How do Prospective Teachers Manage Students' Learning of Mathematics?

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Abstract **– This article describes the preferences of a prospective teacher on the management of learning mathematics in the classroom. This descriptive research involves nine prospective elementary teachers at a state university in Indonesia. Data were collected through the task of designing learning scenarios that included a variety of student ability options. Results show that they prefer to apply problem-based learning and cooperative learning and selecting choices of learning approaches mainly based on the level of student mathematical ability, instead of gender and motivation. As a suggestion, prospective teachers need to be given skills to make argumentative decisions in deciding the appropriate learning approaches.**

Keywords **– management of learning, prospective teachers, students' ability.**

1. Introduction

Classroom management is a basis for maintaining an effective school. The teacher is a classroom manager. All of them have some managerial responsibilities. Teachers lead children in the school. They also take part in the management of the whole staff in making significant decisions [1]. Classroom activities need to be well managed because they have an impact on the school management system.

Teachers are responsible for managing students, curriculum systems, learning tools and media, classroom situations, and other support for effective learning [2]. Teachers will be dealing with students with diverse cultural backgrounds, abilities, motivations, learning styles, or interests [3]. A subject matter also requires consideration in the management of learning. The material taught involves the type of knowledge to be invested. The subject matter of a lesson can be factual, conceptual, procedural, or metacognitive knowledge. All components need to be considered to make decisions using an effective learning strategy or model. The ability of teachers to manage learning in planning, implementing, assessing and monitoring learning activities is necessary to achieve the learning objectives of the curriculum [4].

Managerial skills are given when they become prospective teachers at university [5]. They are provided with materials on learning theory, psychology, student characteristics, strategies, approaches, assessments, or learning models, including substantial subjects such as mathematics. All pedagogical-knowledge and content-knowledge are effectively mixed to make decisions about choosing an appropriate, effective, and efficient, innovative learning strategy.

The purpose of this research is to describe the design of prospective teacher management in learning mathematics in the classroom.

2. Review of literature

Classrooms management

Classroom management is all the efforts directed to create an effective learning atmosphere and make students attracted which then can motivate them to learn well following their abilities [6]. Classroom management according to the old concept is a set of teacher activities to create and maintain a classroom atmosphere. The new concept of classroom

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management is a process of selecting and using appropriate tools to deal with classroom problems and situations. Classroom management is also interpreted as the ability of the teacher in facilitating all the potential of the class in the form of giving the most extensive opportunity to each person to do creative and focused activities so that the time and available funds can be utilized efficiently to conduct activities related to the curriculum and development of the students [6].

The scope of classroom management includes curriculum management, student management, academic management, and administrative management [7],[6]. Curriculum management is planning or direction to complete the curriculum. Student management is a process of activities designed and cultivated intentionally and continuously to students to follow the learning process effectively and efficiently. Management of academic activities is the management of teaching and learning activities that include preparing before teaching, carrying out teaching, assessing the learning process and students' achievement, and monitor student progress [8]. Administrative management is non-teaching activities that support the success of student learning, and the process of learning that is administrative, procedural, and organizational such as designing learning tools or other learning equipment.

The main components that tend to be dynamic management are student management and learning process management. Then, Hariri et al. [9] explain that the principles of student management are: (1) student management is part of the overall school management; (2) all forms of student management activities aimed at carrying out educational missions in order to educate students; (3) student management activities attempted to unify the diverse backgrounds of students and their differences; (4) student management activities are regulatory efforts to guide students; (5) student management activities are trying to encourage and stimulate student self-reliance, and (6) student management activities are functional for student life in the future.

Briggs and Sommefeldt [10] explained that the management of the learning process consists: planning - of curricula, learning programs or special projects to support learning; assessment - of student learning; evaluation - of the effectiveness of learning programs and teaching activities against agreed criteria; monitoring - the collection of data on the accepted principles to be used in evaluation.

Managing effective teaching and learning

Effective school management is based on effective teaching and learning management [11]. Besides, Briggs and Sommefeldt [10] illustrate how a school that is learned centered might be designed by a whole-institution focus learning outcomes. Following the arrows from the base of the diagram, consideration of the desired student outcomes guides the planning of the process and content of the learning activities, which in turn influence teaching methods and strategies. These affect how the school is structured and organized. The last link in the sequence is therefore to design the type of leadership, management, resources and culture that will adequately support the structures, the teaching, the learning and the learning outcomes. Instead of the learning outcome being the 'product' of all the elements above it in the diagram, the results shape the nature of the items above, and therefore the institution itself.

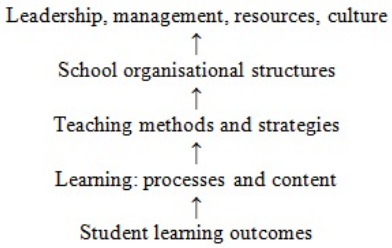

Figure 1. The learning-centered school

The activities of learning and teaching have impact of social and cultural aspects. Models of teaching are therefore strongly influenced both by the prevailing culture of the education system and the generic and particular needs of the learner [10]. Where rote learning is the norm and is an accustomed route towards understanding, it is adopted and valued; where children learn well through engagement with a practical task, this is a preferred approach; where learning a skill is commonly undertaken and assessed 'on the job' in an adult working environment, this is an appropriate model.

The activity of planning, assessment, monitoring, and evaluation are represented as a cyclical model [10].

Figure 2. Briggs and Somerfield's cyclical model

The activity in the circle is a combination of independent activities from all four aspects. Planning, which mostly occupies the cells labeled 'identify need', 'design activity', 'decide on monitoring' and 'allocate resources', is seen to depend upon the evaluation of previous activity and includes consideration of the monitoring and subsequent review processes. Assessment – of individual students – occupies only part of one cell but contributes vitally to the evaluation of student achievements a whole and the success of the curriculum venture. Assessment and its supporting activity, monitoring, permeate the whole cycle. It is the evaluation of the learning process that gives credibility to the planning cycle and, yet, as we shall see, it is often neglected.

This study focused on managing planning that contains decision-making based on the results of the identification of student conditions. However, all aspects of learning management depend on the teacher's initial plan.

3. Research methodology

This is descriptive-explorative research which aims to explore the class management according to the learning approaches or strategies based on three factors: mathematics ability, gender, and motivation. Data were collected through the task of deciding the learning approaches or strategy which considers three aspects: a variety of student ability, gender, and student motivation. As many as nine prospective elementary teachers studying at the master program on elementary education of Universitas Negeri Surabaya, Indonesia, decide to choose a learning strategy that is appropriate to those four aspects of the student's condition. Data analysis with content-qualitative analysis is including data reduction, display data, and conclusion drawing or verification [12]. The task given to the participants is presented in Table 1 as follows.

The task

The following tables indicate the condition of class that you might find in your future classroom teaching. The situation around the proportion of students regarding three aspects: students' academic ability, gender, and learning motivation.

Table 1. The task given to the participants

	student ability			
	I	II	III	IV
high	60%	10%	35%	10%
middle	20%	40%	30%	80%
low	20%	50%	35%	10%

	gender			
	I	II	III	IV
male	50%	10%	90%	100%
female	50%	90%	10%	

	Learning motivation			
	I	II	III	IV
high	40%	5%	50%	-
middle	20%	10%	50%	80%
average	30%	20%		10%
low	10%	65%		10%

Your task is to combine as many as possible of those three aspects, and then decide what learning strategies/ models/ approaches best fit with each of the combinations you make. For example, determine the learning approach for type I, I, I (more high ability students, equal male and female students, and more high motivated-students). Give your reasoning for every decision you make.

4. Results

Learning approaches/model by students' mathematical ability

The learning strategies/approaches/model selected by perspective teachers for each class are not the same. The selection is based on the combination of mathematical ability, gender and motivation. The following combination summarizes these three compositions in the class:

Learning approaches for class with more students having high mathematical abilities

Table 2. Learning approaches selected by a prospective teacher

Combination	Selected learning approach/learning strategy/Learning model
I,I,I	Discussion, games, top-down with cooperative learning, peer tutoring model, debate, constructivism with open-ended approach, inquiry, direct, peer tutoring, STAD (Student teams-achievement divisions),
I,I,II	an investigation, outdoor learning, RME (Realistic Mathematics Education),
I,I,III	Discussion, peer teaching, TPS, peer exchange, jigsaw, inquiry-discovery learning,
I,I,IV	Jigsaw, problem-based learning, STAD,
I,II,I	Cooperative learning, group investigation,
I,II,II	RME, group investigation, guided discovery lesson,
I,II,III	Cooperative learning, cooperative script method, STAD, open-ended approach, students facilitator and explaining,
I,II,IV	Expository methods, Jigsaw,
I,III,IV	TGT (Teams Games Tournament)
I,IV,III	Discovery learning,
I,III,I	Questioning and demonstration method, TGT, Jigsaw, chaining strategy,
I,III,II	RME, TAI (Team Assisted Individualization)
I,III,III	Time token,
I,IV,IV	Guided discovery
I,IV,I	Cooperative, direct, peer tutoring
I,IV,III	Cooperative, peer tutoring

Table 2 presents the summary of the prospective teachers' selection of learning approaches. The learning approaches/models include cooperative learning, namely Jigsaw, TGT, TAI, STAD, constructivism with the open-ended approach, TPS, top-down, and Group investigation, RME learning, problem-based learning, outdoor learning, and inquiry-discovery learning.

Some examples of prospective teachers 'responses in the combination of I, I, I are that this consist of more high-ability students, equal numbers of boys and girls, and students with high learning motivation. In this regards, teachers should use STAD strategy, because this strategy emphasizes the activity and interaction among students to motivate each other and help students master the subject matter in achieving expected goals. Students who have mastered the material and they can deliver the material to their friends to understand in one group. Consequently, low-ability and moderate students can be better in understanding the topics being learned and motivated to learn and who are capable of mastering higher-level learning topics. This strategy can develop student achievement, improve self-confidence, students feel more controlled for the success of achievement and can strengthen interpersonal relationships among group members.

Other results showed the prospective teachers' responses in the combination of I, I, II wherein one class consisted of high-ability students, equal numbers of male and female students, and low student learning motivation. Good learning of this combination, as summarized from prospective teachers' responses is the RME approach. This learning approach can improve students' learning motivation. By RME, learning can be more memorable because RME focuses on the use of context in the real world that makes them motivated to be involved so that it can affect student learning outcomes. In addition, there is a student response in learning in combination learning I, I, III which consists of more high-ability students, equal numbers of boys and girls, and high motivation. The learning strategy that can be used is inquiry-discovery learning because students will be able to transfer new knowledge without much interference from the teacher. Beside, each student already has high mathematical ability and high learning motivation as well, allowing students to become more active and able to find their own new strategies or ideas given by teachers with the meaningfulness of learning.

Unlike the combination classes I, I, IV where the students are in a high-ability class, the number of male and female students is balanced, and each has moderate motivation in learning. A good lesson used is a Jigsaw type of cooperative learning model. In this type, students are divided into groups of 5-6 students heterogeneously. In each group, there is a team of experts who have their respective duties to present or discuss to other groups. After that, the team of experts returns to the initial team and gives the results of their work to be discussed in the initial team. The most important reason is in the classes which consist of more students with higher mathematical ability and motivation, students in that class will be more active and challenged to take responsibility for their respective duties.

Learning approaches for class with more students having low mathematical abilities

Table 3. Students' ability responses

Combination	Selected learning approach/learning strategy/Learning model
II,I,III	RME with the open-ended approach, cooperative script, giving questions and getting the answer, STAD, performance goals
II,II,II	Cognitive apprenticeship, Roleplaying, demonstration
II,II,III	Drilling, cooperative learning, structural approach
II,III,IV	Investigation with a concrete situation, cooperative,
II,III,II	Constructivism with cognitive apprenticeship, visual and verbal
II,I,II	Group discussion, TAI
II,I,IV	Learning method with the joke
II,III,I	Scaffolding, CTL (contextual teaching and learning), NHT (Numbered Head Together)
II,II,IV	Expository with an open-ended approach
II,III,III	TGT
II,IV,II	Snowball Throwing
II,IV,III	Direct
II,IV,IV	Role-playing
II,I,I	Jigsaw
II,IV,I	Cooperative learning

Table 3 shows the responses of students' capabilities of Type II, i.e. where the number of students with low mathematical abilities is dominant. The prospective teachers view that the learning approaches/ models/ strategies that fit with this background include cooperative learning such as the types STAD, TAI, CTL, NHT, TGT, Drilling, and Jigsaw; direct learning, and Expository learning with open-ended approach.

Some of the prospective teachers 'responses in the combination of II, II, IV, the combination which includes more lower-ability students, more female students more middle motivated-students, reveals that the learning approaches that should be used is an expository with an open-ended approach, where students are given a few questions, and then they are asked to finish using their own way. Thus, each student will have different strategies in solving a particular problem in a mathematics lesson. Students with less ability given this opportunity will try to practice and solve the problem so that their motivation will be good.

Furthermore, the prospective teachers also give their response on the best learning approach for the combination of II, I, II where the class has the lower average ability, equal number of male and female students, and more low motivated students. The appropriate learning strategy, they said, is the cooperative learning model of TAI, because with this model there are stages through which students start from placement test as the basis of the teacher to know the cognitive abilities of students and the formation of teams, followed by the stage where the individual concept of planting phase must be achieved so that this will encourage each student to focus more on receiving new learning topics. Thus, each group can work on the problem posed by their teacher properly. Since low groups tend to be more anxious when learning, this strategy can reduce their anxiety in learning. This learning strategy also encourages students' active learning and makes students keep their motivation within a particular lesson.

There is also response on the combination of II, II, III where it consists of more students with low mathematical ability, more female students and the equal number of high-motivated students and low-motivated students. A good lesson in this condition is learning through structural approaches which give the teacher a concise step-by-step activity plan in which the principles of cooperative learning are combined. This is because the communication ability of female students is better than of the male students. Also, if students in the class are given many methods of learning that accentuate motor activity, then they will tend to decrease their learning motivation since the majority of them is women. So, it is necessary to use a learning method that explores their communication skills more and minimize competition among the cooperation in a group. Teachers should be extra in handling individual students because in this case, the teacher cannot rely on friends as peer tutors.

In contrast with the combination of II,II,III, the combination of II, IV, I shows a class with low student abilities, all of which are male and have less learning motivation. In this case, the recommended learning is a model of cooperative learning which is certainly supported by extra assistance from the teachers. This is because they will become active or even be passive because the majority of them are of the same sex. In this case, teachers also need individual approaches that his remain in control.

Learning approaches for class having students with high, middle, and low mathematical abilities equally

Table 4. Students' ability responses

Combination	Selected learning approach/learning strategy/Learning model
III,I,III	Drilling through easy-to-difficult questions, mind mapping, jigsaw, peer tutoring
III,III,IV	Constructivism with reciprocal teaching, crossword
III,II,III	Discovery learning, NHT, Direct
III,III,III	Learning together, Quantum learning, group investigation
III, I,II	Realistic Mathematics Education (RME), SAVI (Somatic, Auditory, Visual, Intellectual), demonstration learning
III,I,I	NHT
III,IV,IV	TGT
III,II,I	STAD, Jigsaw
III,III,I	Cooperative integrated reading and composition (CIRC)
III,IV,III	Cooperative learning with the type of Two Stay Two Stray (TSTS)
III,III,II	Information search
III,I,IV	Team game tournament(TGT)

Based on Table 4, the responses of the prospective teachers of type III indicate that appropriate learning approaches for this type include RME approach, cooperative learning, i.e. mind mapping, drilling, NHT, CIRC (Cooperative Integrated Reading Composition), jigsaw, TGT, and two stray two stay, discovery learning, demonstration learning, SAVI (Somatic, Auditory, Visual, Intellectual) learning, and quantum learning.

The prospective teachers' responses in the combination of III,II,III, the combination which includes more middle-ability students, more male students, and more high motivated-students, reveals that appropriate learning approaches accentuate constructivist learning approach with guided discovery learning. In this learning approach, students are encouraged to learn mostly through active engagement with their respective concepts, and teachers can encourage the rest to conduct experiments that enable them to discover their own principles.

Another example of combinations III, I, II is that emphasize the RME learning model [13] as a good solution in learning this condition. This is because this learning model focuses on constructive student activity, reality (meaningful learning), deep understanding, interaction in learning, and teacher guidance in finding something in learning. Besides, this condition is suitable for the number of male and female students' balanced, high-balanced, moderate, low ability, and high motivation for low-ability students to improve the quality of learning.

Different cases with the combination of III, I, I, that if in a class of students' ability to balance, the numbers of male and female students are also balanced, and high learning motivated. A suitable lesson is to use a cooperative type of Numbered Head Together (NHT) model because students are directly given the opportunity to answer and each student must understand the answer. Students who have the average ability, inevitably have to participate and thus indirectly they are forced to be able to. The teachers are dividing the group heterogeneously and assigning numbers to each student. Then proceed to ask questions and students answer the problem so that the opinions of the students in each group will be united.

While the other combinations III, IV, IV show a balanced ability, the number of male-dominated students and the students' learning motivation is moderate. In this case, good learning includes cooperative learning model of TGT type. Thus, they need to be invited to perform the tournament games that match the material being studied so that the classroom can be conditioned as well as possible.

Also, when compared with the responses of combinations III, III, IV, that showed students moderate, female-dominated and moderate motivation. Appropriate learning is learning using a constructivist approach with an inverted teaching method where the teacher divides the small heterogeneous group to create a conductive group in the classroom. In this reverse learning teachers and students interact using four strategies such as summarizing, questioning, clarifying and predicting. Teachers can also perform scaffolding methods that provide assistance to students during the early stages of learning and then students can take over responsibility if they can do so. Besides, because the class is predominantly female, providing discussions through inverted learning can reduce speaking in the classroom. This learning can also emphasize students' understanding to help improve the mastery of mathematical concepts and activities that students have already undertaken. Therefore, this model is very suitable to enhance the ability and motivation of students who are categorized as such.

Learning approaches for class with more students having middle mathematical abilities

Table 5. Students' ability responses

Combination	Selected learning approach/learning strategy/Learning model
IV,I,I	Inquiry model
IV,IV,IV	Cooperative learning: Numbered Head Together, constructivism, TPS with the open-ended approach, Think pairing sharing
IV,IV,II	Arisan method, swap places
IV,II,IV	TGT, Survey Question Read Reflect Recite and Review (SQ4R), time token
IV,I,IV	Jigsaw, inside-outside-circle, think pair and share
IV,II,II	TGT, example non-example
IV,III,III	Jigsaw
IV,III,II	Picture and picture, think pair and share
IV,III,IV	Guess the words
IV,I,III	Active knowledge sharing strategy

Based on Table 5, the responsiveness of the students' type IV skills indicates that some of the appropriate lessons are cooperative learning type NHT, constructivism, TPS, SQ4R, time token, TGT, and Jigsaw, inquiry learning, and active knowledge sharing strategy learning.

Some examples of student response results based on the above table are as follows. Combinations of IV, I, III that the majority of students are moderate, with equal numbers of men and women, and high motivation. In these circumstances, teachers should use active knowledge sharing strategies, where this strategy can keep learners active from the beginning. Also, students are directly involved in the subject matter to build interest, generate curiosity, stimulate thinking, and establish cooperation with the group in solving the problem.

Other results of combinations IV, I, IV indicate that moderate students, consisting of balanced male and female students and the motivation of students are moderate. The learning that fits into this situation is the think pair and share strategy because this strategy can give students a lot of time thinking, and mutually respond and help each other in the discussion. Besides, students can learn from other students who convey their ideas for discussion before they are delivered in front of the class so students can improve their confidence and be more active in group learning where each group consists of only two members.

Meanwhile, the responses in the combination class IV, II, II are students with moderate ability, where the class is dominated by women who have low motivation. We recommend that learning can be used cooperative learning type TGT. High student ability and low motivation will affect student learning outcomes. Therefore, learning needs to be done in tournament games so that they are more motivated in learning and the lessons in the classroom are also not boring. In contrast to the combination classes IV, III, III where the students are moderately capable, the number of students more, and the student's motivation is balanced. The lesson that can be used is a jigsaw type cooperative learning model. High student ability can be further developed by conducting discussions with peers. With a team of experts owned by each early group, students can be responsible for the material in the can. Furthermore, by discussing with friends in groups, then they will get more material and grow. As a result, learning in the classroom becomes fun because of the involvement of each student.

If a class consists of a combination of IV, IV, IV, where the students are moderate, the majority of the class consists of male students who have moderate student learning motivation. The lessons that can be used are TPS type cooperative learning and open-ended approach. Students are given more complex problems and then discussed with each pair. Students can convey their ideas to solve the problems presented by teachers in various ways so that students are more creative and find many ways.

5. Discussion

The theory of class management, according to Kompri [6], mentions that class management is divided into four aspects, namely curriculum management, student management, academic management, and administrative management. However, the results of this study only discuss academic management and student management. These two aspects of management are directly connected with how students decide the learning approach for a particular situation they meet in the class where they teach. Teachers can manage classroom activities based on model choice, type, strategy, or even through the approach used in learning. Besides, the management of a class can be seen from three factors, each covering the level of student ability, student gender, and student motivation in the classroom.

The results of this study indicate that the prospective teachers indicate their choices of learning approaches mainly based on the level of student mathematical ability, instead of gender and motivation. In other words, prospective teachers did not consider learning motivation or gender as the main factor that influences their decision making towards the learning approach. This finding can be generally seen from Tables 1, 2, 3, and 4. Each table shows the results of different students' abilities of type I (high mathematical ability), type II (low

ability), type III (equal ability), and type IV (middle ability). From these four types, the prospective teachers reveal various kinds of learning approach ranging from direct teaching to cooperative learning by considering the gender and motivation

Our findings show that prospective teachers tend to choose cooperative learning models [14],[15] for all four types of combination. For example, in type I, (i.e. the type which combines situation of I, I, IV high student ability, an equal number of men and women, and moderate motivation), the learning approach is around Jigsaw strategy, (which is included in cooperative learning model). In this type of class, students will be more active and challenged for their respective tasks if using this type of jigsaw cooperative learning. For type II, i.e. a combination of II, I, II which combines low-ability students, male and female students are balanced, and low motivation, the learning model should be considered by using cooperative learning model type TAI, because this learning is learning together by prioritizing student activity so that students' activeness is always maintained during learning. Type III is a combination of III, IV, IV consisting of well-balanced students, students in the majority class of men, and each having moderate motivation. A good lesson in this class is a cooperative learning type TGT. This is because the male students are usually often crowded in the classroom, it is necessary to perform tournaments games for male students appropriate the material being studied in the class so that the classroom situation can be conditioned as well as possible. While in type IV is a combination of IV, IV, IV that contains the ability of students are, the majority of students in the class of men, and have middle motivation. In this class, cooperative learning type of TPS can be given to students, and this is because students can convey their ideas to be able to solve problems in many ways so that students are more creative and find many other ways.

However, when viewed from several results in each of the above tables there are many methods or strategies in addition to cooperative learning. Some also use RME learning, inquiry learning, problem based learning [16], active knowledge sharing strategy learning, demonstration learning, SAVI learning, quantum learning, project based learning [17], expository learning with the open-ended approach and outdoor learning [18]. Of the many models, strategies, methods, learning, teachers can add insight into making decisions where learning is good based on the ability of each student.

6. Conclusion

In sum, this present study would highlight that in managing classroom management from the perspective of how they select learning strategies/ models/ approaches, prospective teachers tend to decide their choices mainly based on the aspect of students mathematical ability, rather than other two aspects: students' gender or students' motivation. Also, no matter how the aspect of students' mathematical ability, gender, or motivation are faced in their classrooms, the prospective teachers tend to choose cooperative learning strategy as the best learning strategy for their students. However, they indicate their wide knowledge of type's cooperative learning model, as shown by various types of cooperative learning models such as STAD, TGT, NHT, two stray two stay, or jigsaw mentioned in their response. Future research may investigate what makes prospective teachers tend to choose this learning model. Is this influenced by their background of knowledge they learned from their university or professional development? Or is this drawn from their beliefs regarding teaching mathematics?. It needs to be further confirmed.

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