Development of electronic module using inquiry based learning (IBL) model integrated high order thinking skill (HOTS) in 21st century physics learning class X

F Nisak* and Y Yulkifli

Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Jl. Prof Hamka, Padang 25131, Indonesia

Abstract. The purpose of this study is to produce an electronic module using IBL integrated model HOTS in 21st century of Physics learning class X with valid and practical criteria. The thinking ability of students in learning physics is still not in accordance with the thinking skills that are needed in the 21st century. One of the reasons is because of the modules used by students still do not contain model steps that are integrated with the level of thinking skills. This type of research is a development research using the ADDIE model which consists of five phases, those are Analysis, Design, Development, Implementation, and Evaluation phase. Which in this research only carried out the development and implementation phase. The research instrument included are a validity questionnaire and practicality questionnaire. Data analysis techniques for validity used the Aiken's V formula and for practicality using descriptive percentages. The results of the development stage show that the electronic module has an Aiken's V value of 0.86 with the valid category. The results of the implementation stage show that the practicality of the electronic module is in the very practical category with a value of 93.27% for teacher responses and 87.86% for student responses. Thus, it can be concluded that the module electronic using IBL model integrated HOTS in the 21st Century Physics Learning of Class X meets the criteria of being valid and practical. The results of the implementation stage show that the practicality of the electronic module is in the very practical category with a value of 93.27% for teacher responses and 87.86% for student responses. Thus, it can be concluded that the module electronic using IBL model integrated HOTS in the 21st Century Physics Learning of Class X meets the criteria of being valid and practical.

1. Introduction
The 21st century is a century characterized by the very rapid development of Science and Technology (IPTEK). The 21st century is also known as the digital era, which is the time when digitalization and information technology and computers, internet networks began to arise (Asrizal, Ali Amran, et al., 2018). In the 21st century all information can be obtained in a short time anytime and anywhere. This
allows everyone to easily access information in a short time. The development of Science and Technology (IPTEK) should be used in learning activities. The characteristics of 21st century learning is the development of thinking skills, the ability to communicate and collaborate with students in solving problems by integrating technology in learning.

The government has perfected the curriculum several times so that learning is carried out in accordance with 21st century learning. Some of the improvements that have been made are replacing the learning curriculum from KTSP to the 2013 curriculum. In the 2013 curriculum, irrelevant material was reduced and an in-depth study was made for relevant materials able to improve the thinking skills of students. In terms of assessment standards, by adapting international assessment models, the assessment of student learning outcomes is currently more focused on helping students to improve higher-order thinking skills. Quoted from the Assessment Guide by Educators and Education Units for Senior High Schools (Kemendikbud, 2017).

The thinking skills of students can be developed in various ways, one of which is learning physics. Physics learning is the process of integrating various components and activities carried out to investigate various natural phenomena using scientific method steps which will later help students build their own knowledge. One of the objectives of learning Physics is develop the ability to reason in inductive and deductive analytical thinking by using the concepts and principles of physics to explain various natural events and solve problems both qualitatively and quantitatively. After studying physics, it is expected that students' thinking skills can develop properly.

The fact is that after 6 years of curriculum changes taking place, currently most high schools in Padang have implemented the 2013 curriculum. The hope that is placed on the implementation of the 2013 curriculum is that the achievement of higher order thinking skills (HOTS) of students is better than before. However, the results of preliminary studies related to the thinking skills of students who come from schools that have implemented the 2013 curriculum are still far from expected. Based on the results of the analysis of students’ semester examinations in Physics subjects, it is obtained that the thinking ability at the LOTS level with a value of 70.21%, then the MOTS ability with a value of 59.77% and the ability at the HOTS level with a value of 40.71%. This shows that currently the HOTS of students is still in the low category and the learning activities carried out so far have not developed the HOTS of students.

The learning carried out in the three schools is still not as expected. The results of the preliminary study analysis showed that 58.33% of teachers had implemented the learning model according to the 2013 curriculum, but the implementation was not optimal and had not been able to increase the activeness of students in learning. The use of the student center learning approach is still lacking with a value of 41.67%. The teacher explained that the approach implemented had used a scientific approach, but it was not optimal for the five steps.

Teaching materials as all kinds of materials used to assist teachers in carrying out learning activities (Prastowo, 2011). Teaching materials are one of the important components in learning because with teaching materials, students can apply the knowledge they have acquired authentically and holistically (Asrizal, A. Amran, et al., 2018). One type of teaching material is modules. Modules are teaching materials that are systematically designed based on a certain curriculum and are packaged in the smallest learning unit that allows them to be studied independently in a certain time unit (Purwanto, 2007). Modules are teaching materials that are arranged systematically in language that is easily understood by students, according to their age and level of knowledge so that they can learn independently with minimal guidance from students (Prastowo, 2011). Module is part of a planned learning unit designed to help individual learners achieve their learning goals (Sukiman, 2013).

The current module in use is not compatible with the module it should be. The results of the preliminary study indicate that the existing modules have not been able to increase students‘ curiosity in learning physics. Investigation activities have not been implemented in the modules used by students. The application of problem-oriented learning models and investigations is in the less category with a value of 58.33%. Furthermore, the module used is not only a print module. The use of printed modules in learning activities has not made it easier for students to learn because of the diverse
learning styles of students. This resulted in the low interest of students in learning physics with a value of 63.33%. Judging from the existing module components, it appears that one module component is incomplete. The feedback component does not exist in the module used. This results in students unable to measure the extent of their understanding independently. So that the function of the module as an independent teaching material for students cannot be carried out properly.

Based on the results of the preliminary study above, there is an imbalance between what is expected and the facts in the field. Efforts that can be made to overcome the above problems are by developing teaching materials in the form of electronic modules. Electronic module means a module integrated with technology in which there are images, animation, video. The electronic module allows students to interact directly with students and makes students more enthusiastic about learning. The electronic module developed is based on a learning model that aims to increase the curiosity of students. This module is structured with learning syntax that allows HOTS students to develop properly.

One learning model that is believed to be used is the Inquiry Based Learning (IBL) model. Inquiry Based Learning is a step to gain knowledge through the inquiry process (Hebrank, 2000). Inquiry based learning is a process that allows teachers and students to ask questions about various topics (Michaela Kostelníková & Miroslava Ožvoldová, 2013). On the other hand, there is an understanding of inquiry based learning, which is a learning model that is flexible, open and refers to a variety of skills and learning resources (Abidin, 2014). The IBL model refers to the steps that help students to be able to form new knowledge through discovery. If students are directly involved in building their knowledge, the knowledge gained will last a long time in themselves. This competence can be achieved if the teacher, as a facilitator, is able to facilitate students in developing their abilities, such as providing teaching materials in the learning process to facilitate the achievement of learning objectives (Yulkifli, Ningrum and Indrasari, 2019).

One of the abilities included in higher order thinking skills is the ability of inquiry or discovery ability (Godson, Ludwika, Faranak Rohan, 2011). By applying the IBL model in the electronic module, it is expected that students' higher order thinking skills (HOTS) can increase. Integrating HOTS thinking levels in the developed modules is expected to help students to practice their HOTS. The use of the Module electronic using IBL model integrated HOTS is felt to be able to help students understand physics learning well and maximize the achievement of students' knowledge competencies. It is also considered capable of developing students' thinking skills, especially at the level of analyzing, evaluating and creating, so that the learning carried out is in accordance with 21st century learning.

The results of developing a good learning product are determined by the quality of the product developed. The quality of learning development results in development research is determined by several criteria, including validity (truth) and practicality (practicality). This research was conducted to determine the level of validity and practicality of the electronic module with the Inquiry Based Learning (IBL) model which is integrated with Higher Order Thinking Skills (HOTS) in 21st century physics learning.

2. Research Methods
This research is included in research and development or R&D. The development model used in this research is the ADDIE development model. ADDIE stands for Analysis, Design, Development, Implementation and Evaluations (Pribadi, 2010). This model can be used for various forms of product development such as models, learning strategies, learning methods, media, and teaching materials. This model is arranged programatically with a systematic sequence of activities in an effort to solve learning problems related to learning resources that are in accordance with the needs and characteristics of students. This research is a development and implementation step of the ADDIE development stage.

This study focuses more on the results at the development and implementation stages. At the development stage, a product validity test was carried out by UNP Physics lecturers, while at the
implementation stage a product practicality test was carried out by teachers and students. Data were obtained from the validity test questionnaire and practicality test questionnaire and were processed using Aiken's formula and percentage.

The validity analysis uses a Likert scale with the following steps: (a) Give a score for each item the answer is very good (4), good (3), sufficient (2), and less (1), (b) add up the total score of each validator for all indicators. The validity value is given using the Aiken's V formula in equation 1.

\[
V = \frac{\sum s}{n(c-1)}
\]

Information:
\(s = r - l_0\), \(l_0 = \) the lowest number of validity assessments (in this case = 1), \(c = \) the highest number of validity assessments (in this case = 4), \(r = \) the number given by the validator. The validity category can be seen in Table 1 below:

| Score   | Criteria     |
|---------|--------------|
| \(V \geq 0.6\) | Valid        |
| \(V < 0.6\)   | Invalid      |

(Source: Azwar, 2015)

Based on Table 1, it can be seen that the criteria of the validity agreement value obtained. This validity is carried out using the Aiken's V formula and categorized into two values, namely valid and invalid. The developed electronic module can be said to be valid when the value obtained exceeds or is equal to 0.6.

Analysis of the practicality of the electronic module questionnaire data using a model inquiry based integrated Higher Order Thinking Skills (HOTS) in 21st century Physics learning based on the questionnaire of teachers and students with the following steps: a. Give a score for each answer item strongly agree (4), agree (3), just normal (2), disagree (1) b. Add up the total score of each validator for all indicators. c. Provide a validity value by using equation 2.

\[
Nilai\ Praktikalitas\ (NP) = \frac{\text{skor\ yang\ diperoleh}}{\text{skor\ maksimum}} \times 100\%
\]

The category of practicality for the electronic module based on the final value obtained can be seen in Table 2.

| Interval (%) | Category          |
|-------------|-------------------|
| 0 - 20      | Very impractical  |
| 21 - 40     | It's not practical|
| 41 - 60     | Less practical    |
| 61 - 80     | Practical         |
| 81 - 100    | Very practical    |

(Source: modified from Riduwan, 2009: 89)

Based on Table 2, it can be seen that the category of the practicality percentage value obtained. Practicality is categorized into five types of percentage values. The electronic module being developed can be said if the practicality value (NP) is at a value of 61% - 100%.

3. Result and Discussion
3.1. Result
This research is a continuation research from the development of the electronic module model of the IBL which has been published previously (Nisak & Yulkifli, 2020). The results of this study explain the development of electronic modules that have been carried out. The results to be explained are the level of validity and the level of practicality of the Module electronic using IBL model integrated HOTS. The level of validity states the level of truth or validity of the electronic module that has been
developed, while the level of practicality states the ease of use of the electronic module. In detail, the
results of the validity and practicality tests of the Module electronic using IBL model integrated HOTS
can be described as follows.

3.1.1 Validity test

The validity test of the electronic module is carried out after the electronic module has been designed.
The results of the design of the electronic module will be tested for their validity. The electronic
module validity test was carried out by three UNP Physics lecturers who were professionals in their
fields. The electronic module validity test includes four aspects, including material substance, learning
design, visual communication, and software utilization. The results of the electronic module validity
test can be seen in more detail in Table 3.

| Aspect                  | Value V | Category |
|-------------------------|---------|----------|
| Matter of Matter        | 0.78    | Valid    |
| Learning Design         | 0.80    | Valid    |
| Visual Communication    | 0.78    | Valid    |
| Utilization of Software | 0.84    | Valid    |
| Average                 | 0.81    | Valid    |

Based on Table 3, it can be seen that the four aspects of the validity test are already in the valid
category. This can be seen from the V value in the aspects of material substance, learning design,
visual communication, and software utilization which is above 0.6. This means that this electronic
module is valid for every aspect and can be used for the learning process.

During the validation process there were several revisions from those suggested by the validator.
The revision of the validator is corrected first before being tested in schools. Some examples of
improvements to the electronic module according to suggestions and comments from the validator can
be seen in Table 4.

| No. | Aspect                  | Before                                      | After                                      |
|-----|-------------------------|---------------------------------------------|---------------------------------------------|
| 1   | Matter of Matter        | The material is too concise, add the material| The material that is too summarized is added and the electronic module is corrected according to the existing module components on a theoretical basis |
|     | Adapt the developed module with the module components on a theoretical basis |                            |                                                                                       |
| 2   | Learning Design         | Add questions for the HOTS category         | Questions that are not yet in the HOTS category are replaced by questions in the HOTS category |
| 3   | Visual Communication    | Add the next button on the material menu because there are no instructions to go to the next page | The next button is added so that users can use the electronic module easily |
| 4   | Utilization of Software | Add instructions for what software to use or the minimum computer requirements for running the program | In the electronic module folder, the manual for the software that supports the electronic module has been added. |
### 3.1.2 Practicality Test

The validity test is carried out after the electronic module is said to be valid. At the ADDIE stage, the validity test is at the application stage. This means that this practicality test is carried out in school and tested on teachers and students.

Questionnaires for practicality test of teacher responses were filled in by professional Physics subject teachers. This questionnaire was filled in by two physics teachers and deals with four practical aspects of the electronic module. The four aspects are useful, easy to use, attractive and efficient. Furthermore, the results of the questionnaire analysis on the practicality of teacher responses can be seen in Table 5.

| Aspect      | Score (%) | Category     |
|-------------|-----------|--------------|
| Helpful     | 90.00     | Very Practical |
| Easy to use | 93.06     | Very Practical |
| Interesting | 96.43     | Very Practical |
| Efficient   | 92.50     | Very Practical |
| Average     | 93.27     | Very Practical |

Based on Table 5, it is shown that the developed electronic module is useful, easy to use, attractive and efficient. So, it can be said that the Module electronic using IBL model integrated HOTS is very practical to use.

The practicality test questionnaire was given to 28 students in the trial school after finishing using the electronic module in learning activities. In the practicality test questionnaire, the response of students also assessed the same four aspects as the teacher’s response, namely useful, easy to use, interesting and efficient. Furthermore, the results of the questionnaire analysis on the practicality of students’ responses can be seen in Table 6.

| Aspect      | Score (%) | Category     |
|-------------|-----------|--------------|
| Helpful     | 88.59     | Very Practical |
| Easy to use | 88.01     | Very Practical |
| Interesting | 89.14     | Very Practical |
| Efficient   | 85.71     | Very Practical |
| Average     | 87.86     | Very Practical |

In Table 6, it can be seen that for every aspect of practicality proposed, the electronic module is in the very practical category. This means that the electronic module that has been developed is useful, easy to use, attractive and efficient according to students. Thus, it can be said that the integrated IBL model electronic module has met practical criteria.

### 3.2 Discussion

At the development stage, one of the steps taken is the validation of the electronic module that has been completed. After validation, the developed electronics can be said to be correct and correct. The validity test is useful for obtaining recognition and correctness of the device with the needs so that it is suitable and suitable for use in learning activities.

The validity test of the electronic module is carried out after the instrument used is said to be valid. This instrument validation activity was carried out by three experts, namely three UNP Postgraduate
Physics lecturers. The results of the validation of the instrument showed that for the validation of the instrument validity test of the electronic module, it was obtained that the aiken's V value was in the valid criteria. Furthermore, for the practicality instrument validation the average acquisition value of aiken's V was also in the valid criteria.

The next stage is to test the validity of the electronic module. This stage is carried out after the product validation instrument is said to be valid. The electronic module validation was carried out by three UNP Postgraduate Physics lecturers. Product validation can be carried out by several experts or experienced experts to assess the weaknesses and strengths of the resulting product (Sugiyono, 2011). The validation component for ICT-based teaching materials refers to four parts, namely material substance, learning design, visual communication, and software utilization.

The results of the validity test show that the material in the Module electronic using IBL model integrated HOTS is in accordance with the learning objectives. Learning objectives are the basic point of a learning process. Without clear learning objectives, the learning process cannot be said to be running optimally. Therefore, in determining the learning material must be adjusted to the learning objectives. The existence of a match between the material and the learning objectives allows the use of this module to help students achieve predetermined learning goals. Module electronic using IBL model integrated HOTS has used navigation that functions properly. The existence of navigation can also make it easier for students to freely move between pages, watch, pause, and play back animated and video content (Nugent et al., 2016).

Furthermore, the Module electronic using IBL model integrated HOTS has provided interactivity to students in the form of feedback. The existence of feedback allows students to use this module as an independent learning material for students. This is because the module is a teaching material that is structured systematically, operationally and directed to help students become more active and independent in the learning process. (Purwanto, 2007; Suratsih, Victoria Henuhili, Tutiek Rahayu, 2009; Prastowo, 2011)

The practicality test results show the use of the IBL model in the electronic module is useful in increasing the curiosity of students. This is because IBL model is a learning model that involves students actively in developing students' thinking habits (Veronicatama Raden Roro Avisa, Murni Ramli, Dewi Puspita Sari, 2016), the IBL model is also designed to invite students directly into the scientific process in a relatively short time (Trianto, 2011). The Module electronic using IBL model integrated HOTS is easy to use in physics learning activities. The activities contained in the module also make it easier for students to find concepts. In addition, this module also makes it easier for students to control learning activities. This is in line with research(Ibrahim, 2010) which states that by using module learners can control the ability and intensity of learning. This is also in accordance with opinion (Nugroho et al., 2019) which states that by using modules, educators can control the completeness of students in learning and control the accuracy of students' learning.

The Module electronic using IBL model integrated HOTS can increase students' enjoyment in learning physics. The electronic module is an innovative medium that can increase the interest of students in other words, there is an increase in the interest of students (Herawati and Muhtadi, 2018). The increase in student interest is because the electronic module is multimedia which consists of several media such as images, animation, video, and audio (Sugianto et al., 2017; Herawati and Muhtadi, 2018). Furthermore, the use of the Module electronic using IBL model integrated HOTS can shorten the time students learn. Lessons are believed to be more practical and time efficient by using practicum activities. This allows participants to more easily understand physics learning as a whole (Yulkifli, Afandi and Yohandri, 2018). Learning with modules allows a student who has a high speed of learning to complete one or more basic competencies faster than other students (Marsri Restu, Ibrahim, 2015). This is because the module can be used as a substitute for the teacher in explaining something in a language that is easily accepted by students according to their level of knowledge and age.(Majid, 2009).
4. Conclusion
Based on the results of the research that has been done, it is found that the Module electronic using IBL model integrated HOTS meets the valid and practical criteria. The average value of the validity test that has been carried out on the electronic module is in the valid category. The validity of this electronic module is assessed on four aspects, including material substance, learning design, visual communication, and software utilization. The practicality level of the electronic module is obtained by distributing questionnaires to teachers and students. The results of the electronic module practicability analysis after being used by teachers and students are in the very practical category. This means that according to the teacher or students the modules that have been developed are useful, easy to use, interesting and efficient.

References
[1]. Abidin, Y 2014 Desain Sistem Pembelajaran dalam Konteks Kurikulum 2013 Bandung: Refika Aditama.
[2]. Asrizal, Amran, Ali, et al 2018 ‘Development of adaptive contextual teaching model of integrated science to improve digital age literacy on grade VIII students’, in Journal of Physics: Conference Series. doi: 10.1088/1742-6596/1116/3/032004.
[3]. Asrizal, Amran, A., et al 2018 ‘Effectiveness of integrated science instructional material on pressure in daily life theme to improve digital age literacy of students’, in Journal of Physics: Conference Series. doi: 10.1088/1742-6596/1006/1/012031.
[4]. Godson, Ludwika, Faranak Rohan, F. K 2011 Higher Order Thinking Skills. Center for Advancement of Learning and Assessment.
[5]. Hebrank, M 2000 Why inquiry-based teaching and learning in the middle school science classroom? Durham: Duke University.
[6]. Herawati, N. S. and Muhtadi, A 2018 ‘Pengembangan modul elektronik (e-modul) interaktif pada mata pelajaran Kimia kelas XI SMA’, Jurnal Inovasi Teknologi Pendidikan. doi: 10.21831/jitp.v5i2.15424.
[7]. Ibrahim, N 2010 Perspektif Pendidikan Terbuka Jarak Jauh: Kajian Teoritis dan Aplikasi Jakarta: Bumi Aksara.
[8]. Majid, A. 2009 Perencanaan Pembelajaran Bandung: Remaja Rosdakarya.
[9]. Marsri Restu, Ibrahim, A. R. 2015 ‘Pengembangan Modul Perhitungan Kimia Berbasis Konstruktivisme di Kelas X SMA Negeri 1 Tanjung Batu’, Jurnal Penelitian Pendidikan Kimia: Kajian Hasil Penelitian Pendidikan Kimia, 2. doi: 10.36706/jppk.v2i2.2899.
[10]. Michaela Kostelniková & Miroslava Ožvoldová 2013 ‘Inquiry in Physics Classes by means of Remote Experiments’, in 2nd Cyprus International Conference on Educational Research, pp. 133–138.
[11]. Nisak, F. and Yulkifli, Y. 2020 ‘Preliminary analysis of development electronic module using inquiry based learning model for 21st century’, in Journal of Physics: Conference Series. doi: 10.1088/1742-6596/1481/1/012070.
[12]. Nugent, G. et al. 2016 ‘Learning from Online Modules in Diverse Instructional Contexts’, Interdisciplinary Journal of e-Skills and Lifelong Learning. doi: 10.28945/3511.
[13]. Nugroho, Y. S. et al. 2019 ‘PENGEMBANGAN MODUL PEMBELAJARAN MATA KULIAH ENERGI ALTERNATIF PROGRAM STUDI PENDIDIKAN VOKASIONAL TEKNIK ELEKTRO’, JINoP (Jurnal Inovasi Pendidikan). doi: 10.22219/jinop.v5i1.8923.
[14]. Prastowo, A. 2011 Panduan Kreatif Membuat Bahan Ajar Inovatif. Yogyakarta: Diva Press.
[15]. Pribadi, Benny A. 2010 Model Desain Sistem Pembelajaran. Jakarta: Dian Aksara.
[16]. Purwanto 2007 Pengembangan Modul. Depdiknas.
[17]. Sugianto, D. et al. 2017 ‘MODUL VIRTUAL: MULTIMEDIA FLIPBOOK DASAR TEKNIK DIGITAL’, Innovation of Vocational Technology Education. doi: 10.17509/invotec.v9i2.4860.
[18]. Sugiyono 2011 *Metode Penelitian Kualitatif dan Kuantitatif*. Bandung: Alfabeta.

[19]. Sukiman 2013 *Penelitian Tindakan Kelas untuk Guru Pembimbing*. Yogyakarta: Paramitra Publishing.

[20]. Suratsih, Victoria Henuhili, Tutiek Rahayu, dan M. L. H. 2009 ‘Pengembangan Modul Pembelajaran Genetika Berbasis Fenomena Lokal’, *Jurnal Cakrawala Pendidikan*. doi: 10.21831/cp.v2i2.316.

[21]. Trianto 2011 *Model Pembelajaran Terpadu Konsep, Strategi dan Implementasinya dalam Kurikulum Tingkat Satuan Pendidikan (KTSP)* Jakarta: Bumi Aksara.

[22]. Veronicaatama Raden Roro Avisa, Murni Ramli, Dewi Puspita Sari, S. A 2016 ‘Penerapan Model Pembelajaran Inkuiri untuk Meningkatkan Rasa Ingin Tahu Siswa pada Materi Sistem Reproduksi Kelas XI MIA 8 SMA Negeri 1 Karanganyar Tahun Pelajaran 2014/2015’, *Jurnal Bio-Pedagogi*, 5.

[23]. Yulkifli, Afandi, Z. and Yohandri 2018 ‘Development of Gravity Acceleration Measurement Using Simple Harmonic Motion Pendulum Method Based on Digital Technology and Photogate Sensor’, in *IOP Conference Series: Materials Science and Engineering*. doi: 10.1088/1757-899X/335/1/012064.

[24]. Yulkifli, Y., Ningrum, M. V. and Indrasari, W 2019 ‘The Validity of Student Worksheet Using Inquiry-Based Learning Model with Science Process Skill Approach for Physics Learning of High School’, *Jurnal Penelitian & Pengembangan Pendidikan Fisika*. doi: 10.21009/1.05210.