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Increasing Learning Motivation Through the Application of Physics E-Module Based on Flipped Learning

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Abstract: Face-to-face learning is being enforceable limitedly. To improve the quality of time in class, teachers can apply the flipped learning method. Flipped learning combines face-to-face in class with online learning. Physics e-module are acceptable as independent teaching material for students before participating in learning activities in class. The learning process in class gets used for discussion and practicum. This research implementation to know the application of physics e-modules based on flipped learning to increase students' learning motivation. This type of research is a pre-experimental type one-group pretest-posttest design. The samples were 16 students in class X Mathematics and Natural Sciences at Public Senior High School Wolowae. The data collection instruments used were questionnaire validation sheets and student learning motivation questionnaires. Based on data analysis, Asymp.Sig. (2-tailed) obtained is 0.00 < 0.05. Thus, there are differences in students' learning motivation before and after of physics e-module based on flipped learning. The increase of students' learning motivation with the acquisition N-Gain value was 0.64. This increase includes the medium category. The application of a physics e-module based on flipped learning in physics learning, especially the material of quantities and measurements, can increase the learning motivation of high school students in class X.

Keywords: Flipped learning; Physics e-module; Learning motivation

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Introduction

Physics is an essential subject for all students (Atwa, Din, & Hussin, 2016). Physics studies various natural phenomena, and all the interactions that go into them cannot be part of everyday life (Prasetyo, Suprapto, & Pudyastomo, 2018). Physics is not only a collection of knowledge in the form of principles, concepts, and facts but also a process of finding things (Dewi & Primayana, 2019). Quantities and measurements are of the physics materials whose implementations are often found in everyday life (Kuswandari, Sunarno, & Supurwoko, 2013).

Students still have difficulty understanding the material of magnitude and measurement (Sinambela, Djudin, & Oktavianty, 2012). The provision of material for quantities and measurements is still not using the teaching aids (Widodo, Sukiswo, & Putra, 2011). While on the measurement material, students are strongly encouraged to carry out experiments on measuring instruments (Husain & Mursalin, 2018). Practicum is implementation so that students gain direct experience in making discoveries based on existing concepts and facts (Dari, Purwaningsih, & Darmaji, 2019). The material for quantities and units still uses printed teaching materials which causes the low interest of students (Indhaka, Supraptono, & Sugiarti, 2016). Thus, learning will be less effective.

Knowledge of quantities and measurements is a prerequisite before students enter experimental-based physics classes (Herwinarso, Untung, Wirjawan, & Pratidhina, 2020). The ability to define and profess the

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relationship of physical quantities precisely and measure them accurately is a requirement in physics (Nasution, 2019). The physics learning process prioritizes direct learning experiences for students (Putra & Sujarwanto, 2016). Thus, appropriate and attractive methods and learning media need in learning physics. Interactive learning helps students not have difficulty understanding the physics material in that study.

Face-to-face learning in schools is carried out on a limited basis while still implementing health protocols. Limited face-to-face learning activities are enforceable with parental permission. The number of hours of study in schools is finite according to the provisions of each school. Currently, several regions have implemented limited face-to-face learning. One of the high schools that authorized finite face-to-face learning is Public Senior High School Wolowae.

Before enforced limited face-to-face learning physics, learning at Public Senior High School Wolowae was done online. The results of the physics teacher interview stated that the physics learning media used during online learning was Google Classroom. The lack of procurement of technological innovation training in education has caused teachers to prepare improvised learned. The teacher summarizes physics material from physics textbooks, then uploads it for students to read. In addition, the teacher sends assignments for students to do independently.

Communication that exists between teachers and students is only through Google Classroom. WhatsApp groups are only for students with homeroom teachers. Obstacles encountered during online learning, such as network problems and internet quotas, cause physics learning to be hampered. Not all base competencies (KD) are teachable because the teacher waits for students to collect assignments from the previous material. Some students stated that they did not submit tasks because they did not understand the physics material assigned.

Based on the outcomes of student interviews, some student questions have been unanswered during the implementation of online learning. There are no learning support media such as learning videos, e-modules, or interactive e-books during online learning. That leads students to have difficulty understanding the physics material that's learned. Students mention that material would be better understood if the teacher explained it directly. The process of learning physics online becomes less fun.

With the implementation of limited face-to-face learning, expected that students will assist in understanding physics material. In addition, all learners' questions are answerable. Teachers get challenged to keep creating an active learning environment for students under current conditions. Utilizations of interactive learning methods and media can help teachers create active learning for students.

The learning method that can use by the teacher namely flipped learning. Flipped learning is one of the solutions that teachers can use during limited face-to-face learning. Flipped learning combines teaching and learning activities in the classroom with online learning (Karim & Saptono, 2020). Class time using for discussion, input, and problem-solving (Al-zahrani, 2015; González-Gómez, Jeong, Rodríguez, & Cañada-Cañada, 2016; Hwang, Lai, & Wang, 2015). Problem solved found by students when studying at home (Nyeneng, Suana, & Maulina, 2018; Winter, 2018).

Learning outside the classroom is carried out online. The teacher sends learning content online before class learning takes place. Learning content that students use for independent study at home can be in the form of learning videos (Astuti, Bhakti, Sumarni, Sulisworo, & Toifur, 2019; Bawaneh & Hamida Moumene, 2020; Hastuti, 2020; Nyeneng et al., 2018). In addition to learning videos, teachers can prepare e-modules (Anindhyta, 2020). With online learning content, students hopefully have sufficient knowledge to carry out activities in the classroom.

E-modules include digital teaching materials that allow students to learn with or without a teacher (Misbah, Khairunnisa, Amrita, Dewantara, Mahtari, Syahidi, Muhammad, Prahani, & Deta, 2021). E-modules were created to facilitate students to learn, which are attractive and available for use anywhere and anytime (Perdana, Sarwanto, Sukarmin, & Sujadi, 2017; Puspitasari, 2019; Susilawati, Pramusinta, & Saptaningrum, 2020). E-modules as individual learning media that support students can actively learn independently (Nabayra, 2020). E-modules equipped with pictures, videos, and animations make it easier for students to understand the material learning (Fadieny & Fauzi, 2019).

The utilizations of e-modules increase students' learning motivation (Perdana et al., 2017; Puspitasari, 2019; Saprudin, Haerullah, & Hamid, 2021; Zaharah & Susilowati, 2020). Learning motivation is one of the essential aspects that are must-have by students to achieve optimal competence (Hastuti, 2020). Learning motivation is the willingness and need of students to participate actives so that they are successful in the learning process (Astuti et al., 2019). Students who already have the motivation to learn can encourage themselves to find solutions to the learning problems they face (Mursyidah, Hermoyo, & Suwaibah, 2021).

Based on the outcomes of teacher interviews, physics learning is carried out only by giving summaries and independent assignments. It causes low motivation of students to learn. During the implementation of online learning, students only learn physics when completing a task given by the teacher. Routine tasks

that are done by students independently cause boredom (Perdana et al., 2017). This approach makes students less active during teaching and learning activities, thereby reducing students' motivation to learn (Bawaneh & Hamida Moumene, 2020). Less learning motivation of students can occur because of the use of media that is less attractive to learning (Zaharah & Susilowati, 2020).

This research will use flipped learning-based physics e-module as a medium in physics learning. The physics e-module adopt as independent teaching material for students before participating in learning activities in class. The quality of time in class will increase as long as the implementation of face-to-face learning is limited. Physics learning with physics e-module based on flipped learning will apply to the material of magnitude and measurement. The use of a physics e-module based on flipped learning hopefully increases the learning motivation of class X high school students.

Method

The type of research is a pre-experimental type one-group pretest-posttest design. This study only took one class as an experimental class without a control class. The research procedure follows the stages of giving a learning motivation questionnaire before using the flipped learning-based physics e-module. Then, the implementation of flipped learning-based physics e-module in learning as a treatment. Physics learning ends with the provision of a learning motivation questionnaire after using the physics e-module**.**

The research implementation in the odd semester of the 2021/2022 academic year at Public Senior High School Wolowae. The population used for the research is 80 students of class X. Sampling using the random sampling technique. The sample criteria are students who take physics lessons and include in the class X Mathematics and Natural Sciences. The number of class X Mathematics and Natural Sciences at Public Senior High School Wolowae is only one class. Class X Mathematics and Natural Sciences consist of 20 students. However, in the implementation, only 16 students participated in all stages of the research. Thus, the number of samples for this study was 16 students of class X Mathematics and Natural Sciences and a physics teacher at Public Senior High School Wolowae.

The three stages in this research are planning, implementation, and final. The planning stage includes the preparation of flipped learning-based physics e-modules, student learning motivation questionnaires, Learning Implementation Plans (RPP), and Student Worksheets (LKPD). Each prepared plan will be performed at the implementation stage. Students fill out the initial questionnaire, carry out learning with flipped learning-based physics e-modules, and fill out the final questionnaire. During the physics learning process, students complete two worksheets. One LKPD is done independently at home, and one LKPD implementation in groups in class. The final stage is data analysis and article writing for publication.

The data collection instrument was a student learning motivation questionnaire (Likert scale) and a validation sheet. Questionnaires use as measuring tools for students' learning motivation before and after given treatment. Aspects of learning motivation measured in the questionnaire are diligence in doing assignments, tenacious in facing difficulties, quickly bored with routine tasks, can defend their opinions, enjoy working independently, and enjoy finding and solving problems. The student learning motivation questionnaire uses a Likert four scale, namely (4) Strongly Agree, (3) Agree, (2) Disagree, and (1) Strongly Disagree.

The students' learning motivation questionnaire validate before being implemented to students. The validation result of the learning motivation questionnaire will be analyzed using the V Aiken index. If the V Aiken index is less or equal to 0.40, the validity is relative to less. If the V Aiken index is between 0.40 - 0.80, the validity is relative to moderate. If the V Aiken index is greater than 0.80, the validity is relative to very valid. Then, learning motivation questionnaire result data were tested for normality using the Shapiro-Wilk test. Data can be declared normally distributed if Asymp.Sig. (2-tailed) > 0.05 (Kurnianto, Wiyanto, & Haryani, 2019).

After testing the hypothesis, it resumed with the Wilcoxon signed-rank test. The Wilcoxon signed-rank test was applied to see the differences in students' learning motivation before and after deploying the physics e-module based on flipped learning. If Asymp.Sig. (2-tailed) < 0.05, then there is a difference between students' learning motivation before and after deploying the physics e-module based on flipped learning (Adawiyah, Susilawati, & Anwar, 2020). Then the increase in learning motivation will be analyzed using the N-Gain value. The category of increasing learning motivation is in Table 1.

Table 1: Gain Value Clasification

N-Gain Value	Category
(<g>) > 0.70	High
0.70 > (<g>) > 0.30	Medium
(<g>) < 0.30	Low

Result and Discussion

The teaching and learning process for physics at Public Senior High School Wolowae is enforceable by the provisions of limited face-to-face learning. In the face of limited time for teaching and learning activities in schools, physics learning is enforceable using physic e-

modules based on flipped learning. The physics e-module uses as support in flipped learning. The physics e-module comes with sample questions, learning videos, and evaluation questions that support quantity and measurement materials. Learning videos are videos explaining the matter directly by the teacher.

The teacher first creates a WhatsApp group with students. Then, the physics e-module got sent to students via WhatsApp Groups. The physics e-modules based on flipped learning are delivered before physics learning is enforceable in schools. Students hopefully have sufficient knowledge of e-modules before participating in classroom activities. Classroom learning gets used for discussion and practicum. The teacher only acts as a facilitator (Astuti et al., 2019; Hwang et al., 2015; Nabayra, 2020; Prasetyo et al., 2018). Thus, the quality of time in class gets improved.

In-class discussions linked the problems in the concept of quantity and measurement were found by students during independent study at home. Apart from discussing, students also carry out practicum. The practicum carried out is related to measuring physical quantities and measurement uncertainty. The concept of quantity and measurement is well-delivered with the implementation of the labs. Learning will be more meaningful with practicum (Anindhyta, 2020). By conducting direct experiments, students will better understand the material of quantities and measurements.

If students already have the motivation to learn, the learning process will be successful (Yulianingsih, Gofur, & Amin, 2017). Learning motivation plays a crucial role in student achievement (Susilawati et al., 2020). Students who already own the motivation to learn will participate actively during the teaching and learning process (Nugroho, Raharjo, & Wahyuningsih, 2013). Applying a physics e-modules based on flipped learning in the learning process on the material of magnitude and measurement hopefully increases students' learning motivation.

The questionnaire will be an advantage as a measuring tool for students' learning motivation. The learning motivation questionnaire before and after applying the physics e-module consists of 30 statements divided into six aspects. Six aspects of learning motivation imposed in this study are diligence in doing assignments, tenacious in facing difficulties, quickly bored with routine tasks, ability to defend their opinions, enjoy working independently, and enjoy finding and solving problems. The student learning motivation questionnaire gets validated before being implemented to students.

The learning motivation questionnaire gets validated by five validators. The results validation of the learning motivation questionnaire was analyzed using the V Aiken index, which appears in Table 2.

Table 2. Validation Results of Learning Motivation Questionnaire

Validator	V Aiken
1	1.00
2	0.99
3	1.00
4	1.00
5	1.00

Based on Table 2, the average V Aiken index is 1.00. Thus, the validation result of the learning motivation questionnaire includes a very valid category. Then, the learning motivation questionnaire was revised based on the input and suggestions given by the validator. The results of the revised questionnaire apply to students.

The data on the results of the learning motivation questionnaire came from 16 research samples. Data from the learning motivation questionnaire tested for normality well before or after applying the physics e-module based on flipped learning in physics learning. The normality test used is the Shapiro-Wilk test. The results of the analysis of the normality test of students' learning motivation questionnaire data appear in Table 3.

Table 3. The Normality Test Result Data of Learning Motivation Questionnaire

Learning Motivation	df	Asymp.Sig. (2-tailed)
Before	16.00	0.76
After	16.00	0.48

Based on Table 3, the data questionnaire on learning motivation before using the physics e-module was distributed normally with Asymp.Sig. (2-tailed) 0.76 > 0.05. Data questionnaire on students' learning motivation after using the physics e-module was distributed normally with Asymp.Sig. (2-tailed) 0.48 > 0.05. Questionnaire data came from limited subjects, so further hypothesis testing is enforceable with the Wilcoxon signed-rank test.

The Wilcoxon signed-rank test is enforceable to know whether there were differences in students' learning motivation before and after deploying physics e-modules based on flipped learning in learning. The analysis result using the Wilcoxon signed-rank test appears in Table 4.

Table 4: The Wilcoxon Signed-Rank Test Result

Learning Motivation	Mean	Minimum	Maximum	Asymp.Sig. (2-tailed)
Before	60.69	54	67	0.00
After	99.00	81	117	

Based on Table 4, the average student learning motivation before implementation of the physics e-module is 60.69, while the average learning motivation

after application of the physics e-module is 99.00. Based on the average gain, students' learning motivation increased after using the physics e-module.

The minimum and maximum values of students' learning motivation before applying the physics e-module are 54 and 67. The minimum and maximum values of learning motivation after using the physics e-module are 81 and 117. The difference in students' learning motivation viewed from the Z value is -3.52 and Asymp.Sig. (2-tailed) is 0.00 > 0.05. Thus, there is an effect of learning physics using flipped learning-based physics e-modules on students' learning motivation.

The increase in learning motivation was analyzed using the N-Gain value (<g>). The obtained value of N-Gain (<g>) is 0.64. The increase in students' learning motivation after enactment of the physics e-module in teaching and learning activities includes the medium category. Thus, applying physics e-modules based on flipped learning in physics learning, especially the material of magnitude and measurement, increases students' learning motivation. It is cheered by research that states that the implementation of e-modules can improve students' learning motivation (Perdana et al., 2017; Puspitasari, 2019; Saprudin et al., 2021; Zaharah & Susilowati, 2020). In addition, learning using flipped learning can increase students' learning motivation (Astuti et al., 2019; Bawaneh & Hamida Moumene, 2020; Hastuti, 2020).

The increase in students' learning motivation can be peer-reviewed by the upgrade in each aspect of learning motivation. The enhancing category in each facet of learning motivation appears in Table 5.

Tabel 5. The Improvement of Each Aspect of Students' Learning Motivation

Aspect of Learning Motivation	N-Gain	Category
diligence in doing assignments	0.67	Medium
tenacious in facing difficulties	0.66	Medium
quickly bored with routine tasks	0.70	Medium
ability to defend their opinions	0.66	Medium
enjoy working independently	0.62	Medium
enjoy finding and solving problems	0.56	Medium

Based on Table 5, the aspect of getting bored quickly on routine tasks has the most increase with the acquisition of an N-Gain (<g>) 0.70. Meanwhile, the lowest increase in the value of N-Gain (<g>) is in the aspect of being happy to find and solve problems, which is 0.56. This finding is under the discovery (Agnezi, Dini, Anggrain, & Maya, 2017; Susana, Afidah, Wahyuni, & Sembiring, 2021) that the average percentage of the facet of enjoying finding and solving problems is the lowest of all aspects used.

The improvement in the faceted of being diligent in doing assignments after learning physics with e-modules is 0.67. As the result of questionnaires, as long as physics learning with e-modules based on flipped learning, students always work hard on assignments. The assignments got by the teacher were always solved on time (Agnezi et al., 2017). Students will immediately work on physics assignments when given by the teacher. For example, students directly collect the task of taking measurements with various kinds of measuring instruments that are encountered every day during class learning. In addition, students feel challenged by the assignment the teacher gives.

The increase in the tenacity aspect of facing difficulties after learning physics with e-modules is 0.66. Learning physics with e-modules based on flipped learning supports students to learn independently. During the processing of learning physics, students create a summary of the material so that it is easy to study. When finding learning difficulties, students try to find solutions independently first. If they do not find an answer, students ask the teacher directly when learning physics at school takes place (Arimbawa, Santyasa, & Rapi, 2017; Sitompul, Astalini, & Alrizal, 2019).

For example, students will take the initiative to ask the teacher directly regarding the material or physics questions in the e-module that are poorly understood when studying independently at home. During independent learning, students continue to struggle to overcome the problems they face (Raiman, Liu, & Wolo, 2021). The questions given in the e-module are done by students actively. Students continue to practice working on difficult physics questions until they find answers. Students feel satisfied when they can work on physics questions to get good grades. Everything students do is a form of effort in overcoming the difficulties experienced.

The increase in the facets of getting bored quickly on routine tasks after learning physics with e-modules is 0.70. In this aspect, students get the top improvement. Learning physics at home or school with flipped learning-based physics e-modules does not make students bored. Sample questions, learning videos, and evaluation questions in the physics e-module support students happy to learn physics. Learning physics in class in the form of practicum and discussion does not cause boredom to students. The assignments were given by the teacher also vary. It supports students to feel happy to do it. When the teacher provides repetitive tasks, it will cause students to be bored and less effective in learning (Susana et al., 2021). The application of physics e-modules and various assignments in physics learning attracts students' attention. Thus, students are encouraged to learn physics.

Improved aspects can maintain their opinion after learning physics with e-modules of 0.66. When the duty is assigned, students believe their answers even though its different from other students. When the discussion is enforceable, students always provide opinions. Students dare to express opinions even though they are different

from other students. Students can respond to varied arguments and defend arguments during discussions. Because students already know the basics and feel right about the opinions given (Sumargiyani, 2018). For example, when discussing the measurement of physical quantities, students dare to express their arguments in front of the class. Students will defend their opinion when there are different opinions from other groups. However, students will accept other gets and want to be corrected if there are errors in the results of group discussions.

The increase in the pleasure of working independently after learning physics with e-modules is 0.62. Assignment from the teacher done by self-power. Students do not cheat on tasks done by other students. Tasks get completed outside of learning hours (Pratiwi, Suma, & Gunadi, 2017). When learning in class takes place, students immediately collect the work they have done. Students believe in the ability to do assignments independently. Then, use your abilities to complete the given physics tasks. Students also always take the time to solve physics problems.

The increase in the pleasure of finding and solving problems after the physics learning process with the e-module is 0.56. This aspect increase has the lowest gain among other aspects of learning motivation. Some students are still yet able to work on challenging questions and complain because of difficult questions (Ilyas & Liu, 2020). For example, students have difficulty working on problems measuring physical quantities, which should include measurement uncertainty by the rules of significant figures. However, when given assignments, students try to find other appropriate references. Some students felt challenged to solve physics problems that were considered difficult by other students. In addition, students also create their physics questions for practice. When having difficulty learning physics, students form study groups with other students. The formation of study groups was an effort to overcome the hardships encountered.

Overall, each aspect of students' learning motivation used in this study increased after using the physics e-module based on flipped learning on the material of magnitude and measurement. Thus, physics learning on the material of quantities and measurements can apply flipped learning-based physics e-modules to increase the learning motivation of class X students.

Conclusion

Students' learning motivation on the material of magnitude and measurement increased after using the physics e-module based on flipped learning in physics learning. Based on the results of the analysis, Asymp.Sig. (2-tailed) obtained 0.00 > 0.05. Students' learning motivation increases with the acquisition of an N-Gain value of 0.64. This increase is in the moderate category. Each aspect of learning motivation applied in this study increased after using the physics e-module based on flipped learning. The research conducted is limited to only one physics material. So, hopefully, further researchers can apply flipped learning-based physics e-modules to other physics materials.

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