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A NEEDS ANALYSİS OF FLİPPED CLASSROOM-BASED MATHEMATİCS LEARNİNG MODEL

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ABSTRACT

This study aims to analyze the need for developing a flipped classroom-based mathematics learning model. This study analyzes junior high schools' mathematics learning activities in Central Java and Yogyakarta province in Indonesia, whether they have used information technology or time effectively in learning. Research also identifies supporting and inhibiting factors in the learning process to develop effective learning models. This research is a descriptive study that uses data collection tools in observation sheets, interview guidelines, documentation, and Focus Group Discussions. The research subjects were teachers and students from 10 junior high schools in Central Java and Yogyakarta. The data obtained were then classified to identify students' needs for a more effective learning model in learning mathematics. The results showed that schools' mathematics learning time was limited, so the teacher could not thoroughly convey the material. Teachers also tend to use the question practice method to solve these problems, but students' understanding is still not optimal. This study's results can recommend developing a flipped classroom model that can overcome limited learning time problems.

INTRODUCTION

In National Education Development, education must have a more significant role in developing the people's potentials to become subjects growing optimally and beneficial to society and national development (Suryana, 2017). However, it still indicates that the quality of education in each region has not been evenly distributed (Idrus, 2012 & Hakim, 2016). It illustrates that education services are not balanced. The number and quality of educational infrastructure are still lacking and do not meet the standards (Raharjo, 2012); inadequate competence

and number of educators (Leonard, 2016); competitions of students' competence on a national and international scale in reasoning, critical analysis, and creativity are still relatively low; limited time in learning in schools (Sundari, 2008); and the low utilization of Information and Communication Technology (ICT) for teachers and students in facing the era of the industry revolution 4.0.

Therefore, it needs a learning model that can utilize Information and Communication Technology, maximize the classroom learning sessions, and improve students' competence to reason and think critically. The flipped classroom learning model was implemented as an alternative solution to the problem. The flipped classroom is a new pedagogical method, which employs asynchronous video lectures and practice problems as homework, and active, group-based problem-solving activities in the classroom (Bishop & Verleger, 2013). The "flipped" classroom is an example of active learning. Throughout the research, active learning was identified as an effective means of student learning and engagement (Braun et al., 2017). Classroom engagement refers to the student's active participation in classroom learning activities (Merlin-Knoblich, Harris, & Mason, 2019).

In general, this study aims to generate a flipped classrooms based mathematics learning model that supports the industry revolution 4.0 era and improve the quality of mathematics teaching in junior high schools. Specifically, the objectives of this study are to describe (a) mathematics learning strategies used by junior high school teachers in Central Java and Yogyakarta provinces, (b) inhibiting and supporting factors in mathematics learning, and (c) the flipped classrooms based mathematics learning model.

The study's urgency is that the learning model being developed can accommodate the teacher time in classroom teaching, encourage teachers and students to maximize the use of ICT, and improve student competencies in reasoning and critical thinking. The generated model (as an outcome) is also expected to have reliability in minimizing the disintegration of the national culture pearls of wisdom due to ICT development in the industry revolution 4.0 era. The flipped classroom seeks to remove didactic instruction from the classroom. It left contact time free for more interactive and engaging teaching and learning activities via electronic videos outside of the classroom (Little, 2015).

The flipped instructional technique for the classroom is thought to be an effective way to organize learning environments to improve students' learning outcomes. Many studies were conducted to examine the flipped classroom's effects on student learning outcomes compared with traditional classroom outcomes, but the results were not conclusive (Cheng, Ritzhaupt, Antonenko, 2018).

Learning Model

A learning model is a form of learning from beginning to end that the teacher typically presents. In other words, the learning model is a frame for implementing learning approaches, strategies, methods, techniques, and tactics.

There are four groups of learning models, namely: (1) social interaction models, (2) information processing models, (3) personal-humanistic models, and (4) behavior modification models (Joyce & Weils, 1996).

Learning models are a set of specific, integrated, and practical teaching principles that teachers use implicitly or explicitly about the conception of effective teaching. These models contain unique materials and manuals for teachers to use in teaching (Gage, 2009). A teaching-learning model is a structural framework that serves as a guide for developing specific educational activities and environments (Maker, 1982). It is a structural framework that serves as a guide for developing specific educational activities and environments. Bossing, teaching model is a pattern or plan that can shape a curriculum or course, select instructional materials, and guide a teacher's action (Bossing, 1952). Learning models are patterns or plans that can shape curriculum or lessons, select teaching materials, and guide teacher actions.

Trianto (2009) suggests the purpose of the learning model is a conceptual framework that describes a systematic procedure for organizing learning experiences to achieve specific learning goals and serves as a guide for instructional designers and teachers in planning teaching and learning activities. Suprijono (2010) explains that the learning model is a pattern used to guide classroom learning and tutorials. Learning models are principles, plans, patterns, and conceptual frameworks that describe systematic procedures for organizing learning experiences used as guidelines for instructional designers and teachers in planning to learn to achieve specific learning objectives.

Flipped Classroom

The concept of a flipped class is traditionally done in class is now done at home. It is traditionally done as homework is now completed in class. But as you will see, there is more to a flipped classroom than this (Bergmann & Sams, 2012). It can be interpreted that basically, the flipped classroom learning model concept is when students do learning that is usually done in class at home. Homework that is usually done at home is done at school. In this model, students learn new material by reading or watching learning videos independently (at home), and then in class, the lesson is discussed or discussed again. However, this model is learning with the help of video media and how to maximize class time with students.

A simple description of a flipped classroom compared to conventional learning is shown in **Tables 1 and 2** (Bishop & Verleger, 2013).

Tabel 1 Restricted definition of the flipped classroom.

Style	*Inside Class*	*Outside Class*
Traditional	*Lectures*	*Practice Exercises & Problem Solving*
Flipped classroom	*Practice Exercises & Problem Solving*	*Video Lectures*

Flipped classrooms are a way that educators can provide by minimizing direct instruction in their teaching practice while maximizing interactions with each other (Johnson, 2013). It utilizes technology that provides additional supporting learning materials for students that can be accessed online. This frees up class time that has previously been used for learning.

Tabel 2 Broader definition of the de-facto flipped classroom.

Inside Class	*Outside Class*
Questions & Answers	*Video Lectures*
Group-Based/Open-Ended Problem Solving	*Closed-Ended Quizzes & Practice Exercises*

Milman stated that the flipped classroom provides many benefits (Milman, 2012). Most of these seem to be a sensible advantage (e.g., increasing learning time is more attractive), especially to teach them in a hybrid or blended concept consisting of some combination of face-to-face and online learning. Figure 1 describes the development of the theory of "student-centered learning" based on the Flipped Classroom.

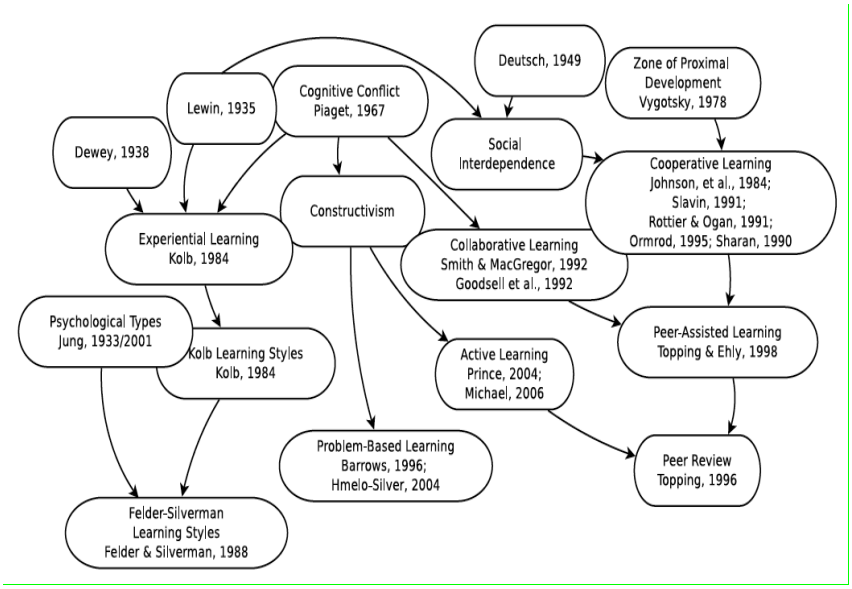

Figure 1. Psycho-Educational Origins of Student-Centered Learning Theories

METHOD

This study applies the descriptive research method to collect data about certain phenomena (Sekaran & Bougie, 2016). The phenomena include: (1) the situations of mathematics learning strategies in junior high schools in Central Java and Yogyakarta as necessary materials (embryos) for products to develop, (2) the situations of the users, (3) the situations of supporting and obstacle factors development and use of the products.

Participants

This study's subjects are the teachers, principals, and junior high school students in Central Java and Yogyakarta. There are five math teachers and ten junior high school students. Other research subjects are education experts and policymakers. The decision of research subjects is carried by taking into account the research objectives. The research objects were ten junior high schools from the provinces of Central Java and Yogyakarta.

Data Collection

Research data collection methods are observation, interview, and documentation. Observations are made to observe human behavior and a system's work processes (Sugiyono, 2014). Observations in this study were carried out using observation sheets by observing the learning activities that the teacher did in class and student activities. This study was conducted using interview guidelines for teachers and students at ten junior high schools in Central Java and Yogyakarta, who were randomly selected. Documentation in research is carried out by collecting documents related to learning activities and supporting data obtained through observation and interviews. Besides, this study uses focus group discussions (FGD). The FGD was conducted in the context of need assessment. It led to the input to prepare a model to develop, evaluate the model's concept, and other issues related to the learning model development.

The data obtained needs to be validated to obtain valid data. Validation was carried out using triangulation (Sugiyono, 2014). Suppose the FGD is also conducted to validate the results of the discussion between the speakers who participated in the discussion. In that case, the discussion and interview results are then validated by comparing the results with the data obtained from observation and documentation. If the data obtained from observations, interviews, and documentation supports each other, then the data can be valid and reliable.

DATA ANALYSIS

The data analysis techniques in this study utilized descriptive qualitative analysis (Moleong, 2007). The data analyzed used qualitative descriptive that is: (1) data of teaching strategies conducted by respondents, (2) data of driving factors and obstacles of mathematics learning, (3) data of reasoning and critical thinking improvement in learning mathematics.

The overall research procedures can be summarized into several main ones. The main procedures are elaborated in the following chart in **Figure 2.**

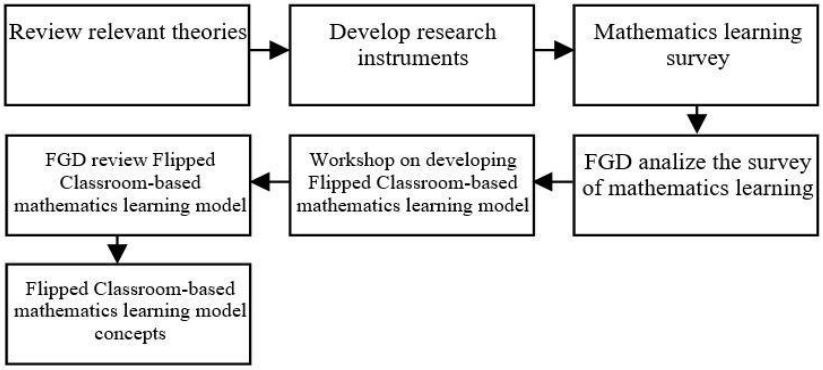

Figure 2. Research Procedures - Research Flow Chart

RESULTS

Respondents in this study are derived from eight junior high schools in Central Java and Yogyakarta. The resource persons have taken consist of five teachers and ten students. The results showed how teachers' mathematics learning activities in several junior high schools in Central Java and DIY. It is shown starting from the learning approaches and methods used, the students' condition, the facilities, the learning resources, and the media used.

Teaching Approaches and Methods

A learning activity is carried out appropriately when a teaching approach has been determined in advance. A teaching approach is a starting point of a teaching process whose features are still very general. Referring 2013 Curriculum, the teachers' approach is the scientific approach. It is in line with the results of Al Azhar 26 Junior High School interviews in Yogyakarta teachers who also apply five stages in the scientific approach in the learning (teaching), namely observing, asking questions, collecting data, associating, and communicating. For instance, at the observation stage, students are asked to observe a site plan or a form given by the teacher. Then in the questioning stage, students are invited to formulate questions related to existing plans or problems. Students are asked to collect data or information to find answers to the problems in the third stage. After the data are collected, students will discuss and relate the gathered information to get the right answer and arrange it in a neat report/summary form. Finally, in the communicating stage, students present their discussion results in front of the class.

Besides determining the teaching approach, teachers also need to determine teaching methods that support the learning activities in class. Teaching methods often used by teachers in learning mathematics include discussions and presentations, lectures, demonstrations, exercises accompanied by discussion, and homework assignments. The form assignments are not merely given in handwriting on the board, but they are instructed to find their material or formula to solve the mathematics problem via the internet. Regarding some of these methods, the method more frequently used by teachers is to supply practical exercises. It is expected that students are accustomed to working on complex math problems and have an in-depth-understanding direct experience in solving problems.

Based on the approaches and methods used, the resource persons' models in learning mathematics vary, starting from lesson study, problem-solving, expository, and think pair share (TPS). However, in the implementation of the lesson study model, teachers of Banguntapan 5 Junior High School still find obstacles, such as the availability time is insufficient because there is plenty of material must be given; thus, learning cannot be completed as planned, and the teachers must provide homework to the students. The number of materials also makes the teachers decide not to use specific methods in teaching. The most important thing the materials are conveyed entirely and students understand. Al Azhar 26 Junior High School Yogyakarta teachers and Wates 4th Junior High School in learning have ever used the problem-solving model. The expository model has also been used by Al Azhar 26 Junior High School Yogyakarta teachers in learning. The TPS model is used by teachers of Depok 4 Junior High School.

In contrast, Muntilan 2nd Junior High School teachers prefer using the task-based teaching method, rarely providing homework. The task-based method is considered easier in improving student understanding by giving the students exercises as frequently as possible. It shows that junior high school mathematics teachers in Central Java and Yogyakarta have implemented various learning models in Mathematics Subject.

The interview results with the teachers and students indicate that the teacher has used various teaching methods. The methods frequently used by the teacher is the task-based method by giving exercises, question and answer method, and presentation method to find out the students' understanding as the learning takes place. Teachers of Al Azhar 26 Junior High School Yogyakarta, Depok 4 Junior High School, Wates 4 Junior High School, Taman Dewasa Ibu Pawiyatan Junior High School, and Jatinom 3 Junior High School have ever invited the students to have discussions in groups dealing with solving mathematics problems. Assigning homework to search for materials independently via the internet has also been applied by Jatinom 3 Junior High School teachers. In contrast, PGRI Semanu Junior High School teachers have done the game method, which has received positive responses from students. They pay more attention to learning and have a better understanding as well.

The interview results concluded that in the teaching approach used, the teachers focus on the students, meaning that the teachers encourage students to learn actively and provide direct learning experience on how to deal with mathematics exercises. The teachers only provide them with a piece of information to understand the materials to learn. Then, the teachers apply strategies, models, and methods that make the students active during learning.

Student Situations in Learning

Students have diverse characteristics, meaning that not all students stay calm and focus on learning during learning activities. Not all students have the confidence to ask the teacher if there is a thing that they do not understand.

It is in line with what the Muntilan 2 Junior High School explained, stating that its characteristics vary. There are active students, very active, some quiet ones, and some others making class noisy. Jatianom 3 Junior High School teachers explain the same thing: students who are active and eager to participate. Students' activeness in the learning was also triggered by rewards given to those who participate in solving the exercise.

Following students' statements, it is found that some students often make the class noisy, so the class becomes less appropriate to the learning environment. Some students ask if something is not yet understood, whether to the teacher or other students, when not too confident asking the teacher. Some students actively answer the teacher's questions. However, some students are passive, afraid of asking questions, and decide to keep silent so that their understanding is not yet established. It is following the observation that passive students are shown not asking questions when given the opportunity. When asked, they have not been able to provide the expected answers.

School Facilities

Schools need to be equipped with various facilities to support learning activities to be more effective. The facilities provided by each school vary, depending on the funds owned by the school. Facilities in almost every school there are science laboratory and computer laboratory. This laboratory is undoubtedly used to support the implementation of learning in schools and give students an authentic experience in learning, especially in Science and Computer Science. However, other teachers can also use a computer laboratory for learning when not in use.

The school is also equipped with libraries and school grounds. Libraries in each school are used to provide a variety of learning resources that can be used by every teacher and student who needs other learning resources and needs to learn in the library. Teachers can also carry out the schoolyard's learning activities if the material being delivered is possible to be given outside the classroom.

Also, most schools have also provided projectors, namely Banguntapan Junior High School, Al Azhar 26 Junior High School, Wates 4 Junior High School, Taman Dewasa Ibu Pawiyatan Junior High School, and PGRI Semanu Junior High School. In contrast, the other three schools have not provided projectors at schools. İt is following the observation results that these schools already have projectors that teachers can use to teach. Equipment inventory data also shows that the school provides a projector that teachers can use in learning. Some of these projectors have been provided in each class, but some have only a few and can be used interchangeably. This projector's availability is intended to assist teachers in showing various videos or films to convey social phenomena or material to be conveyed more realistically. However, not all existing projectors can be used.

Some schools have also provided internet networks that teachers can use in learning. Teachers and students can use this internet network to find the

information needed related to the subject matter and social problems in various regions to be discussed and correlated with the subject matter.

Learning Resources

Learning activities run well if provided with learning resources. Learning resources refer to teachers' spectrum of teaching materials to support specific learning goals, as stated in the lesson plan (Adjei et al., 2015). Learning resources are all materials designed and used by teachers and students to obtain information, skills, and opinions in developing their cognitive processes (Akpan, 2017). Therefore, teachers' and students' information and contains information needed in learning can be called learning resources.

Based on the interviews, teachers' learning resources are often used in learning are textbooks. The textbooks are teacher books and student books provided by the government to support the implementation of the 2013 Curriculum. The books are also provided in e-books, meaning that the society, not only teachers or students, can download these books following needs. However, according to Banguntapan 5 Junior High School teachers, the teacher books and student books are quite confusing. Hence, the teachers decide to use other textbooks, which are considered easier to teach and guide them in understanding the subject materials.

In addition to using textbooks, teachers also use the worksheet and the internet. This worksheet contains a summary of materials and practical exercises to train mathematics formulas to understand efficiently. Suppose the worksheet and textbooks do not include the required material. In that case, the teacher will use the internet to find information or formula and more varied exercises to learn mathematics is not dull. The teachers use the internet as a learning resource and encourage students to find their formula or materials used in learning actively. It intended to make the students focus on learning and better understand because they search for the material themselves. Then, due to the internet's frequent involvement, using the internet in learning activities is considered more attractive to the students' interests.

Based on the interview, it was found that several teachers create their learning (teaching) resources. It is in line with the teacher's statements of Banguntapan Junior High School and Al Azhar 26 Junior High School, stating that they make their learning resources, worksheets, and modules. Their own making of the learning resources was based on the need of students and the materials to provide. It is intended to make the students easily understand the learning materials.

Learning Media

In addition to learning resources, learning activities can run even more effectively if learning media are used. Learning media are communication equipment as learning needs to achieve the learning process's effectiveness and efficiency (Suprianto, Ahmadi, & Suminar, 2019). The implementation of learning media the practicality, attractiveness, and benefits.

Based on the interviews with the five participants in this study, it is found that in learning mathematics, teachers have implemented learning media. The media frequently used by the five teachers in learning mathematics are the boards. The teachers use the boards to present formulas, write exercises and supply answers and questions, and test students' understanding of the formulas they have learned. Thus, students know the process of calculating and solving problems. The board is also an easy-to-use medium to deliver the materials.

In addition to the board, teachers sometimes use PowerPoint media to deliver materials. The teachers of Banguntapan 5 Junior High School considered that PowerPoint is more interesting because the materials can be delivered by including relevant and exciting moving visuals that directly enable the students to see the problem-solving process. The teacher can also add animations to attract the students' attention during the learning from beginning to end, and they are expected to understand the materials.

Teachers also sometimes use teaching aids to deliver the materials. A teaching aid is an object to represent a form or a process authentically to students. A teacher of Muntilan 2 Junior High School states that in her learning, she uses teaching aids. The teaching aids used in learning mathematics are all the students' neighborhood objects, such as tables, chairs, windows, pots, bottle caps, and others. The mathematics learning for junior high school is more about shapes, so objects around the school can be concrete examples of the intended shapes. Thus, students receive the real image of the shape and how to solve their mathematics problems.

Also, almost every junior high student in Central Java and Yogyakarta has a cellphone, and some students also have laptops. Wates 4 Junior High School teacher has ever told the students to use their cellphones to search for materials via the internet. A similar case has also been done by Depok 4 Junior High School teachers, asking the students to use a laptop or cellphone to do daily tests. The teacher has also used the school application, an application that enables the teacher to share materials and provide practice questions online. This application is used as a variation for the teacher in teaching. Students are not easily bored, interested in participating in learning activities, and improve independent learning because this application can be accessed anywhere. The teacher can do remote learning (teaching) and provide materials and exercises.

Learning Environment

Until now, learning activities are carried out in the classroom. It is in line with the teachers and students stating that mathematics learning activities are mostly held in the classroom. Mathematics learning is identical to the use of numbers and symbols constructed into formulas that require the teacher to deliver them in writing or drawing and is usually presented on the boards or in the form of PowerPoint slides. Presentations in writing or drawing are conducted to help students understand and apply them to work on exercises.

However, learning activities are not limited to classroom activities. Teachers can go to various places for learning activities. Even though all the schools sampled in this study were not yet equipped with a mathematics laboratory, the teachers utilize other learning sites. Banguntapan 5 Junior High School teachers use the science laboratory and schoolyard to look for shapes and other forms according to the materials so that these could be used as teaching aids and students do not need to imagine the shapes.

Al Azhar 26 Junior High School teachers also use the library, hall, and school field for their learning activities. Then, Jatinom 3 Junior High School teachers have also instructed the students to study in the library because they are not provided in the handbook, so students need to look for them independently in the library. It is intended to increase the students' independent learning skills and students' active participation during learning.

The students respond positively. According to Al Azhar 26 Junior High School teachers, students feel enthusiastic and pleased when the learning is done outside the classroom. The same thing is stated by several students who are pleased to study outside. Students feel more expressive and active to participate in learning and not quickly feel bored because students have more freedom to move during learning, do not have to sit still while paying attention to the teacher's explanation in front of the class. Nevertheless, some students feel that learning mathematics is better organized in the classroom because many materials require concentration and direct question-answer examples, which can only be explained through a board or PowerPoint slides, even modules, that ease students to understand.

School Policies

Each school has its policy aimed at achieving the school's goals. The policy regulates how students, teachers, and other school members act and behave, not to misbehave and improve their discipline. Based on the interview, there are policies related to the use of the cellphone at school. Some schools allow the students to bring cellphones to school, and some others do not. Schools that do not allow carrying cellphones are certainly to prevent the students from doing other activities during learning activities and increase students' concentration in learning. While schools that allow carrying cellphones apply certain conditions that students must fulfill.

Muntilan 2 Junior High School teachers state that students can bring cellphones if they get permission from the subject matter teachers and the counseling teacher. Al Azhar 26 Junior High School policy allows the students to carry cellphones on Saturdays only. Some schools allow to bring cellphones, but cell phones must be collected in front of the class during learning activities. Students may have their cellphones back during the breaks or when the teacher allows them, and when they come home from school. Students who violate these regulations will be grounded as a form of student discipline improvement.

In addition to policies related to bringing cellphones to school, there are also policies related to bringing laptops to school. Al Azhar 26 Junior High School

teachers and students say that students can bring laptops to school. The laptop is used to support learning, such as taking notes or looking for information or materials needed through the internet.

Students Responses to the Learning

Mathematics is a subject that is not easy to understand, but that does not mean it cannot be understood. Students need confidence and hard work to understand each mathematics formula, so they do and solve them well. Based on the interviews with students, it is found that even though it is a complicated subject, there are still students who like mathematics and make it a favorite subject.

Students expect that the teacher's mathematics learning activities become more varied. The learning does not make them boring—learning (teaching) methods that students like vary, such as discussions, presentations, and even games. Some students prefer being given exercises and discussed in front of the class, so they know their understanding level and their mistakes in the calculation. Besides, some students want the classroom's learning activities and outside the classroom with an exciting game. The teacher also helps them make it easier to understand mathematics formula.

Learning Obstacles

In learning activities, indeed, various problems occur. The problems in learning are teacher books and student books considered confusing for teachers and students to use. Then, teachers also have obstacles in time management. There are a lot of materials in mathematics. However, the allocated time is still not sufficient to cover all materials. Sometimes, the teacher only supplies homework to study independently and provides practice questions to increase their experience in solving particular cases.

Even noisy classes also become a common problem experienced by teachers. In each lesson, students often chat with other classmates and disturb other students who focus on learning. Besides, even with the discussion method, there are often students who do not participate in the discussion but walk from one group to another to interfere.

Another problem is the availability of a Wi-Fi network. The absence of an internet network at schools affects teachers in applying learning methods because they cannot assign them to search for information or materials via the internet at school. Schools that have been provided with Wi-Fi also still experience problems. Wi-Fi is not yet entirely connected and limited, so that it interferes the learning activities, especially those related to internet use, for instance, in computer laboratories. On the other hand, some students find it challenging to utilize the internet.

In mathematics, not all materials have required the help of the media. The reason is that the teacher has not decided on the appropriate media for the materials that they can be appropriately delivered. Students also feel the formula in mathematics is involved, especially in SPLDV and algebra.

Muntilan 2 Junior High School teachers also experience obstacles. The obstacles are that the teachers are seniors, making them rarely use learning media such as LCD. The use of media is considered too troublesome and takes a long time, then makes the materials delivered slowly. Other schools also experience problems related to LCD; for example, the teachers cannot use LCD media due to out of order.

Ways to Overcome Obstacles

Based on the interview, it is found that there are many obstacles experienced by teachers in the learning process. However, teachers have worked hard to make various efforts to overcome them, such as telling the students not to be noisy, or placing them as the learning models, so that they become the center of attention. Also, punishment is given to noisy, such as being required to work on problems in front of the class until they can finish them correctly. Teachers also walk around the class, approaching students one by one and paying attention to each student's activities, so that if some students are not paying attention to the lesson, they can be immediately addressed or told to work on problems in front of the class. Teaching activities with discussions also frequently make class noisy. Therefore, before conducting class discussion activities, the teachers explain the directions, then the students know the discussion steps to do and the time limit.

Other problems related to the formula quantity and complexity must be understood by teachers at Muntilan 2 Junior High School by applying the singing method. The teacher arranges the formulas in a rhythm that is easy to sing and memorize so that when the students forget the formula, they can sing to help them remember. Teachers also often provide practical exercises to discuss in front of the class, so students can immediately find out the mistakes in determining the formula and calculation.

If the problems are related to the students' boredom learning in the classroom, they will let them study outside. The teacher will adjust the materials with learning activities outside to make it more enjoyable.

Teachers Responses to Flipped Classroom

Before the interviews with the teachers were conducted, the researchers explain the Flipped Classroom model. The flipped classroom is a learning model that reverses learning activities between at school and at home (Ozdamli & Asiksoy, 2016), meaning that learning activities at school are done at home, whether through online videos, presentations, or through other online media, while homework that should be done at home is completed at school. Students have more free time at home, while the allocated time for mathematics is not available equally to the materials. Therefore, teachers can apply the flipped classroom model in their teaching by carrying out the learning at the home of each student online and completing homework at school.

This flipped classroom model has been applied in various subjects and is intended to increase the interactions and communication period between the students and the teachers (Uzunboylu & Karagozlu, 2015). The model exchanges learning inside the classroom outside the classroom at one time. This model is expected to provide positive and significant changes in the students' understanding.

Based on the interviews, Banguntapan 5 Junior High School teachers are interested in using the learning model. The teachers consider that the allocated learning time at school is still lacking. Sometimes, the materials that should have been planned to complete in one meeting cannot be accomplished due to various obstacles, such as student discussions that take a long time. These students still do not understand, so it must be repeated.

The explanation of Al Azhar Junior High School teacher that the teacher is interested in implementing it. The teacher feels that the students are still experiencing difficulties with some of the material presented. At the same time, the allocated learning time is sometimes insufficient if it has to be repeated. Wates 4 Junior High School teacher, Bagus, also thinks if the flipped classroom model is well planned, it improves students' understanding because of more allocated learning time. Students can also study independently at home and still ask if there are materials not yet understood. Students also get examples and practical exercises to measure their ability to understand the materials.

Based on the findings in this study, it can be seen that several things are needed by students and teachers in mathematics learning activities, namely: (a) students and teachers need a longer learning time so that the whole subject matter can be adequately conveyed, (b) students require a fun learning method so that students can focus on learning and the material is easy to understand, (c) students need learning media that can be used to make it easier to understand the subject matter, (d) students need examples of questions and how to do them, as well as practice questions to measure their understanding of the subject matter, (e) students need a study room that has a more expansive space so that it is more comfortable to study.

Some of the needs of students and teachers are met by developing a flipped classroom model. Development is carried out in the video section used for independent student learning and learning activities carried out in class. The flipped classroom learning model leads students to learn new materials by reading, watching learning videos independently (at home), and then discussing the materials in class. The responses given by teachers regarding the development of this model is quite good. The teachers are interested in using the flipped classroom model in teaching. However, this model's development needs to go through several stages to become an efficient and effective model to improve students' critical thinking skills. The steps in developing a flipped classroom-based learning model can be seen in **Figure 3**.

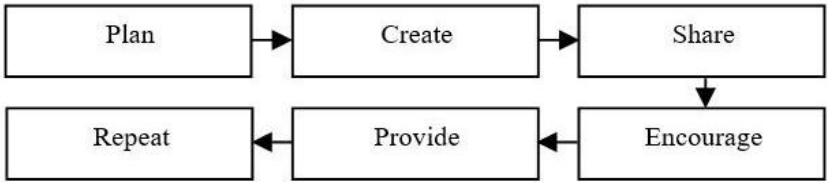

Figure 3. Research Flow Chart

Based on the model, it is elaborated in the following Table 1. Based on the analysis of student needs that has been described, the flipped classroom model that can be developed contains several things. First, the learning video contains subject matter described in detail and is accompanied by examples of problem work so that students can easily understand it. Videos will be easier to understand if accompanied by animation. Second, learning videos and practice questions must be easily accessed or downloaded by students anywhere and anytime, so students can study them anywhere and anytime. Third, the teacher facilitates students to ask questions related to material that is still not understood through online media or devices after studying the material through learning videos. Fourth, learning outside the classroom is given more time so that students can understand the material slowly. Fifth, students can measure the extent of their ability and understanding after watching the learning video by working on practice questions outside the classroom. Sixth, the teacher facilitates students to discuss when learning in class by using the game method in groups so that learning is not boring. Seventh, teachers can carry out evaluation activities to measure how students understand by using written tests individually.

Table 3. Syntax of Flipped Classroom-based Mathematics Learning Model

No.	Syntax	Information
1	**Plan**	Compiling plans for making videos and learning activities including determining the competencies that students must have; determine the subject matter to be given; compile sample questions and how to do them; compile practice questions; arrange assignments for classroom activities and evaluation; setting up recording devices, such as cameras/cellphones, tripods, whiteboards; computer to edit recordings.
2	**Create a video recording.**	Make a learning video using a recording device. The teacher begins to deliver the subject matter with the lecture method and shows how to solve some sample questions and record them. The recordings are then edited in such a way as to make it easier for students to follow and understand them. The video is also equipped with practice questions that students can use to measure student understanding.
3	**Share with students.**	The video that has been recorded is then given to students before learning activities with the recorded material begin so that they can study at home.

4	**Encourage students to prepare**	Clearly state the expectations for your students and the goal of at-home lectures. Give your students a course syllabus and consider handing out a lecture or assignment calendar as well. You can also encourage students to prepare for class by having frequent pop quizzes or lecture quizzes throughout the year.
5	**Provide in-class activities.**	Students participate in class learning after studying the material and working on practice questions through learning videos. Activities in class are carried out by providing practice questions given through discussion and games methods to get bored quickly when participating in the lesson.
6	**Repeat**	In an entirely flipped classroom, all the lectures are out of class. It means you need to have your lectures prerecorded, uploaded online, and ready to go. Remember to have all your in-class activities planned out ahead of time as well, like you would with a traditional lesson plan.

DISCUSSIONS

The finding of this study is a syntax of the development of a flipped classroom-based mathematics learning model. There are six stages in developing a flipped classroom: Plan, Create a video recording, Share with students, Encourage students to prepare, Provide in-class activities, and Repeat. The flipped classroom is a relatively new method of instruction. Teachers need to understand basic pedagogy before attempting a new educational strategy, such as how the model will impact students' ability to think critically and collaborate in their learning. Flipped learning involves moving lectures outside the classroom walls to increase student-teacher interaction within the classroom, to create more time for active learning, and to make more efficient use of the time spent by students and teachers (Stratton, Chitiyo, & Mathende, 2020).

Mathematics learning is building students' understanding of facts, concepts, principles, and skills according to their competencies. Mathematics learning appropriately begins with an introduction to a problem that meets a challenge (contextual problem). Given contextual problems, students are gradually guided to master mathematics concepts. In the field of the learning process, there are terms known as (1) learning models, (2) learning approach, (3) learning strategies, (4) learning methods, (5) learning techniques, and (6) learning tactics. Some educators still find it challenging to differentiate the terms.

A learning model is primarily a form of learning from beginning to end, mainly conducted by teachers. In other words, the learning model is an applied framework of approaches, strategies, methods, techniques, and tactics. Concerning learning models, Joyce and Weil (1996) present four groups of learning models, namely: (1) socio-interactive models, (2) information processing models, (3) personal-humanistic models, and (4) modified-behavior models.

The teaching approach can be interpreted as a starting point kickstart of a learning process, which is still a standard view. Based on approaches, learning (teaching) divided into two, namely: (1) student-centered approach and (2) teacher-centered approach. Teaching strategy is a series of learning activities managed by teachers and students so that learning objectives can be achieved effectively and efficiently. Based on the strategies, learning is divided into two, namely (1) exposition-discovery learning and (2) group-individual learning. Learning techniques can be interpreted as how teachers apply specific methods in teaching. For instance, the discussion method needs different techniques in class to deal with active students and passive ones. Learning tactics can be interpreted as how a teacher individually applies individually specific learning techniques. For example, two teachers both use the lecture method, but the tactics being used might be different.

In the performances, one is interspersed with humor. After all, he/she has a high sense of humor, during the other uses more electronic devices because he/she is good at the field. Based on the description above, learning mathematics is expected to carry out professionally. Teachers are required to understand and have sufficient skills in developing various models, needs, strategies, methods, techniques, and tactics, even design lesson plans promoting practical, creative, and fun learning. Before determining one choice of strategies following the characteristics of students, teachers need to consider (1) the objectives to achieve, (2) materials and learning materials, and (3) student activities, individuals, and integrities.

According to Gage (2009), a learning model is a set of specific, integrated, and practical teaching principles used by teachers either implicitly or explicitly of the useful teaching concept. These models contain particular materials and manuals for teachers to use in teaching. A teaching-learning model is a structural framework that serves to develop specific educational activities and environments. The meaning of this opinion is that a learning model is a structural framework that serves as guidelines to develop certain educational activities and environments. Bossing, teaching models is a pattern or plan that can be used to shape a curriculum or course, select instructional materials, and guide a teacher's action. Learning models are patterns or plans that can shape curriculum or learning, choose teaching materials, and guide teacher acts.

Trianto (2019) states the learning model's intention is a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve individual learning goals and serves as a guide for learning designers and teachers in planning teaching and learning activities. A learning model is a pattern used as guidelines in planning learning in the classroom and tutorials.

The flipped classroom learning model concept is when students do learning as always in the classroom at home, and homework generally done at home is completed at school. In this model, students learn new material by reading or watching learning videos independently (at home), and then in class, the lesson is brought to discussion or discussed again. However, this model is learning with the help of video media and how to optimize class time with students.

A flipped classroom is a way educators can provide by minimizing the number of direct instructions in their teaching practices while maximizing interactions (Johnson, 2013). It utilizes the technology that provides additional supports for learning materials that students can access online. It spends less time than has previously been consumed for learning.

Interest in student involvement is one of the reasons behind the exploding interest in the flipped classroom. The flipped classroom alters the sequence of in-class and out-of-class activities that characterize traditional mathematical classrooms. In the flipped classroom, content that has traditionally been introduced in the classroom is presented to pre-class students through videos, simulations, or other electronic means. Thus, rather than introducing new content to the classroom, students come to the classroom with familiarity with the content. Classroom time will then be devoted to discussions, explorations, collaboration, and additional examples to enhance student understanding (Hodgson et al., 2017).

Milman (2012) mentioned that the flipped classroom provides benefits. Most of them seem to be a good advantage (for example, increasing learning time more interesting), especially to teach them in a hybrid or blended concept consisting of several combinations of face-to-face and online learning.

When designing the flipped classrooms, we suggest that classroom teachers build upon the literature. The researchers' voices will help flipped educators in classrooms escape future problems. To emphasize the exchange of mathematical ideas with consistency and precision and illustrate the multiplicity of approaches, we might perhaps change the classroom culture (Lo, 2017).

The flipped classroom has the potential to improve all levels of mathematics. The strong effect observed has been very gratifying, and it gives me the incentive to continue to employ this class in the flipped classroom. However, the flipped is no panacea. While the students have shown increased final performance, more research could help determine what aspects of the classroom have helped achieve this goal (Collins, 2018).

The flipped classroom aims to improve learning by engaging students in non-traditional education activities. Flipped classrooms have steadily gained popularity over the last decade and are the subject of discussion in teaching and learning forums. The students' performance improved, and a better understanding of concepts was achieved through a flipped-down approach to the classroom. Evidence also indicated an increase in the involvement of learners (Khan & Watson, 2018).
The teachers with varying degrees of technological comfort and teaching experience have improved their practice by expanding their community and tools. The flipped classroom tools scaffolded their learning to improve their practice to make it more student-centered (Goodnough & Murphy, 2017). For many teachers, one of the appeals of flipped instruction is the opportunity to engage students in a broad range of learning activities in a setting where they and the students' peers are readily available to assist and collaborate. Teachers who experienced relatively high levels of behavioral engagement in their

flipped classrooms shared a few standard practices. Students were simply expected to view the assigned video and complete all ancillary assignments (Hodgson et al., 2017).

The flipped classroom was an increase in thought, learning lessons, and quantitative thought. These are good, but there is room for improvement (Lawson, Davis, & Son, 2019). This study in line with the findings presented by Clark (2015) when she studied the effects of the flipped model of instruction on student engagement and performance in the secondary mathematics classroom. She noted that students were resistant at the beginning of the implementation.

Several positive impacts of the flipped classroom implementation identified by Zainuddin et al. (2017). Student motivation and participation, self-directed learning skills, and social interaction. Students can be independent, which, in effect, leads them to positive academic achievement. The flipped class strategy is intended to enable students to be involved and engaged during in-class time activities and learn at their own pace during class time.

On the first day of class with the flipped group, the teacher was supposed to tell the students that they would be part of something that would revolutionize math classes in school. Students would learn math in a way they've never been exposed to. The teacher can implement this style in other math classrooms and see even more positive results (Buch & Warren, 2017).

The study has implications for other teachers who may consider implementing a flipped-down approach to the classroom, particularly regarding the commitment required. Implementing a flipped approach to the classroom in this study consisted of a carefully designed program in which students were provided with clear guidance, appropriate resources, and dedicated teacher support. Teachers who may consider adopting such an approach consider the commitment of time teachers may be required (Muir, 2018).

Teachers who flip and teachers who are considering a flipped approach to teaching may benefit from meeting with colleagues or technology specialists who have experience flipping before teaching their first flipped lesson. The planning and preparation of in-class activities done by a teacher of experienced flippers could foster growth in choosing appropriate and engaging classroom time activities. Given the importance of adequate class time with flipped learning, school administrators should routinely observe teachers who flip and provide ongoing feedback on the delivery of in-class activities and strategies used to facilitate learning, interactions between students and the teacher, and the use of scaffolding and assessment (Graziano & Hall, 2017).

Pedagogical designs in flipped classrooms have increased students' knowledge advancement and conceptual development. Flipped classrooms were inspiring for both teachers and students. For teachers, what used to be a more unidirectional way of teaching in classroom settings is transformed into one that emphasizes student-centered discovery and inquiry. This pedagogical approach encourages students to question the unknown actively and to find solutions on

their own. It also expands the out-of-class learning cycle that helps students have more time to think and experiment in class, thereby enhancing their problem-solving skills (Song & Kapur, 2017).

The flipped classroom approach designed with the use of mathematics software increased student achievement. The learning approach enhanced student understanding and provided visualization in mathematics teaching. However, it has been shown that this strategy has encouraged retention and made comprehension much simpler (Zengin, 2017).

Students show a more optimal learning experience and a higher degree of commitment in the flipped classroom. Students highlight their learning; loyalty to peers, being noticed, feeling safe, teaching relationships, a physical learning atmosphere, interacting with peers, and using videos to learn new content. Student participation's emotional aspect is especially prominent when students focus on learning in flipped classrooms (Steen-Utheim & Foldnes, 2018).

Jan & Kim (2020) looked at the overall effect sizes of flipped classrooms compared to traditional, lecture-based classrooms and found that flipped classrooms had a medium effect on various student learning outcomes. The study found that the flipped classroom had a more significant effect on affective and interpersonal outcomes than cognitive outcomes. This result can be explained by the flipped classroom features that encourage active engagement and learner-centered interaction. Instructors and other educational leaders may seek instruction to redesign and provide educational support for the implementation of flipped classrooms as an effective pedagogical practice.

Studies have shown that this approach can aid in mathematics education. The qualitative responses of students have also shown that they benefited from a flipped-classroom approach. It is consistent with Lo & Hew (2017) 's research approach to improve under-performance and high-capacity student achievement in mathematics.

The types of teaching activities and the role of teachers and students working with active learning strategies, such as flipped classrooms, impact students' attitudes towards mathematics. It indicates that students' attitudes can be influenced by the different teaching methods used at school (Turra et al., 2019).

Roehling et al. (2017) found mixed results for flipped classrooms' efficiency that were moderated by student characteristics and familiarity with previous online or flipped courses. The flipped classroom has the potential for effective pedagogy in mathematics learning. Teachers should be guided to make effective use of online tools for maximum effect. The teacher must also remind students that knowledge not covered during class time is still essential to know. This can be achieved through quizzes or worksheets that hold students accountable for learning prior to their graduation.

The flipped classroom instruction effectively raised interest in the subject and promoted student discourse on problem-solving. The flipped classroom paradigm is an equally successful way of disseminating core mathematics

concepts to students (Scott, Green & Etheridge, 2015). This study suggests that a flipped learning classroom would be ideal for learning mathematics concepts with strategic use of video content concepts.

The flipped classroom model developed also combines face-to-face learning and online learning. Online learning is carried out using learning videos that students can access and download easily anywhere and anytime, so students can learn it anywhere and anytime. Videos cover the subject matter and work on some questions and practice questions that students can do to measure their abilities after studying independently. Students are also facilitated by media that can be used to ask teachers and other students online outside of the classroom if there is a material that has not been understood. In face-to-face learning, it is done by giving assignments that are discussed in groups, and some games can make learning more fun. At the end of the lesson, the teacher can provide a written test to find out the extent to which students understand the subject matter given using the flipped classroom model.

CONCLUSIONS

The study aims at knowing the situations of students learning at school and the teaching strategies conducted by the teachers, as well as the teachers' responses to the flipped classroom learning model. This study shows that junior high school students in Central Java and Yogyakarta are quite varied, active, and passive. Active students are frequently asked if there is something not understood and always answering questions from the teacher, participating in group discussions, and confident to work in front of the class even if not appointed. Some students are passive due to not confident to ask questions even though there is a part of material not yet understood. Some students prefer asking their classmates to the teacher. In mathematics learning, students also prefer the variety of methods teachers use to avoid boredom, such as learning by using games, discussions, media like PowerPoint slides and teaching aids, or learning outside the classroom.

Related to the teacher's teaching strategy, it is more about explaining the materials using the board previously, then supplying exercises and discussing how to answer. Teachers also sometimes assign homework due to insufficient allocated learning time so that the materials have not been completely delivered as the students also learn through exercises at home.

One of the methods considered can be applied to overcome these allocated time problems is flipped classroom. The method of exchanging activities at school with at home and homework to finish can provide the students more time to study. The teachers respond positively to the flipped classroom model, considered to help the teacher deliver all the materials well and increase learning confidence. It requires students to study independently at home, guided by teachers, both directly at school and online. Therefore, the teachers are interested in applying the model in teaching mathematics. Thus, the flipped classroom model's development is carried out through six stages: plan, create a video recording, share with students, encourage students to prepare, provide in-class activities, and repeat.

The development of learning models also needs to pay attention to the needs of students in learning. It is including making learning videos that are fun and easy to understand accompanied by examples of questions and their work, as well as practice questions to find out student understanding—the selection of fun learning methods for classroom learning, such as discussions and games. At the end of the lesson, the test was done to determine students' understanding of the material after learning using the flipped classroom model.

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