Flipped classroom learning model with group investigation strategy to increase the enjoyment of mathematics in elementary school students

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Abstract. Mathematics is very important to learn because it is widely applied in daily life. Enjoyment is an important aspect of learning mathematics. However, the enjoyment of mathematics is still in the low category. Therefore, it is necessary to choose the proper learning model and strategy to create fun mathematics learning activities to encourage students’ enjoyment of mathematics. This study examines the theoretical framework of the flipped classroom learning model with a group investigation strategy to increase the enjoyment of mathematics in elementary school students. The method used in this study is a literature review. Data collected from articles published in various scientific journals and other relevant sources. The results show that to increase students' enjoyment of mathematics, it can be done through how the teacher designs mathematics learning activities for students. The flipped classroom learning model with a group investigation strategy is an innovation that uses a technology-based blended learning approach with the concept of learning carried out outside and inside the classroom so that student-centred learning, more flexible, collaborative, active, and enjoyable.

1. Introduction
Mathematics is an important subject of knowledge to study from a young age due to its many uses in day-to-day life. The study of mathematics is intended to develop mathematical thinking abilities that integrate the cognitive, psychomotor, and affective that students can apply in real life. The study of mathematics in schools need to create activities that make students feel happy to learn about mathematics. Those feelings of happiness and comfort results in the enjoyment of studying are included in the area of affective.

Enjoyment is a subjective feeling from the happiness that is related to a certain activity or event [1]. Aside from that, enjoyment is considered as a mechanism that drives students’ concentration, helping them in the learning process and constructs a learning environment [2]. Enjoyment is the mood of students when completing tasks, which results in enthusiasm and no reluctance in completing that task. This can be displayed through the behavior or facial expression of the student [3].

Based on these three opinions on enjoyment, it can be correlated with the study of mathematics which is indicated by the subjective feeling of happiness when completing
mathematical tasks. This can be observed in the behavior or facial expression also of the enthusiasm of students in an ongoing study of mathematics.

The enjoyment of mathematics are affective, emotional, and behavioral reactions of students about liking or not liking mathematics [4]. In addition, the enjoyment of mathematics is interpreted as happiness with schoolwork especially in the subject of mathematics, enjoying mathematics positively, predicting later mathematical accomplishments, and achievements in mathematics having a positive effect on the enjoyment of mathematics to follow, the enjoyment of mathematics is more strongly correlated with the effort felt and realized by the individual [5].

The nature of enjoyment of mathematics views mathematics as an interesting subject, satisfaction when completing mathematical problems, finding mathematics interesting and having a positive impact, feeling happy in solving mathematical problems, having confidence, having the motivation to reach a target in studying mathematics [6]. The enjoyment of mathematics consists of several indicators, that are enjoying mathematics learning, participating in mathematics discussions, solving new problems mathematics as a challenge and happy in mathematics learning [7].

However, the enjoyment of mathematics among post-elementary school students is still low. They add that teachers influence students’ perceptions of mathematics [8]. Besides that, the drive to interact with peers and workgroups also motivate a fondness for mathematics [8]. A study shows a relation of cause and effect between the enjoyment of mathematics of teachers in teaching and that of students in learning mathematics [1]. The study found that when the enjoyment of mathematics is high, the efforts or attempts of students to study are also high, inversely when teachers do not enjoy teaching mathematics students will feel anxious in learning mathematics. This means that a positive enjoyment of mathematics from teachers in teaching mathematics will positively influence students’ enjoyment of mathematics in learning. Because of that, teachers must develop a process of learning mathematics that can grow an enjoyment of mathematics at an early age. One such instance being in elementary school.

Research experimented to test the influence of game quests on students’ enjoyment of mathematics in reaching a goal in the study of mathematics [9]. The result of this study showed that game quests had a positive impact on the enjoyment of mathematics. This is indicated by higher participant activity due to game quest giving a fun learning experience for students.

Research experimented to investigate the effects of active recreational math games on the anxiety and synergy of elementary school students [10]. The results of this study showed that active recreational math games can increase the enjoyment in learning and contribute to students’ training, overcoming problems and even lowering anxiety surrounding mathematics and increasing mathematical synergy.

Differing from attempts by previous researchers, this article will discuss a theoretical framework about the design of learning that can be done by teachers teaching mathematics in elementary school, through a flipped classroom model learning with a group investigation strategy to increase the enjoyment of mathematics in elementary school students.

2. Methods
The research method used is a literature review, a critical and in-depth study of the data sources obtained from articles published in various scientific journals, which function to build a concept or theory that becomes the basis or foundation in a study to make it easier to solve the problem. The data was collected by browsing articles in several scientific journal publications via the internet such as google scholar, ScienceDirect, etc. Then reduced and analyzed into relevant materials about the flipped classroom learning model, group investigation strategy, and the enjoyment of mathematics.

3. Results and discussion

3.1. Flipped classroom learning model
The flipped classroom learning model is the opposite of traditional learning methods and is a relatively new learning strategy that involves giving learning materials to students at home, while face-to-face learning sessions in class are used for direct practice [11]. The flipped classroom learning model emphasizes on giving students learning materials so they can learn them before going to class the next [12]. Flipped classrooms are intended to enable students to learn using various methods or strategies actively, making the flipped classroom a learning model centred on the student [13].

The flipped classroom can enrich learning resources and create strong interactions in addition to an effective overwatch on learning, perfecting evaluation methods, integrating theory and practice and also creating a limitless classroom [14]. This proves that a flipped classroom learning model not only mobilizes students’ enthusiasm and initiative but also increases students’ academic synergy so that they have a higher interest in studying and more quality talents in the internet era.

Flipped classrooms are the answer to problems faced by students living in an era of rapidly developing technology that requires a learning model that is active, creative, and collaborative [16]. Internet facilities enable flipped classrooms to be done inside and outside the classroom through online learning activities outside of class and face-to-face inside of class individually or in groups.

Referring to the opinion of Bergmann and Sams in reference [17] on flipped classroom which is that, with previous instruction or learning materials being given in class, is now flipped to become more interactive where students access learning materials through videos at home before studying in class begins. In other words, students can learn the materials earlier, meanwhile, school classes become a place to work and solve tasks, develop concepts, and actively getting involved in collaborative learning. In addition, through videos, students can deepen their conceptual knowledge and correct themselves through knowing and rectifying their mistakes [18].

A flipped classroom is a solution for many modern problems by enabling much more activity-based learning instead of information transfer in every face-to-face class sessions, with the hopes of facilitating a more flexible, collaborative, and active learning process [19]. Learning outside of the classroom in a flipped classroom can also be done through learning modules that are disseminated through WhatsApp [13]. These learning modules can be read at home at any time by students to better understand the material before school activities. This home activity will increase the application, comprehension, and ability to remember, meanwhile class activities the learning process increases students’ abilities to create, evaluating, and analysis [18].

The flipped classroom model consists of three steps, which are before class, during class, and after class [18]. The application of the flipped classroom model is marked by preparing to learn outside of classrooms through videos or learning modules independently (before class), learning face-to-face in class as individuals or as groups (during class), and finally concluding with learning exercises to perfect the learning that has been done since preparing outside of class and activities in class (after class).

3.2. Group Investigation (GI) strategy

Group investigation is a teaching method that makes students active in learning so that learning is more meaningful and has a positive impact on learning outcomes [20]. Group investigations are based on interactions between individuals that involve exchanging ideas and experiences through active discussion that can make students work together in a group and each group member has their respective duties and responsibilities [21]. Besides, GI demands students to ask questions about a topic and look for answers together with their friends and shape their findings into meaningful constructions [22].

Group investigation strategy is one type of cooperative learning that emphasizes individual interaction in groups or active student involvement through group investigation and discussion activities in which all members in a group are required to follow all the series of stages in the group.
investigation strategy because each of them has duties and responsibility in the group to achieve learning objectives.

GI learning requires students to be active in solving problems through group formation and joint discussions [23]. Classification of students in GI is carried out heterogeneously, which means one group consists of diversity in abilities and gender of students [24]. GI can develop collaborative and mathematical abilities because students are actively involved in solving problems through group investigations that can be sourced from books, libraries, the internet, and the environment around students [25]. Furthermore, in GI students conduct investigations on topics according to plan, analyze, make reports, and present in front of the class [26]. In the final stage of GI are students with their groups conclude and arrange strategies to present and evaluate group results, this shows the habit of conducting self-assessment and self-control of the results that have been done so that this will help students become independent learners [27].

Tan, Sharan & Lee in reference [28] explained that in GI students formed interest groups to plan and implement investigations and integrate findings into group presentations for class. The GI strategy includes several steps in which students are formed into small groups, selecting and investigating different topics, identifying, initiating investigations, and thinking about possible solutions through gathering and reviewing information from various sources, evaluating various solutions and deciding solutions, presenting results in front of the class, and evaluation [29]. There are seven stages of GI namely teams, identification, planning, investigation, final project, presentation, and evaluation [30].

The implementation of group investigation strategy steps that will be used are: 1) Formation of heterogeneous small groups (Teams), 2) Identifying selected topics and differing for each group (Identification), 3) Planning for the obtained topics (Planning), 4) Conducting investigations which include collecting, analyzing, reviewing, or evaluating various solutions and deciding which solutions are considered appropriate (Investigation), 5) Make a report (Final Project), 6) Present the results in front of the class through group representatives (Presentation), 7) Evaluating together (Evaluation).

Some of the influences given by the GI strategy were students being able to express and refute their opinions well and politely to their friends in the discussion, an improvement in being a good listener and observer, eliciting empathy toward friends through caring, mutual respect and helping in discussions, begin to accept differences in the group members and able to work well together so that a sense of togetherness and solidarity begins to emerge [31]. This is in line with Daminis and Surians [32] that GI can make students easier to accept diversity.

Thus, learning using the GI strategy can facilitate the interaction of students with a variety of different abilities so that students with high abilities can be used as peer tutors for students with papak and asor abilities. This group investigation is conducted face-to-face in class using the seven stages of the learning process on GI.

3.3. Flipped classroom learning model with group investigation strategy to increase enjoyment of mathematics

The flipped classroom learning model is conducted outside and inside the classroom so that it can train students’ responsibilities in learning independently. Outside the classroom, students are required to learn independently through videos or learning modules provided by the teacher, while in the class students are facilitated to conduct group discussions or questions and answers session to apply material that has been previously studied outside the classroom to obtain a sharper understanding. Learning outside the classroom through video provides the ability for students to take responsibility for their learning and control their learning styles and learning speeds by pausing, playing, or advancing video quickly [33]. The advantage of learning by using video is to produce an image and sound representation of an idea or event to students in the class [34]. Videos can present messages in the form of facts or stories or fictitious which are informative, educative, and instructional in learning [35]. Learning through videos can create a fun atmosphere and the language is easy for students to understand [36]. Therefore, students will not feel tense or bored and they will enjoy learning more through the learning video.
Moreover, the video serves as a tool to help students reflect on their level of understanding [37]. The use of video can help students to understand some difficult concepts and clearly understand the explanations contained in the video [38]. Watching videos is a useful learning strategy to improve students’ cognitive processes [39]. Students can communicate with peers and teachers whenever they need it. Through online communication, teachers and students can start prediscussion, tentative discussions, and post information [12]. This can impact on student satisfaction because the teachers’ role as a moderator and facilitator means more time to provide feedback and the students have more opportunities to develop learning that is self-centred, actively involved, and effectively collaborated and they can perceive their abilities to apply the knowledge critically in real-life tasks so that it can help them achieve more satisfying results [19]. This will foster the enjoyment of mathematics in students because students are allowed to contribute actively in the learning process.

Based on this, it can be concluded that flipped classroom has several advantages, namely student-centred learning models, enlivening student, and teacher interaction, giving students opportunities to discuss and asking-answering question, applied more of the class time to provide feedback from the teacher, train students to be responsible and learn independently through video and learning modules that can foster enjoyment of mathematics because it presents the material that can be heard and seen, also arranged by them anywhere and anytime.

To facilitate the activities of students in the class discussions and asking-answering questions to apply what has been learned outside the classroom to be more directed and clear, group investigation (GI) is used in the mathematics learning process to increase the enjoyment of mathematics of elementary school students. GI emphasizes the learning community, meaning that learning occurs through good interaction between the students, the students with the teachers, and the students with the learning resources. GI can develop cooperative and mathematical abilities because students are actively involved in solving problems through group investigation that can be sourced from books, libraries, the internet, and the environment around students [25]. This will be fun for students because students will be encouraged to explore by investigating mathematical problems in groups from various sources.

Classification of students in GI is carried out heterogeneously, which means one group is consists of diversity in abilities and gender of students [24]. In the group investigation formed from a variety of different abilities that are evenly distributed within a group, there are students with high abilities, medium, and low. This can allow the existence of peer tutors in groups that can influence the comfort of students in the mathematics learning process because they can freely and not feel awkward or ashamed to ask their group friends as peer tutors who understand better in a particular concept. The diversity of abilities and gender in GI will increase the enjoyment of mathematics because students carry out the mathematical problem by solving through group investigation activities which they can discuss with each other, exchange opinions, ideas, and information and work together to achieve shared goals.

The existence of discussion and collaboration in GI can have an influence such as training students to be good observers and listeners, opine correctly and politely, the attitude of empathy for friends who can below so that there is an understanding of group members and opinions, begin to build good and harmonious cooperation [31]. The existence of togetherness among group members will bring warmth and harmony so that they feel comfortable in the process of learning mathematics.

Framework combination of flipped classroom learning model with group investigation strategy can be seen through the following chart in figure 1.

The flipped classroom learning model with a group investigation strategy is provided as a learning innovation that can be used by teachers to teach mathematics by offering learning activities that use a blended learning approach that combines e-learning with face-to-face learning in class. The concept of flipped classroom strategy group investigation is that students gain knowledge outside the classroom, while the application and development of concepts are done in the classroom through group investigation.
The existence of this combination will provide a new learning experience for students because students are required to contribute actively in all mathematics learning processes through the stages of a flipped classroom with a group investigation strategy. Students learn the material outside the classroom in advance from the video and learning modules that are shared through WhatsApp, while the face-to-face activities in the class carry out group investigations to apply and develop the knowledge which students get from the videos and learning modules mentioned before.

![Figure 1. The framework of the flipped classroom learning model with a group investigation strategy.](image)

This group investigation will further clarify and direct the activities carried out in the flipped classroom model class, namely the existence of concrete group investigation activities in solving mathematical problems to sharpen and develop students' knowledge. Besides, a group of students is formed heterogeneously in group investigation. This will form a group with various abilities that are different from its members. Students who high, medium, and low abilities will be distributed in each group. With this heterogeneous group, it's to be expected that students with high abilities can become peer tutors and all members of the group can tolerate each other's differences. The existence of tolerance towards differences between group members is expected to show togetherness in groups and create a harmony that makes students feel happy and comfortable in learning mathematics.

Sojayapan [40] examined the effect of a flipped classroom with online group investigations on team learning abilities in senior high school. The results showed that flipped classrooms with group investigation can increase team learning ability. His finding was that the scores of the high team's learning abilities differed significantly from the learning abilities of the medium and low teams. Medium and low team learning ability scores are not much different. The highest learning ability of the low team is followed by the learning ability of the medium team, then the high learning ability of the team. That research is different from the development of a flipped classroom learning model with a group investigation strategy to increase the enjoyment of mathematics in elementary school students.

The novelty of this flipped classroom learning model with group investigation strategy is the difference of research methods used, group investigation activities carried out offline or face-to-face, the elementary school students as the research subjects, the dependent variable is not on the ability of the team but individual attitudes, specifically regarding enjoyment of mathematics. The steps for developing a flipped classroom learning model with group investigation strategy presented include: 1)
Online learning through videos and learning modules that are specifically designed before face-to-face in class and given in WhatsApp (before class). 2) Direct learning in class through group investigation activities offline (during class). 3) Learning ends with reinforcing the material through individual question exercises at home (after class).

From the explanation above, a relationship can be made between the integration of the flipped classroom learning model with a group investigation strategy as a solution to increase the enjoyment of mathematics. This is due to the learning design offered emphasizing the activities of students to participate actively in the process of learning mathematics.

4. Conclusion

The flipped classroom learning model with a group investigation strategy is one of the alternatives that can be used by teachers to increase the enjoyment of mathematics in elementary school students. FC learning model with GI strategy is an innovation toward developing learning models using a blended learning approach that is a combination of direct learning or face-to-face in the classroom and online learning outside the classroom. Lesson material in the form of videos and learning modules is given in advance to be studied outside the classroom before face-to-face at school through the WhatsApp platform to students (before class) while face-to-face learning in class is done through group investigation (during class) activities and reinforcing the material is then done through individual question exercises at home (after class).

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