Validity of inquiry-based nutrition topic module to train critical thinking skills by accommodating cognitive style

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Article Information	Abstract
	The inquiry-based nutrition topic module was developed so that it can be used as an alternative innovative learning media and is expected to accommodate students' learning needs based on cognitive style. This study aims to design an inquiry-based nutrition topic module to train valid critical thinking skills. This study used the 4D research and development model but only reached the product validity stage. The initial stage (define) carried out the MFFT test in class VIIIA SMPN 2 Jenu, the results were 11 students with a reflective cognitive style and 11 students with an impulsive cognitive style. Based on the results of the MFFT test, the design of the inquiry-based nutrition topic module was designed to accommodate cognitive style. The validation instrument was used online using a google form which was carried out by 3 validators from junior high school science teachers in Tuban Regency. The instrument used is a validity sheet which includes material aspects, systematics, language, graphics, suitability with the stages of inquiry, and suitability with critical thinking indicators. Data were analyzed using a quantitative descriptive technique with a Likert scale as a result of the validation carried out by the validator. The results showed that the inquiry-based nutrition topic module to train critical thinking skills met very valid criteria with a mean score of 3.74. This module needs to be tested for its practicality and effectiveness in learning. **Abstrak** Modul topik nutrisi berbasis inkuiri dikembangkan agar dapat digunakan sebagai salah satu alternatif media pembelajaran inovatif dan diharapkan dapat mengakomodasi kebutuhan belajar murid berdasarkan gaya kognitif. Penelitian ini bertujuan merancang modul topik nutrisi berbasis inkuiri untuk melatih keterampilan berpikir kritis yang valid. Penelitian ini menggunakan model penelitian dan pengembangan 4D namun hanya sampai pada tahap validitas produk. Tahap awal (define) dilakukan tes MFFT pada kelas VIIIA SMPN 2 Jenu didapatkan hasil 11 siswa bergaya kognitif reflektif dan 11 siswa bergaya kognitif impulsif. Berdasarkan hasil tes MFFT, desain modul topik nutrisi berbasis inkuiri dirancang dengan mengakomodasi gaya kognitif. Instrumen validasi digunakan secara online menggunakan google form yang dilakukan oleh 3 orang validator dari guru IPA SMP di Kabupaten Tuban. Instrumen yang digunakan adalah lembar validitas yang meliputi aspek materi, sistematika, kebahasaan, kegrafikaan, kesesuaian dengan tahapan inkuiri, dan kesesuaian dengan indikator berpikir kritis. Data dianalisis menggunakan teknik deskriptif kuantitatif dengan skala likert hasil validasi yang dilakukan oleh validator. Hasil penelitian menunjukkan modul topik nutrisi berbasis inkuiri untuk melatih keterampilan berpikir kritis telah memenuhi kriteria sangat valid dengan skor rerata 3,74. Modul ini perlu diuji kepraktisan dan keefektifannya dalam pembelajaran.

A. Introduction

Science is systematic knowledge (Wulandari, 2017). Science applies universally and discusses a set of data regarding natural phenomena that are produced based on the results of observations, practicums or experiments, concluding, and developing theories (Nurhasanah, 2018). The basic principles of scientific methodology in learning science will train a scientific attitude (Mustikawati, 2018; Suryantari et al., 2019). In science learning, with a scientific attitude of high curiosity, critical thinking skills, analytical skills, and the ability to draw the right conclusions, teachers need teaching media or materials to facilitate the learning process (Alamsyah et al., 2022; Maulana et al., 2022).

The reality on the ground is based on the results of observations that the authors have made in the last 3 years (2020-2022), regarding the science teaching materials used by teachers in Tuban Regency, some of them have been integrated with the basic principles of scientific methodology but have not been integrated with certain learning models. The teaching materials used tend to be in the form of student workbooks which consist of material, student worksheets, and a collection of questions. The material presented in learning is still abstract, too broad and lacking in detail, the pictures are also not colored, which causes low understanding and student learning outcomes, because students are not directly involved in the learning process and only accept what is conveyed by the teacher.

One way to improve the quality of learning or the quality of student learning is to develop innovative teaching materials, including modules (Setiyadi, 2017). The advantages of learning using modules include: in the module, clear learning objectives are set so that student learning performance is directed at achieving learning objectives; modules are designed to be attractive, easy to learn, and able to answer needs so as to motivate students to learn; the module can provide feedback so students know their deficiencies and immediately make improvements, the module is flexible because the module material can be studied by students in different ways and at different speeds and can be accessed anywhere; collaboration can be established because competition can be minimized between students and students; and remedial can be done because the module provides sufficient opportunities for students to be able to find their own weaknesses based on the evaluation given (Pratama et al., 2022). Innovative module development can be integrated with learning models. One of these learning models is the inquiry model. Inquiry

learning strategies place more emphasis on the process of thinking critically and analyzing to find their own answers to a problem, so that with this strategy students can be more active in learning or it can be said to be student-centered learning (Hasanah & Adlini, 2022; Rahmadani & Wirdati, 2022). In related research, learning using modules that are integrated with inquiry models is possible to improve critical thinking skills (El Ritli & Adlini, 2020; Pratama, 2019).

In learning, each child is influenced by cognitive style (Rochika & Cintamulya, 2017; Wicaksono & Nufus, 2021). One style that has been extensively studied is called the reflective cognitive style and the impulsive cognitive style (Azhil et al., 2017). The reflective and impulsive dimensions show the child's tendency to respond sooner or later to problem situations with high answer uncertainty. Children who are quick in answering problems but tend to get wrong answers are called children with an impulsive cognitive style, in other words, children with an impulsive cognitive style are characterized by a tendency to make decisions and respond quickly without critical examination. Children who have a slow character in answering problems, but are careful / thorough so that answers tend to be correct, these children have a reflective cognitive style or in other words children who have a reflective cognitive style will spend more time examining problems and considering alternative solutions (Rochika & Cintamulya, 2017).

Based on previous research regarding the development of modules that are integrated with inquiry learning models to improve students' critical thinking skills, none has yet accommodated cognitive learning styles. The integration of the inquiry learning model that is often used is guided inquiry while in the research we are developing is scientific inquiry. Another novelty of this study is that researchers raised the topic of nutrition for class VIII which has rarely been discussed in previous studies.

In relation to the background above, this study aims to design learning using inquiry-based nutrition topic modules to train critical thinking skills that accommodate cognitive styles. The absence of an inquiry-based nutrition topic module to train critical thinking skills by accommodating cognitive style is the author's goal to develop an inquiry-based nutrition topic module to train critical thinking skills by accommodating cognitive style. Learning using the inquiry-based nutrition topic module is expected to be able to train critical thinking skills and new experiences in accordance with the nature and nature of the times for Grade

VIII students by accommodating cognitive styles. This inquiry-based nutrition topic module is also expected to assist teachers in understanding nutrition topic material by better accommodating students' cognitive styles.

B. Material and Method

In this study using research and development procedures (research and development). The purpose of development research here is to produce a product that is valid, practical and effective. The product produced in this research is an inquiry-based nutrition topic learning module to improve critical thinking skills by accommodating cognitive style for class VIII. In the first research procedure prior to product development, the MFFT (matching familiar figures test) test developed by Warli (2013) was carried out to determine the reflective and impulsive cognitive styles of students. The students who were the subject of the study for the trial were class VIIIA students at SMPN 2 Jenu. While the development model used is the development model proposed by Thiagarajan, namely the 4-D model. The 4-D development model (Four D Model) consists of 4 stages, namely: 1) define, 2) design, 3) develop, and 4) disseminate (Kosassy, 2019), but in this study it only reached the develop stage by measuring the validity of the module.

Table 1 Module Validity Interpretation Category

Average Score	Category
1,00 – 1,50	Invalid
1,51 – 2,50	Less Valid
2,51 – 3,50	Valid
3,51 – 4,00	Very Valid

In measuring validity using an online validation sheet instrument using the Google form. Aspects assessed to determine the validity of the module include: material, systematics, language, and graphics. In addition to these four aspects, conformity with the inquiry stages and conformity with critical thinking indicators is also measured. Critical thinking indicators in the module refer to the behavior of Zubaidah's critical thinking indicators (Zubaidah, 2010). This validation method was carried out by 3 science teachers in Tuban District. The data analysis technique in this study is a quantitative descriptive technique by calculating a Likert scale score with the provisions: 1 = not good, 2 = good enough, 3 = good, and 4 = very good (Trisna & Rahmi, 2016). The results of the validation calculations are then interpreted with the interpretation categories as shown in Table 1. The inquiry-based nutrition topic module is declared valid if it gets an average value of > 2.51 (Riduwan, 2013).

C. Results and Discussion

Research on the development of inquiry-based learning modules on nutrition topics to train critical thinking skills that accommodate cognitive styles uses 3 of the 4 stages of the 4-D development model, namely Define, Design, and Develop. The Define stage is the stage for defining and gathering information that is appropriate for the module product being developed consisting of first an initial and final analysis to determine the basic problem by means of analyzing the curriculum (Zahroh & Sudira, 2014). Curriculum analysis was carried out to determine core competencies, basic competencies, and indicators based on the curriculum implemented in grade 8 junior high school, namely TP. 2022/2023 still uses the 2013 curriculum as a reference for developing learning modules to train critical thinking skills. Core Competencies, basic competencies, and indicators obtained are presented in Table 2.

The learning objectives are analyzed to determine the learning objectives to be achieved by students on the topic of nutrition based on learning indicators. The learning objectives for the topic of nutrition, which are adjusted to the stages or syntax of the inquiry learning model, are presented in Table 3.

Second, an analysis of student learning styles using the MFFT (Matching Familiar Figures Test) developed by Warli (2013). The MFFT was tested on class VIIIA students at SMPN 2 Jenu. The research subjects based on the results of the MFFT selected 11 students with a cognitive reflective style, and 11 or 36.67% each of the 30 students who were tested on the MFFT. The total number of students with reflective and impulsive cognitive styles is 73.33%. These results are in accordance with Cintamulya (2019) opinion, individuals with reflective and impulsive cognitive styles are present in more than 50% of the population (Cintamulya, 2019). According to Warli (2013) the criteria are that the group of students with the impulsive style is taken from students who have the fastest time records but the answers are not careful/inaccurate, and the group of students with the reflective style is taken from students who have the longest time records but the answers are careful/accurate.

The results of the MFFT test can be used as a reference in the stages of product design and validity testing. In the design stage, media selection is carried out, this is adjusted to the characteristics

of the material and learning objectives, choosing an attractive format, facilitating and helping students, making initial designs, and preparing test standards. Learning modules designed with inquiry-based nutrition topics to train critical thinking skills. The prototype results of the initial design of the learning device were used as draft I. Figure 1, Figure 2, and Figure 3 are displays of an inquiry-based nutrition topic module to train critical thinking skills. Figure 4, Figure 5, Figure 6, and Figure 7 are module views for each phase of inquiry and activities in the module.

Table 2 Analysis of Core Competencies, Basic Competencies and Indicators

Core Competency	Basic competencies	Indicator
Try, process, and present in the realm of concrete (using, parsing, composing, modifying and creating) and abstract (writing, reading, counting, and composing) according to what is learned in school and from various other sources that are the same in perspective/theory.	3.5 Analyzing the digestive system in humans and understanding disorders related to the digestive system, as well as efforts to maintain the health of the digestive system. 4.5 Presenting the results of investigations on mechanical and chemical digestion	3.5.1 Identifying the types of food ingredients and the content of food ingredients in everyday life through food ingredient testing. 3.5.2 Explain the function of food ingredients. 3.5.3 Analyze daily energy needs. 3.5.4 Propose solutions to problems using the understanding of the Vitamin C Test. 4.5.1 Investigate the nutritional content of food. 4.5.2 Designing an experiment for the content of Vitamin C with pre- and post-heat treatment of the number of drops of betadine needed to change color. 4.5.3 Carry out Vitamin C Test experiments on various types of fruit. 4.5.4 Prepare a trial report on the content of Vitamin C with pre- and post-heat treatment of the number of drops of betadine needed to change color

Table 3 Learning Objectives on the Topic of Nutrition based on the Stages of the Inquiry Learning Model

| Inquiry Stages	Learning Objectives
Discovery Learning	a. Students can identify the type of food through a video showing a balanced nutrition guideline correctly. b. Students can identify the function of types of food through video shows of balanced nutrition guidelines correctly. c. Students can correctly analyze daily energy needs based on calorie needs. d. Students can identify the types of food ingredients and the content of food ingredients in everyday life through showing the food test correctly. e. Students can correctly explain the process of changing the color of the food ingredients test show.
Interactive Demonstration	a. Students can correctly predict the relationship between the number of drops of betadine to change color with the vitamin C content before and after heating through the joint vitamin C demonstration test. b. Students can correctly predict the highest to lowest Vitamin C content of several food and beverage products tested before and after heating based on the results of the Vitamin C demonstration test.
Inquiry Lesson	Students can plan a Vitamin C test experiment that will be done with the group correctly.
Inquiry Lab	a. Students can carry out an experiment to test the levels of vitamin C in fruit without or by heating the number of drops of betadine to change the color correctly. b. Learners can analyze the factors that affect reduced levels of Vitamin C after carrying out the Vitamin C test correctly. c. Students can compile an experimental report on testing the levels of vitamin C in fruit without or with heating on the number of drops of betadine in changing the color correctly.
Real Word Application	a. Students can solve the problem of several cases of vitamin deficiency disease and healthy eating patterns correctly b. Students can correctly make a summary concept map of the learning outcomes material.
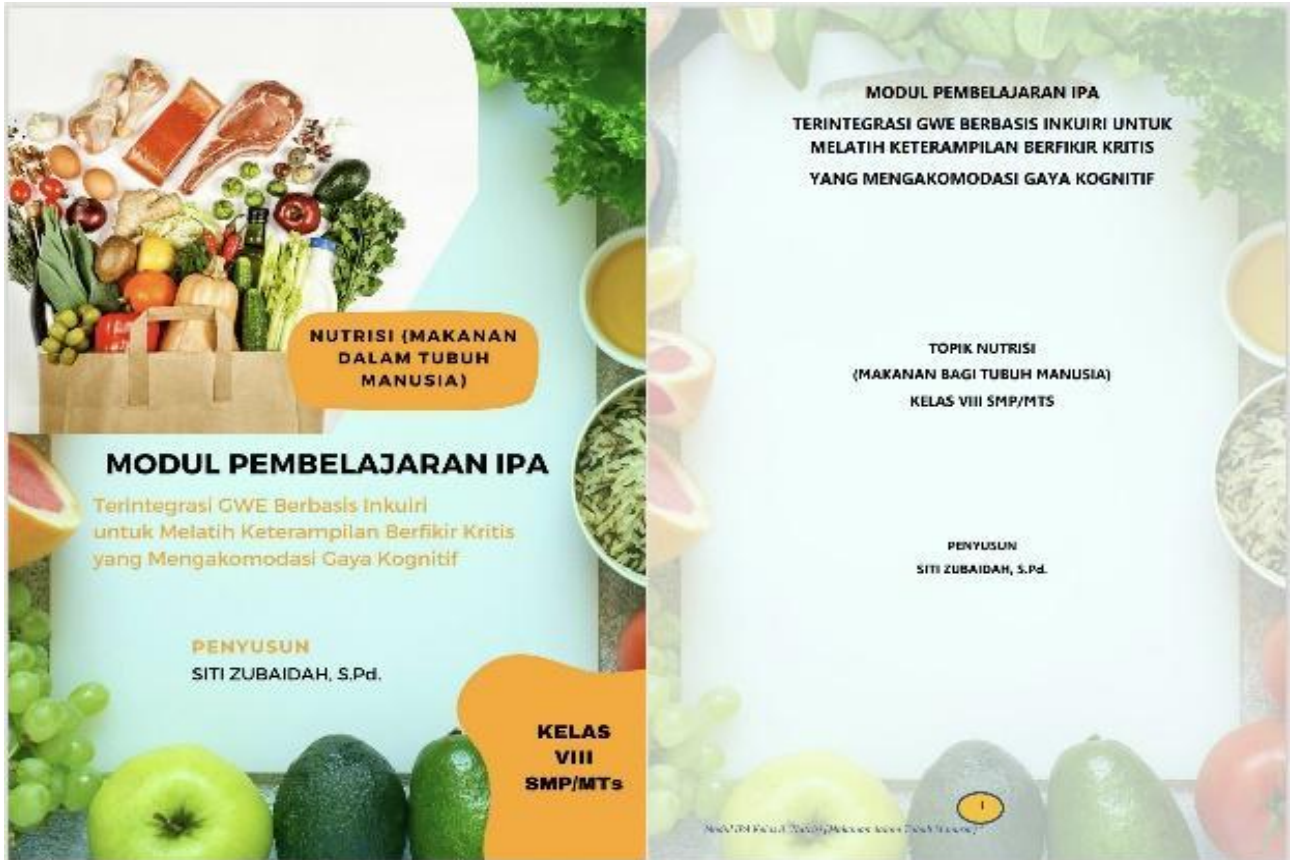
Figure 1 Cover of the inquiry-based nutrition topic module (in Indonesian)
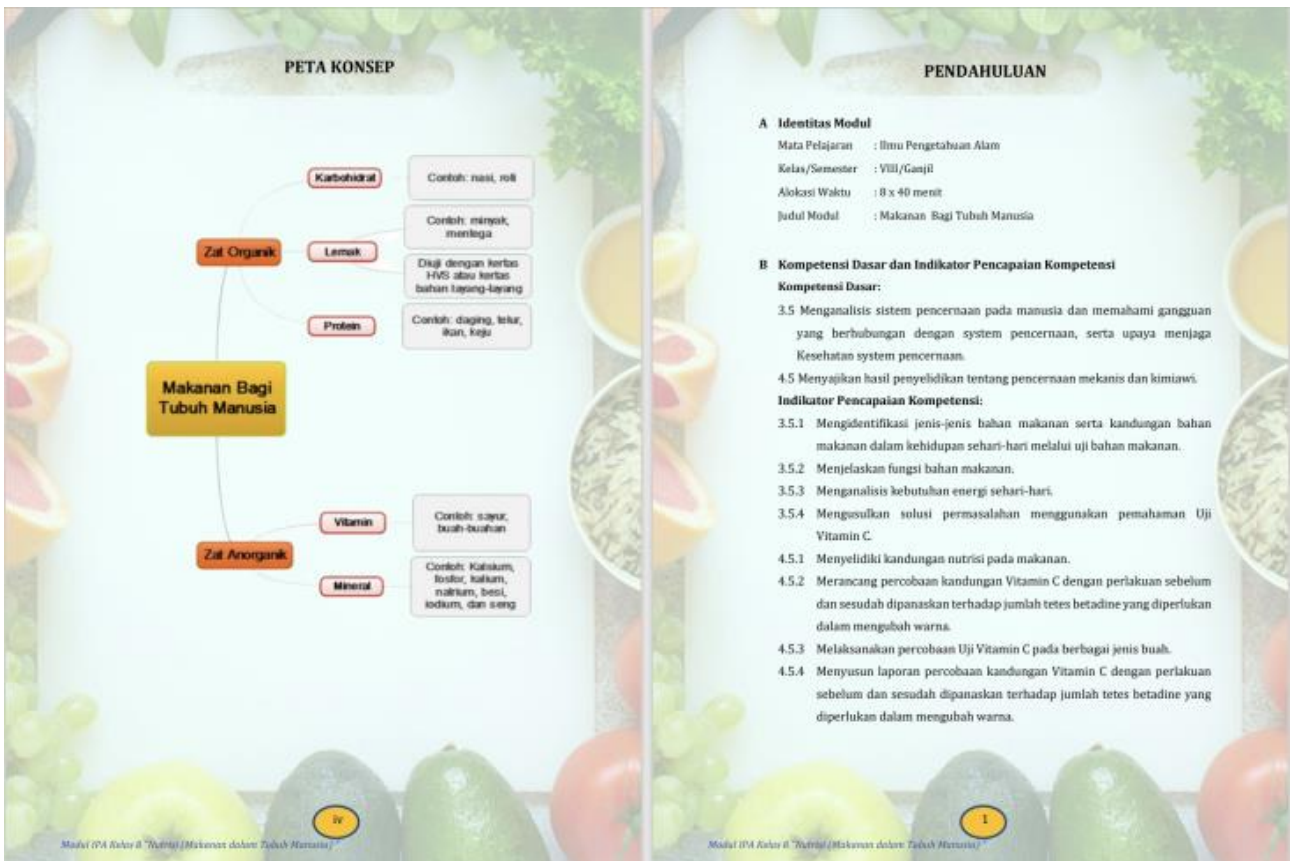

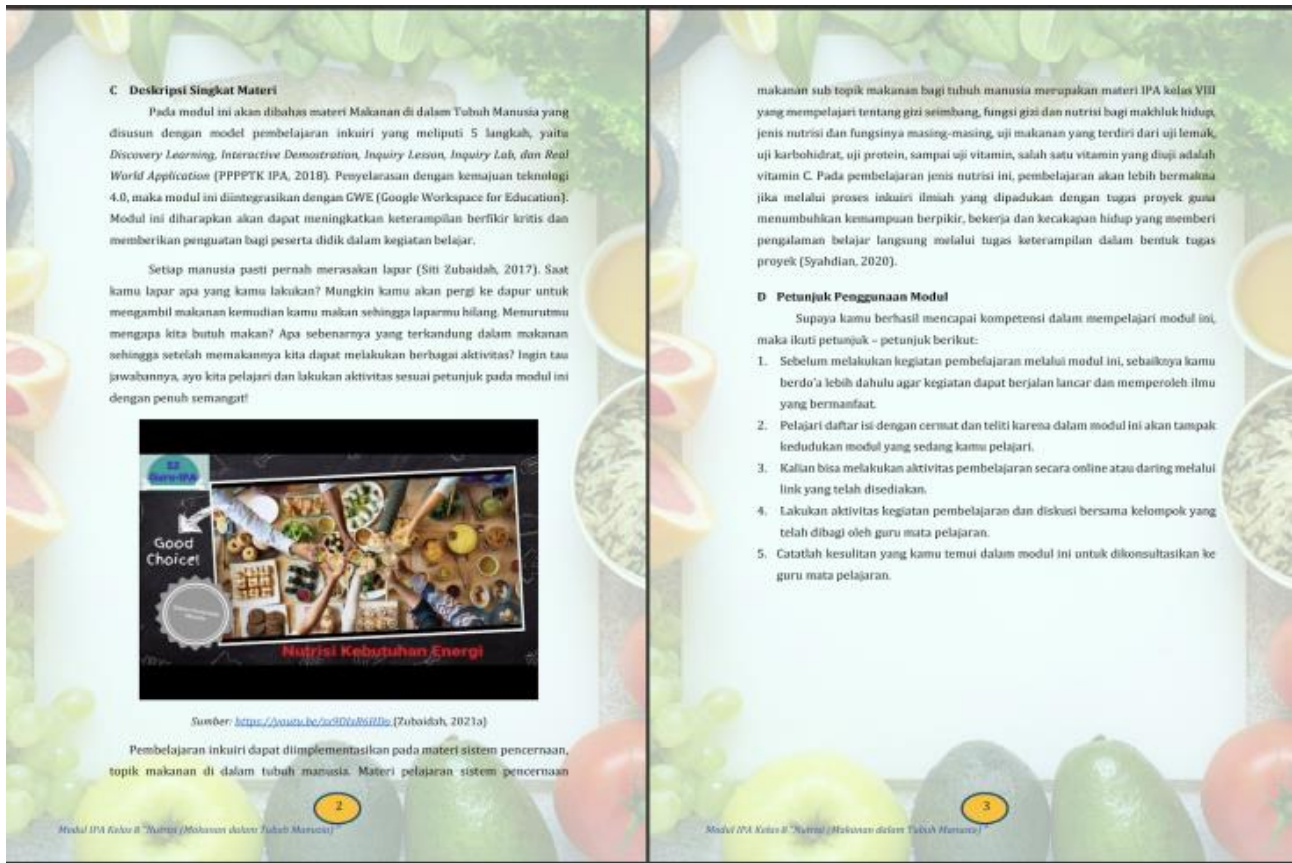Figure 2 Concept map and introduction to the module (in Indonesian)

Figure 3 Brief description and instructions for using the module (in Indonesian)

Figure 4
Phase discovery learning. The critical thinking indicator analyzes the initial concept by identifying the types of food and analyzing energy requirements (in Indonesian)
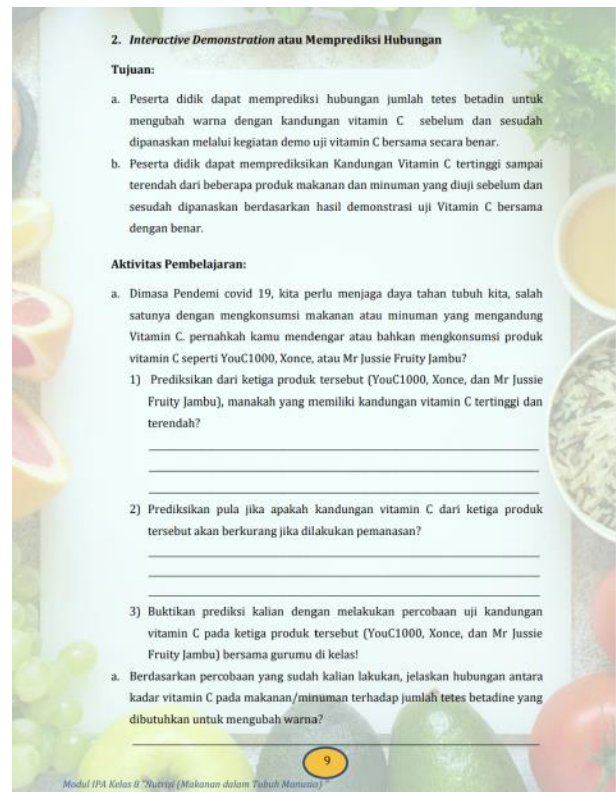

Figure 5
phase interactive demostration. Critical thinking indicators predict the relationship between variables (in Indonesian)
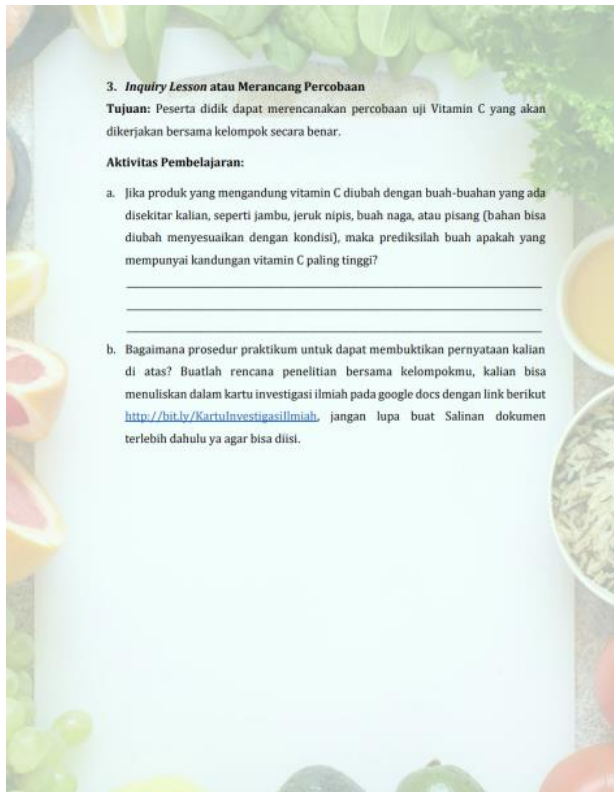
Figure 6
Phase inquiry lesson. Critical thinking indicators planning an experiment in the form of a vitamin C test (in Indonesian)

Figure 8
Phase real word application. Critical thinking indicators solve problems and propose solutions from a case (in Indonesian)

Figure 7
Phase Inquiry Lab. Critical thinking indicators Interpreting data, analyzing, concluding and reporting the results of the experiment (in Indonesian)

In the module product development stage, the validity test was carried out using the validation sheet instrument which was carried out by three validators. The validator referred to here is a science teacher at SMP/MTs. The science teacher validator is responsible for checking the suitability of material, systematics, language, and product graphics in the form of learning modules. In addition to these four aspects, the suitability of the model with the stages of inquiry and suitability with indicators of critical thinking is also measured. Science teachers are assumed to understand material, systematics, language, graphics, compatibility with the stages of inquiry, and compatibility with critical thinking indicators in the inquiry-based nutrition topic module (Ikhtiarni et al., 2021; Lestari & Cintamulya, 2022). The validator also provides comments and suggestions as a basis for improving the inquiry-based nutrition topic module. The validation recap results consisting of material, systematics, language, graphics, suitability with the stages of inquiry, and suitability with critical thinking indicators by the validator can be seen in Table 5.

Based on Table 5, it shows that the results of the validity assessment are viewed from the aspects of material, systematics, language, graphics, suitability with the stages of inquiry, and suitability

with critical thinking indicators. Aspects of the material criteria for the inquiry-based topic module obtained a very valid category with an average value of 3.82. This shows that in the inquiry-based nutrition topic module there is compatibility with basic competencies, indicators, learning objectives, student learning needs, assignments and practice questions. According to Almubarak et al. (2021); Astari (2017); Jannah & Julianto (2018), the results of material validation are concrete evidence indicating that the material presented is appropriate for use in learning with inquiry-based nutrition modules so that learning objectives can be achieved.

Table 5 Recap of Validation Results by Science Teachers

No	Assessment Aspects	Validator Score			Average	Category
		Validator 1	Validator 2	Validator 3		
1	Material Criteria	3,93	4	3,53	3,82	Very Valid
2	Systematic Criteria	4	4	3,33	3,77	Very Valid
3	Language Criteria	3,83	3,83	3,33	3,67	Very Valid
4	Graphical Criteria	3,97	3,83	3,69	3,83	Very Valid
5	Compatibility with the stages of inquiry	3,80	3,60	3,40	3,60	Very Valid
6	Compatibility with critical thinking indicators	3,80	4	3,40	3,73	Very Valid
Average Assessment Aspect Criteria					**3,74**	**Very Valid**

The average score on the aspect of systematic criteria in the inquiry-based nutrition topic module is 3.77 with a very valid category. These results can be stated that the inquiry-based nutrition topic module has a sequence of materials, supplemented by a summary of video material, assignments, and practice questions, each of which is also provided in online form (in the form of a link), ease of activity steps, can be done independently or in groups, and interesting. Inquiry-based nutrition topic module according to linguistic criteria has a very valid category with an average value of 3.67, it can be seen that the module has readability of writing, terms used commonly for students, clarity of delivery, suitability of sentences with correct Indonesian rules, does not cause interpretation double, and the language used is communicative. According to Andriyani & Susilowibowo (2018); Ula & Yulianto (2018), the linguistic component has a fairly important role in the preparation of teaching modules, because good and easy-to-understand language will affect student responses and activities in learning.

The graphical criteria aspect of the inquiry-based nutrition topic module gets an average value of 3,83 with a very valid category. The results of this graphical validation test show that the module has the appropriate screen design display, background, the use of the right colors, the font size and typeface are clear, easy to read, the illustrations are clear, proportional and realistic, the video runs smoothly and can be heard and understood. Attractive media display design, color selection, images, videos, font size and type as well

as the appropriate background can increase student interest in learning (Adiutami & Sujana, 2022).

The conformity criteria with the inquiry stages in the nutrition topic module were stated to be very valid with an average score of 3,60. This shows that the nutrition topic module is in accordance with the inquiry learning model. This nutrition topic module has a phase according to the scientific inquiry model with 5 stages, namely: 1) discovery learning or building concepts; 2) Interactive demonstration or predicting relationships; 3) inquiry lessons or designing experiments; 4) inquiry lab or conduct experiments; and 5) Real Word Application or proposing a solution to a problem. Scientific inquiry is a powerful way of understanding science/science, students learn how to ask questions and use evidence to answer them, conduct investigations and collect evidence, develop explanations from data, communicate and defend conclusions (PPPPTK IPA, 2020).

The conformity criteria with critical thinking indicators in the nutrition topic module are declared valid with a score of 3,73. This is because the activities in the nutrition topic module are appropriate for practicing critical thinking skills. In the process of critical thinking makes it easier for students to find meaningful concepts independently or in groups. Development of nutrition topic modules to train critical thinking skills including analyzing initial concepts, predicting relationships, planning experiments, interpreting data, analyzing, concluding and compiling reports, as well as solving problems and

proposing solutions. Several educational studies show that critical thinking skills are able to prepare students for careers and real life (Zubaidah, 2010). This adapts to the nature and nature of the student era in achieving the highest happiness and safety as human beings and members of society (Rafael, 2022).

Based on the results of validity tests based on material aspects, systematics, linguistics, graphics, compatibility with the stages of inquiry, and compatibility with critical thinking indicators in the inquiry-based nutrition topic module to train critical thinking skills in general it can be stated to be very valid with an average score of 3,76. However, because practicality and effectiveness tests have not been carried out in its use, this research needs to be further developed so that it is feasible and can be implemented in science learning in class.

D. Conclusion

Based on the results of the study it can be concluded that the inquiry-based nutrition topic module to improve critical thinking skills that accommodates cognitive styles is stated to be very valid with a score of 3,74. Each aspect criteria: material is 3.82, systematics is 3,77, language is 3,67, graphics is 3,83, conformity with the inquiry stage is 3,60, and conformity with critical thinking indicators is 3,73. The inquiry-based nutrition topic module to train critical thinking skills that accommodate the developed cognitive style needs to be followed up to the practicality and effectiveness test stage so that this inquiry-based nutrition topic module is suitable for use as a medium in learning.

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