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Inquiry Learning Using Flipped Classroom Approach to Improve Students Self Efficacy in Dynamic Fluid Material

[1]Julia Edwina Hasbi, [2]Didi Teguh Chandra, [3]Winny Liliawati

[1,2,3,]Department of Physics Education, Universitas Pendidikan Indonesia

**Correspondence Author: juliaedwinahasbi@upi.edu*

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ABSTRACT

This study aims to obtain an overview of increasing students' self-efficacy after applying inquiry learning with the flipped classroom approach on dynamic fluid material. The research method used in this research is the mix method. Data analysis techniques are presented in a quantitative descriptive form. The research subjects were students of class XI in one of the public high schools in Kampar Regency, Riau Province with a sampling technique based on certain considerations (purposive sampling). The sample in this study was one class of XI IPA students, totaling 25 students with an average age of 17 years. The research data was obtained through a self-efficacy questionnaire with 28 statements according to the self-efficacy component. The findings of the maximum, minimum and average values of the level of student self-confidence which then after being matched with the table of self-efficacy criteria shows the average level of student self-confidence from moderate (59.4%) to high (68.88%) with the highest average on the generality component. The results showed that inquiry learning with a flipped classroom approach on dynamic fluid materials could increase students' self-efficacy after learning activities with a major effect (d = 1.92) and received positive responses from students in the excelent category.

Keywords: *inquiry, flipped classroom, self efficacy*

INTRODUCTION

Physics has been considered as one of the pillars for the development of science and technology which is always taught in schools from elementary to tertiary level. In simple terms, physics can be defined as a branch of science that studies matter and energy and all interactions between the two through a series of processes known as the scientific method. Therefore, physics can be viewed as the essence of natural science or science (Annam et al., 2020). Basically, physics can be divided into 3, namely physics as a product (a body knowledge), physics as an attitude (a way of thinking), and physics as a process (a way of investigating) (Amin & Sulistiyono, 2021).

In the context of studying physics, apart from understanding concepts, students' self-efficacy also plays an important role in learning physics. In accordance with the implementation of the 2013 curriculum, learning science or physics is directed so that students get real experience which emphasizes that the learning process in educational units is held interactively, inspiring, fun, challenging and motivating students to participate actively. In addition, students are also strived to get enough space for initiative, creativity and independence according to their talents, interests and physical and psychological development. This is stated in Permendikbud No. 22 of 2016 concerning Basic Education Process Standards. Therefore based on the 2013 curriculum, it

can be concluded that the purpose of learning physics is to master the concepts and principles of physics and have the skills to develop knowledge and self-confidence (Kemendikbud, 2014). Based on these objectives, learning physics must be designed so that students have mastery of concepts and skills to develop knowledge and have self-confidence or self-efficacy. Apart from being used to make learning meaningful, mastery of concepts is also one of the most important research issues, in terms of evaluating teaching (Chang et al., 2011).

Based on the results of an interview with a physics teacher and direct observation conducted at a public high school in Kampar Regency, Riau Province regarding the conditions of the Natural Sciences learning process, especially physics, it can be concluded that conditions have occurred that are not ideal. It is found that it is not the students who are the main actors in learning activities but the teachers who are more likely to be activeazizag. This is evidenced by the results of the survey which stated that 88% of students said that physics learning often used the lecture method and 32% of students had difficulty understanding physics concepts (Azizah, Yuliati & Latifah, 2015). Especially during the Covid-19 pandemic, which almost lasted for two years of study, it was found that the learning process was only carried out through Google classroom and WA groups only. Furthermore, the learning process only took place by providing power point material and books in pdf format without any further explanation and students were immediately given practice questions. Therefore, the learning process is dominated by the presentation of knowledge and has not given students the opportunity to think through investigative activities (Ramayanti et al., 2017). This reality shows that in every learning process, most teachers still pay little attention to student involvement. This makes students lose enthusiasm in participating in the learning process and loses students' confidence in being able to master physics lessons. To be concluded, this process produces very low self-confidence (self-efficacy) of students.

To overcome this problem, reduced enthusiasm and loss of student confidence in studying physics, the first important thing to do is to choose the right learning approach. One appropriate learning approach that can be used to increase students' self-efficacy is the flipped classroom learning approach (Ahmed & Asiksoy, 2021; Namaziandost & Çakmak, 2020; Yanah et al., 2018). Flipped classroom or reverse classroom learning was first introduced by Raja Alison in 1993 (Hamid & Effendi, 2019). The research method is considered as an ideal type of learning that deserves to be developed to increase students' self-efficacy. In terms of implementation, apart from going online, the implementation of flipped classrooms can be done face-to-face or blended. In order to optimize the application of the flipped classroom model, Marlowe (2012) suggests to combine the flipped classroom with an appropriate learning model. One learning model that can be combined with the flipped classroom in order to increase student self-efficacy is the inquiry learning model. This argument is supported by studies conducted by Susilawati et al. (2019) and Rafiqah & Dani (2021). Through these conducted studies, it can be concluded that the inquiry learning model is appropriate to be combined with the flipped classroom model.

The inquiry learning model is a learning model that requires student involvement in finding answers to the problems they face themselves. This combined method, inquiry-based flipped classroom model, is considered one of the most effective methods that can be used in the learning process (Loizou & Lee, 2020). Lestari et al (2020) in their research stated that the inquiry learning method with the flipped classroom approach can produce high creative thinking skills. In addition, through their research, Paristiowati et al (2017) showed that student achievement by applying a combination of inquiry and flipped classroom methods was better than just using the guided inquiry method. In addition, there are many other studies which reveal a positive relationship between self-efficacy and learning outcomes using the inquiry model combined with the flipped classroom approach (Hidayati et al., 2018; Olakanmi, 2017; Roshandel et al., 2018; Arslan, 2017; Zuya et al., 2016; Farrand, 2016).

Based on the explanation above, inquiry learning and flipped classrooms are proven to have a positive influence on student learning outcomes in various dimensions of knowledge and skills. Therefore, this research is focused on the application of inquiry learning with a flipped classroom approach to increase students' self-efficacy in learning physics. As a case study, this research will apply a combination of those two learning methods to dynamic fluid material for high school students in class XI at one of the public high schools in Riau Province.

METHODOLOGY

In order to achieve the research objectives, the research method used in this study is a mixed method. Mixed research is a research approach that combines qualitative research with quantitative research (Creswell, 2014). This research uses a sequential mixed methods strategy, especially a sequential exploratory strategy where this research is characterized by data collection and qualitative data analysis in the first stage by conducting interviews with teachers to describe phenomena that occur in the field. The first stage of this research is complemented by carrying out a literature study on previous findings that are relevant to the problem to be solved. Then the results of the collection and analysis data from the first stage will be used as input in the next stage, namely the quantitative research stage. The second stage uses quantitative data to collect and analyze the data, in order to strengthen the results of the qualitative research in the first stage using the pre-test-post-test control group design as the research design. Furthermore, this study involved 1 class, using a pretest to determine students' initial abilities. After this, a posttest was carried out after students applied inquiry learning with a flipped classroom approach.

To find out students' self-efficacy, a questionnaire was used with 30 positive and negative statements. Prior to fill out the questionnaire, the questions were validated by experts, namely post-graduate lecturers and one high school physics teacher. Based on this question validation process, 28 self-efficacy questionnaire statements were obtained which were declared valid and ready to be used with the aim of collecting qualitative data in the third stage. As for the results of the third stage, the results of filling out the questionnaire were obtained and the results of interviews conducted with 8 students consisting of 4 male students and 4 female students. Based on the results of the questionnaire and interview answers, students were then categorized into two groups namely active students (having a high level of self-efficacy) and students who were not active (not having a level of self-efficacy). This is intended to strengthen the research hypothesis whether the results obtained are in accordance with the learning process experienced by students themselves.

The research participants were 25 students of class XI. In more detail, the 25 students used as samples in this study consisted of 7 male students and 18 female students with an average age of 17 years. In terms of sampling technique, the technique used is purposive sampling based on certain considerations. To calculate the level of self-efficacy, after completing the self-efficacy questionnaire by the students, the researchers analyzed the level of self-efficacy for each student by adding up all the scores from the questionnaire answers. Then do the calculation of the percentage. In this study, the interpretation of self-efficacy (SE) is presented in 5 categories of criteria as presented in Table 1 below:

Table 1. Self Efficacy Descriptive Analysis Criteria

Interval	Criteria
81% - 100%	very high
61% ≤ SE < 81%	high
41% ≤ SE < 61%	moderate
21% ≤ SE < 41%	low
SE < 21%	very low

The analysis of the level of self-efficacy in this study is presented in a quantitative descriptive narrative, which is a method that tries to analyze and provide a detailed picture based on the reality on the ground. Then the results will be presented in the form of a table equipped with a description and a Likert scale. The table presents an overview of the data in the form of the percentage of self-efficacy test results both for each dimension of self-efficacy and as a whole. Then an analysis of the data was carried out one by one from each student who was used as the object of research. As the final result, then an assessment is carried out by categorizing it into 5 existing categories according to the criteria above.

To find out the increase in student self-efficacy, it was done by comparing the initial and final questionnaires and then analyzed using the Paired-Sample-t-Test and the effect test with effect size. The process of calculating the effect size is intended to determine the magnitude of the influence of the application of flipped classroom inquiry learning on student self-efficacy. The calculated effect size value is obtained from the difference in the mean and standard deviation of the initial and final questionnaires. The following equation is used to determine the effect size:

$$d = \frac{(M_{Post} - M_{Pre})}{SD_{Pooled}} \quad \text{(1)}$$

$$SD_{pooled} = \sqrt{\frac{(n_{post}-1)S_{post}^2 + (n_{pre}-1)S_{pre}^2}{n_{post}+n_{pre}^{-2}}} \quad \text{(2)}$$

Description:

d : *Effect size*

M_{post} : Final questionnaire means

M_{pre} : Initial questionnaire means

SD_{pooled} : Standard Deviation

S_{post} : Final questionare Standard Deviation

S_{pre} : Initial questionare Standard Deviation

n_{post} : Number of students for final questionnaire

n_{pre} : Number of students for initial questionnaire

The coefficient value of the influence size is interpreted with Cohen's criteria (Cohen, J., 1969) as presented in table 2 below.

Table 2. Interpretation of Influence Measures

Effect size **(d)**	**Description**
d < 0,1	No effect
0,1 < d , 0,4	Minor Effect
0,4 ≤ d < 0,8	Moderate Effect
d > 0,8	Major Effect

The results of the percentage of implementation of the learning, then interpreted by using Table 3 as shown below:

Table 3. Learning Implementation Criteria

Execution intervals	Classification
0 %	None of the activities carried out
1 % - 25 %	A small portion of the activity was carried out
26 % - 49 %	Nearly half of the activities were carried out
50 %	Half the activity were carried out
51 % - 78 %	Most of the activities were carried out
79 % - 99 %	Almost all activities were carried out
100 %	All activities were carried out

Student responses to the learning process and the skills taught were measured using a questionnaire given at each meeting after the learning activity. Then an analysis of the response was carried out using a descriptive analysis of the overall student responses to the statements given. The criteria used in the questionnaire is a Likert scale with five choices, namely strongly agree, agree, undecided, disagree and strongly disagree. Once all the answer items are scored, the next step is to calculate the percentage score. Furthermore, the percentage of scores obtained is compared to the score interpretation criteria as presented in Table 4.

Table 4. Criteria for Responses to Learning

Answer Percentage	Classification
$80\% \leq x < 100\%$	Excellent
$60\% \leq x < 80\%$	Good
$40\% \leq x < 60\%$	Moderate
$20\% \leq x < 40\%$	Less
$< 20\%$	Bad

As for the last stage, interviews were conducted which aimed to find out student responses to inquiry learning with a flipped classroom approach in the learning process. The interviews were conducted by 8 student representatives. The data generated from the interview process is qualitative data as outlined in the form of an interview transcript. The data contains dialogues between students and teachers as interviewers. So that the processing of the data from the interviews was carried out through descriptive analysis.

RESULT AND DISCUSSION

In the first stage of data collection and qualitative analysis, observations and interviews with the physics teacher were carried out. Based on the results of observations, it was found that students were less active and this was evidenced by the results of interviews with teachers who said students were less enthusiastic about learning and had unsatisfactory self-efficacy. Based on the results of the initial questionnaire average score, it was found that the student's self-efficacy score was 83.16. So that it can be said that students' self-efficacy is still in the sufficient category. After the initial questionnaire was given, students were then given treatment for 3 meetings with a duration of 2 x 30 minutes at each meeting. After being given treatment, there was an increase in the level of student self-efficacy by 13.28 so that the final value of student self-efficacy was 96.44. Therefore it can be said that the treatment given succeeded in increasing student self-efficacy. The values of the initial and final questionnaires for self-efficacy are presented in Table 5.

Table 5. Student Self Efficacy for Each Component

Initial Questionnaires				Final Questionnaires			
Component Magnitude				**Component Magnitude**			
Maximum Value	32	80%	High	Maximum Value	34	85%	Excellent
Min Value	16	40%	Low	Min Value	18	45%	Moderate
Average	23,32	58,3%	Moderate	Average	27,76	69,4%	High
Component Strength				**Component Strength**			
Maximum Value	38	76%	High	Maximum Value	40	80%	High
Min Value	20	40%	Low	Min Value	22	44%	Moderate
Average	28,96	57,92%	Moderate	Average	32,88	65,76%	High
Component Generality				**Component Generality**			
Maximum Value	38	76%	High	Maximum Value	42	84%	Excellent
Min Value	19	38%	Low	Min Value	24	48%	Moderate
Average	30,88	61,76%	Moderate	Average	35,84	71,68%	High
Self Efficacy				***Self Efficacy***			
Maximum Value	103	73,57%	High	Maximum Value	113	80,71%	Excellent
Min Value	60	42,86%	Moderate	Min Value	70	50%	Moderate
Average	83,16	59,4%	Moderate	Average	96,44	68,88%	High

Table 5 shows the maximum, minimum and average values of students' self-confidence levels, which after being matched against the self-efficacy criteria table shows the average level of students' self-confidence from enough (59.4%) to high (68.88%) with the highest average on the generality component. Based on these results, it can be concluded that inquiry learning using the flipped classroom approach has succeeded in increasing student self-efficacy.

Increasing student self-efficacy for each component through the application of inquiry learning with a flipped classroom approach using inquiry on dynamic fluid material in general can be seen from calculating the average score of the initial and final questionnaires for each self-efficacy component. The components measured in this study are the magnitude component, the generality component, and the strength component. The average score of the initial and final questionnaires for each component of self-efficacy is shown in Figure 1.

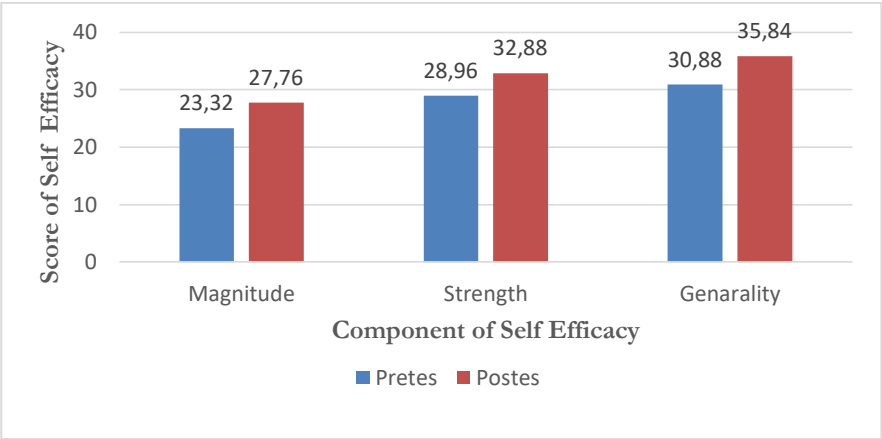

Figure 1. Pretest and posttest average scores for each self-efficacy component

Based on Figure 1, it was found that there was an increase in student self-efficacy for each component after the application of inquiry learning with a flipped classroom approach to dynamic fluid material. The lowest increase was in the strength component, namely confidence in learning and completing assignments where students still tended to be less confident in their ability to learn and complete assignments. So this can affect student performance in learning. In addition, it was found that a variety of models and approaches in learning turned out to be very helpful in increasing student self-efficacy. To find out the significance of increasing self-efficacy by applying inquiry learning with the flipped classroom approach, a comparative analysis was carried out between the results of the initial and final questionnaires. The significance of applying inquiry learning with the flipped classroom approach to increase self-efficacy is obtained through statistical processing to prove the hypothesis. In addition, data processing was carried out using SPSS V.26 software to determine data normality based on the Shapiro-Wilk test method. The selection of the Shapiro-Wilk test was based on the consideration that the number of samples was less than fifty. The processing results are summarized in Table 6.

Table 6. Summary The Normality Test Uses SPSS V.26

Value	Sig.	Description
initial questionnaires	0,400	Normal
final questionnaires	0,065	Normal

Based on the results of the normality test in Table 6, the data is normally distributed with a significance value (sig) > 0.05, namely 0.400 and 0.065. Due to both pretest and posttest data were normally distributed, the hypothesis testing used parametric statistics videlicet a paired sample t-test. The results of testing the hypothesis test can be seen in Table 7.

Table 7. Hypothesis Test Results Using The Paired Sample t-test

Data Resource	Asymp.Sig.(2-tailed)	Description
initial and final questionnaires	0,000	H0 rejected Ha accepted

The results of the paired sample t-test shown in Table 7 show a significance value (sig) <0.05, which is 0.000. This means that there is a significant difference between the value of the initial questionnaire and the final questionnaire of self-efficacy. Therefore it can be concluded that the application of inquiry learning with the flipped classroom approach can significantly increase self-efficacy in dynamic fluid material. To find out how much influence the implementation of inquiry learning has with the flipped classroom approach. Next, the effect test and impact test calculations are carried out as shown in Table 8.

Table 8. Influence Test Calculation Results

Mean	Standard Deviation	D	Criteria
13,28	6,93	1,92	Has major influence

Based on the results of the calculation of the effect test in Table 8, the effect size is 1.92. It can be said that the application of inquiry learning with the flipped classroom approach has a major influence on increasing student self-efficacy.

In the second qualitative collection and analysis stage, a questionnaire on student responses to the learning and skills being taught was measured using a questionnaire given at each meeting after learning. The questionnaire consisted of 15 positive statements which the criteria used in the questionnaire sheet is Likert scale with five choices, namely strongly agree, agree, undecided, disagree and strongly disagree. To see the results of the student response questionnaire to learning as a whole can be seen in Table 9.

Table 9. Student Response Questionnaire Results

Student Response Results	First Meeting	Second Meeting	Third Meeting
Average of Total Student Answers	57,6	58,7	59,8
Percentage of All Student Answers	77%	78%	80%

Based on the data presented in the table, it can be seen that there was an increase in positive responses from students for each meeting held. At the first meeting, it was found that 70% of students gave positive responses to learning with a flipped classroom approach using inquiry. As for the second and third meetings, positive responses were found by 78% and 80% for each meeting respectively. Therefore it can be concluded that based on student responses from the three meetings, inquiry learning with the flipped classroom approach has achieved satisfactory results and is well categorized. In order to validate the above conclusions, interviews were conducted with students after all activities or learning processes had been carried out. Interviews were conducted with 8 students consisting of 4 male students and 4 female students based on their activeness during the learning process and being able to represent other students. Interviews were conducted to find out student responses regarding the learning activities carried out. Then the results of interviews with student representatives were summarized and analysed descriptively.

Based on the results of these interviews, it was found that the responses from 8 students regarding learning activities were very positive. Students really enjoy participating in inquiry learning activities with the flipped classroom approach because this is something new for students or the first experience for all students in the class. Apart from that, they stated another reason that they were happy because of the practice, both directly and using PhET interactive simulations applications. This is because they had never done practicum before, especially during the Covid pandemic, so they only studied in theory or did practical exercises. As for their response regarding the learning activities carried out, it was found that they really enjoyed the learning process because the learning they did was very exciting. They find it easier to understand the concept of fluid dynamics and apply it in everyday life, such as filling a bucket full of water faster if the diameter of the pipe is bigger. In addition, they become more familiar with the workings of atomizers such as perfumes, mosquito sprayers, carburetors, aircraft lift force and others. Students also become more confident with what they learn, ask questions. So it can be said that the learning process with the proposed method makes their self-confidence increase after learning.

The application of inquiry learning using the flipped classroom approach to student self-efficacy shows that there is an increase in the average level of student self-confidence from a moderate level (59.4%) to a high level (68.88%). So it can be said that students have self-efficacy that is more confident about themselves. This can be seen and proven from the three components of self-efficacy which have also increased. Unfortunately, there are still some students who are still unsure of themselves about their abilities. So they are not sure of their abilities before the teacher explains the problems or learning they face. This is because students are used to being given solutions to problems so far, teacher-centered learning makes them always wait for solutions without being sure of what they have. The lowest increase was in the strength component, namely the stability of confidence in studying and completing assignments where students still tended to be less confident in their ability to study and complete assignments and as a result could affect student performance in learning.

So it can be concluded that inquiry learning with a flipped classroom approach can increase student self-efficacy. This proves the theory from research conducted by Yanah et al., (2018); Hanifah & Agustini (2012) that inquiry learning and flipped classrooms can increase student self-efficacy. The increase in the self-efficacy component that has the highest value is the magnitude component and the lowest is the strength component. This is in contrast to the

flipped classroom research conducted on biology subjects Marina & Ridlo (2021) which resulted in an increase in the self-efficacy component with the highest value, namely the strength component and the lowest in the magnitude component.

Overall, the results of this study related to the application of inquiry learning with the flipped classroom approach has a major influence on increasing student self-efficacy. This is in line with the results of inquiry research (Handayani et al., 2018) and the previous flipped classroom which was also applied to physics learning (Ahmed & Asiksoy, 2021; Namaziandost & Çakmak, 2020; Çakiroğlu et al., 2020) but these studies do not add other learning models or strategies. Research that is almost similar to this research is research related to the effect of the flipped classroom approach on the guided inquiry model and student self-efficacy in chemistry teaching (Lestari et al., 2020); (Hidayati et al., 2018). As well as a thesis with the title application of inquiry-based flipped classroom learning to increase self-confidence and student learning outcomes in biology learning (Marlisa, 2020).

Returning to this study, the relatively low increase in self-efficacy can also be caused by the number of learning meetings and learning time that only applies flipped classroom inquiry which is very limited, namely three meetings with 2 x 30 minutes face to face each meeting. Based on the observations of researchers during the learning process, at the first meeting students still seemed confused in participating in learning activities. As the number of meetings increases, students begin to understand the learning activities being carried out. For example, in the second and third meetings students have started to understand how to fill out student worksheets (LKPD) correctly without asking the teacher again. The process of adapting to this new form of learning activity may be one of the factors in the low increase in student self-efficacy.

Based on the overall explanation above regarding increasing student self-efficacy, there are several implications that need to be considered from this research. The first is the application of inquiry learning with the flipped classroom approach when online or blended learning can be an option for teachers in carrying out physics learning which aims to increase student self-efficacy. In addition, the application of inquiry learning using the flipped classroom approach to online or blended learning can be used as a form of physics learning activity during the Covid-19 pandemic. In facing obstacles such as not understanding how to work on LKPD and others, one of the solutions is to invite questions via the whatsapp group or private lines to the teacher.

The researcher admits that this research has some limitations and shortcomings. As the sample in this study is relatively small to be used in investigating the effect of the treatment being studied on self-efficacy. As well as the duration of this study which was too short by only carrying out five meetings in total, i.e. three meetings for learning activities with a time of 2 x 30 minutes for each face-to-face meeting and two meetings for pre-test and student interviews.

CONCLUSION

Based on the results of the research and discussion that has been put forward regarding the application of inquiry learning with the flipped classroom approach to increasing student self-efficacy on dynamic fluid material, it can be concluded that the application of inquiry learning with the flipped classroom approach to student self-efficacy shows an average level of student self-efficacy of moderate to high. The results showed that inquiry learning with a flipped classroom approach on dynamic fluid materials could increase students' self-efficacy after learning activities with a major effect and received positive responses from students in the excelent category. For further research, the researcher suggests testing the effectiveness of implementing inquiry learning with the flipped classroom approach in online or blended learning by comparing the flipped classroom approach with traditional learning. In addition, it is also recommended to combine the flipped classroom approach with other learning models, other skills and can also be on different materials or objects.

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