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Interactive E-module Based on H-Guided Inquiry: Optimize the ICT Skills and Learning Achievements

Nur Rohmah Utami, Akhmad Jufriadi*, and Hena Dian Ayu
Physics Education, Faculty of Science and Technology, Universitas Kanjuruhan Malang, Malang, Indonesia
*henadian@unikama.ac.id

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Abstract

This study aimed to optimize the ICT skills and the learning achievement of the students on the subject of the regular circular motion through the development of the interactive e-module that is based on the Hybrid Guided Inquiry with good criteria. As a result, it could be utilized to help the learning process in class. The learning and development model used was the ADDIE model that stood for Analyze, Design, Development, Implementation, and Evaluation to generate the interactive e-module that could be utilized in the learning process based on the expert's assessment. The final result of the e-module development revealed that it was included in a good category with the content eligibility score was 3.58, and the language eligibility score was 3.4. Meanwhile, the percentage of the ideals score of the interactive module was 87.1%. The result of the small-scale assessment on the 26 of students was 3.32 within the "good" category. The N-gain score that was utilized as the proving suggestions of the ICT skill optimization was 0.85 that was included into "high" category, and 0.61 for the achievement optimization of the students that were categorized into "medium" category after being given the treatment. In this way, the interactive e-module that is based on Hybrid Guided Inquiry on the subject of the regular circular motion was feasible to be utilized as the learning media in class. It was also effective to ease the learning process in optimizing the ICT skills and the learning achievements of the students.

Keywords: Interactive E-module; hybrid guided inquiry*;* learning media of physics

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INTRODUCTION

The 21st Century learning develops skills that focus on student's abilities of collaboration, communication, problem-solving and critical thinking, creativity and innovation (Kulsum & Nugroho, 2014). The result of the study on the learning process that utilizes the information technology reveals a significant improvement on mastery of concepts, activity, quality of the process, and learning outcome of students (Ayu,

Pratiwi, K., & Muhardjito, 2017; Pratiwi, Sujito, Ayu, & Jufriadi, 2018; Pratiwi, Winarko, & Ayu, 2018);.

The rise of the pandemic that is caused by Corona Virus Disease (Cov19) in Indonesia makes the government make several efforts to suppress its spread. One of which is the replacement of face-to-face learning into the online learning that is implemented via virtual classes (Firman & Rahayu, 2020). However, Szpunar, Moulton, & Schacter, (2013) stated that the students would fantasize more often during online learning if it is compared to face-to-face learning. Because of this, the students will have some difficulties to understand the materials that are provided via online media as they need more verbal explanations from the teachers on complex materials. Besides, online learning also causes a lower concentration if it is implemented for an extended period (Firman & Rahayu, 2020).

The development of information technology allows a new learning model that is integrated with technology. The integration between the online learning that utilizes the innovation and the advance of the information technology and face-to-face learning in a classroom is known as the hybrid learning. In addition, they are able to add other supporting learning media to create effective and innovative learning (Pratiwi, Sujito, Ayu, & Jufriadi, 2018).

The technological change that is caused by the technological advancement is considered as a catalyst of change to the education and knowledge world as it connects the thoughts of the latest research with the information and knowledge that can be accessed easily and quickly through the information and communication technology (ICT) (Katz & Macklin, 2014). The ICT skills of the students according to the results of the questionnaire are good, so that the learning process with a hybrid approach can be applied to them (Claro et al., 2012).

The ICT skills enable students to improve their higher-order thinking skills that have an impact on the optimization of their learning achievement. Each student has different learning achievements. In general, the learning method that requires students only act as listeners in the learning process declines the quality of learning in Indonesia (Mukarram, Hartini, & Wati, 2014). Also, the external factor that affects students learning achievement is the lack of learning facilities in the school, such as the use of physics modules (Rafiqah, 2013).

The research to improve the student's quality in the learning process is continued to conduct. The guided inquiry model emphasizes the process of discovering the concept of problem-solving by students (Astuti, Hartini, & Mastuang, 2018). The steps of the guided inquiry learning include the problem orientation, conceptualization, investigation, conclusions and discussion (Pedaste et al., 2015). The involvement of inquiry learning gives an impact on the behaviour of students of all ages that are likely to enjoy the learning process (Cairns & Areepattamannil, 2019).

One of the success indicators of student participation in teaching and learning activities is their understanding of the discussed material (Prayudha, 2017). Another factor that causes a low competency of graduates is the lack of availability of learning tools to meet the learning needs that require the students to apply their concepts and scientific thinking (Rahmi, Hartini, & Wati, 2014). Besides, the process of learning activities is less pleasant (Ayu, Pratiwi, K., & Muhardjito, 2017). Thus, the learning media in the form of interactive modules are needed to meet the needs of learning materials. One of the interactive

modules that can be developed is an electronic module (e-module). The development of an interactive e-module is an attempt to present the module in an electronic form, in which there are pictures, videos and sounds (Prayudha, 2017).

Currently, the learning media used by students are not interactive and less attractive so that they do not guide students in search and find out their own answers to the problems given. So that interactive teaching materials are needed and can optimize the ICT skills and achievement of students through H-GI learning, as well as animation and video explanations that can be accessed directly by students. The main objective of this research and development is to optimize the ICT skills and student achievement in regular circular motion material through the development of interactive e-modules based on the Hybrid Guided Inquiry with good criteria. It is expected that it can be utilized to help the teaching and learning process that takes place in the classroom.

METHODS

An interactive e-module based on H-Guided Inquiry as a medium to optimize the ICT skills and student achievements was developed with the ADDIE model (analyze, design, development, implementation, and evaluate) (Branch, 2010). The analysis of optimization of the ability of the ICT skills and the achievement of students was implemented by analyzing the research instruments in the form of questionnaires and the direct observation to determine the initial ability of the ICT skills. Meanwhile, in order to measure the achievement, the pretest was used to measure the initial ability of students, and the posttest with the same level of difficulty was used to find out the optimization of students learning achievements.

The descriptive analysis in this study was conducted by calculating the average score of the assessment of media experts and material experts. The quantitative scores obtained from the average of expert assessment were converted into qualitative data with a score of 3.25 - 4, which is in the very good category. The interactive e-module products had good eligibility if the criterion of the product validity was minimal, as well as the range of eligibility criteria was fair with a percentage of 60 – 79% (Riduwan, 2012).

The level of reliability of the questions can be seen from the reliability value. If the criteria for the reliability value obtained are in the range $0.8 \leq R11 \leq 1$, it is included in the very high criteria (Arikunto 2013). The optimization of the students' learning achievements and the ICT skills after being given the treatment was obtained by finding a normalized gain value (N-gain). N-gain abbreviated the Normalized gain, or that was the comparison between the actual gain scores and the maximum gain scores (Hake, 1999).

RESULT AND DISCUSSION

This study aimed to develop the learning media in the form of interactive e-modules based on H-GI learning on the subject of regular circular motion using the ADDIE model. The results of each stage of the development model that has been performed are as follows:

Analyze

At this stage, the researcher conducted a needs analysis through observation and questionnaires to the 10^{th} grader of high school students and the physics teachers. The questionnaire distribution had been done before arranging the interactive e-module to discover the problems and the initial conditions of learning. The observation

was performed by observing the learning process in a classroom and interviewing several students randomly.

Based on the results of the analysis of students' needs (Figure 1) it can be stated that the use of learning media was still lack. The results of the observation indicated that the teachers had not used learning media in the form of modules and online-based learning. Whereas, the books and the other learning resources were necessary for students to support their learning process at home, and it can also be controlled by educators (Sumiati, Septian, & Faizah, 2018). The use of modules as teaching materials in learning activities did not only act as media, but also it made the students actively involved in the learning process (Sumiati, Septian, & Faizah, 2018).

According to Sanjaya (2011), the Inquiry learning model is a process to obtain and acquire the information by using critical and logical thinking skills by conducting observations or experiments to find the answers or solve the presented problems. The inquiry learning model could form or develop the initial concepts in students, so they could understand the basic concepts and ideas better, and encouraged students to think and work according to their initiatives, be objective, honest, and open-minded (Kalinda, Maharta, & Ertikanto, 2011).

The student ability in finding online learning resources has been good. The students use the internet to find information or references for learning resources to gain knowledge outside the school. This shows that technological advance is very important for education. The Technological innovation can provide better access to education, information and knowledge, and also offer broader facilities of communication so that it supports the improvement of the quality of education (Rahim, 2011). The results of the needs analysis are presented in Figure 1.

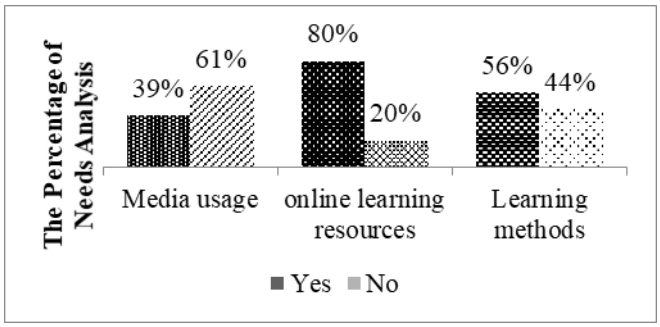

Figure 1 The percentage of needs analysis of students

Design

The second stage of the ADDIE model is the design stage. In the initial phase of product design, the things that needed to be done include: 1) The learning objectives to fit the applicable curriculum, 2) The basic competence and indicators of the subject of regular circular motion, 3) Material design, sample questions and evaluations to measure the students' learning achievements from physics textbook and the internet that would be used and adjusted to the following learning activities.

The design of the interactive e-module included the introduction, learning activities, and evaluation. The Learning activities on the interactive e-modules were adjusted to the steps of the HGI learning method. There are five steps of HGI learning, according to Pedaste et al., (2015) such as; 1) Orientation. In the interactive e-module,

the problem orientation was presented through animations, videos, and also phet simulation links. This step was performed outside the learning hours at school, so it must be done online through the used Learning Management System (LMS). 2) Conceptualization. This step was applied in online classes. The teacher gave several questions to lead the students to formulate hypotheses from the problems that had been presented in the previous step. 3) Investigation. In an interactive e-module, there were student worksheets that would be used to collect data. From this step, the students would be able to make conclusions easier. 4) Conclusion. In this step, the students drew conclusions with the help of the teacher based on what they had been learned. This step must be done face-to-face in the classroom. 5) Discussion. There were two sub-steps in the discussion step, namely, communication and reflection. This was needed to find out the extent to which students understood the lessons which used the H-GI-based interactive e-modules on the subject of regular circular motion.

There were several differences between the interactive e-modules of teachers and students that were consisted of the interactive H-GI based e-module, which is shown in Table 2.

Table 2 The differences between interactive e-modules of teachers and students

No	Teacher Interactive E-modules	Student Interactive E-module
1	There were the instructions on activities that must be implemented by the teachers and students in each step of learning	There were only instructions for students' activities
2	There were some restrictions on what a teacher might not do.	There was no restriction to what a teacher could do.
3	There were some alternative answers for teachers in each step.	There were no alternative answers.

The evaluation that was consisted of the interactive e-module contained formative and summative assessments so that the assessment took place during the learning process. Through the learning achievements, the students were able to know their progress that has been achieved during the learning process (Thaib, 2013).

Development

The interactive e-module was developed into a product by adding animations, sounds, videos, and other supporting images, then converted it into an interactive e-module using flipbook maker pro application. On the cover page, there was the title of the interactive e-module, the logo of curriculum 2013, the type of cognitive assessments, and the skills that were included in the interactive e-module.

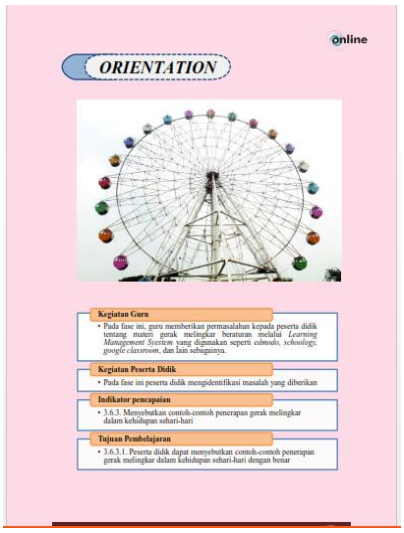

Figure 2 The orientation section of the interactive e-module

Each section of the learning activities was distinguished by the background colour and the instructions of the activities that would be performed. For instance, in the first section of the HGI learning model (Figure 2). Orientation Section of Interactive E-module) in the interactive e-module explained that the section must be performed online. It was also completed by the instructions on what activities the teachers and students should do in an online mode.

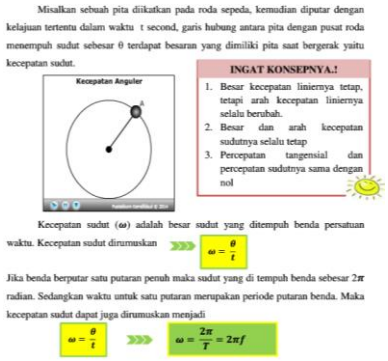

Figure 3 The explanation in the interactive e-module

The presentation of material and examples of regular circular motion subject in interactive e-modules are shown in Figure 3 and Figure 4. The presented material was not only in the form of written explanations, but also accompanied by animations that was equipped with audio explanations (Figure 5).

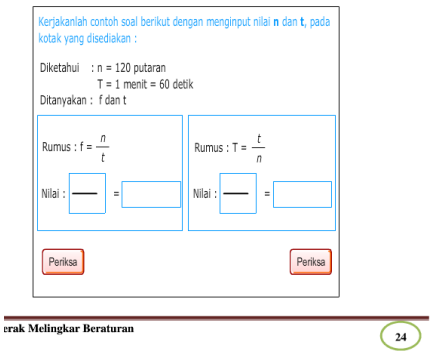

Figure 4 Example of Question in Interactive E-module

Figure 5 Audio icon

The presentation of the evaluation of the interactive e-module is shown in Figure 6. The evaluation of the interactive e-module would be presented after all the learning steps had been performed. The evaluation process was presented with the instructions, 10 objective questions, and 5 description questions.

Figure 3 The evaluation section of interactive e-module

The conversion of the quantitative scores into the qualitative one utilized the average assessment of the media experts and the material experts based on the eligibility criteria. The score of eligibility from the media experts was 3.35 with the criteria of "very good" and was eligible to use. That score was obtained from the average score of the content eligibility of 3.43 and language eligibility of 3.3 as shown in Figure 7.

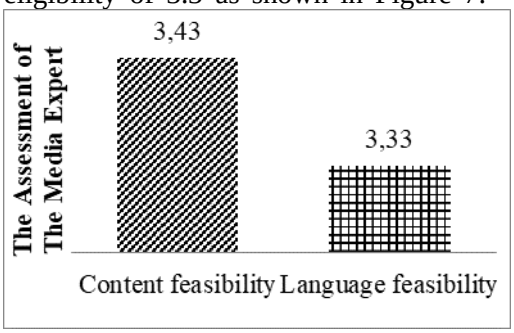

Figure 4 Assessment score of the media expert

Whereas, the eligibility score from the material expert was 3.62 with "very good" criteria. That score was obtained from the average score of content eligibility of 3.74 and language eligibility of 3.5 as shown in Figure 8.

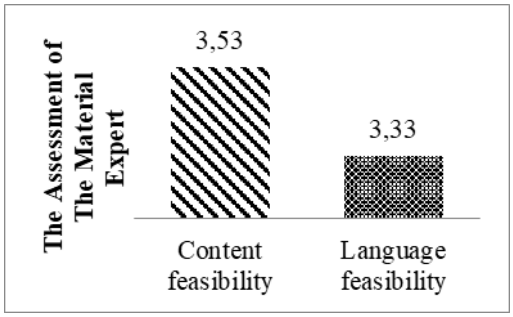

Figure 5 Assessment score of the material expert

The assessment of the content eligibility by the experts included an assessment of the e modules according to several aspects, such as the content of the material that was presented in the module, the use of the module, the readability of the contents of the module, the correlation between displayed images with the related material, colour and cover.

From the assessment above, it can be concluded that the material in the interactive e-module was good, systematic and suitable with the steps of learning activities that were used in the interactive e-module. Moreover, the presented images were correlated with the material and the real life of the students. The language that was used was also communicative so that it could help the students to understand the presented materials and problems.

Apart from being used as the learning media, the e-modules were also used as learning resources for students (Purwaningtyas, 2017). The learning activities became more interesting since the interactive e-modules were equipped with pictures and videos so that it could help students in understanding the lessons (Putra et al., 2017). The role of the interactive e-modules was to help the students in their learning process, which was in line with the module's objectives to facilitate the students to learn without regular supervision (Purwaningtyas, 2017).

Implementation

The implementation that was performed by the researchers was a trial only on 26 students. The implementation stage was conducted to determine the eligibility and the effectiveness of an interactive e-module based on HGI when applied to students. The learning phase in online classes was done at Schoology. This can be seen in Figure 9.

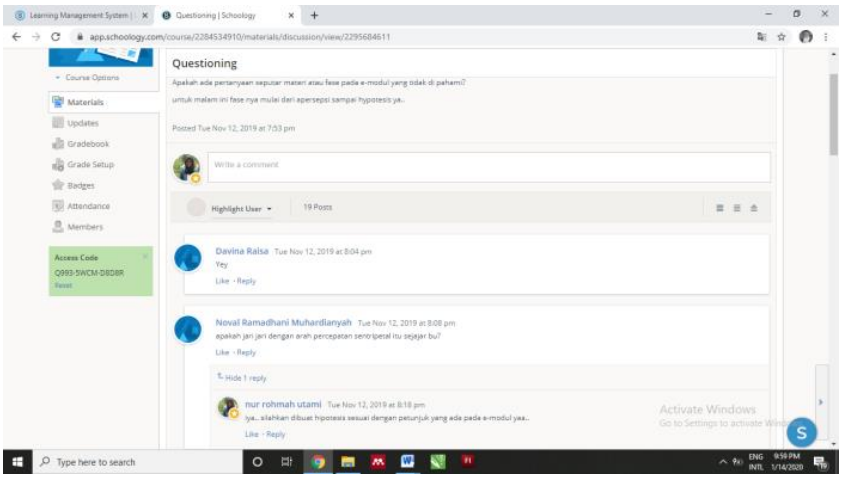

Figure 6 Conceptualization phase in schoology class

Before presenting the interactive e-modules to students, the ICT skills questionnaires were given as a consideration of students' ICT abilities before hybrid learning was implemented. After that, the online pretests and posttests were given to determine the ability of students before and after the learning process by using interactive e-modules. Meanwhile, in order to find out the improvement of students' ICT skills, the assessment was undertaken during the learning process in hybrid classes. Based on the results of the trial, there was an optimization of the achievement and ability of the ICT skills of students after using an interactive e-module based on HGI learning.

Optimization Data for Students' ICT Skills

This optimization was calculated using the N-Gain calculation, which was the ratio of the actual gain score over the maximum gain score (Hake, 1999). Before conducting a learning activity using interactive e-modules based on HGI learning, the researchers committed direct observations and distributed questionnaires related to ICT skills. These questionnaires were used as data for researchers to assess the ICT skills of students before performing the learning activity using an interactive e-module.

The assessment used 5 indicators that were assessed such as determining, accessing, evaluating, making, and communicating on the ICT skills observation sheets of the 26 students before using an interactive e-module based on HGI learning. With a scale of 1-3, it was obtained a total percentage of 68%, which was included in the category of "good". However, in terms of the ICT skills of each student before the presentation of the interactive e-module, there were 58% with sufficient skills, and 42% of students with good skills. This result is shown in Figure 10.

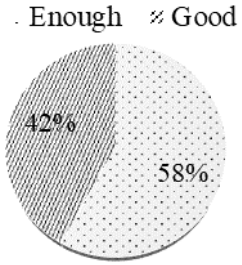

Figure 7 The criteria of ICT skills of each student

The researchers assessed the students' ICT skills by doing direct observation and evaluating the activeness of online classes. The results of the assessment of the ICT skills observation sheets on the 26 students after using an interactive e-module based on HGI learning was 96% that was included in the "good" category. The average percentage of the total optimization of ICT Skills of the 26 students in Grade 10 of MIPA F1 before and after the presentation of interactive e-modules was 24%. The activeness of students in learning activity was due to the use of learning media that utilize computer information technology, which was oriented towards achieving goals in preparing students to learn independently (Nursamsu & Kusnafizal, 2017).

Implementing learning activity using an interactive e-module based on HGI learning, students could discuss the lessons with their friends or do the assignments in online classes that were created by the teacher. The improvement of ICT skills and N-gain of students can be seen in Figure 11.

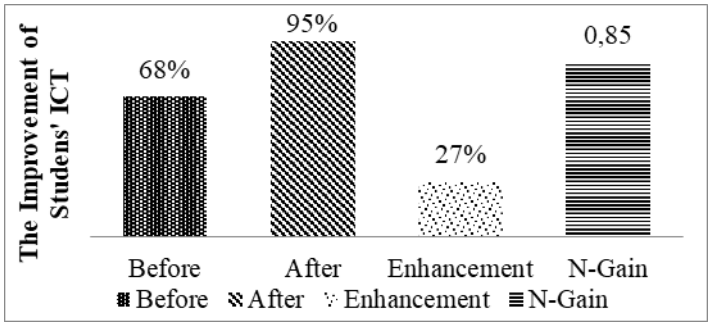

Figure 8 The average of the improvement of students' ICT skills and N-gain

The average of the total score of students' ICT skills before the presentation of interactive e-modules was 68%, which stood in the "good" category. The assessment was conducted during the hybrid learning process. The average of the total score of students' ICT skills after the presentation of the interactive e-module was 95% that is in the "good" category. It can be inferred that there was optimization of students' ICT skills after the interactive e-module was presented. The average score of N-gain in optimizing students' ICT skills was 0.85, which was included in the high category.

The average results of the assessment of students' ICT skills on each indicator that were assessed before and after the presentation of interactive e-modules can be seen in Figure 12. Claro et al. (2012) mentioned that one of the characteristics of the ICT skills was that the mastery of ICT applications (i.e. ICT skills in term of its function). It was a condition for completing cognitive tasks in a digital environment. Without any skills to use ICT applications, the students could not complete the cognitive tasks in a digital environment.

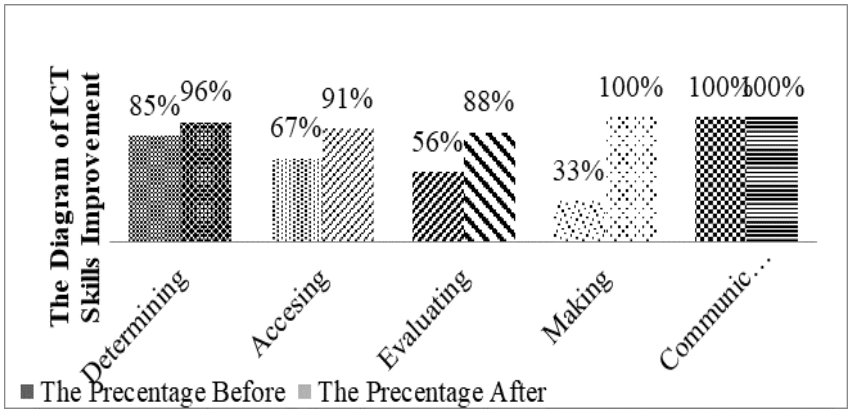

Figure 9 The diagram of ICT skills improvement before and after the presentation of interactive e-module

The Optimization Data of Student Achievements

The researchers provided pretest and posttest to the students to find out the optimization of students' learning achievement on regular circular motion material using the interactive e-modules based on H-GI learning. The N-Gain score to optimize the achievement of the 26 students as subjects of the small-scaled trial was obtained of 0.61 that included in the "Medium" category. Hence it can be concluded that the development of the interactive e-

modules based on H-GI learning was effective for optimizing the student achievement in the subject of regular circular motion. The learning achievements that were achieved by the students were influenced by the effective use of learning media (Ningtyas, Yulianti, & Suyanto, 2013). The average of the improvement of students achievements based on optimization analysis by referring to the N-gain in the pretest and posttest assessments of each indicator of cognitive aspects that existed in the questions can be seen in Figure 13.

Regarding the 4 achievement indicators that are being used, there was a very high optimization in the C4 aspect. This showed that the ability of students to analyze the given questions was very good. According to Gulo, the inquiry learning model involved the students in finding and investigating systematically, critically, logically and analytically, so that the students can analyze, formulate and make their own conclusions (Kusdiastuti, Harjono, Sahidu, & Gunawan, 2018).

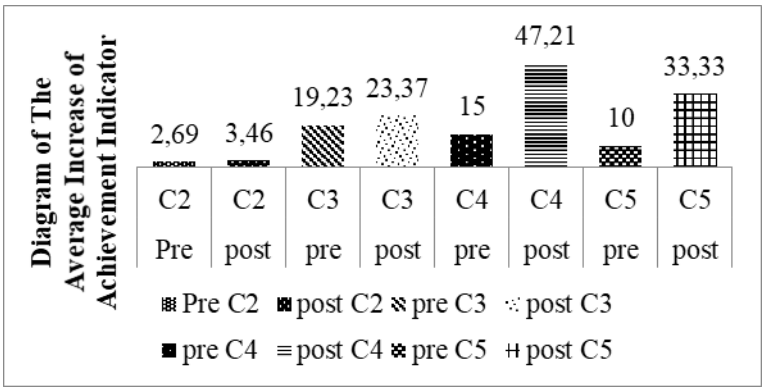

Figure 10 Diagram of the average increase of each achievement indicator based on N-gain scores

On C5 achievement indicator that was finding and evaluating, optimization has also occurred. In the steps of H-GI learning, the students learned to find out the concepts of the lessons being taught. This trained them always to think and explore the knowledge to obtain the solutions for the existing problems.

Several internal and external factors caused the improvement in student learning achievement. This was in line with the study of Sumarni (2017), which revealed that the students would gain good knowledge if they acted as active participants in ongoing learning activities. Also, the learning model and media that were used also affect the students' learning achievement.

The skill of science and the learning achievement of students could be improved by using the guided inquiry learning model because it emphasized a learning process with science process skills (Sumarni, 2017). The use of interactive e-modules based on HGI learning also influenced the students' learning achievement. The application of the guided inquiry model by using an interactive e-module could deepen students' interest in discussion activities to discover something related to the problem (Budiarti, Nuswowati, & Cahyono, 2016).

Evaluation

The evaluation stage aimed to assess the quality of the product being

developed and the learning process while using the H-GI based interactive e-module. The suggestions from the physics teachers as users of the interactive e-modules became one of the evaluation materials that were used by the researchers in the development of the interactive e-modules. The accuracy in writing the interactive e-modules needed to be considered as long as it does not cause errors.

The steps that were provided in the interactive e-module could be used as guidelines for the user of interactive e-modules. The use of interesting interactive e-modules in the form of electronic media could help the students to discover new concepts or knowledge independently. This proved that guided inquiry learning was effective to optimize the students' achievements (Budiarti, Nuswowati, & Cahyono, 2016).

CONCLUSION

According to the results of the research and development that has been implemented, it can be concluded that the interactive e-module based on HGI learning on the subject of regular circular motion had been successfully developed. So that learning using interactive e-modules is classified as effective for optimizing ICT skills and student achievement in developing skills in 21st-century learning seen from the increase in student mastery achievement. Further research for the development of interactive e-modules is still needed. Especially in terms of animation and evaluation displays to make it easier for students to learn, especially on other physics concepts, so that interactive e-module teaching materials are increasingly developing. As discussions, hat interactive e-modules can not be used for all computer specifications. So that future needs to be developed further so that the e-modules developed can be used for all computers.

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