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Thinking Actively in Social and Context Flipped Classroom Learning in Physics of Work and Energy to Improve Students' Critical Thinking, Self-Efficacy and Character Compassion

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ABSTRACT
This study aims to understand, describe, analyze, and measure the increase of critical thinking skills, self-efficacy and the character compassion due to the application of the flipped classroom online learning model equipped by thinking actively in social and context (TASC). This work is quasi-experimental research using the quantitative analysis. Data was collected from several techniques, consist of observation, tests, non-test and documentation. The validity of the data in this study used normality and homogeneity tests, and hypothesis testing using t-test. The results show that the critical thinking ability obtained t-count value 1.988 with a significance 0.052, that means the average critical thinking ability of the experimental group is higher than that of control group. Then, the self-efficacy component, a t-count value of 1.843 was obtained with a significance of 0.068, which means that the average self-efficacy ability of the experimental group is higher than that of the control group. The t-count value of the character compassion component is 1.910 with a significance of 0.058, which means that the average of character compassion ability of the experimental group is higher than to that of the control group. The results of the study showed that the TASC flipped classroom online learning model in physics of work and energy matter can improve critical thinking skills, self-efficacy and character compassion of the students on senior high school.

INTRODUCTION

The advances of education technology and the emergence widely of many Learning Management Systems (LMS) have accelerated online learning using e-learning to develop rapidly. In addition, the direct face-to-face learning is still needed by students since the method still allows students to have

experience interacting with teacher or another students [1]. A mixed learning method combine the direct learning method synchronous and indirect learning method so that the learning can be done at any time asynchronous [2]. The blended learning method is believed to be the best solution when you need flexible learning, more effective-efficient and interactive delivery of material. The online lesson learning can be held in schools by utilizing laptops and smartphones online. The problems due to the online learning is less effectiveness of the learning since the students find some difficulties to understand the material and follow the learning and material presented by the teacher. This will then also affect student learning outcomes [3].

Learning outcomes have a correlation with students' critical thinking skills. This is in accordance with Piaget's theory that states a learning is centered on thought processes or mental processes. The weakness of learning process in Indonesia is its priority to the concept of one-way teacher lectures [4]. Critical thinking is a process of careful evaluation of each opinion as a basis for consideration for making better decisions. The importance of critical thinking skills is because it affects students' ability to solve problems in everyday life [5]. The critical thinking skills of students are still low in the evaluation category. Meanwhile, in relation to critical thinking and problem solving skills, physics lessons have a good correlation in improving students' critical thinking skills [6].

The student ability to solve problems in physics lessons causes a decrease in the quality of learning. The students' self-efficacy in solving physics problems using mathematics can be one of the factors that decrease the quality of learning. The level of self-confidence can affect a person's actions. The low level of self-efficacy has the potential to cause anxiety in solving problems [7]. To manage these negative traits, they need to have the character of compassion. The character of compassion is important for teenagers because it can help teenagers to overcome various problems in their lives. Compassion is interpreted as a willingness to have compassion for others and the environment. Physics learning requires character comparison, for example integrity, honesty, resilience, diligence, loyalty, courage, respect and self control. The elements in compassion are caring, sensitive, willing, and responsive. The relevant research shows that students' critical thinking skills in Grade XI MIPA 2 SMAN 1 Muaro Jambi, Indonesia are classified as low, even though there are some students who still have critical thinking skills. Therefore, students must improve their critical thinking skills in order to solve their daily problems [8].

The urgency of critical thinking skills, level of self-efficacy and character compassion for students because it affects learning outcomes and actions. Therefore, a learning method or model is needed that can improve these three aspects, one of which is TASC (Thinking, Actively, Social and Context). The TASC learning model has four important elements, namely building thinking skills (thinking), active participation of students in learning as actively, social collaboration, and learning that is relevant and related link with student experience as context [9]. Based on these four elements, TASC emphasizes teaching thinking skills to solve problems. The advantage of TASC is that students are more likely to develop the competencies they need and more effectively solve the problems they face both at school and outside of school in real-life situations. TASC learning is actually done face-to-face, but due to restrictions during the Covid-19 pandemic, other models are needed for delivery, such as the flipped classroom. Flipped Classroom is a way of learning to flip where students learn concepts and materials at home through media such as videos that were prepared previously, then discuss in class and the teacher becomes a facilitator [10]. Research conducted states that the application of flipped classroom online can enhance student learning outcomes. The advantage of the flipped classroom is the students are more familiar with smartphone technology to facilitate the learning process. The results of research on flipped classrooms also show that learning can increase interaction and make the class very fun [11]. This happens because the flipped classroom provides opportunities for students to learn according to their grasping power [12]. It is important to conduct this research with the aim of measuring and analyzing how TASC learning is applied through flipped classroom to improve students' critical thinking skills, self-efficacy, and character compassion.

METHOD

This work is a quasi-experimental research using quantitative analysis. This study involved two sample groups given different treatments [13]. The experimental group used the thinking actively in a social context (TASC) learning model, while the control group used a conventional learning model.

Experimental group :	O	X_2	O
	- -		
Control group	: O	X_1	O

Information:
O : Measurement of pretest and posttest on the dependent variable
X_1 : Flipped classroom learning
X_2 : Flipped classroom learning equipped with the TASC model
--- : The experimental and control groups were not randomly selected

Fig 1. *Research design of nonequivalent control group for pretest-posttest*

Figure 1 shows the design applied in this study, i.e. non-equivalent control group design for pretest-posttest. The beginning of the lesson, students were instructed to take initial tests, including tests of critical thinking skills in the question form for the experimental and control groups. Furthermore, students participated in online learning activities for the experimental group to apply the flipped classroom with TASC learning model. The control group applied the flipped classroom with ordinary learning. After that, students were required to take the same final test as the initial test, that is called as pretest, and followed by filling out the self-efficacy and character compassion questionnaires. Critical thinking consist of observation, analysis, inference, communication, and problem solving. Self-efficacy consist of physical and emotional states, imaginalexperience, social persuasion, vicarious experience and performance experience. Character comparison consist of ability to cooperate, responsibility, openness and emphaty. Learning activities was held using video conference apps such as google meet. The application of flipped classroom, learning activities are carried out by implementing the TASC learning model. The four steps include thinking, actively, social and context.

The research sample are grade XI MIPA students of SMA Adhyaksa 1 Kota Jambi, SMAN 17 Kabupaten Tebo, and SMA Negeri 9 Kabupaten Tebo, Jambi Province, Indonesia. This study involved three types of variables, namely independent variables, dependent variables and control variables. The data collection used an instrument in the form of questionnaires, documentation, and observations. This study used the normality investigation to ensure the data normally distributed and the homogeneity test to obtain whether the control and the experimental groups are similar. After testing the prerequisites of the analysis, the hypothesis was tested with the final result using the independent sample t-test.

RESULTS AND DISCUSSIONS

In this study, the normality test was used to see if the data were normally or not normally distributed. The calculation of the normality test using the Kolmogorov-Smirnov test is presented in Table 1.

Table 1. Result of Normality Test of Critical Thinking Experiment and Control Group

	Kolmogorov-Smirnov[a]			
	Statistic	df	Sig.	Data
Experiment group	0.115	48	0.130	Normal distributed
Control group	0.102	48	0.200	Normal distributed

The results of critical thinking normality test for the experimental and the control groups are sig 0.130 and sig 0.200, respectively, which both are more than 0.05 as level of significance, so both groups are normally distributed (Table 1). In this study, the homogeneity test was used to see whether the critical thinking data of the control and the experimental groups are same or not. The data is homogeneous if the value of sig. > 0.05, hence it is said that the variance of two or more data population groups is same. The calculation of the homogeneity test is presented in the Table 2.

Table 2. Result of Homogeneity Test of Critical Thinking of Experiment and Control Groups

Levene Statistic	df_1	df_2	Sig.	Data
0.001	1	95	0.972	Homogen

Table 2 shows the results of the homogeneity test of critical thinking in the control and experimental groups, with sig 0.972, that is more than 0.05, so both groups are same. Having tested the prerequisites for the analysis, then the hypothesis was tested with the post test result, namely the t test using the independent sample t-test, the results of the analysis are presented in Table 3.

Table 3. Analysis of t-test Critical Thinking for Experiment and Control Groups

	T	df	Sig. (2-tailed)
Equal variances assumed	1.988	95	0.052

The results of the independent sample t-test test for the experimental and control groups (Table 3), that the t-count value is 1.988 with sig 0.052 and degrees of freedom (df) 95, while t-table is 1.675 which means the t-count value > t-table. These results means that there was a significant difference of critical thinking between the experimental and control groups.

Table 4. Analysis of t-test for Self-Efficacy for Experiment and Control Groups

	T	df	Sig. (2-tailed)
Equal variances assumed	1.843	95	0.068

Table 4 shows t-count value is 1.843 with sig 0.068 and the degrees of freedom (df) 95, while the t-table is 1.661, which means the t-count value > t table. Since t-count > t-table, it can be concluded that the self-efficacy of students of the experimental and control group has differences.

Table 5. Analysis of t-test for character compassion of experiment and control group

	t	df	Sig. (2-tailed)
Equal variances assumed	1.910	95	0.058

Further, for the character compassion, as shown in Table 5, the t-count value is 1.910 with sig 0.058 and the degrees of freedom (df) 95, while the t-table is 1.661, which means the t-count value > t table. Since t count > t table, it can be concluded that the character compassion between experimental and control group data has differences.

Critical Thinking Skills

The results of students' critical thinking skills in learning the TASC flipped classroom model are shown in Table 2, which produces a significant value of 0.972 > 0.05. The results stated that there is a difference between the experimental and control group. The control group received the usual learning treatment using a flipped classroom, while the experimental group used the TASC flipped classroom model. Due to implementation of TASC model, the critical thinking of students in learning physics,

especially in work and energy topics has increased significantly. The achievement of critical thinking between and control groups are shown Figure 2.

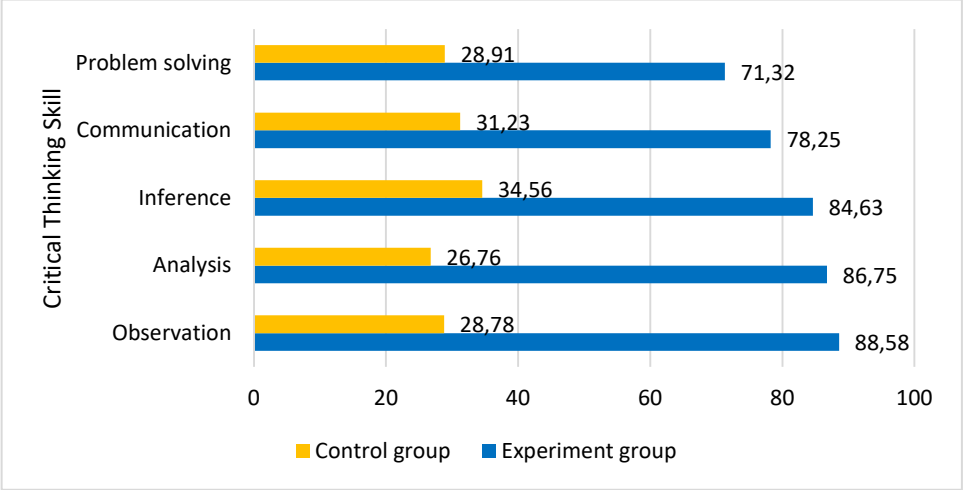

Fig 2. *The achievement of critical thinking between experiment and control group*

The highest achievement of critical thinking skills for experiment group are observation and analysis skills. It can be understood since the TASC flipped learning encourages students to observe the social and context phenomena to be discussed in classroom. It stimulates the students to look at carefully every phenomenon, even examine and investigate what really happen there [14]. Nevertheless, the achievement for other parts of critical thinking skills such as inference, communication and problem-solving skills appears significant there.

The average score of students in the experimental group is 85 while the control group is 75 for score achievement. The experimental group when discussing the problem "A block slides on an inclined surface with a constant speed the energy transformation that occurs" students answered potential energy into thermal energy with the reason that the speed is not constant and not thermal then the answer is correct. While in the control group students answered kinetic energy into thermal energy on the grounds that the motion that occurs at a speed that is not fixed and occurs thermally then the answer is wrong. Critical thinking skills on indicators provide simple explanations well [8]. The ability of students who have high critical thinking can find ways to solve problems such as assignments given. Then for the TASC model the social and context sections are very good. Students explain the learning material of work and energy well and it can interact with each other to answer questions from friends. In this indicator, students in the experimental group are more active than students in the control group [15]. A very effective group is indicated by most of the students' competency attainment of the learning process in the classroom.

Meanwhile, building basic critical thinking skills assisted by the TASC model for thinking and actively as an indicator to define the events related to them. As in the test "Potential energy is energy that affects objects because?" The student answered because of his height. On average, students answered correctly, the reason is because the potential energy of an object is influenced by three factors, namely the mass of the object, the acceleration of gravity of the earth and the height of the object. The greater the mass of an object, the greater its potential energy. Students can use a good mindset to complete observations and make their opinions [16]. The results of this indicator, the experimental group is more active and creative in building basic critical thinking skills than the control group. The ability to think critically and creatively, a student is not only a user or user of existing knowledge, but he will also be a person who is able to produce new knowledge, new thoughts, or new works.

Further, analyzing and identifying learning outcomes are very good. When discussing the problem

"The graph of the speed of an object pushed by a force on a horizontal floor is shown between t_1 and t_2?". On average, students answered correctly, namely the process of an object losing potential energy, because an object moving in straight motion changes uniformly is accelerated after being given a force. Students understand the problem in the given problem. At each step, a conclusion can be drawn appropriately according to the problem at hand. Someone who has the ability to think critically tends to be able to consider every decision that will be taken so that he can draw the right conclusions [17]. The learning approach uses real-world problems as a context to encourage the critical thinking skills of students.

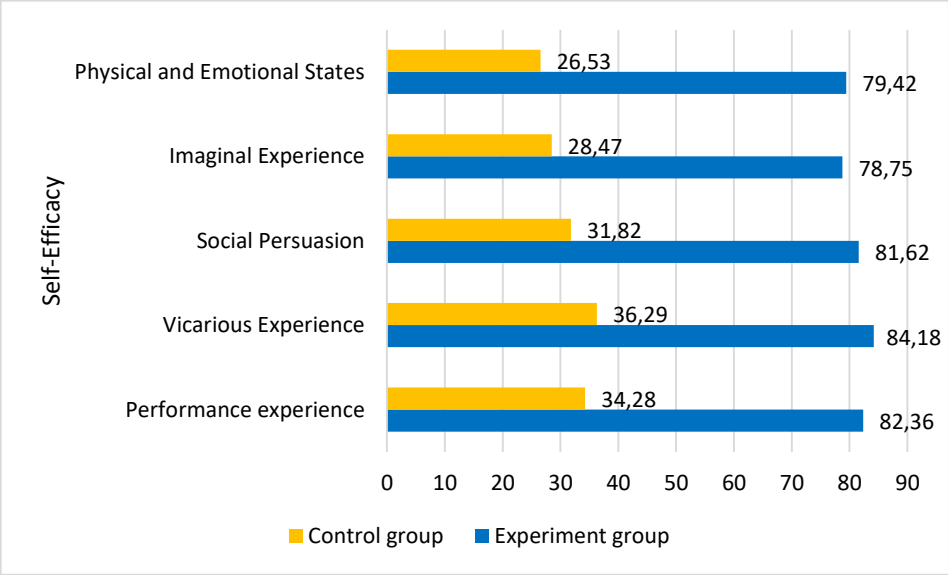

Fig 3. *Achievement of self-efficacy between experiment and control group*

Achievement of self-efficacy between experiment group and control group is shown in Figure 3. All of self-efficacy indicators such as performance experience, vicarious experience, social persuasion, imaginal experience, physical and emotional states have increased significantly. The results of self-efficacy of students in the experimental and control groups have a significant difference, amounting to t-count 1.843 > 1.661 (t-table). Self-efficacy is a student's belief to do school-work or other learning process. The support of the TASC flipped classroom model, students in the experimental group can be confident in what they are doing. One of them is in doing assignments and completing worksheet at home, explaining at school. The average score of the experimental group was 59.21, while in the control group it was 58.28. It can be seen from the students' average self-efficacy that is higher in the experimental group compared to the control group. This has a positive impact on the learning model provided, then how to convey the right material, so that students believe and believe that their work will get good results.

The existence of high self-efficacy has a positive impact on student learning outcomes. Self-efficacy and learning motivation together have a strong relationship with student learning outcomes. Self-efficacy refers to beliefs related to student ability to achieve and complete learning tasks with predetermined target outcomes and time. Self-efficacy is self-confidence to use competencies possessed in specific domains and situations.

The improvement of self-confidence will have an impact on self-confidence in learning process, doing assignments, being active and able to think critically. In addition, Tuada & Suparno [8] also supports the results of this study that project-based flipped classroom learning is effective in learning. However, some students may become overwhelmed because they will spend more time watching videos and doing assignments [18]. Flipped Classroom is a learning model that can make students complete more assignments and have high self-efficacy. Self-efficacy has a positive influence on student learning outcomes. This means that the increasing or better self-efficacy will also increase the learning

outcomes of the students themselves. This finding is in line with previous research by the results of research that self-efficacy has a positive and significant influence on student learning outcomes by 60.5%.

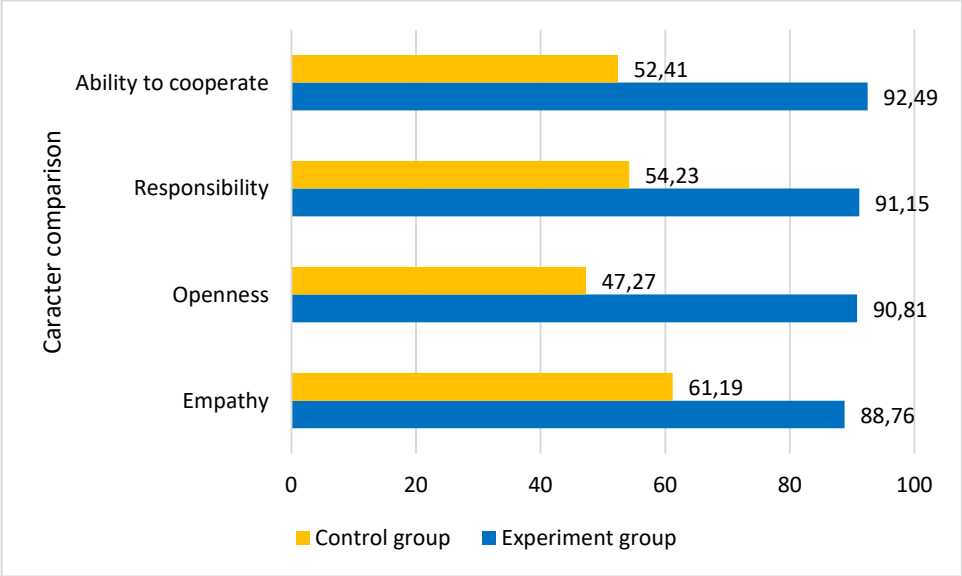

Fig 4. *Achievement of character comparison between experiment and control group*

Further, achievement of character comparison between experiment and control group is shown Figure 4. All of character comparison indicators such as empathy, openness, responsibility, and ability to cooperate has increased. The critical thinking is independent, self-disciplined thinking that tries to reason at the highest quality level by imparting justice. Critical thinkers usually strive to think and live rationally and empathetically. They are also aware of the inherently flawed nature of human thinking when left unchecked. They seek to reduce the strength of their sociocentric and egocentric tendencies. Further, they use their rational tools offering critical thinking – concepts and principles to analyze, evaluate, and improve thinking. They work diligently to develop and sustain some their intellectuals, such as intellect, integrity, humility, decency, empathy, sense of fairness and belief in reason. They realize they must always improve their reasoning abilities to avoid the human irrationality, distortions, biases, self-interest personal and personal interests. They seek to improve the world in any way they can and contribute to a more rational and civilized society. The same time, the complexities recognized often inherent in doing. Simplistic terms about complex issues and seek to consider the relevant rights and needs of others. The complexities in being as thinkers and has a commitment to a lifelong practice toward self-improvement.

The indicators of character compassion in science learning can be seen as the qualities or traits that show that a student has a compassionate attitude towards science and its learning process. Empathy refers to the ability to understand and share the feelings of others. In the context of science learning, it means that the student can understand the perspectives and experiences of others, such as their peers or the subjects they are studying. Openness refers to a willingness to consider new ideas and perspectives, and the ability to embrace diversity and differences [19]. In science learning, this means that the student is open to different scientific theories and is willing to consider different perspectives on a particular topic [20]. Responsibility refers to a sense of duty or obligation to do the right thing, and to act in an ethical manner. In science learning, this means that the student is responsible for their own learning and is committed to doing their best, as well as being responsible for their actions and decisions [14]. Ability to cooperate refers to the ability to work effectively with others and to contribute to group efforts. In science learning, this means that the student is able to work well with others in group projects, discussions, and experiments, and is willing to share their knowledge and ideas [21]. These are some of the common indicators of character compassion in science learning, and

they provide a way to measure a student's attitudes and behaviors towards science and its learning process. It's important to note that the development of character compassion is a long-term process and can be supported through various educational activities and experiences.

Physics learning can accommodate character education because it explores critical skills, students are invited to think critically, analyze problems, and seek solutions to problems. This can direct the development of character understanding such as the ability to think logically, creativity, and persistence in facing challenges and problems. Scientific truth in learning requires character education that involves scientific ethics which helps shape the character of students who are honest, critical, and adhere to the truth. Collaboration and communication in physics experiments and projects, students often work in groups. In learning to get used to directing the importance of cooperation, respecting the opinions of others, and the ability to communicate well. Physics lessons involve character understanding of human impact on the environment, students are given responsibility in protecting nature and the environment. Discipline is involved in completing assignments and following physics lessons. Strong character development provides students with strong character who are ready to face life's challenges and are individuals who are responsible.

TASC flipped classroom learning teaches students to learn actively, think, interact with other groups and dare to present the results of group learning in front of group. Flipped classroom is online learning by providing learning videos and worksheets to be done at home. The flipped classroom also applies face-to-face learning which is done online via zoom. This makes students feel interested in learning, especially physics. One of which is video media in learning activities can improve student learning outcomes because learning videos can convey information as a whole to students even though students have different learning abilities. Through critical thinking skills, students can solve a problem in learning or in their daily life [22]. The flipped classroom model helps in fostering students' critical thinking skills towards learning which has an impact on student learning outcomes and learning motivation.

The results of the character compassion of students in the experimental group and in the control group have data that there is a significant difference, amounting to t-count 1.910 > 1.661 (t-table). The character compassion of experimental group students is quite high compared to that of the control group, there is a sense of compassion for the students themselves. The character of compassion in physics learning is pleasure for students. By having a high character of compassion, it can prevent students from anxiety, especially in learning physics which according to him is difficult to get good results. The character of compassion can prevent someone from falling into a worse condition when experiencing an unexpected situation [23]. Self-compassion plays a unique role in positive emotions such as sense of coherence and feeling of worthy and acceptable. This ability can make it easier for students to see physics problems from several different contexts in solving them so that learning is more meaningful.

CONCLUSION AND SUGGESTION

Students' critical thinking skills after participating in TASC Flipped Classroom online learning activities are students can solve the problems in learning, then students can comment and ask questions that encourage students to be active and think critically. The ability of students' self-efficacy after participating in TASC Flipped Classroom learning activities online is that students get motivated in online learning, students no longer have negative assumptions about their abilities in learning. Describing the character of students' compassion after participating in the online TASC Flipped Classroom learning activity is that students have an empathetic attitude towards their fellow friends and care about the surrounding environment. This research is recommended to broaden participants from several schools, add indicators of character understanding, longer data collection procedures and variations in social contexts so that qualitative aspects can be discussed that make a stronger contribution to the development of effective learning strategies in increasing critical thinking, self-efficacy, and compassion character to students in physics subjects.

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