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ORIGINAL ARTICLE

Examining the Levels of Science Teachers' Use of Self-Regulation Strategies in their Lessons: The Example of Turkey's Southeastern Anatolia Region

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ABSTRACT

In this study, it was aimed to determine the level of use of self-regulation strategies by science teachers while problem-solving in their lessons according to the variables of gender, education level, and professional exprience. This study was carried out on a total of 800 volunteer science teachers working under the Ministry of National Education (MEB) in Mardin, Batman, Diyarbakir, Siirt, Gaziantep, and Şanliurfa city center and its districts. Descriptive survey method, which is one of the quantitative research approaches, was used in the study. The data of the research were collected with the "Scale of Self-regulation Strategies Used in Problem-Solving." The scale used was subjected to factor analysis after being applied to our own sample. After this procedure, Confirmatory Factor Analysis was performed using the AMOS program. As a result of the data analysis, it was seen that the fit indices were within the limits determined by the literature. SPSS package program was used in the analysis of the research data. Since the data showed normal distribution, independent group's t-test and one-way analysis of variance were used for analysis. As a result of the analysis, it was determined that science teachers in the Turkey's Southeastern Anatolia Region sample frequently used more than one self-regulation strategies while solving problems, and there was no statistically significant difference between their use of self-regulation strategies in problem-solving according to their education level, professional experience, and gender variability ($p > 0.05$). To obtain clearer results, it is recommended to study on large samples and to triangulate using qualitative methods such as interviews and classroom observations.

KEYWORDS: Science education; Problem-solving strategy; Self-regulation; Science teacher

INTRODUCTION

The rapidly changing world and the developments it brings along have started to create competition among individuals and societies. Traditional teaching methods and techniques have been repeatedly tested and found to be quite inadequate in meeting the changing needs of society. Countless research and studies have repeatedly demonstrated this fact. One of the most important goals of modern education is the effort to educate individuals who are self-sufficient and capable of overcoming the challenges and difficulties that they encounter in their lives and in society. Throughout the 20th century, scientists have embraced the ability to create and solve problems and have made intensive efforts to transfer this skill (Foshay and Kirkley, 2003). These studies reveal the importance and necessity of being able to develop individuals who can take more responsibility, make decisions, conduct research, question, think, criticize, strategize in the face of events, facts, and problems, and change their strategy when necessary. It is undoubtedly clear that as a national society, we need teaching methods and strategies that can define our vision for the future age appropriately. One of the leading and most important methods and strategies among these is problem-solving strategies. Problem-solving not only involves a scientific approach but also fosters reflective thinking, critical perspectives, and the ability to think creatively and analytically from different points of view (Posamentier and Krulick, 1998). Studies on the level of use of problem-solving strategies and, in parallel, the promotion of self-regulated learning have also revealed that this skill is not a talent but can be learned and developed later (Zimmerman, 2002).

The concept of self-regulation, one of the most important factors affecting learning and academic success, has been defined differently by different scientists. Self-regulation is defined as an active and constructive process, in which individuals determine their own learning goals, try to regulate their cognition, motivation and behavior, and are guided and limited by their goals and contextual features in their environment (Pintrich, 2000). Teachers can help their students learn self-regulation skills by introducing teaching strategies such as attention, organization, self-control, planning, and recall, all of which greatly enhance learning. In addition, the classroom environment itself can be designed to enhance self-regulation skills. Creative thinking in students can be developed and nurtured, making creative thinking skills an important outcome of the learning process for students and teachers. According to Waeytens et al. (2002), students should develop their self-regulated learning throughout their school careers, and teachers should develop their content knowledge, pedagogical content knowledge, and general pedagogical knowledge for self-regulated learning to help students develop self-regulated learning skills and behaviors (Michalsky, 2014; Hofer et al., 1998).

Self-regulation strategies generally consist of three basic and sequential elements. These are self-evaluation, self-monitoring and is planning (Meijer et al., 2006).

Contributing to the literature in this context, Nielsen (2009) gave a different perspective to self-regulation strategies and emphasized that there are six different key elements of metacognition. These are "self-efficacy (an individual's awareness of his/her own learning ability)," "controlling," "awareness," "evaluation," "planning," and is "monitoring." Self-efficacy, self-monitoring, and self-evaluation, among these elements of metacognitive strategies, were examined in our research.

These constitute the main arguments of the metacognitive skill dimensions or self-regulation strategy dimension that we evaluated. If these dimensions are briefly mentioned; self-efficacy: It is the process of an individual's self-confidence and beliefs about their ability to demonstrate reflexes and skills in the events they encounter in their lives (Bandura, 1994:71). Self-monitoring: The individual's monitoring throughout the process. It includes monitoring the materials, learning methods and techniques used, and the functionality of the strategies in these studies (Morgan et al., 2000).

It enables and encourages the individual to control the results and navigate his/her own abilities and performance throughout the process. Self-evaluation: It is a process based on comparing and interpreting the behavior observed as a result of context and learning within the framework of the target-goal or a standard (Perels et al., 2005). It is also the step of providing information about the adequacy, quality, and development process of the individual's work. In this context, the individual's process of taking responsibility for his own learning, evaluating, and valuing his own learning product and organization process (Schraw and Moshman, 1995).

When the research on problem-solving strategies, metacognitive strategies in problem-solving skills or self-regulation strategies are examined, it is found that there are studies examining the effects of teaching self-regulation strategies in solving problem situations in science disciplines (for example, Case et al., 1992; Mevarech and Kramarski, 1997; Schoenfeld, 1985). In developing and supporting students', self-regulation skills tutorials have a key role (De Smul et al., 2018; van Gog et al., 2020). Teachers can contribute to the development of students' self-regulation competencies using different ways such as being a role and model, providing an environment where students can organize their learning environments, providing academic and social support, and giving feedback and correction to students (Zumbrunn et al., 2011).

He emphasized that to effectively develop and support their self-regulation skills, they need to be individuals who can both guide learning and take responsibility as a learner, thus improving their own self-regulation skills. According to Kohen and Kramarski (2017), teachers should effectively develop their students' self-regulation skills. They emphasized that for this, they need to be individuals who can both guide learning and take responsibility as a learner, thus improving their own self-regulation skills. If teachers have self-regulation skills, it will be easier for them to impart this skill to students. In recent years, various studies have been conducted in Türkiye examining pre-service teachers' self-regulated learning strategies (Yavuzarslan, 2017) and their level of use of self-regulated learning strategies (Demirel et al., 2014). However, few studies have been found that directly examine the self-regulation skills of science teachers in their classes. Research has examined the effects of gender, experience, and education level on teachers' self-regulation strategies (Schunk and Greene, 2017). However, existing studies have generally focused on students. Therefore, more recent studies specific to teachers are needed. In this study, it is hoped that determining the level of use of self-regulation skills in lessons by science teachers working in Southeastern Anatolia, one of the socioeconomically disadvantaged regions of Turkey, will contribute to the science education literature.

LITERATURE REWIEV

One of the significant arguments of problem-solving strategies is problem-solving strategies themselves. According to Weinstein and Mayer (1986), some cognitive theorists in the field define problem-solving skills as the cognitive dimension of learning problem-solving abilities, while other cognitive theorists largely interpret problem-solving strategies as internal dimensions encompassing thinking, cognition, and metacognitive self-regulation strategies (Bruno et al., 1992). Problem-solving is an activity that involves using the student's previous experience and knowledge and requires participation in many cognitive actions (Kramarski et al., 2010). In this respect, it can be said that the self-regulation strategies that include the students' cognitive actions and the motivation sources that enable the use of these strategies have an important effect on the problem-solving process. Building on this point, problem-solving strategies consist of metacognitive strategies in addition to cognitive dimensions (Montague et al., 1992). To provide an example, cognitive strategies such as "visualizing the problem" or "summarizing the problem" in problem-solving skills are dimensions of cognitive strategy, in addition to "processing the cognitive dimension." However, after structuring and concluding the problem, metacognitive strategies such as "checking step," "self-monitoring step," or "self-assessment step" function above the cognitive strategies and have different functions from the norm (Açikgöz, 2000).

In this context, these strategies lead to higher-level thinking skills. According to Pintrich et al. (1998), the metacognitive concept within the cognitive process includes knowledge about the cognitive process and how an individual processes and uses this knowledge within the cognitive dimension. Metacognitive strategies involving processing, monitoring, and evaluating information within an insightful context consist of two sub-dimensions: Cognitive knowledge and cognitive regulation (Nietfeld et al., 2005). The cognitive knowledge dimension relates to an individual's awareness of their own learning and the extent of their understanding of their knowledge (Pintrich, 2002). The cognitive regulation dimension is concerned with how individuals regulate and structure their learning responsibilities (Sperling et al., 2004). The cognitive regulation dimension appears in the literature as a subdimension of self-regulation strategies or metacognitive skills. The concept of self-regulation involves the ability to manage one's cognitive activities underlying the functionality of the metacognitive dimension (Flavell, 1976). Individuals must learn to use the monitoring and self-regulation skills within the problem-solving process to reach their target (Özsoy and Ataman, 2009). In this context, valuing the development of problem-solving process skills not only helps acquire the existing skill but also contributes to the advancement of affective and cognitive skills, with self-regulation being one of the main dimensions (Norris, 2003). Measuring self-regulation skills is a good indicator of an individual's level of competence in problem-solving (Schwartz et al., 1998). Self-regulation strategies generally consist of three fundamental sequential components: Self-evaluation, self-monitoring, and planning (Meijer et al., 2006). Similarly, Nielsen (2009) contributed to the literature by providing a different perspective on self-regulation strategies, emphasizing the six key elements of metacognition: "Self-efficacy (an individual's awareness of their own learning ability)," "checking," "awareness," "evaluation," "planning," and "monitoring."

The elements of metacognitive strategies such as self-efficacy, self-monitoring, and self-evaluation form the foundational arguments of the metacognitive skills dimension or self-regulation strategies that we examine and assess in our research.

When reviewing research on problem-solving strategies, particularly regarding metacognitive strategies or self-regulation strategies in problem-solving skills, there are studies examining the impact of teaching self-regulation strategies in solving problem situations in science disciplines (for example, Case et al., 1992; Mevarech and Kramarski, 1997). In his study, Barham (2020) examined the effects of teachers' problem-solving strategy learning and development on problem-solving processes in their lessons. The sample of the study consists of 42 mathematics teachers. During the application process, the current strategies used by teachers in mathematics lessons were identified, and then, the participants were given problem-solving in-service training and in-class discussion practices were carried out. As a result of the study, it was concluded that teachers developed various and more advanced logical reasoning strategies, table and listing strategies, problem-solving strategies, prediction, and checking strategies.

In addition, in our country (Turkey), studies on self-regulation are still in their initial stages, and until recently, there have been limited literature studies, most of which were in the field of mathematics (for example, Üredi and Üredi, 2005; Alci and Altun, 2007; Alci et al., 2010), science education (for example, Arsal, 2010), and physics, biology (Yumuşak et al., 2007), and computer programming (Haşlaman and Aşkar, 2007).

In addition, literature reviews indicate that there are very few studies that use a scale to determine the level of usage of metacognitive or self-regulation strategies by teachers in science classes and in their research or work, examining the effects of this usage in cognitive or affective learning domains (Çalişkan et al., 2008; Neber et al., 2008). Another study examining the gender effect on the use of self-regulation strategies by physics teachers from the sub-disciplines of science found that female teachers were more active in using self-regulation strategies in learning and teaching processes, particularly in problem-solving, compared to male teachers (Neber et al., 2008). In a similar national-scale study, Selçuk et al. (2007) concluded that the frequency of successful use of problem-solving strategies showed a trend in favor of female teachers. In this context, it is clear that there is a need for research to investigate the effects of variables such as gender, education level, and years of experience on the use of problem-solving strategies. In addition, determining whether teachers' professional seniority creates differences in strategy usage and how effectively they can use self-regulation strategies can provide guidance and insights for further research. The purpose of this study is to determine whether gender, education level, and years of professional experience affect the level at which science teachers use self-regulation strategies in their lessons. To achieve the objective, some guiding questions were posed as follows:

1. Does the gender variable affect the levels of self-regulation strategies used by science teachers while problem-solving in their lessons?
2. Does the education level variable affect the levels of self-regulation strategies used by science teachers while problem-solving in their lessons?
3. Does the years of professional experience variable affect the levels of self-regulation strategies used by science teachers while problem-solving in their lessons?

METHODOLOGY

Research Design

In this research, descriptive scanning method was used because the levels of science teachers' use of self-regulation strategies in their lessons were examined in terms of various variables. Descriptive scanning is research conducted on large groups, where the opinions and attitudes of the individuals in the group about a phenomenon and event are taken, and the phenomena and events are tried to be described (Karakaya, 2012:59). This research method is used to describe the structure of objects, societies, institutions, and the functioning of events.

Research Sample

The population of this study comprises all science teachers working in the Southeastern Anatolia Region of Turkey. The sample consists of 800 volunteer science teachers working under the Ministry of National Education (MEB) in the central districts of the provinces of Mardin, Batman, Siirt, Sanliurfa, Gaziantep, and Diyarbakir during the 2023–2024 academic years.

Research Instrument

The data for the study was collected using the "Scale for the Use of Self-Regulation Strategies in Problem-Solving" developed by Çalişkan and Selçuk Sezgin (2010). The 18-item scale aimed at determining the levels of self-regulation strategy usage in problem-solving by science teachers uses a 5-point Likert scale with options ranging from "never (1.00–1.79)," "rarely (1.80–2.59)," "sometimes (2.60 - 3.39)," "often (3.40–4.19)," to "very often (4.20–5.00)." The positive items in the scale are scored from "never" to "very often" as 1, 2, 3, 4, and 5, while negative items are scored from 5, 4, 3, 2, and 1. The 18 items in the scale are grouped into three dimensions: Self-efficacy, self-monitoring, and self-evaluation.

Data Analysis

In data analysis, descriptive statistics, construct validity (internal consistency reliability coefficient analysis), and exploratory factor analysis (EFA) were analyzed using SPSS 26 software, while confirmatory factor analysis was performed using AMOS software.

In the confirmatory factor analysis for the scale, the model fit, that is, the model's acceptability, was assessed based on the necessary criteria. According to Sümer (2000), acceptable normed fit ındex, comparative fit ındex, and goodness-of-fit ındex values should be 0.90 or higher, RMSEA values should be <0.08, and the Chi-square to degrees of freedom ratio (CMIN/DF = 2.529) should be less than 3 or 5. When applying EFA, the Kaiser–Meyer–Olkin (KMO) and Bartlett's test were first applied (Ekiz, 2015).

According to Table 1, the KMO measure is 0.926, Bartlett's test of sphericity has a Chi-square value of 4266.986, and a significance level (Sig.) of 0.000. Since this significance level is below the critical threshold of.05, the Bartlett test is meaningful and feasible, suggesting that a factor can be extracted from the correlation matrix (Şencan, 2005). After this, factor analysis was carried out using the "Principal Components" method. Data are very well-suited for factor analysis based on both the high KMO value (0.926) and the significant Bartlett's test ($p < 0.05$). This suggests that your variables are strongly correlated and appropriate for dimension reduction or EFA.

According to Table 2, an analysis with rotation was conducted, and given the possible relationships between factors, the "direct oblimin" method, one of the oblique rotation techniques, was

Table 1: KMO and Bartlett test results of scale for the use of self-regulation strategies in problem-solving

KMO (Kaiser–Meyer–Olkin)	Bartlett's test of sphericity		
	Chi-square	Df	Sig.
0.926(*)	4266,986	153	0.000(*)

KMO: Kaiser–Meyer–Olkin

Table 2: Correlation matrix results of scale for the use of self-regulation strategies in problem-solving

Component (sub-dimensions)	1	2	3
1	1.000	0.277	−0.580
2	0.277	1.000	−0.378
3	−0.580	−0.378	1.000

selected based on this assumption. In the analysis results, factors (items) with an eigenvalue greater than 1 were accepted as significant. In the examination of factor loadings, a minimum value of 0.30 was accepted (Uzuntiryaki-Kondakci and Capa-Aydin, 2011). As a result of the factor analysis, a three-factor structure with eigenvalues greater than one emerged, explaining 48.09% of the total variance.

The number of items of sub-dimensions of the scale and Cronbach's alpha security coefficients is presented in the Table 3.

According to the reliability analysis results, the overall Cronbach alpha value of the scale is 0.889, which indicates a fairly high internal consistency. This shows that the scale is generally reliable and provides consistent measurements.

When the sub-dimensions are examined: Self-sufficiency (0.815) and self-evaluation (0.806) offer a good level of reliability. This shows that the items of these sub-dimensions are compatible with each other. Self-monitoring (0.764) has a slightly lower Cronbach alpha value compared to the others, but it is within acceptable limits.

FINDINGS

This section presents tables and explanations of the findings related to the sub-problems of the research.

Under this heading, findings related to the question, "Does the gender variable affect the level at which science teachers use problem-solving strategies in their lessons?" will be presented. It was found that the data obtained from the scoring of the self-regulation scale used in problem-solving by the participants followed a normal distribution. In this context, the Kolmogorov–Smirnov test analyses were conducted, and it was accepted that parametric tests could be used with independent groups. To test the data related to the problem being addressed, an independent samples t-test was used (Büyüköztürk, 2005: 39). The analysis results are presented in Table 4.

Table 3: Number of items belonging to scale for the use of self-regulation strategies in problem-solving and Cronbach alpha reliability coefficient

Sub dimension	The number of the items	Cronbach alpha reliability coefficient
Self-sufficiency	9	0.815
Self-monitoring	2	0.764
Self-evaluation	7	0.806
Total	18	0.889

Table 4: Independent t-test results for scale for the use of self-regulation strategies in problem-solving scores of science teachers by gender

Group	N	X	SD	t	F	P
Female	395	68.96	11.02	1.367(*)	0.177	0.674(*)
Male	405	67.87	11.38			

SD: Standard deviation

According to Table 4, there is no difference in the level of use of self-regulation strategies in problem-solving in their lessons among science teachers working in state schools affiliated with the Ministry of National Education in the central districts of Mardin, Diyarbakir, Gaziantep, Siirt, Batman, and Şanliurfa based on gender ($t(1,367) = 0.885$; $p > 0.05$) (Büyüköztürk, 2005: 39).

Furthermore, although the average scores of female teachers (X = 68.96) were higher than those of male teachers (X = 67.87) in using self-regulation strategies in problem-solving, the difference was not statistically significant. Cohen's d value was calculated as 0.097. In this case, d = 0.097 indicates a very small effect size. In other words, the difference between men and women is not statistically significant and is also very small in practical terms.

Under this heading, findings related to the question, "Does the education level of science teachers affect the level at which they use problem-solving strategies in their lessons?" will be presented.

Findings and results regarding whether there is a significant relationship between the education level of the participating science teachers and their strategy preferences on the scale are presented in Table 5.

In Table 5, a one-way analysis of variance (ANOVA) was applied to determine whether there is a significant difference in the level of use of problem-solving strategies according to the education level of science teachers.

On reviewing the data presented in Table 5, it is found that there is no significant difference in the level of use of self-regulation strategies in problem-solving by science teachers in their lessons based on their education level (sig. = 0.206; $p > 0.05$) (Uzuntiryaki-Kondakci and Capa-Aydin, 2009). However, the strategy selection rates of science teachers who have completed a doctorate (X = 74.00) in using self-regulation strategies on the scale are higher than those who have completed a master's degree (X = 69.84), and similarly, science teachers who have completed a master's degree exhibit slightly higher usage rates than those with only an undergraduate degree (X = 68.19). Nevertheless, these differences are not statistically significant. Cohen's d values were calculated as for Undergraduate's versus Master's: 0.15, for Undergraduate's versus PhD: 0.52, for Master's versus PhD: 0.35. There is a very small difference between undergraduate and graduate students. A medium difference is observed between undergraduate and doctoral students.

Table 5: One-way ANOVA results for scale for the use of self-regulation strategies in problem-solving scores of science teachers by education level

The source of variance	N	X	SD	F	Sig.
Undergraduate	708	68.19	11.12	1.584	0.206(*)
Master's	86	69.84	11.74		
Doctorate	6	74.00	12.55		
Total	800	68,41	11.21		

ANOVA: Analysis of variance

The difference between Master's and PhD is small to medium. In other words, the means increase as the level of education increases, but the most significant difference is between the undergraduate and doctoral levels.

Under this heading, findings related to the question, "Does the years of professional experience (seniority) of science teachers affect the level at which they use problem-solving strategies in their lessons?" will be presented.

Findings and results regarding whether there is a significant relationship between the years of professional experience of participating science teachers and their strategy preferences on the scale are presented in Table 6. Since the data obtained from the research showed normal distribution, one-way ANOVA test was used among the parametric tests.

The calculated Cohen's d values are given below:

6–10 years versus 11–15 years (−0.066), 6–10 years versus 16+ years (−0.190), 11–15 years vs. 16+ years (−0.119). All Cohen's d values are <0.2, meaning the effect size is very small. Although the means increase as the length of experience increases, this difference is not statistically significant. The largest difference is between 6–10 years and 16+ years, but even this has a small effect. According to these results, the effect of the length of experience on the relevant variable seems weak.

A one-way ANOVA test was conducted in Table 6 to determine whether there is a significant difference in the level of use of problem-solving strategies among science teachers based on their years of professional experience.

On reviewing the data in the table, it was found that the years of professional experience of science teachers do not bring about a

Table 6: One-way ANOVA results for scale for the use of self-regulation strategies in problem-solving scores of science teachers by years of professional experience

The source of variance	N	X	SD	F	Sig.
0–5 Years	201	68.86	11.32	1.134	0.334*
6–10 Years	252	67.53	11.11		
11–15 Years	216	68.28	11.54		
16 Years and more	131	69.61	10.62		
Total	800	68.41	11.21		

ANOVA: Analysis of variance

statistically significant difference in their use of self-regulation strategies in problem-solving in their lessons (sig. = 0.334; $p > 0.05$) (Büyüköztürk, 2016).

DISCUSSION AND CONCLUSION

The study aimed to determine whether gender, education levels, and years of professional experience affect the level at which science teachers use problem-solving strategies in their lessons. This section discusses that the study results in comparison to similar studies in the literature and presents the conclusions drawn from these discussions.

The first sub-problem of the study sought to answer the question: "Does the gender variable affect the level at which science teachers use problem-solving strategies in their lessons?" An independent t-test yielded a result of $t(1.367) = 0.885$; $p > 0.05$. According to this result, there is no difference in the level of use of self-regulation strategies in problem-solving by science teachers in their lessons based on gender.

In reviewing the relevant literature, varying results were found at national and international levels regarding the influence of the gender variable on the selection and use of problem-solving strategies. Below, we discuss studies parallel to our own, which found that the gender variable has no impact on the selection and use of problem-solving strategies.

In this study, it was found that the gender variable does not affect the level at which science teachers use problem-solving strategies in their lessons. Similar results were found in the literature. In the study titled "Examining University Students' Learning of Self-Regulation Skills" by Sağirli and Azapağasi (2009) and the studies by Wolters and Pintrich (1998), the gender variable was found to have no significant effect on self-regulation levels. Likewise, in the mathematics study conducted by Alci and Altun (2007), no differences were observed in strategy use between male and female students, which aligns with the results of the current study.

In addition, there were studies involving students other than science teachers that showed the gender variable had no effect on the selection and use of problem-solving strategies. In a study by Sezgin et al. (2000), which aimed to identify the problem-solving strategies used by university students taking science courses and to determine their deficiencies in this regard, no differences were found between male and female students in terms of strategy use, and no differences were found among students studying physics, chemistry, biology, and science teaching.

However, unlike these studies, there were also studies in which the gender variable made a difference in the level of use of problem-solving strategies. In the study titled "Examining the Self-Regulation Levels of Teacher Candidates from Various Perspectives" by Aybek and Aslan (2017), a significant difference in favor of male teachers was found between the sub-dimensions of self-regulation strategies concerning the gender variable. In the research conducted by Yilmaz (2016), it was found that the self-regulation levels of teachers varied significantly concerning the gender variable. In the research conducted by Kaplan (2014) on physical education and sports teaching teacher candidates, it was concluded that the opinions of teacher candidates about self-regulation varied significantly according to their gender. Similarly, Güler (2015) obtained a similar result in his study. İsrael (2003) found differences in the use of strategies between male and female students in his study. Likewise, in the studies conducted by Selçuk Sezgin et al. (2007), significant statistical differences were found in favor of female teacher candidates. In the study by Lee and Browman (as cited in Alci and Altun, 2007), male students were found to use self-regulation strategies more actively in physics learning processes than female students when facing problems. Similarly, a study conducted abroad found that male and female teachers preferred different strategies when facing problems (Pajares and Graham, 1999). In addition, in the study by Ozan et al. (2012), male teacher candidates significantly preferred the surface learning approach more than female students according to their gender.

Reviews of the literature reveal that national and international studies examining the relationship between gender and problem-solving strategies have produced varying results. As seen in the discussions, different conclusions have been reached worldwide regarding the impact of gender on the level of use of problem-solving strategies. Therefore, there is a need for more research investigating the effects of gender on the use of problem-solving strategies.

The second sub-problem of the research sought to answer the question: "Does the education level of science teachers affect the level at which they use problem-solving strategies in their lessons?" A one-way ANOVA test yielded a result of Sig. = 0.206; $p > 0.05$. According to this result, there is no significant difference in the level of use of self-regulation strategies in problem-solving by science teachers in their lessons based on their education level.

Reviews of the literature reveal that, similar to our study, research examining teachers' problem-solving skills and perceptions found no differences based on the education level variable (Zembat et al., 2017).

However, in contrast to these studies, Bagceci and Kinay (2013) found that as teachers' education levels and years of experience increased, their problem-solving skills and perceptions improved. Similarly, Aksu and Karaçop (2015) found significant differences in learning and strategy usage levels based on the grade level of the students' class.

Based on the review of the literature, there is a need for a larger sample of participants to investigate the effect of education levels on the use of self-regulation strategies by teachers and changes in the frequency of using these skills throughout the process.

The third sub-problem of the research sought to answer the question: "Does the years of professional experience of science teachers affect the level at which they use problem-solving strategies in their lessons?" A one-way ANOVA test yielded a result of Sig. = 0.334; $p > 0.05$. According to this result, there is no statistically significant difference in the level of use of self-regulation strategies in problem-solving by science teachers in their lessons based on their years of professional experience.

Literature reviews have revealed studies that parallel our own findings. In Karaman and Bakaç's (2018) study, no significant difference was found between the years of experience of teachers and their program design preferences. Similarly, in Ergüven (2011) study examining whether there is a significant difference between branch teachers' reflective thinking skills and variables such as gender, age, type of school graduated from, years of experience, and branch, it was concluded that there was no significant difference in teachers' reflective thinking skills based on their gender, age, branch, or years of experience.

On reviewing the literature, which includes studies involving science teachers as well as teachers and students from other subjects, different results from our study have been reported. Aydin et al. (2016) investigated the effects of gender, years of experience, and age factors on the self-efficacy perceptions of science teachers and found that teachers' self-efficacy perceptions toward extracurricular activities were high, with significant differences in self-efficacy perceptions based on age and years of experience. Similarly, Bağçeci and ve Kinay (2013) found in their research that as teachers' education level and years of experience increased, their problem-solving skills and perceptions improved. Likewise, Eğerci (2019) found in a study focusing on the problem-solving strategies teachers use in their lessons and the challenges they face while using these strategies that teachers with higher professional competence, including those who completed double major programs, and more years of experience were able to apply problem-solving strategies more comfortably when facing problems. It was also found that teaching for longer durations increased the variety of strategies used.

In their study aiming to determine the problem-solving strategies teachers use, Gürbüz and Güder (2016) found that expert teachers detailed the solutions to determined problems by developing different strategies. This suggests that senior teachers have greater professional development and competence, leading to the development of experience. Similarly, Şahin (2010) stated in his study that there is a high level of correlation between teachers' readiness for self-managed learning, self-efficacy scores, and professional competence scores.

Our study did not find a statistical difference in the level of use of self-regulation strategies by teachers based on their years of professional experience, nor in the changes in the frequency of using these skills over time. However, on examining Table 6, it can be noted that teachers with 16 years or more of professional experience have slightly higher mean scale scores ($\bar{X} = 69.61$) compared to the overall mean ($\bar{X} = 68.41$), although this is not statistically significant ($p = 0.334$; $p > 0.05$). In general, domestic and international literature reviews found high levels of differences in strategy selection and use, teaching style preferences, extracurricular activities, or approaches to educational programs depending on years of professional experience. These findings largely coincide with previous research. For example, Zimmerman (2015) suggests that education level is an important factor in developing self-regulation skills. However, the lack of effect of gender and professional experience contradicts some previous studies (Pintrich, 2004). In the literature, it is stated that teachers with high self-regulation skills tend to receive feedback from their environment and students regarding their teaching processes and to improve their teaching practices (Mattern and Bauer, 2014).

In this context, there is a clear need for larger samples of participants to investigate the impact of years of professional experience on the use of problem-solving strategies by science teachers and to conduct more studies using different and in-depth methods.

Based on the results of this research, recommendations have been developed for faculty members who play an active and effective role in teacher training programs, researchers for future studies, and program development specialists:

- Teaching problem-solving strategies within the framework of self-regulatory strategies is considered vital for the integrity of the study. In this way, teacher candidates can acquire skills such as how to set goals, monitor their progress toward those goals, and self-evaluate their performance.
- Practical training can be provided to teacher candidates in teacher training institutions to enable them to use cognitive and metacognitive teaching strategies in problem-solving.
- Providing sample problem-solving methods by organizing lessons by experts in the field and identifying and eliminating deficiencies using scales or one-on-one interviews can increase teachers' problem-solving skills.
- More research should be conducted to determine the effects of teachers' years of professional experience, education levels, and gender on their levels of using problem-solving strategies.

- The results obtained from the present study indicate that teacher education programs should emphasize self-regulation strategies. In terms of educational policies, it is recommended that professional development laboratories, seminars, and graduate programs be restructured to support these skills.

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