo.com*

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**Abstract:** The development of a Connected Type Integrated Science Module based on differentiated learning aims to make it easier for students to understand science concepts in an integrated manner. This is done by connecting one concept to another by increasing analytical skills and realizing independent learning. Modules were developed to link one concept with another science concept to improve analytical skills and realize independent learning for students. This type of research and development (R&D) uses the ADDIE model with the stages of analysis, design, development, implementation and evaluation. The results of the validity test from material and media experts obtained an average score of 88.1 and 81.8 in both categories. The practitioner test was carried out using the module by the teacher and obtained an average score of 81.15 in the good category. The development and analysis results obtained show that the module can be used in the learning process but further research is needed on the practicality of using this module and it needs to be developed into other Integrated Science materials.

**Keywords:** Module, connected type of integrated science, differentiated instruction.

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## INTRODUCTION

Integrated science learning applied in schools provides opportunities for students to understand natural phenomena that occur and the environment holistically (Astiti, et al, 2021). Studies related to science learning innovations emphasize the linkage of one concept to another (Lang & Olson, 2000). The learning process in integrated science involves and connects several fields of science (Anjarsari, 2013). Such as physics-chemistry, Biology-chemistry biology-physics or a combination of the three.

The expected output of Integrated Science learning is that students can explain and relate phenomena that occur in their lives scientifically. Given the scope of learning from various perspectives that are easily recognized by students in their environment (Rahmi et al., 2022). The reason is that the concept of Integrated Science is useful as a basis for explaining and connecting the surrounding conditions or natural phenomena that exist in the environment with the concept of Science scientifically. Therefore, it is important to carry out learning in an interactive, fun way, and give students the space to hone their creativity (Faiz et al., 2022). This proves that linking one concept to another and the surrounding environment in learning is important.

The fact found that its application in schools is still widely taught separately and independently between physics, chemistry and biology (Diniya, 2019). Some of the factors that cause these problems include: 1) the educational background of the teacher does not come from Integrated Science but special fields such as physics, chemistry and biology that have an impact on the teacher's ability to understand the linkage of science concepts as a whole, 2) lack of teaching methods and Integrated Science learning resources that tend to present material separately, 3) lack of learning media that support the learning process, 4) lack of supporting facilities for integrated learning processes, and 5) students' lack of interest in reading (Agustini, 2020), (Priyatma et al., 2019), (Septiana, 2018). These problems are important to overcome, considering the interrelationships of Integrated Science concepts can be used by students to analyze phenomena in their environment.

The role of educators as facilitators is very important in overcoming these problems. One of the ways to do this is by providing teaching materials and designing appropriate learning strategies. The connected type integration model can be applied in Integrated Science learning. This model connects one concept to another, one topic to another and one skill to another (Nurjannah, 2022) by applying three input factors, namely raw input, instrumental input and environmental input (Nurjannah, 2022). It is intended to present content or material by linking one concept to another to make it easier for students to understand complex phenomena that occur.

Connected-type integration-based modules can be implemented in appropriate learning techniques or models, one of which is differentiation learning. The differentiated learning model focuses on the way students learn and teaching techniques are adapted to students' talents and learning styles (Morgan, 2014). Differential learning also puts forward the concept that students are individuals who have different interests, potential and talents (Nurjannah, 2022). Apart from that, what is focused on is the way or style of students in analyzing the concepts to be studied. Therefore educators must be able to analyze and coordinate differences with appropriate techniques. Integrated science learning with learning differentiation can increase student activity, creativity and learning outcomes (Nawati et al, 2023). Apart from that, it also plays a role in improving scientific

literacy skills through the process of analysis and problem-solving with scientific investigations (Ermawati et al, 2023).

The combination of differentiation learning with connected integration focuses on the interests, talents, and needs of students in the learning process by linking related concepts so that they can realize independent learning (Marlina, 2019). Of course, this allows students to explore their potential without any pressure or restrictions from outside so that they can optimize the learning process and student learning development.

This combination can be the right solution to develop students' skills in analyzing related concept relationships as a whole. This study aims to develop a connected-type Integrated Science module based on differentiation learning on class VII Solar System material. The developed module is expected to facilitate students in analyzing the relationship between Integrated Science concepts and the learning process.

## METHOD

This type of research uses R&D using the ADDIE model with 5 stages, namely analysis, design, development, implementation and evaluation (Cahyadi, 2019) which can be shown in Table 1.

Table 1. ADDIE model

| No | Step ADDIE | activity |
|---|---|---|
| 1 | Analysis | • Analysis of junior high school curriculum<br>• Analysis of material related to the solar system<br>• Analysis of differentiated learning material<br>• Identification of the needs of teachers and students in the integrated science learning process for grade VII junior high schools |
| 2 | Design | • Identification of KD which will be linked to integrated learning<br>• Collect references for the preparation of modules<br>• Drafting the right module design<br>• Choose an attractive layout<br>• Preparing evaluation materials in modules |
| 3 | Development | • Develop teaching materials in the form of integrated science modules of the connected type based on differentiated learning for class VII junior high school students in semester 2 |
| 4 | Implementation | • Assessment by science material expert<br>• Assessment by media experts<br>• Feasibility testing of practitioners (teachers and students) |
| 5 | Evaluation | • Evaluating the development modules and revising the modules |

The analysis phase is carried out to explore problems that exist in schools related to Integrated Science learning. The problem is viewed from the learning achievement in the curriculum, the needs of students, and field conditions so that the differences between expectations and reality are known.

The design stage is carried out by making designs through flowcharts and module designs in terms of layout, font type and size, colour combinations, selection of illustrations and related material input. The development stage is carried out by realizing the design that has been made in the previous stage by paying attention to the characteristics of the module with a connected and differentiation-based integration model. The implementation phase is carried out with a validation test from expert material and media lecturers who are experienced and experts in their fields. This is done to improve the quality of the resulting product.

## RESULT AND DISCUSSION

### *Results*

The development carried out aims to produce a connected type of Integrated Science module based on differentiated learning with the material of the solar system. The module components developed include cover or cover pages, a preface, a table of contents, linkage diagrams that connect materials, materials, practice questions, and a bibliography. The link diagram page between materials and other materials can be presented in Figure 1.

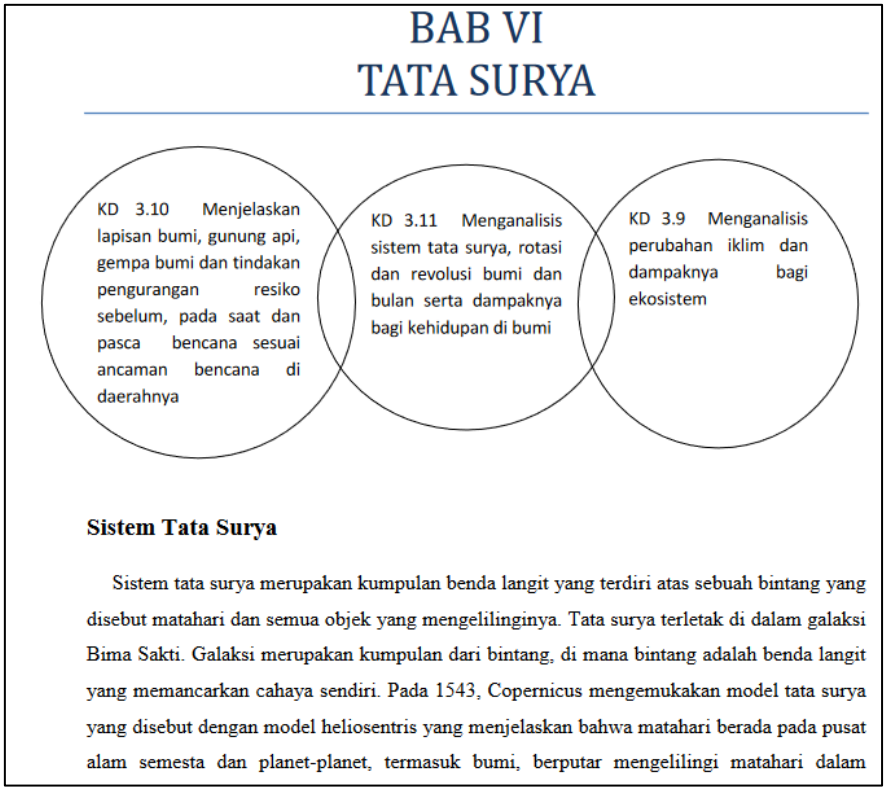


Figure 1. The integration of the material presented in the Module

Figure 1 shows the integration between materials with one another. The link diagram is the main characteristic of the connected integration model. This is intended to link the concepts presented so that a cognitive schema is formed between one concept

and another. The module component is also available on the task page presented in Figure 2.

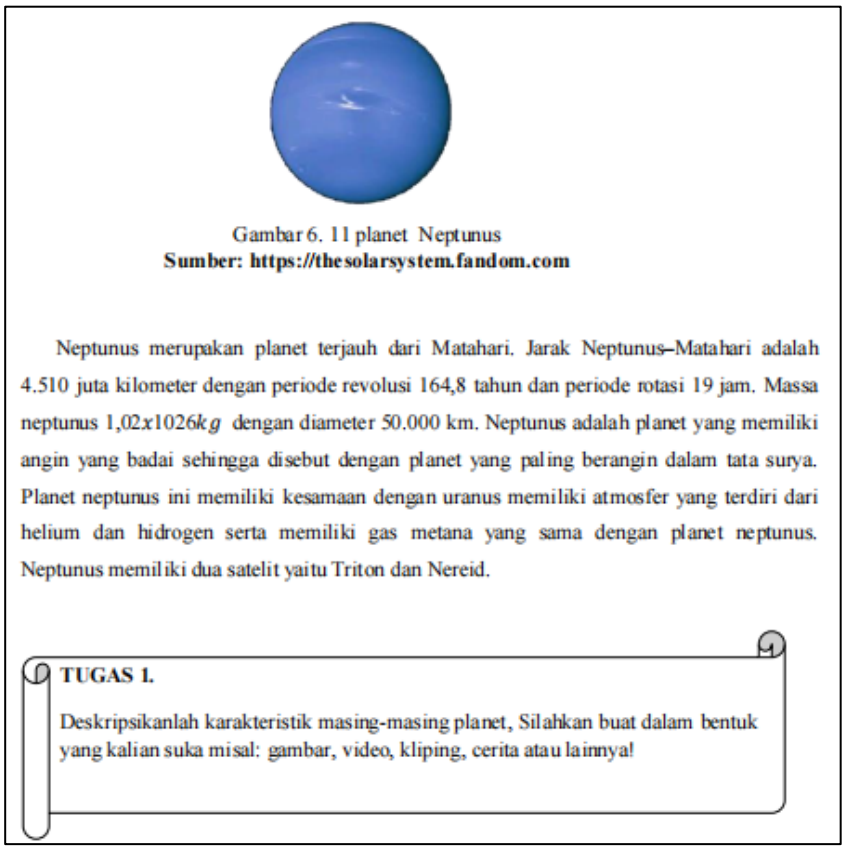


Figure 2. The task presented applies Product Differentiation

The task components presented in Figure 2 apply product differentiation. In this case, the teacher can distinguish content, processes, products and learning environments according to the interests and talents of students (Altun & Nayman, 2022). The goal is also to develop independent learning abilities with criteria that must be met, namely knowledge, skills and learning experience (Rahmi et al., 2022).

The role of tasks in the module is also useful as scientific investigation which is useful in facilitating learning activities based on interests, needs and talents (Kutlu Abu, 2021). Students have broad opportunities to learn and develop diverse learning abilities. In addition, it also plays a role in developing abilities, and knowledge and students are allowed to answer in various forms tailored to their interests and talents, such as pictures, diagrams, descriptions, videos or others. This condition will allow students to explore their potential based on their interests and talents independently.

Task components can be completed with a variety of techniques such as pictures, diagrams, descriptions, videos or others that prioritize the interests and talents of students in line with independent learning. The presentation of the material in the module also has such characteristics that all components embrace the learning styles of the students.

In addition, the module component involves diverse or heterogeneous abilities with the teacher being the facilitator and managing the activities of the learning process

(Mills et al., 2014). The science content presented also pays attention to the differentiation of content, processes and products. The full involvement of students is the main thing in the learning process.

Table 2. Validity test results from media and material experts

| No | Assessment Aspect | Mean | Category |
|---|---|---|---|
| 1. | Material Validity Test | | |
| | Content eligibility | 88.3 | Good |
| | Presentation eligibility | 93.3 | Very good |
| | Module characteristics | 92.5 | Very good |
| | Aspects of Differentiated Learning | 81.8 | Good |
| | Average value | 88.1 | Good |
| 2. | Uji Validitas Media | | |
| | Graphics | 80 | Good |
| | Language eligibility | 83.6 | Good |
| | Average value | 81.8 | Good |

The results of the analysis of the material and media expert validation tests are presented in Table 2. The average score of the material and media validity tests obtained in each category is good. The validity test was also carried out on education practitioners, namely Integrated Science teachers whose results are presented in Table 3. The average score on the practitioner test was obtained in a good category. The analysis can be said that the connected type of integrated science module based on differentiated learning is feasible and can be used in the learning process.

Table 3. Practitioner Test Results

| **No** | **Aspect** | **Average** | **Category** |
|---|---|---|---|
| 1 | Conformity of the material with KI and GPA | 80 | Good |
| 2 | Material support | 90 | Very Good |
| 3 | Presentation technique | 80.8 | Good |
| 4 | Presentation support | 80.8 | Good |
| 5 | straightforward | 80 | Good |
| 6 | Communicative | 83 | Good |
| 7 | Conformity with the level of development of students | 80 | Good |
| 8 | Connected integration | 86.6 | Good |
| 9 | Knowledge and skills learned by students | 76 | Good |
| 10 | Simple book content typography | 83.3 | Good |
| 11 | Easy-to-read typography | 80 | Good |
| 12 | The typography of the book content makes it easier to understand | 73.3 | Enough |
| | Average value | 81.15 | Good |

The developed module can be a learning resource that provides holistic material with integrated concepts that are not taught separately. This is in line with the goal of differentiation learning that educators must be able to facilitate the learning process and carry out tasks to meet the learning needs of each student by monitoring progress and

identifying their learning needs (Masters, 2010), one of which is with the Integrated Science module facility based on connected type learning.

Several studies that are in line state that differentiation learning has a role in good outcomes (Mills et al., 2014). In addition, it also has an important role in mapping and analyzing the learning needs of students (Faiz et al., 2022). The results of the development, analysis and support of several findings that are in line can be said that the modules developed can be used in the learning process and learning guidelines for students.

### *Discussion*

Science learning, with its goal of fostering a comprehensive understanding of natural phenomena, requires an integrated approach. The effectiveness of integrated science instructional materials in enhancing knowledge and digital literacy, as demonstrated by the research results of Asrizal et al. (2018), emphasizes the need for innovative approaches. Connected type integrated science learning emerges as a viable solution, as it establishes connections not only between concepts but also across topics, skills, and even between semesters within a subject (Suanah, 2018).

The developed module serves as a valuable tool for educators to elucidate the interconnectedness of science concepts in an integrated manner. It operates as a guide for implementing differentiated learning, empowering students to engage in independent learning. The module's content review reveals a rich tapestry of interrelated materials, simplifying the process for students to connect concepts within the learning environment. This interconnected approach enables students to analyze the relationships between concepts, facilitating the development of analytical skills in understanding various phenomena.

Differentiated learning, focused on addressing individual student needs (Fitria, 2022), emerges as a key component of the integrated model. Research findings by Suwartiningsih (2021) underscore the positive impact of differentiated learning on natural science learning outcomes. Successful implementation of differentiated learning hinges on teachers' understanding of students' needs, emphasizing the importance of teachers being well-prepared. Optimal execution of connected-type integrated learning requires teachers to master the material thoroughly, necessitating thorough preparation for effective implementation.

In summary, this discourse emphasizes the critical role of integrated science learning in enhancing students' understanding of natural phenomena. The connected type integrated science model, supported by the developed module, provides a practical framework for educators to guide students through interconnected science concepts. The integration of differentiated learning, informed by understanding individual student needs, further enhances the effectiveness of this approach. Ultimately, successful implementation rests on educators' thorough preparation and mastery of the integrated model, ensuring a holistic and impactful learning experience for students (Adawiyah et al., 2020; Astuti et al., 2020).

## CONCLUSION

The results of the development, analysis and discussion can conclude that the connected type Integrated Science module based on differentiated learning can be used in the learning process. This was obtained from the analysis of the validity test of media,

material and practitioner experts who scored in the good category. This module can be used as a reference in implementing integrated science learning and applying differentiated learning as a form of independent learning. Suggestions that can be given to further research are developing connected type modules based on differential learning by integrating cultural elements or everyday life phenomena that can stimulate critical thinking abilities.

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