Influence of contextual-metacognitive on Self-Regulatory Strategies students in math IV

N Nanang* and I Purnamasari
Department of Civil Engineering, Sekolah Tinggi Teknologi, Garut, Jawa Barat, Indonesia

*nanang@sttgarut.ac.id

Abstract. The problem in this study is the low Self-Regulatory Strategies (SRS) of students in Mathematics IV. The purpose of this study is to determine the differences in SRS between students who get a contextual approach with a metacognitive strategy (PKM), contextual approach (PKT), and conventional approach (PKV). This research is an experiment. The subjects in this study were students of Civil Engineering STT Garut semester 4 of 2018 which consisted of three classes (groups). The experimental group-1 was given PKM, the experimental group-2 was given PKT, and the control group was given PKV. The instrument used was a SRS scale based on a Likert scale. Data analysis was performed with ANOVA test. The main results of this study are students who get PKM and PKT significantly better SRS than students who study with PKV. Based on these results, the researcher proposes: (1) the PKM and PKT approaches should continue to be developed and used as an alternative choice for lecturers in Mathematics IV daily lectures and (2) the application of the PKM and PKT approaches becomes input material for policy makers to develop intelligence potential college student.

1. Introduction
Lectures on campus are expected to develop all the potential intelligence possessed by students to support the nation’s competitiveness in the future. One of the ways to improve the nation's competitiveness is to produce graduates who are qualified, skilled, professional, capable of lifelong learning, and have life skills that can help themselves in facing various challenges and changes. The knowledge possessed by students makes it possible to be of benefit to people's lives at large. Such conditions will certainly affect the pride and self-esteem that students will get in social life [1].

Lectures on campus that have the potential to achieve life skills are one of them is Mathematics lectures. Mathematics does have many benefits in everyday life, but because mathematics has a fairly abstract nature so it is difficult to be able to apply mathematics in everyday life if we are only educated graduates (who generally only know the theory, not many applications yet). Mathematics is not only applied in the life of a professional mathematician, but mathematics is also often used by a doctor, electronic engineer, programmer, civil engineer, mechanical engineer, economist, accountant, manager, and many other experts in the field [2].

But in reality, the average value of Mathematics, especially the value of Mathematics IV for Civil Engineering students of STT Garut has not been satisfactory. How should mathematics be approached? Is mathematics science? Is that a set of skills to memorize? Can mathematics study be integrated more deeply into classical education? [3]. For that matter, the writer tries IV Mathematics lectures starting
with the introduction of problems that are appropriate to the situation (contextual problem). According to the CTL (Contextual teaching Learning) learning approach that combines subject matter with the daily direct experience of students in their environment, this learning concretely involves "hands - on and minds - on" activities, ie learning that is directly experienced and remembered by students. In contextual learning, the delivery of material is in a context that is appropriate to the environment and is meaningful to students [4].

CTL is a learning strategy that emphasizes the process of full student involvement to be able to find the material being studied and relate it to real life situations so that it encourages students to be able to apply it in their lives [5]. This shows that CTL is a teaching system that is based on the reason that understanding emerges from the relationship between content and context. Context gives meaning to the content. Thinking more about content can be achieved if given a broader context within which students can make connections. So an important part of lecturer work is to provide context. The concept of contextual lectures involves seven main components of lectures, namely constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment [6].

In lectures that develop Self Regulated Strategy (SRS), the selection of lecture approaches must be able to activate students in their thought processes. The approach to the problem is closely related to how accurately someone assesses the knowledge he has and uses it in order to control cognitive processes, hereinafter referred to as metacognitive processes. So it can be concluded that the metacognitive process is an individual’s awareness of his own thought process and his ability to control the thought process [7]. Regarding the evaluation in this study are students who organize themselves (strategic students) as follows: (a) Using various cognitive strategies, (b) Regulate metacognition, (c) Bringing beliefs and adaptive motivational emotions, (d) Planning and controlling time, (e) Participate in choices, controls and regulations, and (f) Create a strategy aimed at avoiding external and internal interference [8].

Metacognition is the ability to realize, know, the process of cognition that occurs in yourself and is the ability to direct the process of cognition that occurs in yourself. So it can be said that metacognitive plays a role in shaping individual character [9]. Teaching and learning processes that support metacognitive learning are constructivism. Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of "mental construction." In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context of ideas, as well as by students’ beliefs and attitudes. Constructivism is a learning theory found in psychology which is different from how people might acquire knowledge and learn. It therefore has a direct application to education. The theory suggests that humans construct knowledge and meaning from their experiences. Constructivism is not a specific pedagogy. Piaget's theory of constructivist learning has had a wide ranging impact on learning theories and teaching methods in education and is an underlying theme of many education reform moves. Research support for constructivist teaching techniques has been mixed, with some research supporting these techniques and other research contradicting those results [10].

Metacognition strategies such as: (1) Predicting outcomes; (2) Evaluating work; (3) Questioning by the teacher; (4) Self-assessing; (5) Self-questioning; (6) Selecting strategies; (7) Using directed or selective thinking; (8) Using discourse; (9) Critiquing; and (10) Revising. Mognition involves choosing the best way to approach learning. Students with good metacognitive skills can set goals, organize their activities, choose among various learning approaches, and replace those strategies if needed [11].

Based on the description above, the author tries to develop a contextual lecture model with the metacognitive strategy as follows:

- Introduction, where the main lecture activities at this stage are as follows: 1) Lecturers and students form groups (learning communities), 2) Lecturers inform their tasks and how to do them, and 3) Training how to learn in groups;
- Discussion, where the lecturer presents contextual problems with the following learning atmosphere: 1) The lecturer motivates students' curiosity about the topic to be studied, 2)
Presents contextual problems, 3) Understands contextual problems, 4) Solves contextual problems, 5) Comparing and discussing answers, and 6) Inferring:

- Independence, where after students understand the concept, students work independently to solve practice questions;
- Reflection and summarize, where the lecturer together with students reflect. Lecturers give questions directly to students randomly about what interesting things students get from lectures. If the problem solving process is correct, then the lecturer asks students questions, for example: what if ...? Is there another way? Try to do it another way! Furthermore, the lecturer reflects what students have learned. The lecturer reviews the newly learned concept, then directs students to summarize the subject matter that is considered important.

Another thing to consider in the application of contextual lectures with metacognitive strategies is the problem of SRS or student strategy in self-regulation. One of the learning skills that has an important role in determining success in higher education is the ability to self-regulate learning or also called self-regulated learning [12]. Students who have a strong and positive SRS are able to determine their own learning goals, are able to determine the targets to be achieved, get their own social support in order to be successful, conduct self-evaluations, and monitor their learning activities. SRS is one of the factors contributing to the success of student learning. closely related to how students can regulate themselves in learning. While student activities in SRS are as follows.

When students take initiative and regulate their own learning, they gain deeper insights into how they learn, what works best for them, and, ultimately, they perform at a higher level. This improvement springs from the many opportunities to learn during each phase:

- In the planning phase, students have an opportunity to work on their self-assessment and learn how to pick the best strategies for success;
- In the monitoring phase, students get experience implementing the strategies they chose and making real-time adjustments to their plans as needed;
- In the reflection phase, students synthesize everything they learned and reflect on their experience, learning what works for them and what should be altered or replaced with a new strategy [13].

The SRS components are indicators in the preparation of the "SRS Scale". These indicators include: 1) Planing, namely determining learning goals, diagnosing learning needs, and finding learning resources; 2) Monitoring: monitoring attention, monitoring thinking, monitoring time use; and 3) Arrangement (Regulating): regulate learning, arrange work on assignments, arrange work on examinations.

This study aims to apply contextual lectures with PKM and examine their influence on SRS in terms of campus categories and students’ initial Mathematics IV knowledge. To determine the effect of PKM on student SRS, the authors formulate the problem in this study as follows: Are there differences in student SRS in Mathematics IV lectures between students who get PKM, PKT, and PKV?

2. Methods
This research is an experimental study with a research design:

```
A       X1       O
A       X2       O
A       O
```

Information:
X1: Application of PKM
X2: Application of PKT
O: SRS scale measurement
A: Random grouping of subjects.
The grouping of students is based on the results of the final Mathematics III exam. The research subjects were all Civil Engineering students who contracted Mathematics IV in 2020 which consisted of three classes. Class A as many as 32 students get the PKV approach, Class B as many as 34 students get the PKT approach, and class C as many as 28 students get the PKM approach.

3. Results
The study will reveal comprehensively the quality of SRS students among students who obtain PKV, PKT, and PKM in Mathematics IV. Students fill in the SRS scale sheet after all lectures before the Midterm Examination is complete. The SRS scale sheet provides SRS scale data with summaries as shown in Table 1.

Table 1. Mean and standard deviations from the combined SRS data.

| Group | N  | Average | Standard Deviation | Minimum Score | Maximum Score |
|-------|----|---------|--------------------|---------------|---------------|
| PKV   | 32 | 82,4    | 7,91               | 54,00         | 117,00        |
| PKT   | 34 | 99,7    | 8,76               | 64,00         | 148,00        |
| PKM   | 28 | 102,7   | 6,61               | 66,00         | 151,00        |

Note: The ideal score on the SRS scale is 167

Table 1 illustrates that the SRS mean score of PKM group students is higher than the PKT and PKV groups. While the mean SRS score of PKT students was higher than PKV groups. The standard deviation for each group is relatively the same. This study uses the Kruskal-Wallis statistical analysis to find out whether or not there are significant differences. A summary of the results of the Kruskal-Wallis calculation is presented in Table 2.

Table 2. SRS difference test based on the lecture approach.

| Scale | Chi-Square | Df | Asymp. Sig. |
|-------|------------|----|-------------|
|       | 59,206     | 2  | 0,000       |

From Table 2, the calculated value = 59.206 is greater than the value \( \chi_{krit}^2 = \chi_{(2,0.05)}^2 = 5.991 \). This means that Ho is rejected, in other words there are significant differences in SRS scores between students studying with the PKV, PKT and PKM approaches on the combined data. So it can be concluded that SRS PKM group students are better than PKT and PKV groups. While the SRS mean score of PKT group students is better than PKV group.

The Scheffe test results shown in table 3 are to find out which lecture approach is significantly different in SRS students.

Table 3. Scheffe test SRS average score based on the lecture approach.

| Approach (I) | Approach (J) | Mean Difference (I-J) | Std. Error | Sig. | Ho |
|--------------|--------------|-----------------------|------------|------|----|
| PKV          | PKT          | -17,37111             | 2,64518    | 0,000| Reject |
| PKT          | PKM          | -20,30134             | 2,64518    | 0,000| Reject |
| PKM          | PKV          | 17,37111              | 2,64518    | 0,000| Reject |

In Table 3 it can be seen that the probability value (sig.) For each pair of lecture approaches is smaller than \( \alpha = 0.05 \), it can be concluded that the SRS of students who get PKM is significantly different from students who get PKT and PKV. Likewise, SRS for students who received PKT were significantly different from students who received PKV.

While the results of previous studies reveal that (a) general learning behavior is promoted by metacognitive strategies mediated by self-efficacy and (b) cognitive strategies are almost directly
influenced by monitoring strategies. Current studies reveal that general learning behaviors and cognitive strategies involve processes that are different from metacognitive strategies [14].

4. Discussion
This study produced several findings about the SRS of students in Mathematics IV lectures which were analyzed based on the group approach to lectures, campus categories, and Mathematics IV initial knowledge. The results showed that based on the group approach to lectures, SRS students on the PKM approach were significantly higher than students who obtained the PKT and PKV approaches. Likewise, SRS for students who obtained the PKT approach was significantly higher than students who obtained PKV. The average SRS score on PKM lectures was 102.66 (61.5%) from the ideal score of 167, the PKT approach was 99.73 (59.7%), and the PKV approach was 82.36 (49.3%). The SRS group of students in Mathematics IV is based on the average percentage score of the ideal score (S), with the following conditions:

\[
\begin{align*}
S \geq 80\% & : \text{Students have a high strategy} \\
60\% \leq S < 80\% & : \text{Students have a moderate strategy} \\
S < 60\% & : \text{Students have a low strategy}
\end{align*}
\]

Based on the above grouping, the SRS students who get the PKM approach are in the medium classification, while SRS students who get the PKT and PKV approaches are in the low classification.

All this illustrates that the PKM approach has more influence on the SRS compared to the PKT and PKV approaches. The PKM approach gives more opportunities for students to evaluate a situation or problem by identifying things that are needed, conducting investigations, exploring, solving problems, reflecting, and active lecturers asking questions if there are students or study groups who have a deadlock in solving problems in order to arrive at the correct final solution. All of them train students to have SRS skills. This shows that independent learning with the Self-Regulatory Strategic Self Learning model can form a new perspective in strategy research [15].

5. Conclusion
Based on the results of the analysis, findings, and discussion in the previous section, there are differences in the SRS of students in Mathematics IV lectures between students who get PKM, PKT, and PKV. SRS students in Mathematics IV who obtain the PKM approach are better than the PKT and PKV approaches. SRS students in Mathematics IV learning who get a PKT approach are better than PKV. SRS students who get the PKM approach are in the medium classification, while SRS students who get the PKT and PKV approaches are in the low classification.

Acknowledgment
The authors acknowledge Sekolah Tinggi Teknologi Garut is the funder for this research.

References
[1] Utama W 2008 8 Manfaat Kuliah Sampai ke Perguruan Tinggi
[2] Gusmawan T 2015 Penerapan Matematika Dalam Kehidupan Sehari-hari
[3] Treloar T 2012 The Purpose of Mathematics in a Classical Education
[4] Jumiatin E K 2015 Penerapan Metode Ctl (Contextual Teaching And Learning) Dalam Meningkatkan Pemahaman Perkalian Dasar Mapel Matematika Pada Siswa Kelas Ii Semster Ii Sd N Tutup Kecamatan Trangkil Kabupaten Pati Tahun Pelajaran 2014/2015
[5] Nanang N and Sukandar A 2020 Meningkatkan Kemampuan Siswa SDIT Miftahul Ulum Pada Operasi Bilangan Bulat Melalui CAI-Contextual Mosharafa J. Pendidik. Mat. 9 71–82
[6] Ratnawati R and Nanang N 2014 Perbedaan Kemampuan Pemecahan Masalah Matematik antara yang Menggunakan Pembelajaran Kontekstual dengan Problem Based Learning di Mts Al-Mu’amalah Garut Mosharafa J. Pendidik. Mat. 3 43–54
[7] Alifiani A 2015 Mapping Mathematics Untuk Menganalisis Proses Metakognitif Siswa Dalam Memecahkan Masalah Aljabar J. Pendidik. Mat. 1 22–32
[8] González-Torres M C and Torrano F 2008 Methods and instruments for measuring self-regulated learning Handb. Instr. Resour. their Appl. Classr. 201–19
[9] Kusuma A S H M and Nisa K 2019 Hubungan Keterampilan Metakognitif Dengan Hasil Belajar Mahasiswa S1 PGSD Universitas Mataram Pada Pembelajaran Menggunakan Pendekatan Konstruktivisme J. Ilm. Profesi Pendidik. 3
[10] Bada S O and Olusegun S 2015 Constructivism learning theory: A paradigm for teaching and learning J. Res. Method Educ. 5 66–70
[11] Muhaili 2015 Meningkatkan Kesadaran Metakognisi Melalui Strategi Pembelajaran Metakognisi pada Pembelajaran Kimia di Sekolah Menengah Pros. Semin. Nas. Pendidik. Sains Tahun 2015
[12] Daulay S F and Rola F 2009 Perbedaan self regulated learning antara mahasiswa yang bekerja dan yang tidak bekerja Fak. Psikologi. Univ. Sumatera Utara
[13] Ackerman C 2019 What is self-regulation?(+ 95 skills and strategies) Posit. Psychol. Progr.
[14] Akamatsu D, Nakaya M and Koizumi R 2019 Effects of metacognitive strategies on the self-regulated learning process: The mediating effects of self-efficacy Behav. Sci. (Basel). 9 128
[15] Habók A and Magyar A 2018 Validation of a self-regulated foreign language learning strategy questionnaire through multidimensional modelling Front. Psychol. 9 1388