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Analysis of Students' Academic Self-Concept and Metacognitive Skills in Problem-Based Learning in Senior High School

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Abstract: The study is grounded on the significant role of psychological factors such as academic self-concept and metacognitive skills in achieving success in mathematics learning, particularly in the 21st-century education era. This study aims to describe the condition of students' academic self-concept and metacognitive skills in mathematics learning through Problem-Based Learning (PBL) at a senior high school in Denpasar. This research employed a descriptive method with data collected through observation, interviews, and questionnaires. The observations revealed that although teachers implemented PBL and included social-emotional competencies in the teaching module, the implementation remained normative without concrete strategies, such as self-regulation techniques like S.T.O.P. Preliminary data showed that students' average academic self-concept score was 3.01 (moderate category), while metacognitive ability scored 3.36 (moderate category). Field findings indicated: (1) students were passive when facing problems, (2) reluctant to participate despite being capable, (3) difficulties in explaining strategy choices, (4) dominance of high-achieving students during discussions, and (5) limited error reflection. These findings indicate weaknesses in academic confidence, perceived competence, and metacognitive regulation, including planning, monitoring, and evaluation. The results highlight the need for PBL integration with social-emotional strategies and self-regulation techniques to enhance students' academic self-concept and metacognitive skills.

INTRODUCTION

The 21st century education requires students to not only master academic content, but also develop a variety of non-cognitive competencies that support long-term learning success. These non-cognitive competencies include motivation, self-regulation, academic self-concept, and metacognitive skills. According to Marsh (1990), academic self-concept is an individual's representation of their academic abilities, which plays an important role in shaping motivation, attitudes toward learning, and subsequent academic achievement. Students with a positive academic self-concept tend to have stronger self-confidence in facing learning challenges and

are more achievement-oriented (Marsh, 1990). On the other hand, metacognitive skills, as defined by Flavell (1979), include awareness and regulation of one's own thinking processes, which enable students to plan, monitor, and evaluate their learning strategies. These abilities have been proven to be one of the strongest predictors of improved academic outcomes because they help students become reflective, independent learners (Schraw & Dennison, 1994). Thus, the challenge of modern education is not only to emphasize how much knowledge students can absorb, but also how students are able to build positive beliefs about themselves and manage their thinking processes effectively.

Longitudinal research by Marsh and colleagues found that the reciprocal relationship between academic self-concept and academic achievement is significant, whereby past achievement influences the development of self-concept, and self-concept also predicts future achievement (Marsh & Martin, 2011). However, several studies show that academic self-concept tends to decline when students enter upper secondary school (high school), due to social changes, increased academic demands, and differences in the learning context (school, teachers, peer environment). For example, a study by "Academic Self-Concept Dramatically Declines in Secondary School" on a large sample ($n \approx 7{,}379$ students) found that in the transition from elementary school to junior high/high school, there was a significant decline in students' academic self-concept (Postigo et al., 2022).

Meanwhile, metacognitive skills is an ability that includes awareness, regulation, and evaluation of one's own thinking processes (planning, monitoring, evaluation), which is recognized as an important factor that enables students to manage their own learning processes, improve learning strategies, and enhance academic outcomes. Research by Garzón et al (2020), shows that students with high metacognition tend to have better academic achievement, where aspects such as cognitive regulation and monitoring are known to be significantly related to academic grades.

In the context of the Problem-Based Learning model, it has emerged as a promising approach to improving students' metacognitive skills and affective aspects, including academic self-concept. PBL requires students to work starting

from real problems, problem solving, collaboration, reflection, self-evaluation, and presentation, all of which involve metacognitive components. International studies show that the application of PBL can significantly improve metacognition—for example, Sutarto et al (2022), in the article "The Effect of Problem-Based Learning on Metacognitive Ability in the Conjecturing Process of Junior High School Students" found that PBL significantly improved metacognitive skills compared to conventional methods in junior high school students in the process of mathematical conjecture.

However, despite the abundance of research on PBL and metacognition, as well as studies examining the relationship between academic self-concept and achievement, there are gaps in the literature in several aspects, including the lack of research that simultaneously measures and analyzes PBL, metacognition, and academic self-concept in high school. Many studies focus on only one or two constructs (e.g., PBL with metacognitive skills, or self-concept influencing achievement or vice versa), but few combine all three. The next aspect, the cultural context and education system of developing countries, including Indonesia, has been relatively little explored in depth, especially in the high school setting. This is because self-concept and metacognition can be greatly influenced by culture, social norms, and academic literacy in schools. The next aspect is that adequate longitudinal or long-term experimental research designs are needed to observe changes in academic self-concept and metacognitive skills over time through PBL interventions, requiring studies with periodic measurements and robust control designs. For example, the meta-analysis Self-Concept and Academic Achievement: A Meta-Analysis of Longitudinal Relations shows a moderate positive correlation between past self-concept and subsequent achievement (and vice versa) in longitudinal samples.

Research by Efklides & Tsiora (2002) on metacognitive experiences, self-concept, and self-regulation suggests that metacognitive experiences (e.g., feelings of difficulty, estimation of the correctness of answers, and efforts made) are related to the formation of mathematical self-concept and self-regulation. However, this research was conducted on a younger population and was not specific to the PBL

setting in high school. Based on these conditions, the researchers were interested in conducting this study with the aim of describing the academic self-concept and metacognitive skills of students in Problem-Based Learning implemented in a high school in Denpasar.

RESEARCH METHODS

This study uses a quantitative approach with a descriptive design. This approach was chosen because the main objective of the study was to analyze students' academic self-concept and metacognitive skills in the context of implementing a project-based learning (PBL) model at the senior high school level. The descriptive design allowed researchers to obtain an empirical picture of the level of students' academic self-concept and metacognitive skills.

The subjects of this study were tenth-grade students from a private high school in Denpasar, who were selected purposively on the basis that students at this level already had more complex learning experiences and were beginning to engage in project-based learning activities. The sample size was 47 students, obtained through cluster random sampling based on class.

The data collection techniques used were observation, interviews, and questionnaires. The research instruments consisted of two types of questionnaires. First, an academic self-concept questionnaire adapted from the Self Description Questionnaire (SDQ) developed by Marsh (1990), which has been widely used to measure students' perceptions of their academic abilities. This questionnaire uses a 5-point Likert scale with indicators including academic self-confidence, perceptions of achievement, and attitudes toward learning. Second, the metacognitive ability questionnaire was adapted from the Metacognitive Awareness Inventory (MAI) developed by Schraw & Dennison (1994), which covers two main dimensions, namely metacognitive knowledge (declarative, procedural, conditional knowledge) and metacognitive regulation (planning, monitoring, evaluating). The data on academic self-concept and metacognitive ability obtained were analyzed using descriptive statistics. Descriptive statistics

were used to describe the profile of students' academic self-concept and metacognitive ability through mean values and category distributions.

RESULTS AND DISCUSSION

When researchers conducted in-depth interviews with mathematics teachers at schools, it was revealed that in mathematics learning at school, teachers had implemented the Problem-Based Learning model, whereby at the beginning of the lesson, teachers presented contextual problems (routine contextual questions) related to the material to be taught, then asked students to understand the material based on these problems, followed by group discussions and group presentations. The teaching modules developed by teachers included social-emotional competencies, but these were only listed in the syntax or learning steps for both teachers and students. There is no detailed explanation or alternative actions that teachers can take to achieve these social-emotional competencies (such as the S.T.O.P. technique in self-management). In teaching, teachers use several strategies to improve students' academic self-concept, such as pairing students with lower abilities with students with higher abilities and arranging special groups. These things are only done by teachers on a situational and conditional basis.

Based on the results of classroom observations, several student conditions were also found, including 1) there were students who tended to be passive when faced with problems and tended to wait for instructions from the teacher, 2) there were students who were shy about raising their hands to answer questions from the teacher, even though when called on by the teacher, they were able to provide answers and explanations, 3) some students were sometimes confused and had difficulty when asked to explain the reasons behind the strategies or methods they used to solve problems, 4) during group discussions, there were students who were highly capable but were selfish in sharing their knowledge and teaching other students in the group, and 5) only a few students reflected on the mistakes they made because they were more focused on the final result than on the thinking process.

The results of observations 1 and 2 show that there are students who tend to be passive when faced with problems and wait for instructions from the teacher, as well as students who are shy about raising their hands to answer questions even though they are able to provide answers when called on. These two phenomena reflect weaknesses in certain aspects of academic self-concept as described by Marsh (1990) in the Self-Description Questionnaire (SDQ) framework, which includes five indicators: academic confidence, perceived competence, motivation and interest in learning, pride in achievement, and reaction to failure.

The first finding, that students tend to be passive and wait for instructions from the teacher, indicates low academic confidence and perceived competence. Low academic self-confidence makes students less confident in their ability to start solving problems independently, so they prefer to wait for instructions from the teacher. This is in line with Marsh's (1990) opinion that students with low academic self-concept often doubt their ability to complete academic tasks. Research by Q. Wang & Pomerantz (2009) also found that students with low self-concept tend to avoid active involvement in learning due to a lack of confidence in their success.

Meanwhile, the second finding, that students are shy about raising their hands even though they are actually capable of answering, also indicates weak academic confidence that affects participation in class. Shyness in demonstrating ability can inhibit the expression of academic competence, thereby limiting active involvement in discussions. This is also reinforced by research by Valentine et al (2004), which found that academic self-concept has a significant relationship with active participation and academic achievement; students with low self-concept are more likely to avoid involvement even though they have cognitive potential.

In addition to low academic self-concept, the results of classroom learning observations also showed a number of student behaviors that indicated low metacognitive skills, particularly in the aspects of metacognitive knowledge and metacognitive regulation, as stated by Flavell (1979). According to Flavell (1979), metacognition includes an individual's knowledge of their own thinking processes and the ability to control those processes through planning, monitoring, and evaluation. Finding 1, namely that students are passive when faced with problems,

indicates weak metacognitive planning. Students who tend to be passive and wait for instructions from the teacher show limitations in the aspect of metacognitive regulation, particularly planning. Within Flavell (1979), framework, students with high metacognitive skills will develop strategic steps, activate relevant knowledge schemas, and choose problem-solving strategies before acting. Conversely, waiting for the teacher's instructions indicates a lack of initiative to devise a solution strategy, which signifies limitations in the cognitive control process. Research by Schraw & Dennison (1994) and Veenman et al (2006), confirms that students with low metacognitive regulation rarely engage in independent planning and are more dependent on external cues.

Finding 3, namely confusion in expressing the reasons for the strategy, indicates weak metacognitive knowledge and monitoring. Students' difficulty in explaining the reasons for their choice of strategy indicates weak conditional knowledge and monitoring of the thinking process. Conditional knowledge includes understanding when and why a strategy is used. The inability of students to explain the reasons for their chosen strategies indicates that they are not only weak in monitoring, but also in reflecting on the relevance of strategies to the demands of the problem. This is in line with Kuhn (2000) findings, which emphasize that reflection on the reasons for choosing a strategy is a characteristic of mature metacognition. A study conducted by Veenman & Spaans (2005) also states that students with low metacognitive skills tend to use strategies without realizing the reasons for their selection.

Finding 5, namely minimal reflection on errors, indicates weak metacognitive evaluation. The finding that only a small number of students reflected on their errors, while the majority focused more on the final result than on the thinking process, indicates limitations in the evaluation of key components of metacognitive regulation. Evaluation includes assessing the effectiveness of the strategies used and making corrections if necessary (Flavell, 1979). When students ignore process reflection and only assess results, they lose the opportunity to identify weaknesses in their strategies and improve them in the future. Research by Efklides (2008) and Zimmerman (2002) confirms that the ability to self-evaluate

plays an important role in effective learning. The results of research by Wahyuni & Yerizon (2023) reveal that, in general, many students experience difficulties in the monitoring and evaluation stages, resulting in repeated mistakes and a focus only on obtaining the final answer, rather than understanding the process. Afri & Windasari (2021) also convey a similar finding, namely that, overall, students' metacognitive skills are still not fully developed, especially in the aspects of monitoring and evaluation.

Other studies also show that low metacognitive skills have an impact on weak knowledge transfer and academic performance (Veenman et al., 2006). This reinforces the finding that weak planning, monitoring, and evaluation skills in the thinking process are indicators of low metacognition in students. This condition is consistent with Flavell's model (1979) and is reinforced by various studies emphasizing that academic success, especially in mathematics, is highly dependent on students' ability to plan, monitor, and evaluate their thinking processes.

In addition to the interview and observation results above, the data from the questionnaire analysis conducted by the researcher, as listed in Table 1 below, also supports these findings.

Table 1. Results of Data Analysis on Students' Academic Self-Concept and Metacognitive skills

Data	Rata-rata Skor	Kategori
Academic Self-Concept	3,01	Moderate
Metacognitive skills	3,36	Moderate

Based on the table above, it shows that for 10th grade students at Saraswati 1 Denpasar Senior High School (SLUA), the average academic self-concept score is 3.01, which is in the moderate category, and the average metacognitive ability score is 3.36, which is also in the moderate category. Based on the findings from the interviews, observations, and the data above, it was found that even though the Problem-Based Learning approach had been implemented, students still exhibited passive behavior, difficulty in expressing strategies, and socio-emotional barriers such as shyness and selfish attitudes. This shows that the implementation of PBL has not fully developed students' metacognitive skills and academic self-concept, nor has it supported the strengthening of socio-emotional competencies.

CONCLUSIONS AND RECOMMENDATIONS

The results of the observation show that even though teachers have implemented the Problem-Based Learning model and included social-emotional competencies in the teaching modules, the implementation is still normative without detailed strategy guidelines, such as self-management techniques like S.T.O.P. The average score for students' academic self-concept was 3.01 (moderate category), while their metacognitive skills averaged 3.36 (moderate category). Field findings reveal several phenomena: (1) students are passive when faced with problems, (2) they feel embarrassed to participate even though they have the ability, (3) they have difficulty explaining the reasons for their problem-solving strategies, (4) high-ability students dominate discussions, and (5) there is a lack of reflection on mistakes. These findings indicate that aspects of academic confidence and perceived competence are still weak, and metacognitive regulation such as planning, monitoring, and evaluation are not yet optimal.

The results of this study emphasize the need for problem-based learning interventions integrated with social-emotional and self-regulation strategies to improve students' academic self-concept and metacognitive skills.

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