Development of Online Module Based on Discovery Learning to Improve Critical Thinking Ability in Basic Concepts of Science at Primary School Teacher Education

Dewi Nilam Tyas, Desi Wulandari, Panca Dewi Purwati, Aldina Eka Andriani, Siti Maryatul Kiptiyah
Department of Elementary School Teacher Education, Faculty of Education,
Universitas Negeri Semarang, Indonesia
dewinilamtyas@mail.unnes.ac.id, wulanipa@mail.unnes.ac.id, pancadewi@mail.unnes.ac.id, aldinaekaandriani@mail.unnes.ac.id, marya.qiptiy@mail.unnes.ac.id

Abstract

The Covid-19 pandemic has had a significant impact in the field of education, one of which is the implementation of online learning policies. In online learning, teaching materials are needed to facilitate students to learn and develop themselves to achieve competencies according to course objectives. In the science class subject, discovery learning is very important to improve students' critical thinking skills. This study aims to develop a module based on discovery learning approach to improve critical thinking skills in the digestive system and nutrition in the basic concepts of science subject, majoring in primary school teacher education, Faculty of Education, UNNES. Module with discovery learning development based on the Ministry of Education development model that adapted from Borg and Gall procedure development through some steps: (1) doing product development analysis, (2) developing beginning product, (3) expert's validation and revision, (4) small-scale field test and product revision, and (5) significant scale field test and last product. The research results showed that the quality of the product in validation aspect fulfill very good criteria based on the mark from a material expert, media expert, and students. This module was proven to improving students' critical thinking skills.

Keywords
Covid-19; science; online module; discovery learning; critical thinking

1. Introduction

Education in the era of the industrial revolution 4.0 is closely related to artificial intelligence, which integrates cyber technology in learning. But now, we have entered the era of society 5.0 which is a continuation of the 4.0 era which was full of innovations in the technology sector. Education is one of the fields that directly implements developments from the era of society 5.0. According to Nastiti (2020: 64) people in this era are faced with technology that allows access in virtual spaces that feel like physical space so that existing technology will create new values that will serve various needs without being limited by space and time.

These technological advances have been very useful in assisting learning during the Covid-19 pandemic (Shofwan et al. 2021). Which is carried out online. In connection with the Covid-19 pandemic which began to enter Indonesia since early March 2020, the government issued Circular Number 15 to strengthen the Circular of the Minister of Education and Culture Number 4 of 2020 concerning the Implementation of Education in an Emergency for Corona Virus Disease (Covid-19). As quoted from the kemdikbud.go.id page, it is stated in this circular that the purpose of implementing School from Home is to ensure the fulfillment of the rights as students to obtain educational services during the Covid-19 emergency, protect citizens in education units from the adverse effects of Covid-19. 19, preventing the spread and transmission of Covid-19 in education units and ensuring the fulfillment of psychosocial support for educators, students, and parents. Based on this circular, which was followed up by the rector's decision, the college level also carried out learning from home by applying the concept of distance learning assisted by various e-learning platforms. In this regard, lecturers must have the ability to utilize IT-based learning media, such as constructivist modules and the web (Hamdunah et al., 2016).

The application of distance learning certainly requires teaching materials that can make students learn actively and independently without the limitations of space and time (Fakhruddin & Shofwan, 2019). In addition, the essence of learning should also be conveyed in its entirety through the selected learning media integrated with the appropriate platform. CPMK (Course Learning Outcomes), namely learning outcomes that are specific to subjects, covering aspects of attitudes, skills and knowledge that are formulated based on several graduate learning achievements that are charged to the subject of basic science concepts. One of the distinctive features of this course is studying research to develop critical thinking skills.

In this regard, lectures on basic science concepts also require the development of innovations in exploiting the potential of technology to carry out online lectures. The use of learning media for blended learning has a positive impact on the achievement of learning objectives and student learning outcomes (Stapa and Mohammad, 2019), (Kahar & Rahmawati, 2020). The module is proven effective to improve student learning outcomes (Kariman et al., 2019). The use of printed modules has also been proven effective in improving students' critical thinking skills (Agusta, 2019). Discovery learning model increases student activity in the learning process by helping students find information independently so that it affects student learning outcomes which tend to increase. (Ana, 2019), (Putrayasa et al, 2014). Virtual learning is proven to increase the effectiveness of learning (Said, 2014). Based on this, the authors propose the idea of developing an Elena-based online module with the Discovery Learning approach for the Basic Concepts of Natural Science course, PGSD Department, Semarang State University. The online module can be used for self-study with activities that can be adapted to the development approach and its appearance can be designed as attractive as possible. Elena was chosen because it is a learning system developed by UNNES with complete features for the learning process. Discovery Learning was chosen as a module development approach because this learning model is in accordance with the characteristics of science learning to develop critical thinking skills.

2. Literature Review

Based on the guidelines for writing modules issued by the Direktorat Tenaga Kependidikan/Directorate of Education Personnel (2008: 3-5), a module can be said to be good and interesting if it has: self-instructional, self-contained, stand alone, adaptive and user friendly. Based on research Setiawan et al. (2017) it is known that the science module is suitable for improving students' ability to explain scientific phenomena which is one of the indicators of process dimensions. Meaningful learning occurs when students can connect their learning with everyday experiences. Research conducted by Khasanah et al. (2017) showed that the critical thinking skills module based on the system of respiratory material developed had a significant effect on learning outcomes. According to Berhitu (2020) understanding concepts in learning can be developed through experimentation with an accurate observation so that situationally students engage actively and independently, so that online modules with a discovery learning approach can be used for independent learning to achieve learning goals. In this module there are student worksheets, which according to Saraswati & Nuryani (2018) student worksheets are a set of activities fundamental that must be completed by students to maximize understanding in an effort to establish basic abilities according to the achievement indicators that will be taken.

According to Sinambela (2017) the steps for the implementation of discovery learning are: 1) Stimulation, students are given problems at the beginning, so they are confused which then causes desire to investigate this. 2) problem statement, the second stage of this learning is that the teacher gives students the opportunity to identify as many as possible occurrences of the relevant problem with lesson material, then wrong only one is selected and formulated in hypothetical form. 3) Data collection, serves to prove related statements that exist so that students the opportunity to collect various appropriate information, read the source studying accordingly, observing related objects problems, interviews with sources related to the problem, do an independent trial. 4) Data processing is an activity to process data and information previously obtained by students. All of the information obtained is processed at a certain level of confidence. 5) Verification, that is, an activity to prove whether a preexisting statement is true or not. which is already known and is associated with the results of existing data. 6) Generalization draws a conclusion that will be used as general principles for all the same problems. Galuh et al (2015) stated that application discovery learning learning model scientifically approach to improve science process skills and higher order thinking ability on high school students show effective results. So, this syntax is adapted into the developed module.

Advances in technology and science require every human being to always be ready to develop their competence and be adaptive to changing times, thus ensuring the availability of human resources capable of building the nation and

state. When associated with the world of education, these resources include teachers and prospective teachers (Aryati et al., 2020). Critical thinking is at the heart of tertiary education and is also a key focus of university preparation courses (Wilson, 2016). It is important for students to develop critical thinking skills as one of the 21st century skills (Haryani et al., 2021). Based on this, the ability to think critically which is integrated in digital learning is very important to train prospective teachers, in this case, students of primary school teacher education.According to Santrock (2011), critical thinking is reflective and productive thinking, and involves evaluating evidence. Jensen (2011) argues that critical thinking means an effective and reliable mental process, used in pursuing relevant and correct knowledge about the world. Ennis (2011) states "critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do".

Critical thinking is part of Higher Order Thinking Ability, able to improve academic achievement in the field of physics (Ramos, Dolipas, Villamor, 2013), determine the level of problem-solving capability, including the quality of the solutions provided (Kyung-Sook Kim,2014). Based on this definition, it is known that critical thinking is thinking reasoned and reflective by emphasizing making decisions about what to believe or do. Tao (2014) revealed that critical thinking ability refers to active thinking and learning knowledge based on individual decision making and cognitive processes to make sensible decisions.

3. Methods

This research is a development of the type of design research and development which consists of two main stages, namely the preliminary stage and the formative evaluation stage which includes self-evaluation, expert review and one-to-one, small groups and field tests. The research subjects were 150 students of Elementary School Teacher Education at Semarang State University. The research was conducted for 2 months from the stage of preparing the material for the online module to limited product trials. This research uses data analysis techniques descriptively and inferential analysis. Inferential statistical analysis was used by independent sample t-test. conducted to determine the effectiveness of the module to improve students' critical thinking ability

In the preliminary stage, the researcher determines the location and time of the study including the number of students who will be the research subjects. Furthermore, the researcher identifies the problem through direct observation and interviews with students and the head of the department. The next stage, researchers doing product development analysis. The analysis stage is carried out based on the data obtained from the identification of the problems in the first stage. Analysis of the problems or constraints faced by students related to learning activities for advanced science concepts with the existing content in the new lecture curriculum. If previously the basic science concept was divided into two, where the physics and biology material were separated, then in this semester the two courses were combined into one and there was no learning media that was really suitable in relation to the depth of the material and the contents of the semester lecture plan. Depth analysis and material development and reduction are also carried out according to the scope of learning to be carried out. The second stage is the developing beginning product which includes the platform to be used, the material content and appearance and the suitability of the activities in the discovery learning-based online module which will be used to achieve learning objectives and develop critical thinking ability. Researchers also conducted a pretest to determine the initial critical thinking ability of research subjects

In developing beginning products, the researcher conducts a formative evaluation, the researcher conducts an evaluation by conducting his own assessment of the learning media design to be developed. the roles of science in enhancing society's knowledge about natural resources or the natural phenomena in daily life become absolute (The Indonesian Ministry of Education and Culture, 2014) Researchers look again at the suitability of the Discovery Learning approach to student activities contained in the developed online module. At this stage, the researcher succeeded in compiling the first online module which can be called the prototype online

The next stage is expert's validation and revision, at this stage the prototype of the online module being developed begins to be consulted with material experts and media experts for review. The evaluation results provided by material experts and media experts will be used as consideration for revising the online module prototype 1. Online module prototype 1 is also given at the one-to-one stage which will be tested on several students. Then students provide a review in the form of comments and suggestions related to the content and appearance of the online module prototype 1. Comments and suggestions obtained from students will be used as consideration for revising the online module prototype 1. Practical assessment of online modules based on discovery learning conducted by

students is also recapitulated. based on the acquisition of a questionnaire filled out by students. Based on suggestions and comments from material experts, media experts and students as samples, a revision was made to the online module prototype 1. The results of this revision are referred to as the online module prototype 2.

In the small-scale field test and product revision stage, the developed prototype 2 online module is then given to the small group stage which will be tested on several students. At this stage students use learning media and provide feedback in the form of comments and suggestions for prototype 2 learning media to see the practicality of discovery learning-based online modules. The practicality review at the small group stage will be combined with the practicality results obtained in the one-to-one stage. Comments and suggestions obtained from this stage will be taken into consideration for revising the online module prototype 2. The revised results of the online module prototype 2 will be the final product which we can call the prototype online module 3 which will then carry out the significant scale field test and last product stages. This stage was carried out on 150 students who were research subjects to see the potential effect of discovery learning-based online modules on the critical thinking ability of elementary school teacher education students, including to see student responses after using this online module.

4. Data Collection

Data collection as one of the important aspects in the success of this research was carried out through interviews, document study and pretest-post test. The instruments in this study were interview guide sheets, documentation, questionnaires, and pretest and post-test questions to measure critical thinking ability. The interview sheet is used to obtain preliminary data as a needs analysis as a basis for conducting module development, he needs analysis includes what materials and media were needed and what was not currently available. The next data collection uses a questionnaire. The method of documentation according to (Arikunto, 2002) is defined as data collection where researchers investigate written objects such as books, magazines, documents, regulations, and so on. This method is used to analyze the suitability of teaching materials developed with the curriculum and to select material from various references.

The questionnaire is a data collection technique through forms containing questions that are asked in writing to a person or group of people to get answers or responses and information needed by researchers (Mardalis, 2008). The questionnaire in this study was used to obtain information or reviews from respondents on the online module being developed. Information and reviews from material experts, media experts and students are used to see the validity and practicality of the online module, including seeing the module's potential effect on improving students' critical thinking ability. The pretest and post test instruments were used to measure the increase in critical thinking ability in the field trials of the developed modules.

5. Results and Discussion

5.1. Numerical Result

5.1.1. Doing product development analysis

The doing product development analysis stage includes preliminary stages to obtain information related to problems that require immediate solutions, this stage can be referred to as a need assessment. As previously explained, the curriculum changes make the basic science concepts and basic science concepts advanced into one course, so it is important to select materials and develop appropriate teaching materials. The decisions taken by students as prospective teachers are one of the important things and must be studied intensively (Sadijah et al., 2021), so it is important to practice decision-making skills through developing critical thinking skills. This stage also considers input from students as research subjects, including determining the sample that will be used in a limited trial. According to Khaerunnisa (2019), these conditions have the potential to develop internet-based learning media, so that learning resources for prospective teacher students in the preparation of learning tools.

5.1.2. Developing beginning product

At the developing beginning product stage, the researcher designed an online module that would be developed to suit the discovery learning syntax, which includes stimulation, problem statement, data collection, data processing, verification and generalization. The syntax was adapted to be developed into an online module. The next stage is selecting the appropriate platform to support the discovery learning-based online module display being developed. The platform chosen is Elena. Quoted from the elena guide for students from unnes,ac.id. Elena (Electronic Learning Aid) is an e-learning site developed by the Semarang State University (Unnes) based on MOODLE version 2.0 to support academic activities. The menu options on this elena are complete, so they can display Figures, videos, links, narrations or include video conferencing. This menu platform allows presentation of material, discussion, other activities and evaluation according to discovery learning syntax. The discovery learning helps students create and organize knowledge because students are actively involved and construct their own knowledge (Honomich & Chen, 2012:1)

In designing the online module, researchers also collect material and compile teaching materials from various relevant references to then make material selection according to the curriculum as outlined in the semester learning plan while still paying attention to the depth of the material to be adjusted to the competence of prospective elementary school teachers. At this stage, the researcher also begins to design evaluation questions to measure critical thinking ability according to the material in the developed module. The results of this design will then enter the self-evaluation stage which will then become the online module prototype 1. The initial design which is part of the online module content can be seen in Figure 1. The initial design which is part of the online module content
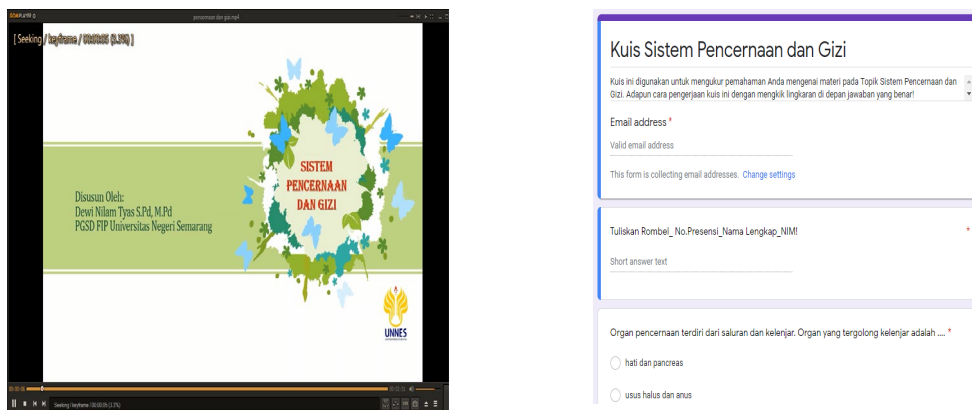

Figure 1. The initial design which is part of the online module content

In the initial design Figure 1, which is part of the online module content, it includes learning videos of the digestive system in the form of exposure to important concepts such as the digestive organs which can be divided into digestive organs and tracts, glands and secreted enzymes. Equipped with animated videos of the digestive process, indigestion. In the nutrition sub-section, it is explained about macronutrients and micronutrients, sources of benefits and impacts of malnutrition. In this initial design, quiz questions were also developed using google forms to measure conceptual understanding of the material presented in the developed online module.

At the developing beginning product stage, the researcher also conducted an assessment of the online module being developed by reviewing the discovery learning syntax contained in the learning activities in the module, checking the design, content and layout contained in this online module again. The learning experience is realized through the use of learning approaches as well as a variety of learning media and students centered (Syahroni et al., 2016). Researchers also develop contextual activities that are relevant to real problems in daily activities. This will facilitate students to better understand the concept (Anggraini et al., 2019). After self-evaluation, there were several improvements to the file, such as the placement of images, typos and sentence structure that were not yet effective, so some revisions needed to be made. After the revision is carried out, a prototype of the online module 1 is obtained which is ready to be tested at the next stage. At this stage, a pretest is also carried out to determine the level of critical thinking in students. This is evidenced by the results of the normality and homogeneity of the data on the pretest value of critical

thinking ability. The results of the data normality test on the pretest value of critical thinking ability and scientific literacy can be seen in the Table.1 Data Normality Test Results Pretest Value of Critical Thinking Ability

Table 1. Data Normality Test Results Pretest Value of Critical Thinking Ability

Aspect	Kelas	Signifikansi	(p) Sig	Description
critical thinking abilities	Experiment	0,365	p>0,05	Normal
	Control	0,942	p>0,05	Normal

Based on the data in Table 1, it can be seen that the significance value of the control class and experimental class is greater than 0.05 (Sig> 0.05), this value indicates that the pretest data on critical thinking ability in the control class and experimental class are normally distributed. This shows that both of them have the same critical thinking ability.

5.1.3. Expert's validation and revision

The expert's validation stage involves several experts as validators which are divided into 2, namely material experts and media experts. Material experts are experts related to scientific fields that are the content of the online module, material experts check the validity of the developed modules in terms of content and language aspects. Validation by expert judgment is an important activity to assess whether the product design will rationally be more effective than the previous product or not. It is said to be rational because validation is still rational thinking, not field facts (Sugiyono, 2015). The results of the material expert's validation can be seen in Table 2. Validity Results of Material Experts.

Table 2. Validity Results of Material Experts

No.	Aspect	Total Score	Maximum Score	Pecentage (%)	Description
1.	Content	56	60	93,3	Very valid
2.	Language	35	40	87,5	Very valid

Based on the assessment of material experts, it is known that the online module developed is in the very valid category.

Media experts perform validity to see the validity of the developed online module in terms of presentation, graphics and language aspects. The third media expert's assessment can be checked in Table 3. Validity Results of Media Experts.

Table 3. Validity Results of Media Experts

No.	Aspect	Total Score	Maximum Score	Pecentage (%)	Description
1.	Presentation	55	60	92	Very valid
2.	Graphic	53	60	88	Very valid
3.	Language	35	40	87,5	Very valid

Based on the assessment of media experts, it is known that the online module developed is in the very valid category.

5.2 Graphical Results

Based on the evaluation from material experts, it is known that the online module developed is in the very valid category. The language aspect is assessed by material experts and media experts because this language aspect includes the writing and use of biological terms which are the content of the online module, so that aspects of language in general and the use of scientific terms are important things to be validated by media experts and material experts.

Researchers also conducted validation at the one-to-one stage of the process along with the expert review stage. At this stage the researcher tested the practicality of the online module prototype 1 which was tested on three students. Based on students' responses to the online module prototype 1, it is known that this module is very practical and easy to use, but there are parts that are a little confusing regarding the instructions for carrying out activities in this discovery learning based module (this section will be revised). Discovery learning model applied in the preparation of this module has learning scenarios to solve a problem they got themselves (Pangaribowo et al., 2017). The display of the online module prototype 1 is as shown in the Figure 2. Online Module Prototype 1.
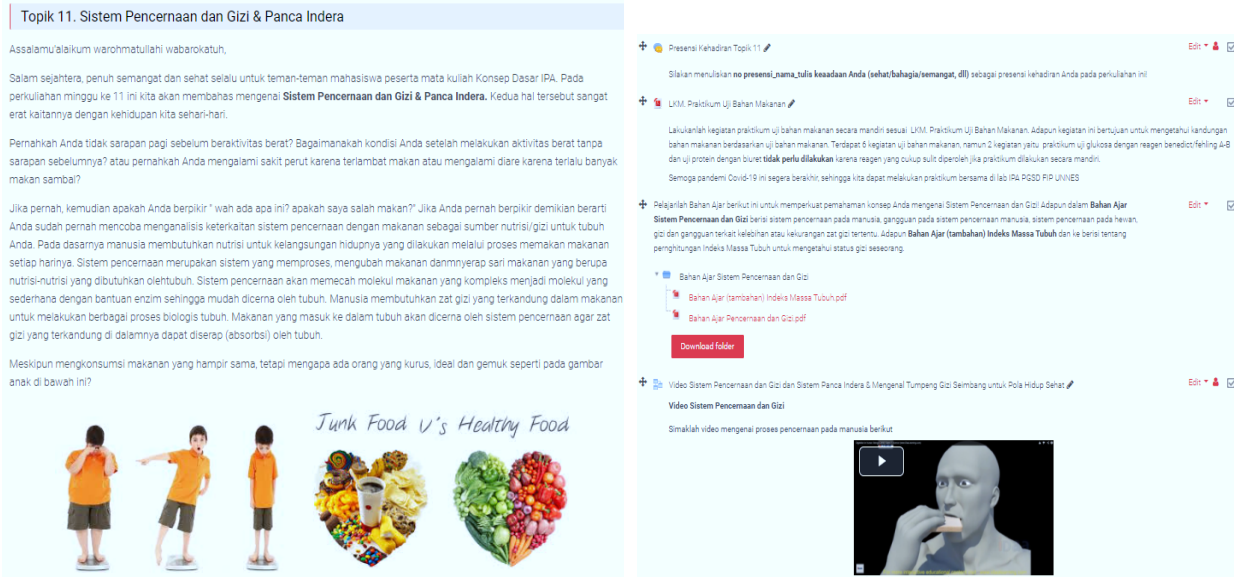
Figure 2. Online Module Prototype 1

On the Online Module Prototype 1, it begins with greeting the online module user, followed by giving an introduction or acceptance to enter the next step. In this introductory part, the discovery learning syntax begins to be applied, namely providing a stimulus in the form of questions related to daily activities. Questions about breakfast habits were then linked to the condition of the body after activities as well as questions related to digestive system disorders. Stimulus is also equipped with pictures of malnutrition and junk food vs healthy food. The existence of this image also adds to the attractiveness of the developed online module.

After the introduction, it was followed by filling in attendance and student worksheet files containing guidelines for conducting simple practicums. Through this simple practicum, students are expected to be able to build their own knowledge based on a series of activities starting from providing stimulus, problem identification, data collection, data processing, verification and generalization. As a form of conditioning, this online module provides teaching materials that contain essential concepts from the material on the digestive system and nutrition that have been studied and practiced. At this section is also included videos that have been prepared in the initial design and appropriate additional video.

The revision of the online module prototype 1 was carried out based on comments and suggestions given by material experts and media experts at the expert review stage as well as comments and suggestions given by students at the one-to-one stage. This revision of the online module prototype 1 results in a prototype online module 2. Research from Gojkov et al. (2015) showed that students did not have an objective view of their critical thinking level, so that guidance from the teacher through the developed module was important to do.

5.2.1. Small-scale field test and product revision

At this stage the researchers tested the prototype module 2 to 6 students by logging into the Elena platform to study the material, carrying out activities systematically according to the order in the module and working on evaluation questions. Based on student responses to the online module prototype 2, it is known that this module is very practical and easy to use.

Revisions were made to the 2 learning media prototype based on the reviews, comments and suggestions that the students had given at the small group stage. The results of the revision of the online module prototype 2 are called the online module prototype 3. The online module prototype 3 will be used for testing at the field test stage. The revision made is to deactivate the display description on the course page so that some material descriptions are not displayed directly in the online module and add an animated video of the digestive process. The part of the online module based

on discovery learning after being revised is as Figure 3. The part of the online module based on discovery learning after being revised.

Figure 3. The part of the online module based on discovery learning after being revised

After the revision, part of the online module based on discovery learning looks like figure 3. In that section what was revised was a discussion room on the material of the digestive system and nutrition, the discussion was more focused on the results of the practicum that had been carried out based on the student worksheets. After the discussion, there is a digestive and nutrition system quiz section which has been developed at the initial design stage and as a closing it is the individual's task to make a practicum report accompanied by analytical questions related to the digestive system and nutrition. So, as a whole, this online module consists of an introduction, attendance room, student worksheets, teaching materials and learning videos, discussion rooms, quizzes and individual assignments. The series of activities are arranged based on the discovery learning syntax and the use of this module must be sequentially based on the activities that have been compiled.

5.2.2. Significant scale field test and last product.

After obtaining a valid and practical prototype of the online module 3, the field test stage is carried out. This stage is the final stage in the formative evaluation stage in developing discovery learning-based online module to improve critical thinking ability in basic science concepts courses. Online module prototype 3 will be tested on research subjects, namely elementary school teacher education students who take this course which consists of 150 students to determine the potential effect of the module being developed on increasing students' critical thinking abilities. The students required alternative teaching materials to increase their science generic skills (Nastiti et al., 2018). At this stage students are given a questionnaire about student responses to the online module prototype 3. The results of the student's questionnaire responses at this field test stage can be seen in Table 4. Results of Student Responses in the Field Test Stages.

Table 4. Results of Student Responses in the Field Test Stages

No.	Aspects	Total Score	Skor maximum	Persentase (%)	Description
1.	Practicality	57	60	95	Very good
2.	Ease of Use	38	40	95	Very good

In the field trial, a post test was also carried out to measure students' critical thinking abilities. As stated by Bambang Subali (2013) learning should end with evaluation and assessment to see the effectiveness and efficiency of the

program. Test subjects who have the same initial critical thinking ability. The increase of avarege thinking ability can be seen in Figure 4. Increase of average critical thinking ability.
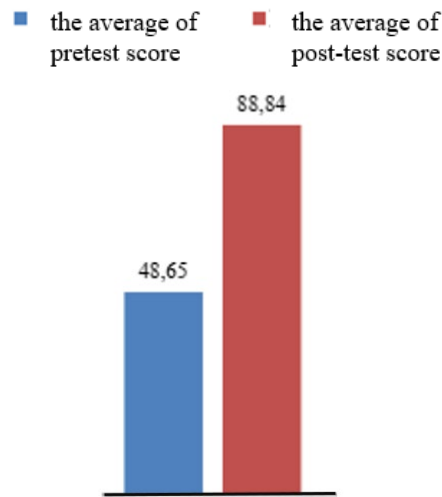

Figure 4. Increase of average critical thinking ability

The increase in critical thinking ability can be seen based on the gain score which reaches 0.78 (high category). The results of the independent sample t-test analysis on the value of critical thinking ability can be seen in Table 5. Results of Independent Sample T-Test for Critical Thinking Ability below:

Table 5. Results of Independent Sample T-Test for Critical Thinking Ability

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Gain_ Critic al Think ing	Equal variances assumed	0.830	.052	13.630	103	.000	.47086	.03455	.40234	.53937
	Equal variances not assumed			11.971	49.647	.000	.47086	.03933	.39184	.54987

Based on the results from Table 5, it is known that the Sig. (2-tailed) value for critical thinking ability is 0,000. Critical thinking as an important educational goal and is understood to mean reasonable reflective thinking that is focused on deciding what to believe or do (Thaiposri & Wannapiroon, 2015). Because the significance value is smaller than α (0.05). So, based on the results of field trials, it is found that the average difference in changes in critical thinking ability from the pretest and post-test results or the gain score can be seen if the use of discovery learning-based online modules that are developed is effective to improve students' critical thinking abilities.

This discovery learning-based online module has several advantages. First, this module is a teaching material that can be used independently so that it overcomes limited face-to-face time in class, especially during the Covid-19 pandemic. Second, the material developed in this online module is still actual so that it will broaden students' insights and be in accordance with daily life. Third, discovery learning is chosen as the basis for developing this module in

accordance with the material and activities developed and stimulates critical thinking ability. Practices critical thinking skills such as problem solving, decision making, interpretation, logical reasoning (Tabačková, 2015).

6. Conclusion

The procedure of development of discovery learning-based online module to improve the critical thinking ability of elementary school teacher education students through some steps: (1) doing product development analysis, (2) developing beginning product, (3) expert's validation and revision, (4) small-scale field test and product revision, and (5) significant scale field test and last product. The research results showed that the quality of online modul based on discovery learning product in validation aspect fulfill very good criteria based on the mark from a material expert, media expert, and students. This module was proven to improving students' critical thinking ability

References

Ana, N. Y. (2019). Penggunaan Model Pembelajaran Discovery Learning Dalam Peningkatan Hasil Belajaran Siswa Di Sekolah Dasar. *Pedagogi: Jurnal Ilmu Pendidikan*, *18*(2), 56.
https://doi.org/10.24036/fip.100.v18i2.318.000-000

Agusta, E. (2019). Bilingual Module Innovation With Saintific-Based Regulated Learning Self Strategy. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *9*(1), 33–44. https://doi.org/10.30998/formatif.v9i1.2918

Aryati, L., Pujiastuti, H., & Sudiana, R. (2020). Development of Learning Media with the STEM Approach on Materials of Sequences and Series. *Jurnal Ilmiah Pendidikan MIPA*, *10*(148), 91–102. https://journal.lppmunindra.ac.id/index.php/Formatif/index%0ADevelopment

Berhitu, M. (2020). *The Effect of Project-Based Learning (PjBL) Models on Improving Students ' Understanding of Concepts , Retention , and Social Attitudes*. *10*(148), 143–152.

Fakhruddin, I. S. (2019). The Impact of Non-Formal Education in Community Development: A Case Study in Pati, Indonesia. *International Journal of Innovation, Creativity and Change, 5*(5), 339-352.

Galuh, A. et al. 2015. Penerapan Model Pembelajaran *Discovery Learning* untuk Meningkatkan Aktivitas dan Prestasi Belajar Pokok Bahasan Larutan Penyangga Pada Siswa Kelas Xi Ipa Semester II SMA Negeri 1 Ngemplak Tahun Pelajaran 2013/2014 [Electronic version]. *Jurnal Pendidikan Kimia (JPK)*, Vol. 4 (2) tahun 2015

Gojkov, G., Stojanović, A., & Rajić, A. G. (2015). Critical Thinking of Students – Indicator of Quality in Higher Education. *Procedia - Social and Behavioral Sciences*, *191*(2012), 591–596. https://doi.org/10.1016/j.sbspro.2015.04.501

Hamdunah, Yunita, A., Zulkardi, & Muhafzan. (2016). Development a constructivist module and web on circle and sphere material with wingeom software. *Journal on Mathematics Education*, *7*(2), 109–116. https://doi.org/10.22342/jme.7.2.3536.109-116

Haryani, E., Cobern, W. W., Pleasants, B. A. S., & Fetters, M. K. (2021). Analysis of teachers' resources for integrating the skills of creativity and innovation, critical thinking and problem solving, collaboration, and communication in science classroom. *Jurnal Pendidikan IPA Indonesia*, *10*(1), 92–102. https://doi.org/10.15294/jpii.v10i1.27084

Honomichl, R.D., & Chen, Z. (2012). The role of guidance in children's discovery learning. *Wiley Interdisciplinary Reviews: Cognitive Science*, *3(6)*, 615-622

Istiyono, E., Mardapi, D., & Suparno. (2014). Developing higher order thinking skills test of physics (PhysTHOTS) for senior high school students. *Jurnal Penelitian dan Evaluasi Pendidikan*, 18 (1), 1–12

Kahar, M. S., & Rahmawati, M. S. (2020). *The Development of Physics Learning Materials to Improve Students ' Learning Results*. *10*(21), 57–66.

Kariman, D., Harisman, Y., Sovia, A., & Prahmana, R. C. I. (2019). Effectiveness of guided discovery-based module: A case study in Padang city, Indonesia. *Journal on Mathematics Education*, *10*(2), 239–250. https://doi.org/10.22342/jme.10.2.6610.239-250

Khaerunnisa, E., Pamungkas, A.P., Rafianti, I., Pujiastuti, H., & Setiani, Y. (2019). *Development of a content management system (CMS) for mathematics learning tools of mathematics pre service teachers*. *Formatif: Jurnal Ilmiah Pendidikan*. *Formatif: Jurnal Ilmiah Pendidikan MIPA,* 9 (2): 117-130. http://dx.doi.org/10.30998/formatif.v9i2.2978

Khasanah, A. N., Sajidan, S., & Widoretno, S. (2017). Effectiveness of critical thinking indicator-based module in empowering student's learning outcome in respiratory system study material. *Jurnal Pendidikan IPA Indonesia*,

6(1), 187–195. https://doi.org/10.15294/jpii.v6i1.8490

Kyung-Sook, Kim and Jung-Hyun Choi. (2014). The relationship between problem solving ability, professional self concept, and critical thinking disposition of nursing students. *International Journal of Bio-Science and Bio-Technology. Vol 6, No. 5, 131-142.*

Ministry of Education and Culture. (2014). *Materi pelatihan guru implementasi Kurikulum 2013 tahun ajaran 2014/2015: Mata pelajaran IPA SMP/MTs (Teacher training materials for the implementation of Curriculum 2013, academic year 2014/2015: Natural Science subject for junior high school and its equivalent Islamic school).* Jakarta: Ministry of Education and Culture

Nastiti, D., Rahardjo, S. B., Elfi Susanti, V. H., & Perdana, R. (2018). The need analysis of module development based on search, solve, create, and share to increase generic science skills in chemistry. *Jurnal Pendidikan IPA Indonesia*, *7*(4), 428–434. https://doi.org/10.15294/jpii.v7i4.12393

Nastiti, F., & Abdu, A. (2020). Kajian: Kesiapan Pendidikan Indonesia Menghadapi Era Society 5.0. *Edcomtech Jurnal Kajian Teknologi Pendidikan*, *5*(1), 61–66. https://doi.org/10.17977/um039v5i12020p061

Pangaribowo, D. R., Keliat, N. R., Sastrodihardjo, S., & Hutangoal, D. R. (2017). Penerapan model Pembelajaran Discovery Learning dan Permainan Smart Case untuk Meningkatkan Hasil Belajar Siswa Kelas VII C SMP Kristen 2 Salatiga The Application of Discovery Learning Model and Smart Case Game to Improve Students ' Learning Results of St. *Bioedukasi*, *10*(1), 47–57.

Putrayasa, I. M., Syahruddin, S. P., & Margunayasa, I. G. (2014). Pengaruh Model Pembelajaran Discovery Learning dan Minat Belajar terhadap Hasil Belajar IPA Siswa. MIMBAR PGSD Undiksha, 2 (1).

Sadijah, C., Murtafiah, W., Anwar, L., Nurhakiki, R., & Cahyowati, E. T. D. (2021). Teaching higher-order thinking skills in mathematics classrooms: Gender differences. *Journal on Mathematics Education*, *12*(1), 159–179. https://doi.org/10.22342/jme.12.1.13087.159-180

Sagap, Sarjan N. H, M. P, Muchlis Djirimu. (2014). The analysis of conceptual understanding in biology subject by using multiple reasoned choice on cell topic to the student of class XI IPA at SMAN 1 Dampal Selatan. *Jurnal Ejip Biol.* 2 (3), 1-8

Said, H. (2014). Pengembangan Model Pembelajaran Virtual Untuk Meningkatkan Efektivitas Pembelajaran Pada Madrasah Negeri Di Kota Parepare. *Lentera Pendidikan : Jurnal Ilmu Tarbiyah Dan Keguruan*, *17*(1), 18–33. https://doi.org/10.24252/lp.2014v17n1a2

Saraswati, A. M., & Nuryani, C. E. (2018). Pengembangan lembar kegiatan siswa (LKS) berdasarkan model pembelajaran guided discovery. *Jurnal Aksioma, 9* (1), 97-112. http://dx.doi.org/10.26877/aks.v9i1.2516.

Setiawan, B., Innatesari, D. K., Sabtiawan, W. B., & Sudarmin, S. (2017). The development of local wisdom-based natural science module to improve science literation of students. *Jurnal Pendidikan IPA Indonesia*, *6*(1), 49–54. https://doi.org/10.15294/jpii.v6i1.9595

Shofwan, I., Aminatun, S., Handoyo, E., & Kariadi, M. T. (2021). The Effect of E-Learning on Students' Learning Interest in the Equivalence Education Program. *Journal of Nonformal Education*, *7*(1).

Sinambela, P. N. (2017)*. Kurikulum 2013 dan Implementasinya dalam Pembelajaran. Generasi Kampus, 6 (2)*

Stapa, M. A. & Mohammad, N. (2019). The use of ADDIE model for designing blended learning application at vocational colleges in Malaysia. *Asia-Pacific Journal of Information Technology and Multimedia*, 8(1), 49–62

Sugiyono. (2015). *Metode Penelitian Kombinasi (Mix Methods).* Bandung: Alfabeta

Syahroni, M. W., Dewi, N. R., & Kasmui. (2016). The effect of using digimon (Science digital module) with scientific approach at the visualization of students' independence and learning results. *Jurnal Pendidikan IPA Indonesia*, *5*(1), 116–122. https://doi.org/10.15294/jpii.v5i1.5800

Tabačková, Z. (2015). Outside the Classroom Thinking Inside the Classroom Walls: Enhancing Students' Critical Thinking Through Reading Literary Texts. *Procedia - Social and Behavioral Sciences*, *186*, 726–731. https://doi.org/10.1016/j.sbspro.2015.04.042

Thaiposri, P., & Wannapiroon, P. (2015). Enhancing Students' Critical Thinking Skills through Teaching and Learning by Inquiry-based Learning Activities Using Social Network and Cloud Computing. *Procedia - Social and Behavioral Sciences*, *174*, 2137–2144. https://doi.org/10.1016/j.sbspro.2015.02.013

Biographies

Dewi Nilam Tyas was born in Gunungkidul, October 28, 1993. Currently working as a lecturer at Elementary School Teacher Education, Faculty of Education, Universitas Negeri Semarang. She completed her undergraduate program at the Universitas Negeri Yogyakarta on Biology Education Department in 2015 and finished her postgraduate program

in Biology Education at the same university. Her latest work is entitled "*Explorative Study on The Application of Learning Model in Virtual Classroom during Covid-19 Pandemic at The School of Yogyakarta Province*" which was published in the Proceedings of the Universitas Muhammadiyah Surabaya on September 8, 2020. The author can be contacted at email dewinilamtyas@mail.unnes.ac.id.

Panca Dewi Purwati was born in Blora, July 21, 1965. She currently works as a lecturer at Elementary School Teacher Education, Faculty of Education, Universitas Negeri Semarang. She completed his undergraduate program at the Department of Indonesian Language and Literature Education, IKIP Negeri Semarang in 1988, completed her Masters in 2009 at the Indonesian Language Concentration Education Study Program at the Postgraduate Program of Universitas Negeri Semarang. The doctoral level graduated in 2014 for the Language Education Study Program at PPS Universitas Negeri Semarang. Her latest work is entitled *Development of an Eclectic Model Based on the Noble Value of Pancasila in Learning to Write People's Poetry* which is published in the Journal of Indonesian Language and Literature Education FPBS UNNES (ISSN 2252-6722). The authors can be contacted at email pancadewi@mail.unnes.ac.id

Desi Wulandari was born in Batang,, December 17, 1983. She is lecturer in Elementary School Teacher Education, Faculty of Education, State University of Semarang. He is an alumni of the State University of Semarang in Physics Education and a Master's in Science Education at the State University of Semarang. Currently he is continuing his studies in the Doctoral Program of Science Education at Semarang State University. The authors can be contacted via email wulanipa@mail.unnes.ac.id

Aldina Eka Andriani was born in Purbalingga, June 25, 1992. Now, she works as a lecturer at Elementary School Teacher Education, Faculty of Education, Universitas Negeri Semarang. His latest work is entitled "*Using Prezi Presentations to Increase Knowledge About Natural Science Learning Media for Elementary School Teachers Gugus Kemuning*" which was published in the Proceedings of the University of Malang. The authors can be contacted via email aldinaekaandriani@mail.unnes.ac.id

Siti Maryatul Kiptiyah was born in Kendal, November 17, 1987. Currently working as a lecturer at Elementary School Teacher Education, Faculty of Education, Universitas Negeri Semarang. She completed her undergraduate program at the Universitas Negeri Semarang on Mathematics Department in 2011 and finished her postgraduate program in Elementary Education (Mathematics) at the same university in 2016. Her latest work is entitled "*The Implementation of Blended Learning Based Realistic Mathematics Education in Mathematics Teaching*" which was published in the Proceedings of ICET Malang City on December 31, 2019. The author can be contacted at email maryaqibtiy@mail.unnes.ac.id