Analysis of Self-Regulated Learning of Students in Mathematics Education Study Program in Number Theory Course

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Abstrak: Teori bilangan merupakan mata kuliah konten matematika pertama di prodi Pendidikan Matematika FIP UPH yang tidak memiliki kelas responsi. Kelas responsi dilaksanakan sebagai pendamping pada empat mata kuliah konten yang memiliki hubungan erat dengan konten matematika sekolah, yaitu Kalkulus 1, Kalkulus 2, Geometri, dan Aljabar Linear. Berdasarkan kuesioner yang telah disebar, calon guru matematika menilai bahwa kelas responsi sangat membantu mereka dalam mengikuti perkuliahan dan dalam mendalami konsep-konsep matematika yang berhubungan. Namun di sisi lain, dengan adanya kelas responsi maka mahasiswa mau-tidak mau harus kembali belajar sehingga belajar mereka seperti "ditentukan". Implikasinya kemandirian belajar mahasiswa tidak akan berkembang dengan maksimal. Padahal kemandirian belajar merupakan aspek penting yang perlu dimiliki calon guru. Penelitian ini dilakukan untuk melihat bagaimana kemandirian belajar calon guru matematika dalam mata kuliah teori bilangan. Instrumen penelitian yang akan digunakan adalah kuesioner, skala kemandirian belajar, dan wawancara. Penelitian ini merupakan penelitian deskriptif kualitatif karena mendeskripsikan dan menganalisis pembelajaran mandiri mahasiswa pada mata kuliah Teori Bilangan. Hasil yang diperoleh dari instrumen akan dilihat secara deskriptif dan dianalisis lebih mendalam secara kualitatif. Temuan dari penelitian ini adalah sebagian besar mahasiswa memiliki tingkat kemandirian belajar sedang. Adapun aspek atau indikator kemandirian belajar yang perlu mendapatkan perhatian khusus yaitu menetapkan tujuan/target belajar. Studi selanjutnya dapat melihat kemandirian belajar mahasiswa calon guru yang memang tidak memiliki kelas responsi. Mahasiswa calon guru perlu terus melatih dan mengembangkan kemandirian belajarnya agar kelak menjadi guru profesional yang senantiasa berkembang seiring kemajuan zaman.

Kata kunci: Calon Guru; Kemandirian Belajar; Responsi; Teori Bilangan.

Abstract: The number theory is the first mathematics content course in the UPH FIP Mathematics Education study program, which does not have a response class. The response class was conducted as a companion to four content subjects with close relations with school mathematics content, namely Calculus 1, Calculus 2, Geometry, and Linear Algebra. Based on the questionnaire that has been distributed, prospective mathematics teachers consider that the response class is beneficial for them in attending lectures and in exploring related mathematical concepts. However, on the other hand, students inevitably have to go back to learning to be determined with the response class. The implication is that students' self-regulated learning will not

develop optimally. However, self-regulated learning is an essential aspect that prospective teachers need to have. This research was conducted to see how self-regulated learning of future mathematics teachers in number theory courses. The research instruments used are questionnaires, the scale of self-regulated learning, and interviews. This research is a qualitative descriptive study because it describes and analyzes students' self-regulated learning in the Number Theory course. The results obtained from the instrument will be viewed descriptively and analyzed more deeply qualitatively. The findings of this study are that most students have a moderate level of learning independence. The aspects or indicators of learning independence that need special attention are setting learning goals/targets. Future studies can look at the self regulated learning of prospective teacher do not have a response class. Prospective teacher students need to continue to train and develop their learning independence to become professional teachers who continue to develop along with the times.
Keywords*: Prospective Mathematics Teachers; Self-Regulated Learning; Tutorial Program; Number Theory.*

Introduction

In the view of the education world, a teacher is a person who becomes a role model for students (Cheung, 2019; Lumpkin, 2013), not only in terms of thinking skills but also in terms of attitude. The way the teacher acts in the classroom also attracts students' attention. Without the teacher realizing it, students always pay attention to the teacher, such as how teachers prepare to learn, how teachers carry out and manage to learn, how teachers behave when given input, even how teachers learn. Being a teacher doesn't mean that he or she stopped learning. A teacher should have a passion continue learning (Darling-hammond, 1998; Frost, 2011; Sundari, 2017), want to continue developing him/herself, and always want to know what developments are happening around him/her. It means that a teacher is someone who continually upgrades him/herself with the zest of a lifelong learner.

Prospective teacher students are students who will be prepared to become teachers. Therefore, a student-teacher candidate needs to have self-regulated learning (Kramarski & Michalsky, 2009; Paris & Winograd, 2003) so that one day they can become lifelong learner teachers. Self-regulated learning is one of the soft skills that need to be trained in students as agents of change related to the times every day (Karimpour et al., 2018; Nursyahidah & Albab, 2018). Bandura defines self-regulated learning as an individual's ability to monitor his behavior in learning and individual effort (Hargis, 2000). Self-regulated learning is not instantaneous and can grow by itself but needs to be continuously trained and developed. For this reason, self-regulated learning needs to be fostered since teachers are still in the learning period.

Mathematics students in the UPH FIP Mathematics education study program are expected to become professional mathematics teachers under the study program's mission. As an output from this study program, mathematics teachers are expected to teach mathematics well, not only teaching procedural skills but also in basic concepts. Therefore, for courses directly related to school mathematics content, a response class is held as a companion. In a regular class, the lecturer teaches fundamental concepts and gives examples of questions, while in a response class, the assistant lecturer deepens question development. UPH Mathematics Education Study Program defines response class as an activity non-lecturing. It includes a structured academic activity as a forum for deepening material or strengthening student knowledge through practice questions, discussions, and many more (Dirgantoro et al., 2017). The aim is that students will increasingly understand the basic concepts and development of questions in the course so that later they can guide students well.

The courses that get a response class are differential calculus, integral calculus, geometry, and linear algebra. Technically, students study in a regular class for three credits and a response class for two credits. As students take those classes, they are automatically enrolled

in the response class. Response class requires students to re-study the concepts that have been discussed in the regular class and study them through a more varied range of questions, both in difficulty and in types of problems. Based on the questionnaire distributed to students, all students acknowledged that the response class was beneficial because it helped them better understand the concepts learned in class and apply them to the practice questions. Through response class, students repeat the discussion in more depth through the exercises given so that students become more trained and get to know various types of questions related to the concepts that have been explained.

Because response classes are only held for courses directly related to school mathematics material, other courses do not have response classes. The first mathematics content course that does not have a response class is Number Theory, with a weight of two credits. Most of the topics in this course are new topics for students so that they should be more excited and find out things that are new to them. In this case, it requires self-regulated learning. Self-regulated learning is one of the soft skills students need. Nursyahidah & Albab (2018) stated that students are agents of change who need provision in the form of hard skills and soft skills in order to be able to participate in competition in a world that is constantly changing every day. Prospective teacher students need self-regulated learning and also need to foster it so that their enthusiasm for learning continues to be fostered. Later, when they become teachers, these students can have the enthusiasm to continue to improve their quality.

Ardiawan's research (2016) explains that students who get response class have better Number Theory learning outcomes than students who do not get the response class. Meanwhile, Tahar & Enceng's research (2006) states that the higher the self-regulated learning of students, the better their learning outcomes. In line with this, Long & Aleven's research (2016) states that self-regulated learning can enhance students' domain-level learning outcomes. Research by Damayanti, N., Siregar, M., Harahap (2015) states a significant positive relationship between learning motivation and self-regulated learning in students. This research will look at how self-regulated learning of students who do not get response class, even though in other content classes previously students received response classes. So that a clearer and more complete picture will be obtained regarding the self-regulated learning of prospective teacher students. This study will analyze how students' self-regulated learning in the Number Theory class, whether by not having a response class, students have good self-regulated learning.

Based on this background issue, there are two problems in this study which are: do students who not get a response class have good self-regulated learning? And how is the quality of students' self-regulated learning in number theory class that does not have a response class?

Method

The research method used is a descriptive qualitative method because it describes and analyzes students' self-regulated learning in the Number Theory course, which does not have a response class. The research was conducted at Pelita Harapan University with 35 students of the 2018 Mathematics Education Study Program, consisting of 7 men and 28 women. The research subjects were selected according to the research objectives, which are students who were study number theory course.
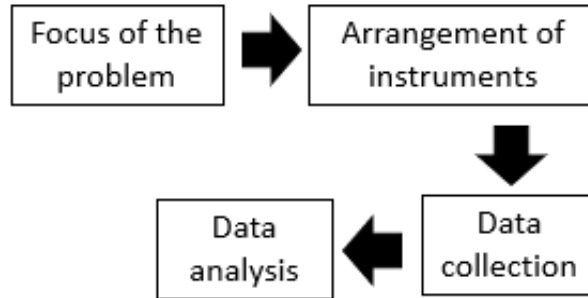
Figure 1. Research flow diagram

This study focuses on describing students' self-regulated learning in the Number Theory course. The main research instrument used is the self-regulated learning scale that has been validated and used in previous studies, where the validity of each statement is in the high and medium categories; and reliability of 0.73 (Dirgantoro, 2014), which is in the high category (Suherman, 2003). Apart from the self-regulated learning scale, other instruments used were oral interviews and written questionnaires. Indicators of self-regulated learning that will be seen in this study are: 1) learning initiatives; 2) diagnosing learning needs; 3) set learning goals/targets; 4) monitor, organize, and control learning; 5) view adversity as a challenge; 6) seek and utilize relevant sources; 7) choosing and applying appropriate learning strategies; 8) evaluate the learning process and outcomes; and 9) self-concept (Sumarmo, 2002). Data collection was carried out throughout the research in the even semester of 2019/2020. Students fill out the self-regulated learning scale and written questionnaire, and carry out oral interviews at week 15, before taking the final exam. After the data is obtained through these three instruments, the next step is to process and analyze the data results to answer the problem formulation in this study. Data analysis was carried out in the following steps (1) reducing data by checking and re-recording the collected data (2) interpreting, namely interpreting what is manifested in the form of a statement (3) making inference, namely seeing the level of student learning independence (based on the self-regulated learning) (4) making conclusions, based on the analysis of the results of interviews and questionnaires tailored to the research objectives then interpreted in the form of a statement.

Due to time research constraints, this study's limitation is that it only examines students of the 2018 Mathematics Education Study Program.

Findings and Discussion

Students were distributed questionnaires regarding their readiness to take the Number Theory course without a response class in the first week of Number Theory class. The results obtained based on the questionnaires are:

- First, as many as 75%, most students feel anxious when they find out that the Number Theory course does not have a response class. The reason is that they are afraid of not understanding and not being able to follow the lesson correctly if there is no guidance in working on practice questions. In the response class, the questions discussed were many and varied so that students were worried that in the number theory class, there were only a few examples of questions that could be discussed in the theory class. There is less time to

deepen the content in class because most of the time is used to discuss theories, so there is not enough time to discuss any questions. Budiman & Suryakancana's research (2018) shows a negative correlation of math anxiety on students' self-regulated learning. When the level of students' anxiety is high, their self-regulated learning tends to below.

- Second, most students, as many as 69.4%, agreed that their learning method would change in the absence of a response class. Students stated that they should be more active in self-regulated learning. Research by (Yuliana, 2018) and (Fauzan, 2019) provides results that self-regulated learning significantly affects student activity. It means that to generate active learning, student-teacher candidates also need to develop their self-regulated learning.

- Third, although there is no response class, 72.3% of students believe they will pass the number theory course. Students have the confidence to be able to follow number theory courses well even without response classes. Pratiwi & Laksmiwati's research (2016) state that there is a positive correlation between self-confidence and self-regulated learning. It means that the higher the level of student self-confidence, the higher the level of self-regulated learning.

- Fourth, most students plan to use specific strategies such as being more diligent in reading the material; repeat the material that has been learned in class; and more practice questions in spare time. Besides, they immediately ask for help from friends, seniors, or lecturers to teach if something is not understood; and do a self-study by looking for other sources (borrow books from the library or via YouTube videos); or study with friends. It means that students already have the initiative in planning their learning activities.

Students' answers to the initial questionnaire indicated that they were quite ready to take the Number Theory course, the first content course without a response class. Points 2, 3, and 4 show that students are confident and believe that they will be more independent in their future studies.

Students carry out a face-to-face Number Theory course for 16 meetings where there is a mid-term and final exam in the 8th and 16th weeks. Before the final exam, students were asked to fill in the self-regulated learning scale at the end of the learning activities (week 15). The following table shows a descriptive score of students' self-regulated learning for prospective teachers.

Table 1. Descriptive Self-regulated Learning Score

Self-regulated Learning	Score
Number of students	35
Mean (average)	75,91
Deviation standard	10,714
Minimum score	58
Maximum score	105

The interpretation of the students' self-regulated learning scores is normative. (Azwar, 2013) states that normative means the score obtained is referred to in the score relative to a norm so that the measurement results in the form of numbers (quantitative) can be interpreted

qualitatively. The normative references used to interpret student self-regulated learning in this study are as follows:

Low   : $X<(\bar{x}-s)$
Middle : $(\bar{x}-s)\leq X<(\bar{x}+s)$
High   : $(\bar{x}+s)\leq X$

By using the formula above, the following grouping results are obtained below:

Table 2. Results of Self-regulated Learning Score Grouping

Group	N	Percentage (%)	Mean
Low	6	17,1	60,33
Middle	24	68,6	76,25
High	5	14,3	93

From Table 2, it can be shown that more than two-thirds of students fall into the moderate category. The next table shows the mean score for each self-regulated learning indicator where the minimum score = 1 and the maximum score = 4.

Table 3. Mean Score of Self-regulated Learning Indicators

Self-regulated learning indicators	Mean
Learning initiatives	2.68
Diagnosing learning needs	3.06
Setting learning goals/targets	2.29
Monitoring, organizing, and controlling learning	2.63
Viewing adversity as a challenge	2.68
Finding and using relevant sources	2.83
Choosing and implementing the right learning strategy	2.54
Evaluating the learning process and outcomes	2.96
Self-concept	2.63

Based on Table 3, only one of the nine indicators scored above 3, while the other eight indicators scored less than 3. From the data table above, it also appears that the indicator with the highest score is diagnosing learning needs. Students have enough to understand the extent of their learning needs, where they need help from their colleagues/lecturers, ask themselves

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questions to confirm their understanding, and provide additional time to study more challenging material. The indicator that has the lowest score is in setting learning goals/targets. Students are still lacking in setting goals/targets to be achieved before learning Number Theory, and most students often study to get good grades. It means that students do not understand the true nature of learning.

Based on the results of interviews with the students, several things become obstacles in developing their self-regulated learning, which are:

1. Inconsistency in adhering to the learning schedule that has been made because there are other activities. Students at FIP UPH are full scholarship students who live in the dormitory. It causes quite a lot of activities that need to be done outside of lectures. Students said it was difficult to divide their time between studying and carrying out other activities. Nevertheless, students need to go back to learning about time management. (Sunarya et al., 2017) state that students need to be trained to be able to manage and make the best use of their time so that the goals that have been set can be achieved. The way is to arrange a schedule of activities, determine priority scales, and evaluate what has been done. It is because self-regulated learning is an active process in which students set their goals and then try to monitor their efforts to achieve these goals (Saija, 2018; Wolters et al., 2003).

2. Still maintains that studying is only when there are demands: assignments, quizzes, exams; laziness to repeat learning again without being prompted; and learning by mood. It can happen because students do not realize the essence of learning. Learning should not only be for short term goals but long term goals. Prospective teacher students need to remember that one of the competencies a teacher needs is professional competence. It means that prospective mathematics teachers also need to master these competencies. Professional competence for a mathematics teacher is to master school mathematics material and then package it properly so that students are interested in learning it (Dirgantoro, 2018). It is possible when students prepare and train themselves to sharpen mathematical concepts.

3. Have a fear of being wrong and not confident when they come across difficult content. It emerges from students' past experiences as they become students in a school who feel underappreciated when making mistakes. It raises math anxiety in student-teacher candidates. Mathematical anxiety is a feeling of discomfort, which is like fear and worry when facing a math problem (Dzulfikar, 2016). Mathematical anxiety among student-teacher candidates needs to be scrapped gradually so that in the end, they are ready to become mathematics teachers who can work and educate students.

Constraints experienced by students can become obstacles in the process of developing student learning independence. This is in line with Schraw & Brooks' research (Samo, 2016) that students can show gradual progress in terms of independence if they follow four steps, namely: (1) taking enough time and continuing to try even though challenges arise during the learning process; (2) develop integrated basic knowledge; (3) developing appropriate strategies in learning mathematics; and (4) believe that they will succeed if they are able to pass the three previous steps.

Based on the self-regulated learning scale score, which is still in the medium category, students still need to improve their self-regulated learning. It needs to be trained and developed continuously. Several previous studies stated that:

1. Yang (Hargis, 2000) stated that learners with a high degree of self-regulated learning tend to learn better under their control; can monitor, evaluate or organize their learning effectively; save time in completing tasks; and manage learning time efficiently.

2. Self-regulated learning is indispensable in the learning process (Duckworth et al., 2009; Järvelä & Järvenoja, 2011), and mathematics learning is no exception.
3. Yang (Duckworth et al., 2009; Hargis, 2000; Samuelsson, 2008; Sumarmo, 2002) stated that there is a strong relationship between self-regulated learning and mathematical achievement.

Therefore, self-regulated learning is an important aspect that needs to be trained and continuously developed, considering that it refers to how students become masters in their learning process (Zimmerman, 2015).

Bandura (Hargis, 2000) states that self-regulated learning is an individual's ability to monitor their behavior, and is an individual challenging exercise. It means that self-regulated learning results from an active and constructive process for a learner to monitor their learning activities. Prospective student teachers who have good self-regulated will develop into a teacher who is sensitive to their students' times and needs.

Self-regulated learning is not an academic ability or student talent inherited by learners genetically (Sumarmo, 2002). However, self-regulated learning can be trained and taught to students so that this ability is possible to be developed. Duckworth et al. (2009) argue that self-regulated learning can be developed and enhanced through appropriate teaching, guidance, and support. For this reason, the lecturer needs to help and guide students to continue training and developing their self-regulated learning. De Corte et al. (Darr & Fisher, 2005) claimes that learning which can develop self-regulated learning is learning, which uses settings in small and classical groups, as well as learning that provides realistic and challenging tasks. It follows the suggestions proposed by Schunk (Sumarmo, 2002) to help students become independent in learning. Nevertheless, above all, a prospective teacher, especially a Christian teacher, needs always to give his life to be led by the Holy Spirit so that he can continue to grow to become a tool for God's work in the world (Chrismastianto, 2018).

Conclusion

The conclusions of this study are: first, most students (68.6%) have a moderate level of learning independence, students are still in the transition and adjustment stage to be more independent in learning. Second, the quality of student learning independence of prospective teachers needs to be continuously trained and developed, especially in the indicators of setting learning goals/targets so that in time they can become professional mathematics teachers.

Recommendations for further research are to continue to review the scale of self-regulated learning under the context of the research subject. This research can also be continued to study students' self-regulated learning in subsequent courses after students are accustomed to attending lectures without response classes.

Gratitude Greetings

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