BABEŞ-BOLYAI UNIVERSITY

FACULTY OF PSYCHOLOGY AND
EDUCATIONAL SCIENCES

DOCTORAL SCHOOL “DIDACTICS, TRADITION, DEVELOPMENT, INNOVATION”

SUMMARY - PHD THESIS

Solving Mathematical Word Problems Using Self-regulated learning Skills

Supervisor: Prof. univ. dr. Liliana Ciascai

Author: Suzan Khatib

Cluj-Napoca

2025

Content of Thesis

Abstract

This doctoral thesis explores the learning and teaching of mathematical word problems, emphasizing the role of self-regulated learning (SRL) in enhancing problem-solving skills. The research examines both current and future teachers' perspectives to identify effective instructional strategies and interventions. Four studies were conducted to achieve this objective. Study 1 investigated the perspectives of 163 Romanian mathematics teachers on students' difficulties with word problems and the challenges teachers face. Findings highlighted issues such as poor text comprehension, difficulties in mathematical representation, and systemic constraints, emphasizing the need for curriculum improvements and professional development. Study 2 examined the perceptions of 161 pre-service teachers regarding word problems. While recognizing their importance, participants reported challenges in problem-solving strategies, indicating a need for enhanced teacher training. Study 3 explored 146 in-service teachers' use of SRL strategies in teaching word problems. Although teachers acknowledged SRL's benefits, variations existed in their application of explicit SRL techniques. Feedback from teachers contributed to refining an SRL-based instructional guide. Study 4 assessed the impact of an SRL-based intervention on future teachers' problem-solving abilities. A quasi-experimental design showed significant improvements in structured problem-solving and SRL competencies among the experimental group, confirming the effectiveness of SRL strategies in mathematics education. The findings underscore the importance of integrating SRL into teacher training and classroom instruction to enhance students' problem-solving skills. This research provides evidence-based recommendations for curriculum development, teacher training, and pedagogical approaches aimed at improving mathematics education.

Keywords

Mathematical Word Problems, Self-Regulated Learning, Teaching Practices, Teachers' Perspectives, Future Primary School Teachers, Mathematics Education

Introduction

Mathematics plays a crucial role in solving real-world problems and advancing society, yet many students struggle with learning it due to complex concepts, diverse solution methods, and traditional teaching approaches that lack coherence (Edeh, 2022, 2024; Waswa & Al-Kassab, 2023). These difficulties extend beyond academics, affecting students' self-confidence and learning awareness (Johnson & Myklebust, 1967). Word problems are essential for linking mathematical concepts to daily life, fostering critical thinking and problem-solving skills (Koehler & Sammon, 2023). However, many students face challenges in understanding mathematical texts, converting them into equations, and selecting appropriate solutions due to weak analytical thinking and limited self-regulated learning (SRL) skills (Jatileni & Neshila, 2024; Iilonga & Chirimbana, 2024; Pearce et al., 2013).

Solving word problems requires analytical skills beyond arithmetic, including text interpretation, extracting relevant data, and logical reasoning (Papadopoulos & Kyriakopoulou, 2022). SRL is a key strategy in this context, enabling students to set goals, choose strategies, monitor progress, and evaluate results (Huang et al., 2024). SRL involves three main stages: planning (goal setting and strategy selection), implementation (applying strategies and self-monitoring), and evaluation (reviewing results and adjusting approaches) (Zumbrunnet al., 2015). This method helps students become independent learners capable of handling academic challenges.

Teaching SRL from an early age develops critical thinking, organization, and self-assessment skills, making students more adaptable and prepared for lifelong learning (Al-Kassab & Waswa, 2022; Vessonen et al., 2024). Training in goal-setting, planning, and self-monitoring enhances students' awareness of effective learning strategies, improving both academic performance and essential life skills (Hemmler & Ifenthaler, 2024; Savina, 2021). Teachers play a pivotal role in this process, as their ability to analyze word problems and apply SRL strategies directly impacts student learning outcomes (Karlen et al., 2023). A teacher proficient in SRL can guide students in structuring problem-solving steps, developing self-learning habits, and fostering independence (Bloom, 2013).

Despite its importance, mathematics remains a challenge for many students, particularly with word problems. Traditional teaching, weak analytical thinking, and limited SRL skills contribute to these difficulties. Implementing SRL strategies in education can significantly enhance problem-solving skills and academic independence. Training teachers to integrate SRL into their instruction is essential to improving education quality, ensuring students develop effective learning habits, and preparing them for continuous learning and real-world problem-solving.

Statement of the Problem

Mathematics is an essential component in preparing generations for success in the global economy, playing a pivotal role in achieving academic and professional excellence, especially in the fields of science, technology, engineering, and mathematics (Geist, 2010; Smith, 2016; Yüksel-Şahin, 2008). Despite this importance, mathematics is still considered one of the most difficult subjects, which makes it challenging for many students to learn it (Arslan, 2013; Maloney, Schaeffer & Beilock, 2013). In Romania, passing the baccalaureate exams, especially in mathematics, is a prerequisite for admission to prestigious university majors (European Commission, 2023). However, results from international tests such as TIMSS and PISA show that Romanian students' performance in mathematics remains below the global average, with eighth-grade students' scores remaining stable over the past decades, with significant disparities in performance between students, reflecting large educational and social gaps (RPMS Team, 2024). The results of the 2024 national assessment also showed that only 69% of students were able to achieve average or higher grades, indicating continued difficulties in mathematics education (Radio România Internațional, 2024).

In addition, socio-economic challenges emerge as a major factor influencing student achievement, with the PISA 2022 report showing that socio-economic status explains 26% of the variance in performance, a figure higher than the global average (OECD, 2022). Lack of resources, especially in rural areas, and weak teacher training programs also make it more difficult to deliver effective mathematics education (RPMS Team, 2024). One major challenge is the disconnect between theoretical mathematics and its practical applications. Studies show that many students do not understand the relationship between mathematics and their daily lives, making learning more difficult (Kloosterman & Clougan, 1994). In this context, word problems play an important role in promoting applied understanding of mathematics, as they help develop critical thinking and practical problem solving (Koehler & Sammon, 2023; Hardini & Widayati, 2023).

Despite the importance of word problems, there is a lack of studies that examine the challenges faced by students and teachers in solving and teaching them, especially with regard to the extent to which future teachers are prepared to employ effective strategies in this area. Research suggests that future teachers' attitudes towards mathematics could be improved if their university studies include courses that focus on developing critical thinking and enhancing mathematical analysis skills (Zsoldos-Marchiș, 2014). Among the strategies that can improve mathematics education, self-regulated learning (SRL) stands out as an effective approach that helps students manage their learning by setting goals, monitoring their progress, and evaluating their performance (Karlen et al., 2023). However, research shows that Romanian high school students suffer from weaknesses in these skills, which affects their performance and self-confidence (Marchiș & Balogh, 2010; Marchiș, 2012).

Based on these data, this study aims to analyze the challenges faced by students and teachers in solving word problems, and to explore the readiness of future teachers to use self-regulated learning strategies. It also seeks to evaluate the impact of applying these strategies on students' performance in solving mathematical problems, and to provide evidence-based recommendations to improve teaching practices, enhance students' success in mathematics, and prepare teachers to be more efficient and effective in this area.

Chapter 1. Mathematical Word Problems

This chapter outlines the theoretical framework of the research by exploring various dimensions of mathematics learning and the challenges it entails. It begins by examining the underlying causes of students' negative attitudes towards mathematics, the difficulties they encounter, and the strategies that can support their learning and enhance their perception of the subject. Special attention is given to mathematics education at the primary level, with a review of the Romanian educational system, the goals of teaching mathematics in early education, and effective pedagogical approaches that foster better learning outcomes at this stage.

A significant focus of the chapter is the process of solving mathematical problems, highlighting its essential role in developing students' critical thinking skills. It also addresses the teacher's role in promoting problem-solving abilities and reviews the theoretical foundations of different problem-solving methodologies. Furthermore, the chapter delves into mathematical word problems, explaining their definition and significance, and analyzing how their formulation impacts students' understanding. It offers practical teaching strategies aimed at helping learners approach and solve such problems in a structured and systematic manner, while also identifying the common difficulties students typically face in this area.

Additionally, the chapter emphasizes the fundamental importance of mathematics as an exact science that underpins technological, scientific, and statistical advancements. Mathematics contributes to the development of critical thinking, problem-solving capabilities, and organizational skills. However, many students perceive mathematics as a difficult and abstract subject, which often results in decreased motivation and poor academic performance (Yadav, 2020; Ribeiro, 2023; Hwang & Son, 2021). Research indicates that teaching methods and parental involvement significantly influence students' attitudes. Traditional, teacher-centered instruction and passive learning environments tend to reduce engagement, while interactive approaches that connect mathematical concepts to real-life applications have been shown to improve comprehension and student interest (Aguilar, 2021; Posamentier & Krulik, 2016). Moreover, frequent absences during early educational stages negatively affect the acquisition of mathematical knowledge due to the cumulative nature of the subject (Kenschaft, 2014).

To overcome these challenges, contemporary studies advocate for the implementation of active learning strategies, including the integration of technology, the use of storytelling techniques, and problem-based learning approaches, all of which aim to enhance student engagement and understanding (Mohamed & Kandeel, 2023; Hwang & Tu, 2021). Persistent mathematical difficulties—such as poor arithmetic performance and weak problem-solving skills—are often associated with rote memorization and limited classroom interaction (Karagiannakis et al., 2014; Boaler, 2016). In some cases, private tutoring has even led to decreased motivation in school-based mathematics learning, further widening the gap (Guill & Bos, 2014). Addressing these issues requires a shift in instructional practices toward teaching mathematics as an analytical process, with a strong emphasis on conceptual understanding, problem-solving, and the development of critical thinking skills (Febriyanti et al., 2021; Khattab, 2008).

In Romania, compulsory education extends until the twelfth grade, with a structured curriculum aligned with European educational standards (European Commission, 2023). Elementary students require interactive teaching approaches, such as games and visual aids, to maintain attention and enhance engagement (Ahmad et al., 2022). Reforms aimed at improving curriculum flexibility, financial support, and teacher training contribute to raising education quality (Olugbenga & Olaniyan, 2022).

Problem-solving is central to mathematics education, as it develops analytical and creative thinking skills while enabling students to apply mathematical concepts in real-life contexts (Tang et al., 2020). Effective problem-solving strategies involve identifying a problem, exploring solutions, and evaluating results, making learning more interactive (Hmelo-Silver, 2004). Teachers play a key role in stimulating critical thinking, fostering collaboration, and integrating technology to support problem-solving instruction (Jonassen, 2010; Gazdos, 2016). Through these strategies, students enhance their reasoning skills, make informed decisions, and develop lifelong learning abilities (Schoenfeld, 2016).

Several cognitive theories support problem-solving instruction. Gestalt Theory emphasizes perceiving problems as wholes rather than isolated parts, fostering insight-driven solutions (Köhler, 1947; Wertheimer, 2017). Piaget’s Theory highlights the role of cognitive development in structuring knowledge through assimilation and accommodation (Mcleod, 2024; Feldman, 2004). Information Processing Theory compares the human mind to a computer, processing and storing information, while memory and attention influence problem-solving efficiency (Atkinson & Shiffrin, 1968; Labusch et al., 2019). Ausubel’s Theory underscores meaningful learning, where linking new information to prior knowledge strengthens comprehension through concept maps and diagrams (Bryce & Blown, 2023; Cottingham, 2023). Gagné's Theory supports a hierarchical learning model, where problem-solving is built through step-by-step skill acquisition, immediate feedback, and real-world applications (Buscombe, 2013; Jabsheh, 2024).

Together, these theories emphasize the role of structured, interactive learning in mathematics education, reinforcing the need to integrate problem-solving strategies, critical thinking, and active engagement into teaching practices. This approach enhances students' analytical skills, fosters deeper understanding, and supports their ability to tackle mathematical challenges creatively and effectively.

Mathematical word problems require students to analyze textual information, convert it into equations, and apply mathematical operations to find solutions (Brook, 2017). Unlike simple arithmetic calculations, they develop critical thinking and logical reasoning by encouraging students to connect multiple elements and interpret real-world contexts (Verschaffel et al., 2020). These problems are essential in mathematics education because they enhance problem-solving skills, promote systematic thinking, and improve real-life applications such as budgeting and decision-making (Schoenfeld, 1985). Solving them helps students organize their thoughts, collaborate in teams, and develop analytical skills (Nursyahidah et al., 2018). Their integration with other sciences, such as physics and economics, broadens students' understanding of mathematics in various fields (Yeasmin, 2023). Additionally, word problems serve as a tool for identifying gifted students, as they often require creative and unconventional thinking (Wang et al., 2019). Thus, their role extends beyond finding solutions, as they build an analytical mindset that enhances students' ability to tackle challenges (Gurat, 2018).

The clarity and structure of word problems significantly influence students' learning experiences. Unclear or ambiguous problems create confusion and reduce motivation, while well-formulated problems enhance engagement and logical reasoning (Olivares Díaz et al., 2020; Novotna, 2004). Real-world connections make problems more relatable and improve understanding, while irrelevant or artificial scenarios can lead to disengagement (Verschaffel et al., 2020). The difficulty level should be appropriate for students, as overly complex problems can cause frustration and lower confidence (Hadi, 2005; Brown & Walter, 2005). Effective problems should stimulate creative thinking, encourage inference, and challenge students beyond routine exercises (Cai & Leung, 2014). Additionally, engaging and interactive problems improve student participation and foster a positive attitude towards learning (Taş & Bolat, 2023). Assessment and feedback are also essential, as well-designed problems allow teachers to evaluate students' reasoning processes and provide constructive support (Hadi, 2005).

Various problem-solving strategies help students develop systematic and analytical thinking. The Pólya method, which consists of understanding the problem, devising a plan, implementing the solution, and reviewing, is widely used for structured reasoning (Pólya, 1945). Dewey's method emphasizes problem identification, strategy selection, and verification, fostering critical thinking (Abdelqader, 2018). The Krulik & Rudnick model incorporates additional steps, including data analysis and solution generalization, helping students apply their learning to different contexts (Krulik & Rudnick, 1996). Other strategies include logical reasoning, equation construction, pattern recognition, and simplification, which help students navigate complex problems systematically (English, 2023; Keeton, 2024). Working backward and using visual tools such as graphs and tables are also effective for organizing information and identifying relationships (Decin, 2023; Posamentier & Schulz, 1996).

Teachers play a critical role in guiding students through problem-solving by making mathematics more accessible and engaging (Chapman, 2015). Effective teaching strategies include rephrasing problems, encouraging interaction, and integrating problems into everyday lessons (Sacks, 2013; NCTM, 2016). Collaborative learning environments foster teamwork and diverse perspectives, while technology and visual aids enhance comprehension (MC Ekeh, 2023; Mattock, 2019; Supap et al., 2010). Additionally, questioning techniques and mathematical storytelling develop critical thinking and real-world connections (Ben-Zvi Assaraf & Orion, 2009; Große, 2014). Competitions and digital learning tools further boost motivation and engagement, making mathematics more dynamic and enjoyable (McCarthy-Curvin et al., 2021; Hogbin, 2020).

Students face three primary challenges when solving word problems:

1. Student-related difficulties – Many students struggle with reading comprehension, text interpretation, and converting word problems into equations, leading to errors in calculations and solution planning (Sepeng & Madzorera, 2014; Bernadette, 2009). Viewing mathematics as abstract rather than meaningful also weakens motivation and confidence (Pearce et al., 2013; Tong & Loc, 2017).

2. Problem formulation issues – Complex wording, excessive information, and unclear concepts often hinder understanding, making it difficult for students to extract relevant data (Daroczy et al., 2015; Seifi et al., 2012; Cruz & Lapinid, 2014).

3. Instructional factors – Traditional teaching methods, insufficient textbook explanations, and reliance on standardized tests limit students' exposure to effective mathematical thinking strategies, making word problems more difficult (Pearce et al., 2013; Skinner et al., 2016).

These challenges highlight the need to develop students’ problem-solving skills through self-regulated learning (SRL), which is the focus of this research. The study aims to explore how SRL strategies can enhance students’ ability to solve word problems, as understanding the theoretical challenges behind problem-solving difficulties helps identify effective teaching solutions. By addressing these issues, this research contributes to developing better mathematics instruction methods, ensuring that students gain deeper analytical and problem-solving skills tailored to their needs.

Chapter 2. Self-Regulated Learning

The chapter addresses the concept of self-regulated learning (SRL) as one of the modern educational methods that help students control their learning by setting goals, applying appropriate strategies, monitoring their progress, and evaluating their performance. The chapter discusses the theoretical roots of this concept, and reviews its different models, strategies, basic skills, components, and characteristics of students who rely on it. In addition, the chapter addresses the role of the teacher in supporting this approach, and the challenges that may hinder its application, while suggesting methods to enhance SRL and improve its results in the educational environment.

Self-regulated learning (SRL) is a process in which learners actively direct their behavior and knowledge to acquire skills and achieve academic goals through planning, monitoring, and self-evaluation (Zimmerman, 2008; Pintrich, 2000). It encompasses cognitive, motivational, and affective factors that enhance autonomy in learning (Boekaerts et al., 2005). The concept of SRL emerged as educational psychology shifted its focus in the 1960s from a teacher-centered approach to one that empowers learners to control their own learning process (Harding, 2018). Over time, research expanded to include the role of motivation and cognitive strategies in learning, leading to the development of models that highlight self-regulation as a key factor in academic success (Schunk & Zimmerman, 2008).

SRL is grounded in several major theories. Behaviorism emphasizes reinforcement and punishment in shaping behavior, where learners can regulate their actions through self-monitoring, self-direction, and self-reinforcement (Schunk, 2004). Bandura's social cognitive theory highlights the interaction between personal, behavioral, and environmental factors, with a strong emphasis on self-efficacy as a motivator for learning autonomy (Usher & Schunk, 2018). Vygotsky's social development theory underscores the role of social interaction and language in developing self-regulation, where the zone of proximal development (ZPD) and self-directed speech enhance learners' ability to control their learning process (Schunk, 2004). Despite their contributions, these theories face challenges such as overemphasizing environmental influences or neglecting individual and cultural differences in learning (Cocking & Renninger, 2013).

Several SRL models share common principles, portraying learners as active agents in knowledge construction who set clear goals, regulate their motivation, and adapt their learning based on personal and environmental factors (Boekaerts & Corno, 2005). Pintrich's

SRL model consists of four phases: goal setting and planning, continuous monitoring, strategic control, and self-evaluation, making it a comprehensive framework for fostering educational autonomy (Pintrich, 2000). Zimmerman's model, rooted in social cognitive theory, outlines three stages: forethought (goal setting and strategic planning), performance (self-monitoring and implementation), and self-reflection (evaluating outcomes and adjusting strategies), with a strong focus on motivation in learning (Zimmerman & Schunk, 2001). Boekaerts' model emphasizes the regulation of cognitive processes, learning management, and the control of emotions and motivation, helping students develop effective self-regulation skills (Taylor, 2021). These models collectively emphasize the importance of learners' active role in managing their education and provide strategies to support sustained academic success.

SRL strategies enhance learning quality by promoting organization, motivation, and time management (Wolters, 2003). Zimmerman (1989) categorizes these strategies into goal setting, comprehension monitoring, and self-regulation techniques. They are divided into three domains: knowledge organization through repetition, note-taking, and structured planning; motivation regulation through self-talk, intrinsic motivation, and learning environment management (Schunk & Zimmerman, 2008); and behavioral and contextual regulation through time management, collaborative learning, and seeking assistance when necessary (Zimmerman & Schunk, 2011). These strategies reflect learners' awareness of their role in the learning process, emphasizing essential skills such as goal setting for better focus and planning, structuring the learning environment for increased productivity, and adopting performance-based techniques such as journaling and time management, which are particularly valuable in self-directed learning settings (Bembenutty et al., 2013). Additionally, seeking assistance is a crucial skill that fosters learning without creating dependency, while self-assessment enables learners to review their progress, refine their strategies, and improve performance (Cleary, 2018).

SRL consists of three main components: cognition, metacognition, and motivation, which collectively define an individual's ability to control their learning process (Al-Hussainan, 2016). Cognition relies on prior knowledge to set goals, anticipate outcomes, and choose effective strategies (Schunk & Zimmerman, 1998). Metacognition involves the learner's awareness of their mental processes, allowing them to monitor progress, analyze successes and failures, and refine strategies, thereby boosting confidence in their abilities (Chaudhary, 2018; Schraw et al., 2006). Motivation is the driving force behind learning, helping students focus, persist through challenges, and remain engaged. It is influenced by goal value, self-confidence, social support, and external rewards (Carneiro et al., 2011; Teng, 2022; Jovanovic & Matejevic, 2014).

Self-regulated learners possess strong awareness of learning strategies such as rehearsal, organization, and elaboration, which enhance comprehension and information retrieval (Hemmler & Ifenthaler, 2024). They exhibit high motivation, enabling them to face challenges and sustain learning (Mammadov & Schroeder, 2023). These learners also excel in planning, time management, and self-organization to achieve academic goals (SERC, 2024). Emotional regulation, focus, and the ability to avoid distractions further enhance their performance (Pintrich, 1995; Carneiro et al., 2011). Additionally, they engage in self-assessment, relying on feedback to improve their learning strategies (Winne & Perry, 2000; Dibenedetto, 2018), and develop independence and confidence in their abilities, which contributes to academic excellence (Zimmerman & Schunk, 2011).

SRL fosters autonomy, organization, and self-motivation, improving academic performance and developing essential skills such as time management, problem-solving, and critical thinking (Zimmerman, 2002). It also enhances self-efficacy, encouraging lifelong learning (Schraw et al., 2006It also promotes cooperative learning by fostering responsibility and efficient time allocation (Zimmerman, 2002). Overall, SRL equips learners with independence, self-motivation, and adaptability, preparing them for future academic and professional challenges.

Teachers are able to play a crucial role in fostering SRL by guiding students in goal setting, time management, and self-assessment, which enhances academic independence (Zimmerman, 2002). They teach self-regulation strategies, encourage the use of digital tools to enhance performance (Boekaerts, 1999), and provide constructive feedback to motivate students (Cleary, 2018). Teachers also promote critical and reflective thinking through performance analysis activities and encourage students to problem-solve without excessive dependence on external support (Zimmerman, 2011). By modeling self-regulation skills themselves, teachers inspire students to adopt these practices (Schunk & Zimmerman, 1998).

Despite its benefits, SRL faces several challenges, including a lack of awareness among students and educators, reducing its adoption (Zimmerman, 2002). Low motivation can lead to reliance on others instead of independent learning (Schunk, 1989). Poor time management is another major barrier to achieving academic goals (Boekaerts, 1999), along with the absence of a supportive environment that provides necessary resources and minimizes distractions (Cleary, 2018). These obstacles can be mitigated through awareness programs, workshops (Zimmerman, 2002), and strategies to enhance motivation, such as linking learning to students' interests and providing positive reinforcement (Schunk, 1989). Effective time management tools like Google Calendar (ACC, 2019) and structured learning environments that minimize distractions (Cleary, 2018) also contribute to successful self-regulation. Training students in goal-setting, self-monitoring, and digital learning tools such as Moodle and Google Classroom further strengthens independent learning (Aliyeva, 2023; Bembenutty et al., 2013).

Several evidence-based strategies enhance SRL and academic performance. Spaced repetition, which involves reviewing information at intervals, reduces forgetting (Ebbinghaus, 1885). Summarization helps students extract key ideas and improve comprehension (Brown et al., 2014). The Feynman Technique promotes deep understanding by encouraging students to simplify concepts in their own words (Indah et al., 2021). The Pomodoro Technique enhances focus by dividing study sessions into short intervals with breaks (Cirillo, 2018). Collaborative learning strengthens comprehension through discussion and peer interaction (Johnson & Johnson, 1991). Multisensory learning engages multiple senses to improve recall and retention (Sousa, 2011). By incorporating these strategies, students can enhance their efficiency, develop independence, and become lifelong learners equipped to navigate evolving academic and professional landscapes.

Chapter 3. Original Contributions

3.1 Theoretical Objectives

This thesis aims to address the theoretical, methodological and applied aspects related to learning and teaching mathematical word problems, from the perspective of both current and future teachers, with a particular focus on the role of SRL skills in improving the ability to solve these problems. To achieve the objectives of this research, four main studies were conducted that addressed the following aspects:

First, the research aimed to explore teachers’ perspectives on the difficulties students face in solving mathematical word problems, in addition to the methods teachers use in teaching them, and the challenges they face. The focus was also on providing recommendations aimed at improving teaching methods and curricula, which contribute to facilitating students’ understanding of these problems.

Second, the research focused on exploring students’ (pre-service teachers’) perceptions and attitudes towards mathematical word problems, including their importance, the challenges they face when dealing with them, the methods they use in solving and teaching them, and their readiness to integrate these problems into their future teaching practices.

Third, the research aimed to analyze teachers' views and practices regarding SRL by assessing their level of SRL skills, and their role in enhancing these skills among students, especially in the context of solving mathematical verbal problems.

Fourth, the research sought to evaluate the effectiveness of SRL-based teaching in improving students' (pre-service teachers') ability to solve mathematical verbal problems by following organized and systematic steps. The study also analyzed the impact of this intervention on students' attitudes towards SRL, and their ability to apply SRL strategies effectively.

3.2 General Methodology

The study objectives were achieved through four main research tracks, which included the use of electronic questionnaires and a quasi-experimental study, with a focus on data analysis using descriptive statistical methods and non-parametric tests.

1. Mathematics teachers’ survey: A questionnaire was distributed to 163 Romanian teachers from preschool, primary and secondary education stages, to explore their

perceptions about solving mathematical word problems, the difficulties students face, and common teaching methods. The validity and reliability of the questionnaire were verified using Cronbach's Alpha and the data were analyzed using arithmetic means, standard deviations and percentages.

2. Survey of students (pre-service teachers): Data were collected from 161 students of Babeş-Bolyai University, who are preparing to teach mathematics in the future. The questionnaire included their perceptions about the importance of word problems, the challenges they face, and the solution strategies they use. The questionnaire was subjected to validity and reliability tests, and the data were analyzed using descriptive statistical methods.
3. Teacher Survey on SRL: The survey included 146 teachers with master's and doctoral degrees in education, to explore their perceptions of SRL, their level of proficiency in SRL, and their methods for promoting these skills in students. The data were subjected to descriptive statistical analysis to compare participants' responses.
4. Quasi-experimental study: An intervention program was implemented with an experimental group of 43 students (pre-service teachers) and a control group of 39 students (pre-service teachers) in the specialty of primary and preschool education pedagogy. The program included training courses on solving verbal mathematical problems using a teaching guide based on SRL skills. The effectiveness of the intervention was measured using pre- and post-tests and an SRL questionnaire.

Also this chapter reviews the original research contributions of the thesis, through four main studies, which aim to analyze the challenges and practices associated with teaching and solving mathematical word problems, as well as exploring the role of SRL in improving academic performance.

3.3 Study 1. Challenges and Practices in Teaching and Solving Mathematical Word Problems: Teachers' Perspectives and Proposed Solutions

This study highlights the challenges associated with teaching and solving mathematical word problems, which are one of the most complex aspects of mathematics education, due to their need for deep understanding, mathematical representation, and critical thinking (Geiger et al., 2017; Thevenot, 2017). Students face difficulties in transforming word problems into mathematical equations, while teachers struggle with the limitations of traditional curricula and teaching methods, as well as environmental factors such as classroom density and lack of resources (Smith & Morgan, 2016; Likuru & Mwila, 2022).

This study aims to explore teachers' perspectives on these challenges, understand the reasons behind them, and collect proposed solutions to enhance teaching methods (Bernardo, 1999; García et al., 2019). The research is particularly relevant in the Romanian context, where the education system faces significant challenges in mathematics education, as reflected in the results of international assessments such as PISA (OECD, 2022). By providing recommendations based on teachers' experiences, the study seeks to improve curricula, develop effective teaching strategies, and support teacher training, which contributes to enhancing students' learning and developing their mathematical skills more effectively (Schunk, 1989; Zimmerman, 2002).

3.3.1Methodology

This study aims to analyze the challenges associated with teaching and solving Mathematical Word Problems (MWPs) from the perspective of teachers, explore the methods and practices currently used, and provide practical recommendations for improving teaching strategies, curriculum design, and achieving better learning outcomes.

The research sample consisted of 163 Romanian mathematics teachers working in preschool, primary, and lower secondary levels, with the largest proportion (87.7%) of teachers in primary, followed by 10.4% in lower secondary, and 1.8% in preschool. The sample was selected using snowball sampling, where the questionnaire was distributed to master's and doctoral students at Babeș-Bolyai University working in the field of education, and they were asked to share it with their colleagues, in addition to disseminating it in online teacher groups and with some teachers known to the researchers to ensure wide participation. In terms of years of experience, the largest proportion was for teachers with 15-19 years of experience (19%), followed by those with 5-9 years (17.2%), then 20-24 years (17.1%), while the smallest proportion was for teachers with 25-29 years of experience (9.2%). The majority of participants were women (150 female teachers versus 13 male teachers). In terms of academic qualifications, 50.9% of teachers had a master's degree, 41.1% had a bachelor's degree, while 7.4% had a doctorate. Geographically, most teachers worked in urban areas (86.7%) compared to only 13.3% in rural areas. The sample included teachers from Cluj (the largest proportion – 80 teachers), followed by Sălaj (19), Suceava (7), Neamț (5), Bacău (4), and other regions in smaller proportions.

A questionnaire consisting of three main parts was used to collect data. The first part covered the demographic characteristics of teachers such as educational background, years of experience, gender, language used in teaching, and school size. The second part contained Likert scale questions to measure students' attitudes towards MWPs, the challenges they face, the teaching methods used, and the frequency of using certain strategies. The third part included open-ended questions to explore teachers' perspectives on the difficulties students face in MWPs, the steps teachers take to address them, and their suggestions for improving the educational curricula. The questionnaire was validated by presenting it to doctoral supervisors and experts in mathematics education, and was modified based on their feedback to ensure its accuracy. Reliability was also checked using Cronbach's Alpha, which reached 0.88, indicating a high level of internal consistency and reliability. The questionnaire was distributed via Google Forms several times during the years 2020-2024 due to poor response, until the required number of participants was reached in 2024, after which the data was analyzed using descriptive statistical methods to calculate arithmetic means, standard deviations and percentages, in addition to comparisons to reach conclusions about the challenges and effective teaching methods in MWPs.

3.3.2 Results

The data was collected automatically and processed using Microsoft Excel & JASP. Teachers' responses to the questionnaire were tabulated and compared.

In the first question, teachers were asked to rate statements about students' general attitude toward solving word problems on a scale of 1 to 5, where 1 represents "strongly disagree" and 5 represents "strongly agree". Their responses are presented in Table 3.1.

Table 3.1

Descriptive Statistics of the Responses

The attitude	**M**	**SD**	Disagree (%)	Agree (%)
Students face difficulties in solving math word problems	3.681	1.052	13.5	58.3
On quizzes and other forms of testing their math knowledge, students dread having to solve math word problems	3.583	1.047	13.9	55.3

The results in Table 3.1 show that teachers generally agree that students face challenges with math word problems. The mean scores are moderately high (M = 3.681 and M = 3.583), indicating a tendency toward agreement on both statements. The standard deviations (SD = 1.052 and SD = 1.047) suggest a moderate variation in teachers' perceptions. In terms of percentages, more than half of the teachers agreed or strongly agreed with the statements (58.3% and 55.3%), while only a small proportion disagreed (13.5% and 13.9%). These findings highlight that teachers recognize both the difficulty and emotional strain students experience when solving word problems.

In the second question, teachers were asked to rate the difficulties students face in solving mathematical word problems using a 4-point scale, where 1 represents "not at all difficult," and 4 represents "very difficult". Their responses are presented in Table 3.2.

Table 3.2

Descriptive Statistics of Responses

The difficulty	M	SD
Deep reading of the word problem	2.896	0.775
Identifying word problem's data	2.816	0.87
Identification of additional information (if necessary)	2.89	0.762
Identifying the requirement of the word problem	2.706	0.838
Determining the steps needed to solve the word problem	2.816	0.803
Translating the content of the word problem into mathematical symbols	2.933	0.847
Checking how the child understood and solved the word problem	2.736	0.922
Choosing the strategy/method for solving the word problem	2.832	0.859

The results in Table 3.2 indicate that teachers perceive several aspects of solving math word problems as moderately to highly difficult. The most challenging aspect was "Translating the content of the word problem into mathematical symbols" (M = 2.933, SD = 0.847), with a combined 68% of teachers rating it as difficult or very difficult.

Similarly, "Deep reading of the word problem" (M = 2.896) and "Identification of additional information" (M = 2.89) were also reported as challenging, with about 73% of teachers in each case rating them as difficult or very difficult.

In contrast, "Identifying the requirement of the word problem" had the lowest mean (M = 2.706, SD = 0.838), and a lower proportion of teachers (62%) rated it as difficult or very difficult, while about 38% saw it as not at all or slightly difficult.

Overall, the findings highlight that translating word problems into mathematical symbols and understanding their deeper meaning (through deep reading and identifying additional information) are the most difficult aspects for teachers, as reflected by higher combined percentages of perceived difficulty.

The third question asked teachers to evaluate their approaches in teaching math word problems using a 5-point Likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree". Their responses are presented in Table 3.3.

Table 3.3

Descriptive Statistics of the Responses

The approach	M	SD	Disagree (%)	Agree (%)
I use different methods to explain word problems to students	4.025	0.962	8	73
I use word problems to show students applications of math concepts	4.052	0.889	6	76.8
Daily math exercises include at least one word problem	3.748	1.036	12.9	58.7
I use real-life word problems or student experiences	3.916	1.013	11	70.3
I ask the students to formulate word problems	3.658	1.066	15.4	57.4

The results in Table 3.3 indicate that teachers generally report high agreement with using various approaches to teach word problems. The highest mean was for "I use word problems to show students applications of math concepts" (M = 4.052, SD = 0.889), with about 77% agreeing and only 6% disagreeing, showing strong endorsement of this practice.

Similarly, "I use different methods to explain word problems to students" had a high mean (M = 4.025), with 73% agreement and 8% disagreement, reflecting diverse instructional strategies.

On the other hand, the lowest mean was observed for "I ask the students to formulate word problems" (M = 3.658, SD = 1.066), with 57% agreement and a higher 15% disagreement, suggesting that this approach is used less frequently or perceived as more challenging.

Overall, teachers appear to strongly support using varied, real-life, and application-oriented methods to teach word problems, with the highest agreement on connecting word problems to real-world math concepts.

In the fourth question, teachers were asked to indicate how often they use specific procedures in teaching mathematical word problems, using a 4-point scale where 1 represents "never," and 4 represents "always". Their responses are presented in Table 3.4.

Table 3.4

Descriptive Statistics of Responses

The procedure	M	SD
Creation of drawings / graphs / tables necessary for organizing data or clarifying the stages of solving problems	3.178	0.769
Applying critical thinking	3.178	0.769
Using the math word problem as an introduction to explaining a new math concept	2.883	0.849
Using role play in explaining math word problems	2.779	0.91
Using a story to introduce the context of the math word problem	2.742	0.927

The results presented in Table 3.4 indicate that “Creation of drawings, graphs, or tables necessary for organizing data or clarifying the stages of solving problems” and “Applying critical thinking” received the highest mean scores (M = 3.178, SD = 0.769). This suggests strong agreement among teachers on the importance of these two strategies. Supporting this, about 79% of teachers reported using drawings, graphs, and tables “many times” or “always,” while around 80% reported using critical thinking at the same frequency. Only a very small proportion — less than 2% — indicated that they “never” use these strategies.

On the other hand, “Using the math word problem as an introduction to explaining a new math concept” scored a lower mean (M = 2.883, SD = 0.849). Approximately 65% of teachers reported using this strategy “many times” or “always,” whereas nearly 4% reported that they never use it.

Similarly, “Using role play in explaining math word problems” and “Using a story to introduce the context of the math word problem” had the lowest means (M = 2.779, SD = 0.910 and M = 2.742, SD = 0.927, respectively). Only about 64% of teachers reported using role play “many times” or “always,” and 61% reported the same for using a story. Notably, about 9–10% of teachers stated that they “never” use these two methods, and around 27–29% use them only “sometimes,” indicating considerable variability in their application.

In summary, teachers appear to strongly favor strategies that emphasize visual organization and critical thinking (both widely and consistently used) while methods that involve storytelling or role play are applied less frequently and show greater differences in usage among teachers.

The fifth question asked teachers to rate the obstacles and challenges they face as math teachers in teaching word problems using a 5-point Likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree". Their responses are presented in Table 3.5.

Table 3.5

Descriptive Statistics of Responses

The obstacle	M	SD	Disagree (%)	Agree (%)
The limited time allowed to finish the manual	3.761	1.201	17.1	66.2
Large number of students per class	3.804	1.18	14.1	67.4
Lack of school materials needed to explain math word problems to students	3.503	1.13	17.8	55.4
Lack of teacher training courses in teaching mathematics	3.209	1.199	28.2	43.5
The textbook does not contain activities dedicated to learning problem-solving strategies	3.442	1.066	19.7	50.2
Textbook math problems do not belong to the student's reality	3.448	1.043	17.8	49.7

Table 3.5 presents descriptive statistics of teachers' perceptions of the main obstacles in teaching math word problems. The highest mean scores were reported for "Large number of students per class" (M = 3.804, SD = 1.180) and "The limited time allowed to finish the manual" (M = 3.761, SD = 1.201), with approximately 67% and 66%, respectively, agreeing or strongly agreeing that these are significant obstacles. These findings suggest that time constraints and large class sizes are the most prominent challenges faced by teachers.

On the other hand, the lowest mean was observed for "Lack of teacher training courses in teaching mathematics" (M = 3.209, SD = 1.199), with only 43.5% agreeing or strongly agreeing on its importance, and a relatively high 28.2% disagreeing or strongly disagreeing. Similarly, "The textbook does not contain activities dedicated to learning problem-solving strategies" and "Textbook math problems do not belong to the student's reality" had moderate means (M = 3.442 and M = 3.448, respectively) and agreement percentages around 50%, indicating more varied opinions about these obstacles.

It is also notable that the standard deviations for all obstacles are relatively high (around 1.0–1.2), reflecting some diversity in teachers' views. Overall, the results highlight that structural factors like time and class size are perceived as the most significant barriers, while factors related to resources and training are perceived as less pressing but still relevant.

For the third section of the questionnaire, which consists of 7 open-ended questions. In the first question, the teachers were asked to explain why the students have difficulty in solving math word problems.

The reasons teachers cited for students' difficulties in solving word problems in mathematics varied. Thirty-nine teachers cited poor reading and comprehension problems as the main reason for these difficulties. 19 teachers attributed these difficulties to a lack of focus and attention. Focus is essential when dealing with multi-step problems. On the other hand, 18 teachers felt that the main reason behind these challenges was that students did not learn effective strategies for solving word problems. 14 teachers indicated that lack of training and daily practice affects students' ability to solve mathematical verbal problems, while 12 teachers attributed the difficulties to the complexity of the problems themselves due to long sentences and difficult vocabulary that may hinder students' understanding, while 11 teachers believed that students' cognitive abilities, such as limited intelligence and logical thinking and difficulty moving from abstract to concrete thinking, play a role in these challenges. 10 teachers stated that students' lack of patience, whether when reading the problem or while solving it, negatively affects their performance, while 7 teachers indicated that reliance on indoctrination, lack of resources and unqualified teachers constitute an obstacle in teaching verbal problems, while 5 teachers pointed out that the limited time allocated for teaching is among the influencing factors. Three teachers also stated that psychological pressure and anxiety related to mathematics affect students' performance, while 2 teachers indicated weak family support and lack of parental involvement in helping their children, and two other teachers confirmed that verbal problems do not reflect students' reality, which makes it difficult for them to interact with and understand them.

In the second question, the teachers were asked to specify what other (than those mentioned above) difficulties do students face in solving mathematical text problems.

It was noted that some respondents confused the difficulties of solving word problems with the reasons for those difficulties, as their answers to this question were similar to their answers to the previous question, which led to the exclusion of inappropriate answers. Twenty teachers indicated that students have difficulty maintaining their concentration while solving word problems. Seventeen teachers explained that students have difficulty reading the problem, in addition to difficulty in understanding what they read and extracting important information. Twelve teachers also indicated that students have difficulties in thinking logically, mentally visualizing, and linking information. Ten teachers reported that students have poor self-control and self-motivation, which leads to feelings of frustration and abandonment of trying to solve problems they find difficult. Eight teachers indicated that students have difficulty converting textual information into mathematical equations, while seven teachers stated that students have difficulty identifying the most appropriate method for solving the problem and planning their approach to the solution, while another seven teachers indicated that students have difficulty managing time, especially with the small amount of time allocated to the class compared to the amount of mathematical concepts they need to learn during the school year.

The third question asked teachers whether they have attempted to help students overcome difficulties in solving math word problems. To this question, 86% of the respondents answered "yes," while 14% answered "no.

The fourth question specifically targets teachers who answered "yes" to the third question, asking them to describe the methods they have already used to help students overcome difficulties in solving mathematical word problems, excluding those mentioned previously.

Teachers highlighted several strategies for addressing these challenges. Training students in in-depth reading was mentioned 50 times. Additionally, dividing the text of the problem into smaller parts and understanding each part to reach an overall comprehension of the problem was cited 35 times. In 27 instances, teachers mentioned teaching students a step-by-step strategy for solving word problems and encouraging them to follow these steps consistently.

Furthermore, explaining problems using tangible materials or engaging methods, such as drawings, stories, games, and movies, was noted 25 times. Another 25 mentions emphasized the importance of continuous and intensive practice with a variety of word problems. Finally, using practical problems from students' daily lives and integrating other sciences with mathematics were mentioned 20 times as effective approaches.

The fifth question asks teachers to provide additional suggestions for other educators to use in addressing mathematical word problems difficulties.

12 responses encouraged teachers to use modern methods to explain and present word problems, such as turning them into games, organizing competitions to solve them, and explaining them through graphs, drawings, and tangible materials. 11 responses recommended the need to encourage students to solve more word problems on a daily basis, whether in class or through homework, while 11 other responses emphasized the importance

of continuous practice and training to solve word problems. 7 responses suggested that word problems include real-life applications. 5 responses focused on the need to guide students to respect and follow the correct steps to solve problems, while 5 other responses recommended dividing problems into smaller parts to understand each part separately, which facilitates their full comprehension. In addition, 5 responses recommended teaching students correct reading techniques and encouraging them to reformulate the problem in their own words to enhance their understanding.

4 responses advised the need to give equal attention to all levels of students, and 4 other responses suggested working in groups or pairs when solving these problems. 3 responses called for promoting critical thinking through the use of guided questions that stimulate deep thinking, and 3 other responses emphasized the importance of teachers themselves mastering word problem-solving skills, which calls for providing training courses to keep them up to date with the latest technologies. 2 responses recommended the use of digital resources and educational platforms to promote independent learning, while 2 other responses stressed the need for teachers to be patient with students. Other scattered suggestions included encouraging students to formulate word problems themselves, preparing lessons and solutions in advance to ensure they are presented correctly, and working with families to increase students' motivation to solve mathematical problems.

The sixth question ask teachers how the math textbooks contribute to difficulties in solving math text problems? (Not mentioned above)

Teachers' opinions varied regarding the extent to which textbooks create difficulties for students in solving verbal problems in mathematics. Fourteen teachers believe that the examples in the books are complex and their texts are unclear, while 12 teachers believe that the number of examples provided is insufficient to help students learn a specific way to solve verbal problems. Another 12 teachers believe that textbooks are poorly designed, randomly prepared, and unattractive to students. On the other hand, nine teachers indicated that the problems presented in the books do not reflect reality, as they have not been updated for a long time, making them old and irrelevant to the students' future. Seven teachers considered the books to be good and do not suffer from major problems, while six teachers believed that the books lacked diversity in the problems, as they focused either on very difficult or very easy problems. Four teachers indicated that there were typographical and linguistic errors in the books, while four other teachers confirmed that the books did not include examples that clearly explained the strategies that students should follow when solving verbal problems.

The seventh question ask teachers to formulate suggestions for curriculum designers and mathematics textbook authors to support overcoming difficulties in solving mathematical text problems.

The teachers' suggestions were as follows, 21 teachers proposed that textbooks should include a larger number of examples, for each type of word problem, accompanied by clear instructions on problem-solving strategies and examples of common mistakes to be avoided. 17 teachers suggested that the problems in textbooks should be relevant to the students' environment, connected to real-life scenarios, and appropriate for their skill level. 11 teachers recommended making textbooks, more engaging by modifying the way problems are presented, such as using games or attractive illustrations, and incorporating students' favorite characters. Another 11 teachers proposed that problems should gradually increase in complexity, ensuring a logical progression of concepts and taking into account the students' age and comprehension level. 9 teachers suggested simplifying the wording and conceptual complexity of word problems, as well as improving their presentation. 5 teachers recommended that textbooks be adjusted to align with current school programs, taking into account teachers' current competencies and their feedback. 2 teachers proposed reviewing textbooks to eliminate typographical and linguistic errors.

3.1.3 Conclusion

This study highlights the challenges students and teachers face in solving and teaching mathematical word problems, including difficulties in text comprehension, cognitive demands, inadequate teaching materials, and curricular constraints. It identifies effective teaching strategies, such as incorporating real-life contexts, using visual aids, and promoting active learning, emphasizing the need for systemic collaboration to improve mathematics education. However, limitations such as reliance on questionnaires, a non-representative sample, and gender imbalance must be considered. Future research should explore the long-term impact of these strategies, address systemic barriers, examine cultural and gender influences, and enhance teacher training programs to create a more inclusive and effective learning environment that strengthens students' mathematical problem-solving skills and connects them to real-world applications.

3.4 Study 2. Future Primary School Teachers' Opinions Regarding the Mathematical Word Problems

This study highlights the importance of mathematical word problems in developing students' problem-solving and critical thinking skills, yet many struggle due to weak comprehension, ineffective teaching, and poorly structured problems (Sepeng & Madzorera, 2014; Johnston, 2023; Taş & Bolat, 2023). Focusing on primary school trainee teachers, this research examines their challenges, perceptions, and readiness to teach word problems effectively (Sosa-Gutierrez et al., 2024; Zsoldos-Marchiş, 2015). Using a questionnaire-based approach, the study offers insights to improve teacher training and mathematics curricula, ensuring future educators can equip students with essential analytical skills for real-world applications (Bernadette, 2009; Seifi et al., 2012; Skinner et al., 2016).

3.4.1 Methodology

This study examines the perspectives, challenges, and preparedness of 161 pre-service teachers from Babeș-Bolyai University, Romania, regarding mathematical word problems. Participants were recruited through a snowball sampling method, with a sample comprising 156 women and 5 men. Most were in their third year of undergraduate studies, while others were at different academic levels, including master's and doctoral programs. Their backgrounds varied across disciplines such as socio-human sciences, pedagogy, natural sciences, philology, and mathematical informatics. Ethnically, 90% were Romanian, and participants came from various counties, with the highest representation from Cluj, Maramureș, and Sălaj. Regarding mathematics performance, most scored between 8 and 8.99 in their final high school year, while 42.9% did not study math for the baccalaureate.

To collect data, a 51-item questionnaire was developed and validated through expert review by three doctoral supervisors specializing in mathematics education and twelve PhD students. It included demographic questions and explored participants' views on the importance of mathematical word problems, their attitudes and emotions toward solving them, the challenges they face, their problem-solving strategies, their opinions on teaching methods, and their preparedness to teach these problems in the future. A five-point Likert scale was used to assess responses, and reliability testing using Cronbach's alpha (0.872) confirmed strong internal consistency. The questionnaire was administered online via Google Forms during the 2023-2024 academic year, providing valuable insights into improving teacher preparation and mathematics curricula to enhance students' problem-solving skills.

3.4.2 Results

Firstly, participants were asked to rate how much they liked mathematics during school on a scale from 1 to 5, where 1 means "not at all" and 5 means "very much." The responses were as follows: 10% of students chose 1, 20% chose 2, 38% chose 3, 23% chose 4, 10% chose 5.

The results indicate a variation in the level of interest in mathematics among students. A large proportion of students (38%) chose the average rating (3), indicating a neutral or moderate attitude towards the subject. It is noteworthy that the same proportion of students (10%) expressed strong aversion (rating 1) or great enjoyment (rating 5) of mathematics.

In the first section of the second part of the questionnaire participants were asked to rate statements about their opinions on the importance of mathematical word problems using a 5-point Likert scale, where 1 represented "strongly disagree," 2 represented "disagree," 3 represented "neither agree nor disagree," 4 represented "agree," and 5 represented "strongly agree". The findings from the analysis of this section are presented in Table 3.6.

Table 3.6

Descriptive Statistics of Responses

The statement	M	SD	Agree (%)	Disagree (%)
Solving word problems represents a goal in itself in teaching mathematics	3.646	0.925	55	9.6
It is important to have the ability to solve word problems	4.037	0.901	71	5
Word problems highlight to students the real-life applications of mathematical concepts	3.857	0.843	64	4
Mathematical word problems develop students' logical thinking	4.13	0.923	72	4
Solving mathematical word problems develops students' ability to cope with real-life problems	3.509	1.119	52	17
Solving word problems requires applying mathematical knowledge and skills in new situations	3.845	0.965	61	8
Word problems help students develop the ability to self-regulate their thinking processes	3.702	0.993	57	11.6

Word problems improve students' text comprehension skills	4.087	0.897	71	3

The results, summarized in Table 3.6 indicate that participants generally agreed on the importance of these problems in developing cognitive skills.

The highest mean was recorded for the statement “Mathematical word problems develop students’ logical thinking” (M = 4.13, SD = 0.923), with 72% of participants agreeing or strongly agreeing. This was followed by “Word problems improve students' text comprehension skills” (M = 4.087), supported by 71% agreement. The lowest mean appeared for “Solving mathematical word problems develops students’ ability to cope with real-life problems” (M = 3.509, SD = 1.119), with 52% agreement and 17% disagreement, reflecting more varied views.

Standard deviations were lowest for “Word problems highlight real-life applications” (SD = 0.843), showing strong consensus, and highest for the real-life problem-solving statement (SD = 1.119), indicating greater variability in perceptions.

Overall, the findings suggest consensus on the role of word problems in fostering logical thinking and reading comprehension, while opinions about their contribution to real-life problem-solving were more divided.

In the second section, participants were asked to rate their feelings about mathematical word problems using a five-point Likert scale, where 1 represented "strongly disagree," 2 represented "disagree," 3 represented "neither agree nor disagree," 4 represented "agree," and 5 represented "strongly agree." The findings are summarized in Tables 3.7.

Table 3.7

Summary of Students’ Ratings on Their Feelings Toward Solving Mathematical Word Problems

The statement	M	SD	Agree (%)	Disagree (%)
I find solving word problems more interesting than solving other types of problems	3.28	0.97	37	21
I am afraid if I have to solve word problems on a math test	2.609	1.174	19	44

I gain more confidence when I can solve a difficult word problem	3.901	0.989	68	6
I like to solve word problems	3.193	1.11	35	23
I feel good when I correctly solve a word problem in mathematics	3.888	1.031	62	8
I feel anxious when I have to solve a word problem in mathematics	2.46	1.173	17	56

Table 3.7 reflects the students' mixed feelings toward solving mathematical word problems.

The highest mean score was recorded for the statement "I gain more confidence when I can solve a difficult word problem" (M = 3.901, SD = 0.989), with 68% of the students agreeing and only 6% disagreeing. Similarly, "I feel good when I correctly solve a word problem in mathematics" received a high mean (M = 3.888), with 62% in agreement and only 8% in disagreement, indicating that success in solving word problems contributes to students' positive emotional responses and self-confidence.

On the other hand, "I feel anxious when I have to solve a word problem in mathematics" had the lowest mean (M = 2.46, SD = 1.173), with 56% disagreeing and only 17% agreeing, suggesting that most students do not associate solving word problems with anxiety.

Regarding preferences, only 37% of the students agreed with the statement "I find solving word problems more interesting than solving other types of problems" (M = 3.28), while 21% disagreed. Similarly, 35% agreed with "I like to solve word problems" (M = 3.193), while 23% disagreed, indicating moderate enthusiasm.

Additionally, 44% of the students disagreed with the statement "I am afraid if I have to solve word problems on a math test" (M = 2.609), while only 19% agreed.

Overall, the results show that while students generally associate solving word problems with confidence and satisfaction, their interest and anxiety levels vary, reflecting the need for balanced instructional strategies to support motivation and reduce fear.

In the third section, participants were asked to rate their difficulties in solving mathematical word problems using a five-point Likert scale, where 1 represented "strongly disagree," 2 represented "disagree," 3 represented "neither agree nor disagree," 4 represented "agree," and 5 represented "strongly agree." The findings are presented in Table 3.8.

Table 3.8

Descriptive Statistics of Responses

The statement	M	SD	Agree (%)	Disagree (%)
I need to read math word problems several times to understand them	3.68	1.06	57	13
I have difficulty understanding the text of a mathematical problem	2.57	1.4	18	51
It is difficult to translate word problems into mathematical symbols	2.56	1.1	22	51
I find it difficult to determine the data and requirements in mathematical word problems	2.13	1	10	64
I have difficulty identifying keywords that help me solve mathematical word problems	2.36	1	16	57
I find it difficult to determine which operations to use to solve mathematical word problems	2.21	0.95	7	63
I find it difficult to determine the method that should be used to solve a word problem in mathematics	2.47	1	17	51
I work harder on word problems in mathematics than in math exercises	3.14	1	36	24

The results in Table 3.8 show that students reported moderate levels of difficulty when solving mathematical word problems. The highest mean (M = 3.68, SD = 1.06) and the largest percentage of agreement (57%) were recorded for the statement "I need to read math word problems several times to understand them," indicating that understanding the problem statement is a significant challenge for many students.

Additionally, 36% of students agreed with the statement "I work harder on word problems in mathematics than in math exercises" (M = 3.14, SD = 1), reflecting the extra cognitive effort required to tackle these problems.

On the other hand, the lowest means (ranging from M = 2.13 to M = 2.36) and the smallest agreement percentages (between 7% and 17%) were found for statements related to identifying data, operations, and methods, while disagreement percentages were high (over 50%). This suggests that most students do not experience significant difficulties with these aspects.

Overall, the findings suggest that although students generally understand how to analyze and solve word problems in mathematics, their main difficulties lie in comprehending the problem text, indicating a need for targeted instructional support to develop comprehension skills.

The fourth section asked participants to specify the methods they used to solve math word problems, using a five-point Likert scale, where 1 represented "strongly disagree," 2 represented "disagree," 3 represented "neither agree nor disagree," 4 represented "agree," and 5 represented "strongly agree." The findings are presented in Table 3.9.

Table 3.9

Descriptive Statistics of Responses

The statement	**M**	**SD**	**Agree (%)**	**Disagree (%)**
I practice solving word problems in mathematics through homework	3.32	1.12	43	22
I have learned methods for solving word problems in mathematics	3.61	1.11	56	18
If I get stuck on a word problem in mathematics, I give up	2.28	1.09	12	56
If I find a word problem in mathematics difficult, I tend to guess the answer	2.31	1.15	14	57
I make sure that the solution meets all the conditions stated in the word problem	3.77	0.98	57	7
I check that the solution to the word problem is correct	4	0.96	71	7
I use different methods to understand the word problem in mathematics, such as drawing shapes and illustrations	3.83	0.97	61	9
After solving the problem, I think about whether it could be solved in another way	3.26	1.27	46	28

The results in Table 3.9 show that students reported generally positive strategies and attitudes toward solving mathematical word problems. The highest mean (M = 4.00, SD = 0.96) and agreement rate (71%) were observed for the statement "I check that the solution to the word problem is correct", indicating that most students are conscientious about verifying their answers. Similarly, high means and agreement were noted for statements like "I use different methods to understand the word problem, such as drawing shapes and illustrations" (M = 3.83, agreement = 61%) and "I make sure that the solution meets all the conditions stated in the word problem" (M = 3.77, agreement = 57%), suggesting that many students employ diverse and careful strategies when solving word problems.

Conversely, the lowest means (around 2.28–2.31) and low agreement percentages (12–14%) appeared in statements such as “If I get stuck on a word problem, I give up” and “If I find a word problem difficult, I tend to guess the answer”. These findings, along with high disagreement rates (56–57%), imply that students generally persevere rather than giving up or guessing when faced with challenging problems.

Overall, these findings indicate that students tend to adopt effective problem-solving strategies and maintain a positive attitude toward solving mathematical word problems, although there remains a minority who may struggle and could benefit from additional support in building persistence and confidence.

The fifth section investigates the opinions of participants on the methods used to teach mathematical word problems. Students were asked to rate their responses using a five-point Likert scale, where 1 represented "strongly disagree," 2 represented "disagree," 3 represented "neither agree nor disagree," 4 represented "agree," and 5 represented "strongly agree." The findings are presented in Table 3.10.

Table 3.10

Descriptive Statistics of Responses

The statement	M	SD	Agree (%)	Disagree (%)
Focusing on the strategies students use to solve word problems in mathematics is more important than focusing solely on the final answer.	4.149	0.93	72	4
More emphasis can be placed on teaching students specific methods for solving word problems in mathematics.	4.193	0.898	78	5
Accepting all correct solution methods provided by students, not just the ones previously taught, is considered valuable.	4.292	1.035	77	7
Encouraging students to explain their problem-solving strategies contributes to a deeper understanding.	4.248	0.929	78	6
Finding multiple ways to solve the same word problem is seen as a beneficial practice.	4.193	0.991	76	8
Formulating their own word problems helps students engage more deeply with mathematical content	3.981	1.081	64	8

Visualizing word problems using various formats (graphical, figurative, etc.) supports students' comprehension.	4.311	0.903	80	4
Routinely verifying the correctness of solutions is an important part of the problem-solving process	4.28	0.93	76	4
Justifying their methods for solving problems encourages students to think critically	3.963	1.042	70	10
Learning multiple solution strategies can enhance students' flexibility in mathematical thinking	4.205	0.93	75	5

The results in Table 3.10 show that the respondents, as future teachers, demonstrated highly positive attitudes toward promoting effective strategies for solving mathematical word problems.

The highest mean (M = 4.311, SD = 0.903) and agreement rate (80%) were recorded for the statement "Visualizing word problems using various formats (graphical, figurative, etc.) supports students' comprehension", highlighting the importance that these future teachers place on visual representations to enhance understanding.

High means and agreement percentages were also observed for statements emphasizing diverse and student-centered strategies, such as "Encouraging students to explain their problem-solving strategies contributes to a deeper understanding" (M = 4.248, agreement = 78%), "More emphasis can be placed on teaching students specific methods for solving word problems in mathematics" (M = 4.193, agreement = 78%), and "Accepting all correct solution methods provided by students, not just the ones previously taught, is considered valuable" (M = 4.292, agreement = 77%). These findings suggest strong support from future teachers for flexibility, explanation, and strategic thinking over a focus on the final answer alone.

At the other end, the lowest mean (M = 3.963, SD = 1.042) and a lower agreement rate (70%) were noted for the statement "Justifying their methods for solving problems encourages students to think critically", followed by "Formulating their own word problems helps students engage more deeply with mathematical content" (M = 3.981, agreement = 64%). Although the values remain relatively high, these items indicate slightly lower enthusiasm or possibly greater perceived difficulty in implementing these practices compared to others.

Overall, the results suggest that future teachers value a variety of instructional approaches that emphasize student understanding, flexibility, and active engagement in solving mathematical word problems, with particularly strong support for visual aids and the acceptance of multiple correct solution paths.

In the sixth question, participants were asked how prepared they are to teach word problems in the future. Responses were rated using a five-point Likert scale, where 1 represented "strongly disagree," 2 represented "disagree," 3 represented "neither agree nor disagree," 4 represented "agree," and 5 represented "strongly agree." The findings are presented in Table 3.11.

Table 3.11

Descriptive Statistics of Responses

The statement	M	SD	Agree (%)	Disagree (%)
I am confident in my ability to solve math problems with text	3.652	0.91	54	7
I am confident that I will be able to teach my students to solve math problems with text	3.826	0.912	67	9

As shown in Table 3.11, the respondents generally expressed a positive level of self-confidence regarding both their current ability to solve mathematical word problems and their future ability to teach students how to approach such problems.

The highest mean (M = 3.826, SD = 0.912) and agreement rate (67%) were observed for the statement “I am confident that I will be able to teach my students to solve math problems with text”, indicating that most future teachers feel capable of preparing students to tackle such tasks effectively.

Likewise, a considerable number of participants reported confidence in their own skills, with a mean of (M = 3.652, SD = 0.91) and 54% agreement on the statement “I am confident in my ability to solve math problems with text”. The relatively low disagreement rates (7–9%) further reinforce the positive self-perceptions of the respondents.

Overall, these findings suggest that the participants demonstrate a solid level of self-efficacy both in solving word problems themselves and in teaching these skills, providing a promising foundation for effective instruction.

3.4.3 Conclusion

This study highlights the perceptions, challenges, and readiness of prospective teachers in teaching mathematical word problems, emphasizing their role in fostering logical thinking, reading comprehension, and real-world problem-solving. While many trainee teachers expressed confidence in teaching word problems, gaps remain in their problem-solving skills, critical thinking, and self-regulation strategies, underscoring the need for targeted teacher training. The preference for visualization and flexible problem-solving aligns with best practices but requires stronger connections to reading comprehension and real-world applications. However, study limitations, including reliance on a questionnaire, gender imbalance, and varied academic backgrounds, may affect the generalizability of findings. Future research should explore the long-term impact of teaching strategies, examine cultural and gender influences, and integrate qualitative methods to provide deeper insights. Additionally, enhancing digital resources, interactive teaching approaches, and curriculum links between reading and problem-solving can contribute to more effective mathematics education, equipping future teachers to develop students' critical thinking and real-world problem-solving abilities.

3.5 Study 3 Exploring Self-Regulated Learning Practices and Skills Among Teachers in Romania

This study explores the role of self-regulated learning (SRL) strategies in education, emphasizing their impact on academic success and independent learning. While SRL has been extensively studied among students, research on its application by teachers remains limited, despite its importance in fostering metacognitive skills and guiding students toward self-directed learning (Zimmerman, 2002; Schunk & DiBenedetto, 2020). Given the increasing reliance on digital transformation and evolving educational demands, understanding how teachers apply SRL strategies is crucial for enhancing teaching effectiveness and student outcomes (Karlen et al., 2024). This study investigates Romanian teachers' SRL practices, assessing their perspectives, implementation, and the factors influencing their use. It aims to provide insights for developing professional training programs that support teachers in modeling and integrating SRL into their instruction. Additionally, the study evaluates a tool for a future intervention program designed to improve mathematical problem-solving through SRL. By examining teachers' role in fostering self-regulated learning, this research contributes to improving educational quality, lifelong learning skills, and student adaptability to modern challenges (Opriș et al., 2022).

3.5.1 Methodology

This study explores Romanian teachers' perceptions, practices, and competencies related to self-regulated learning (SRL) and evaluates a proposed guide for solving mathematical word problems using SRL. The research sample consisted of 146 teachers recruited through a non-probability snowball sampling method, including master's and doctoral students at Babeș-Bolyai University, online teacher groups, and personal networks. Participants represented various educational levels, with 28.1% teaching primary and lower secondary levels, 20.5% in preschool, and smaller percentages in high school and higher education. Teaching experience varied, with 45.9% having less than five years, while only 12% had over 20 years of experience. Academically, 56.8% held a bachelor's degree, 41.1% a master's, and 2.1% a PhD. The respondents were geographically diverse, primarily from Cluj (66), Sibiu (12), and Maramureș (9), with smaller representations from other counties.

The study utilized a structured questionnaire with three sections. The first section collected demographic data, such as gender, experience, and teaching level. The second section used a five-point Likert scale to assess teachers' views on SRL (14 items), their own SRL skills (17 items), and their use of SRL teaching practices (24 items), including fostering student independence and reflection. The third section featured open-ended questions, allowing teachers to provide feedback on the proposed SRL-based word problem-solving approach and the questionnaire itself. The survey was distributed online during the 2023-2024 academic year.

The questionnaire underwent expert validation by doctoral supervisors and PhD students, with revisions based on their feedback. Reliability analysis using Cronbach’s Alpha (0.960) confirmed strong internal consistency, with a 95% confidence interval of 0.950 to 0.969, indicating high stability and reliability (Cronbach, 1951). These findings support the questionnaire's suitability for assessing teachers' engagement with SRL and guiding improvements in teacher training and instructional strategies.

3.5.2 Results

The data was collected automatically and processed using Microsoft Excel & JASP.

In the first question, teachers were asked to rate statements about their opinions on SRL, using a 5-point Likert scale, where 1 indicates ‘strongly disagree’ and 5 indicates ‘strongly agree.’ The findings from the analysis of the first question are presented in Table 3.12.

Table 3.12

Descriptive Statistics of Responses

The statement	M	SD	Disagree (%)	Agree (%)
The teacher should not teach students SRL skills, because a student is either naturally self-regulated or not	2.28	1.3	59.5	18.5
Human skills cannot be developed (they are innate).	1.81	1.18	78.7	11
The self-regulated student has a higher motivation for learning	4.09	0.89	4.8	76.1
The self-regulated student has greater self-confidence.	4.19	0.77	1.4	80.8
SRL develops lifelong learning skills	4.4	0.83	2.1	86.3
Learning skills are an integral part of SRL.	4.21	0.82	2.7	80.1
SRL promotes personal responsibility in the learning process	4.28	0.82	2.7	82.2
Teachers should be role models for SRL for their students.	4.41	0.76	2.1	87.7
Students who learn self-regulated are more capable of managing their time and resources efficiently	4.32	0.81	2	82.9
SRL encourages critical reflection on one's own learning processes	4.3	0.81	2.7	83.5
SRL is essential for the learning requirements of the 21st century	4.25	0.83	2.4	72.6
SRL improves students' academic performance	4.33	0.76	2	86.9
Teachers should create opportunities for students to practice and develop SRL skills	4.34	0.76	2.1	87
SRL skills can be taught and developed through training and practice	4.25	0.81	2.4	82.9

The analysis of teachers' responses to statements about self-regulated learning (SRL) in Table 3.12 revealed generally high mean scores and agreement percentages for positively phrased statements, indicating strong support for the value and teachability of SRL.

Conversely, the two negatively phrased statements showed low means and high disagreement percentages, reflecting clear rejection of their premises.

Specifically, the statement "Human skills cannot be developed (they are innate)" recorded the lowest mean (M = 1.81, SD = 1.18) with 78.7% of teachers disagreeing, and "The teacher should not teach students SRL skills, because a student is either naturally self-regulated or not" also scored low (M = 2.28, SD = 1.3) with 59.5% disagreement, indicating that most teachers reject the idea that SRL is purely innate or unteachable.

In contrast, the highest mean was observed for "Teachers should be role models for SRL for their students" (M = 4.41, SD = 0.76), with 87.7% agreement. Similarly, high means and strong agreement (ranging from 72.6% to 87.7%) were reported for other positively phrased statements, such as "SRL improves students' academic performance" (M = 4.33, SD = 0.76; 86.9% agreement) and "Teachers should create opportunities for students to practice and develop SRL skills" (M = 4.34, SD = 0.76; 87% agreement).

Overall, these results highlight teachers' strong belief in the importance, teachability, and benefits of SRL, as well as their recognition of their own role in modeling and fostering these skills in students. The standard deviations, ranging from 0.76 to 1.3, indicate relatively high consensus on these issues, particularly for positively phrased statements.

Teachers were asked in the second question to evaluate statements about their self-regulation skills using a 5-point Likert scale, where 1 indicates 'strongly disagree' and 5 indicates 'strongly agree.' The results for this question are presented in Table 3.13.

Table 3.13

Descriptive Statistics of Responses

The statement	M	SD	Disagree (%)	Agree (%)
In my annual planning, I constantly adapt the objectives of learning units and lessons according to the development of the students.	4.2	0.85	3.4	80.1
I set clear objectives for each lesson and strive to achieve them	4.5	0.71	2.1	91.1
I monitor my progress toward achieving the established objectives	4.4	0.65	0.7	92.4
I modify teaching strategies that are not effective	4.5	0.72	1.4	89.1
I keep myself updated with the latest teaching practices and methods	4.3	0.79	2.1	82.2

I ask for help from my colleagues when I need support or suggestions	4.2	0.96	4.1	80.8
I try to complete my tasks as well as possible in order to receive positive feedback from the students	4.5	0.70	0	87.7
I try to complete my tasks as well as possible in order to receive positive feedback from the school administration	4.2	0.97	7.1	76.7
I believe that the lack of my professional success is due to insufficient effort	3.2	1.29	28.1	47.3
I strive to develop and succeed in the future	4.6	0.64	0	91.8
When I face a problem, I immediately begin to look for possible solutions	4.5	0.69	0	88.4
I learn from my mistakes and try not to repeat them	4.6	0.64	0	91.8
I work with maximum dedication to achieve my goals	4.5	0.65	0	91.1
Being a teacher gives me professional satisfaction	4.5	0.77	2.1	89.1
I am capable of controlling my emotions in the classroom	4.3	0.73	1.4	87
I am open to feedback and use it to improve myself	4.7	0.66	0.7	91.7
I prioritize effective time management to maximize student learning	4.4	0.71	1.4	98.1

The analysis of the statements in Table 3.13 reveals that teachers reported generally high levels of self-regulated teaching practices, as reflected in both the mean scores and the percentages of agreement. The mean values ranged from 3.2 to 4.7, with the highest mean observed for the statement “I am open to feedback and use it to improve myself” (M = 4.7, SD = 0.66), indicating a strong acknowledgment of the value of feedback. Similarly, high means were recorded for “I strive to develop and succeed in the future” and “I learn from my mistakes and try not to repeat them” (both M = 4.6, SD = 0.64), reflecting teachers’ commitment to continuous growth and reflective practice. In contrast, the lowest mean was found for “I believe that the lack of my professional success is due to insufficient effort” (M = 3.2, SD = 1.29), suggesting more diverse views on the relationship between effort and success. Standard deviations across statements were generally low (ranging from 0.64 to 1.29), indicating overall consistency among respondents.

The analysis of the response percentages supports these findings. Agreement levels (“agree” and “strongly agree” combined) ranged from 47.3% to 98.1%, with the highest level of agreement observed for the statement “I prioritize effective time management to maximize student learning” (98.1%), underscoring the perceived importance of managing time effectively. High levels of agreement were also noted for statements such as “I learn from my mistakes and try not to repeat them” (91.8%) and “I strive to develop and succeed in the future” (91.8%). Conversely, the lowest agreement was recorded for “I believe that the lack of my professional success is due to insufficient effort” (47.3%), highlighting divergent opinions regarding personal responsibility for success.

Together, these findings demonstrate that teachers strongly endorse self-regulated teaching practices, particularly those related to reflection, professional development, feedback, and time management, while showing more varied perceptions on the role of personal effort in professional success.

The third question measures to what extent do teachers foster the development of SRL skills in their students, using a 5-point Likert scale, where 1 indicates ‘strongly disagree’ and 5 indicates ‘strongly agree.’ The results of the third question are presented in Table 3.14.

Table 3.14

Descriptive Statistics of Responses

The Statements	M	SD	Disagree (%)	Agree (%)
I talk to students about SRL and its importance	3.5	1.07	16.4	51.4
I rely on modern educational methods such as debates, cooperative learning, inquiry-based learning, reflection and critical thinking, experiments, etc.	4.2	0.83	2.7	80.2
When I teach, I think aloud so that I can convey my learning and problem-solving strategies and techniques to students	3.7	1.06	12.4	59
I verbalize the solution to complex or difficult tasks	4.2	0.91	4.8	82.9
I prepare students to learn effectively on their own	4.2	0.82	2.1	81.5
I encourage students to set their own learning goals	4.2	0.82	2.1	82.2
I teach students to identify and understand their emotions	4.3	0.85	2.8	82.9
I teach students how to regulate their emotions when situations require it	4.3	0.87	2.8	82.2
I provide students with an appropriate learning environment	4.5	0.73	1.4	89
I encourage students to ask questions and seek help	4.6	0.64	0	91.8

I encourage students to recognize, accept, and independently correct their mistakes	4.5	0.71	0.7	89
I explain the evaluation criteria to students	4.5	0.77	0.7	86.2
I provide immediate feedback	4.4	0.88	4.1	85.6
I offer detailed feedback that helps students understand their strengths and weaknesses	4.4	0.75	0.7	85.6
I encourage students to find different ways to solve problems	4.5	0.72	1.4	89.7
Before a student starts learning and doing homework, I give clear instructions about what needs to be learned and how it will be evaluated	4.5	0.71	0.7	89.1
I encourage students to use apps or online platforms to organize their lessons and homework	3.9	1.12	12.3	67.8
I ask students to complete longer tasks and projects, for which they need to plan their time and manage their work over a longer period	3.9	1.04	8.9	65.1
I help students organize their time better and find a balance between school and other activities	4	1.04	9.5	75.3
I encourage students to set small rewards for themselves to stay motivated when they achieve their learning goals	4	1.09	13	72.6
I teach students how to search for useful information on the internet or from books to learn on their own	4.2	0.95	4.8	81.5
I encourage students to collaborate with each other, discuss ideas, and find solutions together for learning tasks	4.4	0.72	0.7	87.7
I motivate students when I notice they lose interest in learning	4.5	0.67	0	90.4
I keep the class organized and provide a structured learning environment	4.5	0.78	2.1	88.3

The analysis of the mean (M) scores and standard deviations (SD) in Table 3.14 indicates a generally strong agreement among teachers regarding the listed practices and strategies. The mean values range from 3.5 to 4.6, reflecting positive attitudes toward self-regulated teaching. The highest mean (4.6) was observed for “I encourage students to ask questions and seek help,” demonstrating strong alignment with practices that support student engagement and open communication. In contrast, the lowest mean score (3.5) was recorded for “I talk to students about SRL and its importance,” suggesting room for improvement in explicitly discussing SRL concepts with students.

The standard deviations range from 0.64 to 1.12, with lower values indicating consistent responses and higher values suggesting more variability in certain practices. Additionally, the percentage analysis shows high levels of agreement (“agree” and “strongly agree”) for most statements, with combined percentages ranging from 51.4% to 91.8%. The highest agreement (91.8%) was for “I encourage students to ask questions and seek help,” underscoring the importance teachers place on fostering open communication and support. On the other hand, the lowest combined agreement (51.4%) was observed for “I talk to students about SRL and its importance,” indicating less emphasis or variability in explicitly addressing SRL with students.

These findings highlight overall positive practices while identifying specific areas for further focus and improvement.

In the 4th question, teachers were asked to provide their opinions on the suggested interventions for solving problems through SRL. They were kindly requested to review the steps outlined and share any suggestions, comments, observations, or additions they felt were relevant for each step.

Step 1: Read the problem carefully multiple times.

Step 2: I think about whether I have understood the problem statement (terminology, relationships, etc.).

Step 3: I identify the given data and the required information in the problem statement.

Step 4: I think about similar problems I have solved before to determine the type of problem and so on.

Step 5: I create the model (graphical, algebraic, etc.) based on which I solve the problem.

Step 6: I think about how I can solve the problem and identify the steps for solving it.

Step 7: I carefully apply the steps to solve the problem, step by step (I formulate questions, perform calculations, and find the results).

Step 8: I constantly reflect on the solution process, and if I get stuck, I go back to a previous step to overcome difficulties.

Step 9: When I obtain the result, I analyze it to see if it is credible (I check if the result is a natural number, its size relative to the data, verify it, etc.).

Step 10: I look for another way to solve the problem (I write the problem exercise, solve the problem algebraically, etc.).

Step 11: I reflect on what I have learned from the problem and the problem-solving process.

Step 12: I self-assess my performance in solving the problem (process and result).
Step 13: Throughout the problem-solving process, I try to manage my emotions to persevere in solving problems.

The feedback from teachers strongly supports the proposed steps, affirming their clarity, relevance, and effectiveness in fostering problem-solving through SRL. The minor suggestions provided offer valuable enhancements that can be incorporated as complementary strategies. These steps, validated by this study, are now ready to be utilized in the subsequent study.

3.5.3 Conclusion

This study underscores the vital role of self-regulated learning (SRL) in education and highlights teachers' commitment to fostering SRL skills in students, emphasizing its impact on motivation, self-confidence, and independent learning. While teachers actively promote questioning, creativity, and responsibility, the study identifies areas for improvement, such as raising SRL awareness, refining assessment criteria, and enhancing strategies like "think aloud." Teachers also demonstrate SRL in their professional growth through goal-setting, collaboration, and feedback, though differences in perceptions about personal effort in success suggest areas for further exploration. However, limitations such as reliance on self-reported data, non-probability sampling, and geographic imbalance may affect result generalizability. Future research should integrate qualitative methods, expand geographic representation, and explore the impact of teacher self-efficacy, technology, and cultural factors on SRL implementation. Addressing these gaps can strengthen teacher training programs, enhance SRL integration in curricula, and ultimately improve student learning outcomes and educational quality in the long term.

3.6 Study 4. Solving Mathematical Word Problems Using Self-Regulated Learning Skills

This study highlights the critical role of self-regulated learning (SRL) in mathematics education, emphasizing its impact on academic success, problem-solving, and independent learning (Schunk & Zimmerman, 2007; Valle et al., 2008). While traditional teaching methods often fail to develop deep mathematical understanding, SRL enables students to plan, monitor, and assess their learning, improving motivation, time management, and persistence (Zimmerman, 1989; Cleary & Kitsantas, 2017). Research shows that students with strong SRL skills perform better in mathematics, particularly in solving word problems, which require both mathematical reasoning and contextual understanding (Verschaffel et al., 2020; Huang et al., 2024). However, many teachers struggle to integrate SRL strategies effectively, limiting students' ability to apply structured problem-solving methods (Harskamp & Suhre, 2006; Kizilcec et al., 2017). This study introduces an SRL-based educational approach to help pre-service teachers acquire the motivational, cognitive, and behavioral skills necessary to implement SRL in their classrooms. As one of the first studies to examine SRL in teacher education in Romania, it fills a critical knowledge gap by providing empirical evidence on how SRL strategies can be integrated into teacher training programs, ultimately enhancing teaching effectiveness and student learning outcomes (Karlen et al., 2023; 2024).

3.6.1 Methodology

Study objectives

This study aims to evaluate the effectiveness of SRL-based instruction in enhancing students' (pre-service teachers') ability to solve mathematical word problems by following systematic, structured steps. Additionally, the study aims to:

1. Assess the extent to which SRL-based instruction enhances students' (pre-service teachers') ability to systematically approach mathematical word problems.
2. Compare the pre-test and post-test results of the experimental and control groups to evaluate the effectiveness of SRL-based interventions.
3. Analyze changes in students' (pre-service teachers') SRL attitudes and skills before and after the intervention.
4. Examine the relationship between students' (pre-service teachers') SRL abilities and their performance in solving mathematical word problems.

Research Hypotheses

Main Hypothesis (H1): Students who receive an instructional intervention based on SRL principles will demonstrate significant improvement in both their performance in solving mathematical word problems and their adoption of SRL strategies, compared to students in the control group.

Sub-Hypotheses:

H1.1: There will be a significant increase for the experimental group students' self-reported SRL abilities after the intervention.

H1.2: Students in the experimental group will show a statistically significant improvement in their ability to systematically follow SRL problem-solving steps after the intervention.

H1.3: Students in the experimental group will demonstrate better ability in solving mathematical word problems compared to the control group.

H1.4: There will be a positive correlation between students' SRL skills and their performance in solving word problems.

Null Hypothesis (H0): There will be no significant difference between the experimental and control groups in their post-test scores or SRL abilities after the intervention.

Participants

The study employed a convenience sample within a quasi-experimental design. The experimental group (EG) included 43 third-year undergraduate students (42 females, 1 male) from Babeș-Bolyai University, selected from the 105 initially enrolled based on full participation in all three tests and attendance of at least six intervention sessions. The control group (CG) consisted of 39 female students from the same major in Năsăud, selected from 62 based on similar criteria.

For the questionnaire analysis, only students who completed both pre- and post-tests and questionnaires were included, resulting in 29 students in the EG and 25 in the CG. All participants had only high school-level math knowledge and had not studied university-level mathematics or math didactics but had taken psychology and learning management courses.

Sampling was non-random and based on collaboration with a known professor, allowing practical implementation but limiting generalizability. Participation was voluntary, with confidentiality assured and the option to withdraw at any time.

Instruments Development & Validation

To evaluate the impact of SRL strategies on students' mathematical problem-solving abilities, the study utilized three main instruments:

Tests

A pre-test and post-test were given both to the EG and CG. These tests were designed to assess students' mathematical problem-solving skills and their ability to follow structured problem-solving steps. The test was scored out of 10 points for reaching the correct solution and 13 points for adherence to SRL based problem-solving steps. Also, an intermediate test and a re-test were given to the EG. The problems from the tests were formulated in 2 versions and were administered to the students in order to make sure that they work individually.

Questionnaire

A developed SRL questionnaire, based on relevant literature in the field, was administered to both the EG and CG. This questionnaire was used to measure students' SRL attitudes, skills, and application before and after the intervention. The questionnaire utilized a 5-point Likert scale (1 = completely disagree, 5 = totally agree) and was divided into three general questions: (1) general opinions about SRL (13 items), (2) evaluation of SRL skills

(17 items), and (3) assessment of the real-life application of SRL abilities (16 items). The validity was established by presenting the instrument to several doctoral supervisors, it was then revised based on their feedback and suggestions, resulting in the final version of the instrument.

SRL Guide for problem-solving

A structured SRL problem-solving guide, was used to the EG. This guide provided a step-by-step approach to solving mathematical word problems, ensuring the application of SRL skills. The guide consisted of 13 structured steps, guiding students through the problem-solving process. The validity of this guide was confirmed in Study 3.

Intervention procedures

The experiment was carried out during the first semester of the 2024-2025 academic year, as follows.

Week 1: Administration of the pre-test and pre-questionnaire to assess students' initial problem-solving abilities and SRL skills, to both EG and CG. The pre-test results were also used to ensure comparability between the experimental and control groups.

The intervention lasted for 10 weeks, with a session of 1-1.5 hour per week. In weeks 2-11, EG students participated in an intervention program based on SRL in solving mathematics problems. At the same time, both EG and CG participated in Mathematics and Mathematics Didactics courses and seminars. Mathematics courses and seminars were allocated 3 hours/week and consisted in the study of the following concepts: natural numbers, integer numbers, rational numbers, square root and operation with them, geometry, measurements and units of measure. Mathematics Didactics courses were allocated 2 hours/week in which methodology of teaching mathematical concepts in primary and preschool education was studied. Mathematics Didactics seminars were allocated 1 hour/week in which methods of solving word problems were studied: graphic method, false hypothesis method, comparison method, backward method, combined methods.

In the following, we will present the specific contents of the intervention to EG.

Week 2: Introduction to the EG of the structured SRL problem-solving guide. Students and teacher discussed and solved the pre-test problem collectively. A session on SRL was conducted, covering its concept, stages, importance and strategies for becoming a self-regulated learner.

Week 3: Teacher conducted a discussion session with students regarding to the Zimmerman's model of SRL and SRL strategies. Students were then given a worksheet containing a mathematical word problem and the SRL problem-solving guide. They were required to apply each step, documenting their thought process and learning experience for each stage. After completing the task individually, students participated in a group discussion, where solutions were presented on the board, allowing them to identify and correct their mistakes collaboratively.

Week 4: Teacher conducted a discussion session with students on emotional self-regulation and self-motivation, including effective techniques for self-control and self-motivation. Students were then given a worksheet and followed the same SRL problem-solving guide as in the previous week.

Week 5: Students received a worksheet which included the SRL problem-solving guide and a math problem which they have to solved individually applying the guide. Then, teacher conducted a frontal discussion to review and refine their solutions.

Week 6: Students took an intermediate test assess their progress and ensure that the intervention was proceeding as planned. Additionally, they were assigned a written task in which they had to develop a detailed step-by-step plan on how they would help their future students become more organized and cultivate SRL skills.

Week 7: Teacher conducted a discussion session with students of the intermediate test problem, following the same approach used since the beginning of the program.

Weeks 8–11: Sessions followed the same structure as described in Week 5.

Week 12: Administration of the post-test and post-questionnaire for both the EG and CG. There was also a discussion with the EG of post-test problem based on the same structure as described in Week 5.

Week 14: After 3 weeks from the post-test (included 2 weeks of vacation) a re-test was administrated to EG.

3.6.2 Results

For the questionnaires

The results of the pre- and post-intervention questionnaire were calculated based on the three questionnaire questions. The pre-intervention questionnaire questions were labeled as **Pre Q1** for the first question (set of items), **Pre Q2** for the second question (set of items), and **Pre Q3** for the third question (set of items). Similarly, the post- intervention questionnaire questions were labeled as **Post Q1**, **Post Q2**, and **Post Q3**. These labels will be used consistently in the summary tables to differentiate between the pre- and post-intervention questionnaire responses for each question.

The reliability of the pre- intervention questionnaire responses was assessed using Cronbach's Alpha, which indicated a high level of internal consistency ($\alpha = 0.919$) for the CG and ($\alpha = 0.949$) for the EG. Similarly, the post-intervention questionnaire responses demonstrated excellent internal consistency, with Cronbach's Alpha values of ($\alpha = 0.933$) for the CG and ($\alpha = 0.924$) for the EG. These results confirm the reliability of the questionnaire and its suitability for use in this study (Cronbach, 1951).

Initially, the Shapiro-Wilk test was conducted to examine the normal distribution of participants' responses. The results revealed that most p-values were below the significance level of 0.05, except for Pre Q3 ($p = 0.216$). However, as the majority of p-values were below 0.05, the data does not follow a normal distribution. Based on these findings, the Mann-Whitney U test will be used to compare pre- and post-intervention responses between groups, while the Wilcoxon signed-rank test will be applied to compare pre- and post- intervention responses within the same group (Field, 2018).

The Mann-Whitney U test was conducted for the control and experimental groups on the pre-questionnaire to assess the equivalence of the groups before the intervention. This test was applied to examine whether there were any significant differences between the two groups in terms of the three key dimensions measured by the questionnaire:

Q1. General opinions about SRL.

Q2. Evaluation of SRL skills.

Q3. Assessment of the real-life application of SRL abilities.

Additionally, the Mann-Whitney U test was also performed on the post-intervention questionnaire results to evaluate the progress made by each group in these areas after the intervention. This analysis aimed to determine the effectiveness of the intervention program in enhancing participants' self-perceived SRL skills across the three dimensions. The results are shown in Table 3.15.

Table 3.15

Mann-Whitney U Test

	U	**P**	**Rank-biserial correlation**
Pre Q1	369.000	0.917	0.018
Pre Q2	294.500	0.241	-0.188

Pre Q3	290.000	0.211	-0.200
Post Q1	488.000	0.030	0.346
Post Q2	498.000	0.019	0.374
Post Q3	504.000	0.014	0.390

The Mann-Whitney U test results as shown in Table 3.15 indicate no significant differences between the experimental and control groups before the intervention, as reflected by the high p-values for the pre-intervention questionnaire items (Q1: $p = 0.917$, Q2: $p = 0.241$, Q3: $p = 0.211$), suggesting that the groups were equivalent at baseline. However, significant differences were observed after the intervention in all three dimensions measured by the post-intervention questionnaire. Specifically, the EG showed significant improvements in general opinions about SRL (Post Q1: $p = 0.030$), evaluation of SRL skills (Post Q2: $p = 0.019$), and assessment of the real-life application of SRL abilities (Post Q3: $p = 0.014$). The rank-biserial correlation values (Q1: 0.346, Q2: 0.374, Q3: 0.390) indicate moderate to strong effect sizes, further supporting the effectiveness of the intervention.

Table 3.16

Descriptive Statistics for Each Question by Group

	Experimental (N=29)			**Control (N=25)**		
	M	**SD**	**Med.**	**M**	**SD**	**Med.**
Pre Q1	4.16	0.58	4.3	4.08	0.77	4.2
Pre Q2	3.92	0.46	4.05	3.98	0.74	4.2
Pre Q3	3.73	0.55	3.6	3.92	0.75	3.9
Post Q1	4.45	0.51	4.7	4.05	0.74	4.3
Post Q2	4.16	0.42	4.1	3.78	0.62	3.8
Post Q3	4.13	0.42	4.1	3.80	0.49	3.8

The results presented in Table 3.16 complement the findings of the Mann–Whitney U test shown in Table 3.15. Prior to the intervention, the median values for the experimental and control groups were largely comparable, indicating similar initial distributions. Following the intervention, the experimental group exhibited higher median values across all three dimensions, suggesting a positive shift in the distribution of scores.

The Wilcoxon Signed-Rank test was conducted separately for the control and experimental groups to analyze within-group differences between the pre- and post-questionnaire responses. This test was applied to examine whether there were significant changes in participants' perceptions of their SRL abilities across the three key dimensions measured by the questionnaire:

Q1. General opinions about SRL

Q2. Evaluation of SRL skills

Q3. Assessment of the real-life application of SRL abilities

By comparing the pre- and post-questionnaire responses within each group, this analysis aimed to assess the impact of the intervention on participants' self-perceived SRL skills. The results are presented in Table 3.17.

Table 3.17

Wilcoxon Signed-Rank Test for Both Groups

	Measure 1	Measure 2	Z	P	Rank-biserial correlation
EG	Pre Q1	Post Q1	3.040	0.001	0.695
	Pre Q2	Post Q2	3.461	< .001	0.749
	Pre Q3	Post Q3	4.349	< .001	0.958
CG	Pre Q1	Post Q1	0.029	0.517	0.007
	Pre Q2	Post Q2	1.440	0.927	0.329
	Pre Q3	Post Q3	0.874	0.813	0.200

The Wilcoxon Signed-Rank test results as shown in Table 3.17 indicate significant improvements in the EG's SRL abilities across all three dimensions measured by the questionnaire. Specifically, the EG showed substantial positive changes in general opinions about SRL (Pre Q1 to Post Q1: $Z = 3.040$, $p = 0.001$), evaluation of SRL skills (Pre Q2 to Post Q2: $Z = 3.461$, $p < 0.001$), and assessment of the real- SRL abilities (Pre Q3 to Post Q3: $Z = 4.349$, $p < 0.001$). The rank-biserial correlation values (ranging from 0.695 to 0.958) suggest strong to very strong effect sizes, supporting the effectiveness of the intervention in enhancing the participants' SRL skills.

In contrast, the CG didn't show significant changes in any of the three dimensions. The p-values for the CG were all above the conventional threshold of 0.05 (Pre Q1 to Post Q1: $p = 0.517$, Pre Q2 to Post Q2: $p = 0.927$, Pre Q3 to Post Q3: $p = 0.813$), indicating that there were no significant differences in their responses, suggesting that the lack of intervention, led to no measurable changes in SRL perceptions.

For the tests

The tests results were calculated by dividing the total score into two components: 10 points, for correctly solving the mathematical problem, labeled as **Pre-Test Problem** in the pre-test and **Post-Test Problem** in the post-test. Additionally, 13 points, were assigned for adherence to the SRL problem-solving steps, labeled as **Pre-Test SRL Steps** in the pre-test and **Post-Test SRL Steps** in the post-test. These scores were converted into a 10-point scale, to facilitate effective statistical analysis.

Initially the Shapiro-Wilk test was conducted to assess the normality of the data for both groups' test results. The results indicated that all variables (e.g., Pre-Test SRL Steps, Post-Test SRL Steps, Pre-Test Problem, Post-Test Problem) had p-values less than 0.05, suggesting that the data did not follow a normal distribution. Consequently, non-parametric statistical tests were employed. The Mann-Whitney U test was used to compare differences between the experimental and control groups, while the Wilcoxon Signed-Rank test was applied to analyze within-group changes.

The Mann-Whitney U Test was conducted to compare the CG and the EG on the pre-test results to ensure the equivalence of the two groups in terms of their ability to solve mathematical word problems and their knowledge of the steps for solving mathematical word problems based on SRL. Additionally, the test was conducted on the post-test results to assess the effectiveness of the intervention program and to determine whether there were significant differences between the groups in favor of the EG.

The results of the Mann-Whitney U test and the descriptive statistics are presented in Table 3.18 and Table 3.19.

Table 3. 18

Mann-Whitney U Test

	U	**P**	**Rank-biserial correlation**
Pre-Test SRL Steps	924.000	0.427	0.102
Pre-Test Problem	814.000	0.817	- 0.029
Post-Test SRL Steps	1648.000	<0.001	0.965
Post-Test Problem	1115.000	0.001	0.330

Table 3.19

DescriptiveStatistics

	Pre-Test				Post-Test				Re-test			
	SRL Steps		Problem		SRL Steps		Problem		SRL Steps		Problem	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
EG (N=43)	2.3	1.08	5.79	4.05	8.9	1.7	9.38	1.5	8.8	1.7	9.4	1.57
CG (N=39)	2.2	1.1	5.83	4.27	2.6	1.4	7.74	3.5	-	-	-	-

As shown in Table 3.18, the pre-test results indicate no statistically significant differences between the EG and CG, as confirmed by the p-values (0.427 for "Pre-Test Steps" and 0.817 for "Pre-Test Problem"), and small rank-biserial correlation values (0.102 and -0.029, respectively). This confirms the equivalence of the two groups before the intervention, establishing a solid baseline.

The descriptive statistics in Table 3.19 further illustrate these findings. For the pre-test, the mean scores for both SRL steps (2.3 for the EG and 2.2 for the CG) and problem-solving (5.79 vs. 5.83) are nearly identical, further supporting the lack of initial differences.

The post-test results showed significant differences presented in Table 3.18 ($p < 0.001$ for "Post-Test SRL Steps" and $p = 0.001$ for "Post-Test Problem") are reflected in the descriptive statistics in Table 3. 31. The EG achieved significantly higher mean scores in both SRL steps ($M = 8.9$, $SD = 1.7$) and problem-solving ($M = 9.38$, $SD = 1.5$) compared to the CG ($M = 2.6$, $SD = 1.4$ for SRL steps, and $M = 7.74$, $SD = 3.5$ for problem-solving).

The re-test, administered to the EG three weeks after week post-test, showed that the results did not change significantly from the post-test results. This suggests that the effect of the intervention based on SRL remained sustainable over time.

The rank-biserial correlation values in Table 3.18 (0.965 for "Post-Test SRL Steps" and 0.330 for "Post-Test SRL Problem") further support the strength of the intervention's impact, indicating a strong effect size for steps and a moderate effect size for problem-solving. Together, these results demonstrate the effectiveness of the intervention program in significantly improving the EG's performance compared to the CG.

The Wilcoxon Signed-Rank Test was conducted to compare the performance of both the CG and the EG before and after the pre-test and post-test in terms of adherence to SRL steps and the accuracy of solving word problems. This analysis aimed to assess changes within each group over time. The results are shown in Table 3.20

Table 3.20

Wilcoxon Signed-Rank Test for Both Groups

	Measure 1	Measure 2	Z	P	Rank-biserial correlation
	Pre-Test SRL Steps	Post-Test SRL steps	5.711	< .001	1.000
EG	Pre-Test Problem	Post-Test Problem	4.372	< .001	0.925
	Pre-Test SRL Steps	Post-Test SRL steps	2.069	0.050	0.532
CG	Pre-Test Problem	Post-Test Problem	1.981	0.049	0.429

As shown in Table 3.20. For the EG, the results show highly significant improvements in both problem-solving SRL steps and problem-solving performance after the intervention. The Z-values are 5.711 ($p < 0.001$) for "Post-Test Steps vs. Pre-Test Steps" and 4.372 ($p < 0.001$) for "Post-Test Problem vs. Pre-Test Problem", both indicating statistically significant progress. Additionally, the rank-biserial correlation values (1.000 for steps and 0.925 for problems) suggest a very strong effect size, confirming that the intervention had a substantial impact on the EG's performance.

On the other hand, the CG showed some improvement, but to a much lesser extent. The Z-values are 2.069 ($p = 0.050$) for "Post-Test Steps vs. Pre-Test Steps" and 1.981 ($p = 0.049$) for "Post-Test Problem vs. Pre-Test Problem", indicating that these differences are statistically significant, but marginal. The effect sizes (0.532 for steps and 0.429 for problems) are moderate, suggesting that while the CG exhibited slight improvements, these changes were likely due to natural progression or practice effects rather than any specific intervention.

Spearman's correlation test was conducted to examine the relationship between Post-Test Steps and Post-Test Problem within the EG to determine whether adherence to structured problem-solving SRL steps positively influences the accuracy of problem-solving. The results showed a moderate positive correlation (Spearman's rho = 0.334, $p = 0.028$), indicating that as adherence to the SRL steps increases, the correctness of the solution also tends to improve. The statistically significant p-value suggests that this relationship is unlikely to be due to chance.

3.6.3 Conclusion

This study confirms the effectiveness of self-regulated learning (SRL)-based instruction in improving students' (pre-service teachers') problem-solving skills and self-learning strategies, supporting the general hypothesis (H1) while contradicting the null hypothesis (H0). The experimental group (EG) showed significant progress, demonstrating that SRL training enhances both structured problem-solving and independent learning. However, limitations such as a small, non-random sample, inconsistent attendance, and unmeasured factors like intrinsic motivation, self-efficacy, and cognitive abilities may affect the generalizability of the results. Future research should explore SRL's impact on more complex mathematical problems, expand to pre-university students, and conduct longitudinal studies to assess the sustainability of SRL benefits. Additionally, examining motivational and cognitive factors could provide deeper insights into how SRL influences academic performance and independent learning.

CHAPTER 4. CONCLUSIONS

This chapter explores the relationship between theory and practice in solving mathematical word problems, emphasizing the role of self-regulated learning (SRL) in improving problem-solving skills. Grounded in Information Processing Theory (Duque de Blas et al., 2021; Fuchs et al., 2016) and Zimmerman's SRL model (2000), the study confirms that students who effectively apply planning, monitoring, and self-assessment strategies perform better in mathematical problem-solving. The findings highlight that teachers' awareness of SRL strategies and their integration into instruction significantly enhance students' academic performance, motivation, and independent learning. The study also reinforces the importance of training teachers in SRL techniques to bridge the gap between theoretical knowledge and practical application.

The research, conducted through four studies, provided comprehensive insights into students' and teachers' perspectives on mathematical problem-solving and SRL. Study 1 analyzed 163 teachers' views, identifying key challenges such as poor text comprehension, limited resources, and curriculum constraints, underscoring the need for active learning strategies. Study 2 examined 161 future teachers' perceptions, revealing their confidence in teaching mathematical problems but highlighting their need for further training in problem-solving strategies. Study 3, based on 146 in-service teachers, found a strong belief in SRL's benefits but variability in actual classroom implementation, emphasizing the need for professional development. Study 4, a 12-week intervention, demonstrated that students trained in SRL-based instruction significantly improved their problem-solving accuracy, adherence to structured steps, and self-regulation skills, supporting the integration of SRL strategies into teacher training programs.

The study has theoretical implications, as it fills a knowledge gap in Romanian education by exploring the impact of SRL on future teachers' problem-solving abilities. It aligns with Cognitive Load Theory (Sweller, 1988, 1994), Constructivist Learning Theory (Piaget, 1970, 1972), and Sociocultural Theory (Vygotsky, 1978), demonstrating how self-regulation, active engagement, and guided learning enhance mathematical problem-solving. Methodologically, the research contributes by developing tailored research tools, such as a validated SRL-based intervention tested in a real classroom setting, ensuring its applicability to teacher education programs.

Practical contributions include providing empirical evidence supporting the integration of SRL into teaching mathematics, identifying curriculum gaps, and offering a structured training model that helps future teachers guide students through systematic problem-solving processes. The study's findings can inform educational policies to enhance teacher training curricula and improve students' critical thinking and independent learning.

However, some limitations should be considered. The sample size was relatively small, and participant selection was non-random, which may limit the generalizability of findings. Additionally, individual differences in motivation, cognitive abilities, and prior SRL exposure were not controlled, which could influence the results. The study also focused on a limited set of SRL strategies, and while it confirmed their effectiveness, longitudinal studies are needed to assess their long-term impact. Future research should explore SRL's role in solving more complex mathematical problems, expand to younger students, and integrate modern teaching strategies, such as digital learning environments and collaborative learning, to enhance SRL implementation across diverse educational contexts.

General Conclusion

Solving mathematical word problems is a critical skill in developing students' critical thinking and is essential to achieving the mathematical competence required in the 21st century. Teachers play a fundamental role in improving this skill, as the quality of their teaching depends on their familiarity with modern pedagogical concepts, active learning strategies, and their ability to employ SRL as a tool to promote students' independence in solving mathematical problems.

The findings of this thesis emphasize the Importance of raising awareness among teachers, especially future teachers, about SRL strategies, not only as teaching tools, but as a comprehensive approach that helps students develop their problem-solving skills in more effective ways. This points to the need for more in-depth training for future teachers on how to integrate self-directed learning into the teaching of word problems, which will enable them to support their students in developing effective strategies for planning, self-monitoring, and self-assessment during the learning process.

Moreover, teachers' perceptions of mathematics education, along with their pedagogical and scientific skills, greatly influence their choice of teaching methods and means, which is directly reflected in students' performance in solving mathematical word problems. Teachers' passion for mathematics and their keenness to adopt modern teaching practices enhance the quality of education and drive towards more effective learning outcomes.

Finally, students' motivation to learn plays a crucial role in developing their mathematical problem-solving skills. The ability to control their learning process and make informed decisions about the methods they follow depends largely on their readiness for self-learning and their intrinsic motivation, which makes it essential for educational programs to adopt teaching strategies that support independent learning, encourage students to take responsibility for their learning, and develop their problem-solving skills in a sustainable and effective manner.

List of References

Abdelqader, K. (2018). Difficulties of solving word problems in mathematics for high school students in Gaza governorates. *Al-Aqsa University*. Retrieved from https://www.researchgate.net/publication/329558587_swbat_hl_almsalt_allfzyt_fy_alryadyat_ldy_tlab_almrhlt_althanwyt_bmhafzat_ghzt Source in Arabic [عبدالقادر، خالد (2018). صعوبات حل المسألة اللفظية في الرياضيات لدى طلاب المرحلة الثانوية بمحافظات غزة. *جامعة الأقصى*.]

ACC. (2019, November 25). Time management skills that improve student learning. *Australian Christian College.* Retrieved from https://www.acc.edu.au/blog/time-management-skills-student-learning/

Aguilar, J. J (2021). High School Students' Reasons for disliking Mathematics: The Intersection Between Teacher's Role and Student's Emotions, Belief and Self-efficacy. *International Electronic Journal of Mathematics Education*, 16(3), em0658. https://doi.org/10.29333/iejme/11294

Ahmad, I., Deeba, F., & Rehman, K. U. (2022). Teachers' perspectives on strategies for effective classroom management: A qualitative inquiry. *Research Journal of Social Sciences & Economics Review*, 3(4), 73–85. https://doi.org/10.36902/rjsser-vol3-iss4-2022(73-85)

Alber, R. (2011, May 24). *6 scaffolding strategies to use with your students: Support every student by breaking learning up into chunks and providing a concrete structure for each*. Edutopia. Updated January 24, 2014. Retrieved from https://www.edutopia.org/blog/scaffolding-lessons-six-strategies-rebecca-alber

Al-Hussainan, I. (2016). Self-regulated learning: Concept and theoretical perspectives. *The Arab Journal*. Source in Arabic [الحسينان، إبراهيم. (1438 هـ). التعلم المنظم ذاتياً: المفهوم والتصورات النظرية. *المجلة العربية*.]

Aliyeva, G. (2023). *The use of e-learning tools for teaching English in high school*. DOI: 10.57125/ELIJ.2023.09.25.03

Al-Kassab, M., & Waswa, D. (2022). Mathematics learning challenges and difficulties: A students' perspective. In *Proceedings of the 7th International Arab Conference on Mathematics and Computations (IACMC 2022).* Zarqa University, Jordan. Retrieved from https://tinyurl.com/47ent3rh

Arslan, M. (2013). *A Research about Primary Education Students Maths Fear Who Is Afraid of Mathematics*. LAP Lambert Academic Publishing.

Aspiring Youths (2024, February 18). *Essay on importance of learning*. Retrieved January 6, 2025, from https://aspiringyouths.com/essay/importance-of-learning/

Atkinson, R., & Shiffrin, R.(1968). Human memory: A proposed system and its control processes. *Psychology of Learning and Motivation*, 2, 89-195. https://doi.org/10.1016/S0079-7421(08)60422-3

Bandura, A. (1986). *Social foundations of thought and action*: *A social cognitive theory*. Prentice-Hall.

Bandura, A. (1991). *Social cognitive theory of self-regulation*. Organizational Behavior and Human Decision Processes, 50(2), 248–287. https://doi.org/10.1016/0749-5978(91)90022-L

Bandura, A. (1997). Self-efficacy: The exercise of control. W. H. Freeman.

Bembenutty, H., Cleary, T. J., & Kitsantas, A. (Eds.) (2013). *Applications of self-regulated learning across diverse disciplines: A tribute to Barry J. Zimmerman.* Information Age Publishing.

Ben-Zvi Assaraf, O., & Orion, N. (2009). System thinking skills at the elementary school level. *Journal of Research in Science Teaching*, 47(5), 540–563. https://doi.org/10.1002/tea.20351

Bernadette, E. (2009). *Third grade students' challenges and strategies to solving mathematical word problems* (Master's thesis, The University of Texas at El Paso)

Bernardo, A. (1999). Overcoming obstacles to understanding and solving word problems in mathematics. *Educational Psychology*, 19(2), 149-163. https://doi.org/10.1080/0144341990190203

Bloom, M. (2013). Self-regulated learning: Goal setting and self-monitoring. *The Language Teacher*, 37(4), 46. https://doi.org/10.37546/JALTTLT37.4-6

Boaler, J. (2016). *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching*. Jossey-Bass.

Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International Journal of Educational Research*, 31(6), 445-457. https://doi.org/10.1016/S0883-0355(99)00014-2

Boekaerts, M., & Corno, L. (2005). Self-Regulation in the Classroom: A Perspective on Assessment and Intervention. *Applied Psychology: An International Review*, 54(2), 199–231. https://doi.org/10.1111/j.1464-0597.2005.00205.x

Boekaerts, M., Pintrich, P., Zeidner, M. (2005) *Handbook ofself-regulationn*. Elsevier Academic press

Broadbent, J., & Poon, W. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, 27, 1–13. https://doi.org/10.1016/j.iheduc.2015.04.007

Brook, E. (2017). Investigating the adult learners' experience when solving mathematical word problems. In F. S. Topor (Ed.), *Handbook of research on individualism and identity in the globalized digital age* (pp. 310–331). Information Science Reference/IGI Global. https://doi.org/10.4018/978-1-5225-0522-8.ch014

Brown, P., Roediger, H. & McDaniel, M. (2014). *Make it stick: The science of successful learning*. Harvard University Press.

Brown, S., & Walter, M. (2005). *The art of problem posing* (3rd ed.). Routledge.

Brownlow, L. (2021). Framing word problems: Task confidence in early childhood pre-service teachers. *Mathematics Teaching Research Journal*, 13(2), 5-22. Flinders University, Adelaide, Australia. Retrieved from https://eric.ed.gov/?id=EJ1382708

Bryce, T. & Blown, E. (2023). Ausubel's meaningful learning re-visited. *Current Psychology*, 43(5), 1–20. https://doi.org/10.1007/s12144-023-04440-4

Buscombe, C. (2013). Using Gagne's theory to teach procedural skills. *The Clinical Teacher*, 10(5), 302–307. https://doi.org/10.1111/tct.12051

Cai, J., & Leung, S. (Eds.) (2014). *Posing and solving mathematical problems: Advances and new perspectives*. Springer.

Carneiro, R., Lefrere, P., Steffens, k. & Underwood, J. (2011) *Self-Regulated Learning in Technology Enhanced Learning Environments: A European Perspective*. Sense Publishers.

Chapman, O. (2015). Mathematics teachers' knowledge for teaching problem solving. *LUMAT: International Journal on Math*, *Science and Technology Education*, 3(1), 19–36. https://doi.org/10.31129/lumat.v3i1.1049

Chaudhary, B. (2018) *Motivational and Self-Regulated Learning of Creative Students*. Book Bazooka Publication.

Cirillo, F. (2018). The Pomodoro Technique: The acclaimed time-management system that has transformed how we work. Crown Publishing Group.

Cleary, T. (2018). *The Self-Regulated Learning Guide: Teaching Students to Think in the Language of Strategies.* Taylor & Francis.

Cleary, T. & Kitsantas, A. (2017). Motivation and self-regulated learning influences on middle school mathematics achievement. *School Psychology Review*, 46(1), 88–107. https://doi.org/10.17105/SPR46-1.88-107

Cocking, R. & Renninger, K. (2013). *The Development and Meaning of Psychological Distance.* Psychology Press

Corno, L. (1986). The metacognitive control components of self-regulated learning. Contemporary Educational Psychology, 11(4), 333-346. https://doi.org/10.1016/0361-476X(86)90029-9

Cronbach, L. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297–334. https://doi.org/10.1007/BF02310555

Cruz, J. & Lapinid, M. (2014, March). Students' difficulties in translating worded problems into mathematical symbols. *In The DLSU Research Congress Proceedings*. Retrieved from https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2014/LLI/LLI-I-009-FT.pdf

Daroczy, G., Wolska, M., Meurers, W., & Nuerk, H. (2015). Word problems: A review of linguistic and numerical factors contributing to their difficulty. *Frontiers in Psychology*, 6, 348. https://doi.org/10.3389/fpsyg.2015.00348

Decin, M. (2023). Visual representations in teaching mathematics. *Sprin Journal of Arts, Humanities and Social Sciences*, 2(5), 21–30. https://doi.org/10.55559/sjahss.v2i05.107

Díaz Quezada, M. (2020). Difficulties and performance in mathematics competences: Solving problems with derivatives. International Journal of Engineering Pedagogy (iJEP), 10(4), 35. https://doi.org/10.3991/ijep.v10i4.12473

Dibenedetto, M. (2018) *Connecting Self-regulated Learning and Performance with Instruction Across High School Content Areas*. Springer.

DiBenedetto, M., & Zimmerman, B. J. (2013). Construct and predictive validity of micro analytic measures of students' self-regulation of science learning. *Learning and Individual Differences*, 26, 30–41. DOI: 10.1016/j.lindif.2013.04.004

Duque de Blas, G., Gómez-Veiga, I., & García-Madruga, J. A. (2021). Arithmetic word problems revisited: Cognitive processes and academic performance in secondary school. *Education Sciences*, 11(4), 155. https://doi.org/10.3390/educsci11040155

Ebbinghaus, H. (1885). *Memory: A contribution to experimental psychology*. Dover Publications

Edeh, S. C. (2022). Importance of math in everyday life: 12 benefits and uses. *Bscholarly*. Retrieved January 2, 2025, from https://bscholarly.com/importance-of-math-in-everyday-life/

Egri, E., Opriş, E.-T., & Marchiş, I. (2022, March). Experimenting gamification for developing self-regulation skills during mathematical problem solving. *16th International Technology, Education and Development Conference*. https://doi.org/10.21125/inted.2022.2671

English, L. D (2023). Ways of thinking in STEM-based problem solving. ZDM: The International *Jou.rnal on Mathematics Education*, 55(1–2), 1–12. https://doi.org/10.1007/s11858-023-01474-7

European Commission (2023). Organisation of the education system and its structure – Romania. *Eurydice*. https://eurydice.eacea.ec.europa.eu/national-education-systems/romania/organisation-education-system-and-its-structure

Febriyanti, R., Mustadi, A., & Jerussalem, M. A. (2021). Students' learning difficulties in mathematics: How do teachers diagnose and how do teachers solve them? *Jurnal Pendidikan Matematika*, 15(1), 23–36. https://doi.org/10.22342/jpm.15.1.10564.23-36

Feldman, D. H. (2004). Piaget's stages: The unfinished symphony of cognitive development. *New Ideas in Psychology*, 22(3), 175–231. https://doi.org/10.1016/j.newideapsych.2004.11.005

Fuchs, L. S., Gilbert, J. K., Powell, S. R., Cirino, P. T., Fuchs, D., Hamlett, C. L., Seethaler, P. M., & Tolar, T. D. (2016). The role of cognitive processes, foundational math skill, and calculation accuracy and fluency in word-problem solving versus pre algebraic knowledge. *Developmental Psychology*, 52(12), 2085–2098. https://doi.org/10.1037/dev0000227

Gagné, R. M. (1965). *Conditions of learning. Holt,* Rinehart and Winston

GarcÍa, T., Boom, J., Kroesbergen, E. H., Núñez, J. C., & Rodríguez, C. (2019). Planning, execution, and revision in mathematics problem solving: Does the order of the phases matter? *Studies in Educational Evaluation*, 61, 83-93. https://doi.org/10.1016/j.stueduc.2019.03.001

Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles*, *and guidelines*. John Wiley & Sons. https://doi.org/10.1002/9781118269558

Gazdos, J. (2016). *Teachers' professional development on problem solving*. Sense Publishers. https://link.springer.com/book/10.1007/978-94-6300-711-5

Geist, E. (2010). The Anti-Anxiety Curriculum: Combating Math Anxiety in the Classroom. *Journal of Instructional Psychology*, 37(1).

Große, C. S. (2014). Learning to solve story problems—Supporting transitions between reality and mathematics. *European Journal of Psychology of Education*, 29(4), 635–654. https://doi.org/10.1007/s10212-014-0217-6

Guill, K., & Bos, W. (2014). Effectiveness of private tutoring in mathematics with regard to subjective and objective indicators of academic achievement: Evidence from a German secondary school sample. *Journal of Educational Research and Evaluation*, 6(2014), 34–67.

Guo, W. (2022). Exploratory case study on solving word problems involving triangles by pre-service mathematics teachers in a regional university in Australia. *Mathematics*, 10(20), 3786. https://doi.org/10.3390/math10203786

Gurat, M. G. (2018). Mathematical problem-solving strategies among student teachers. *Journal on Efficiency and Responsibility in Education and Science*, 11(3), 53–64. https://doi.org/10.7160/eriesj.2018.110302

Hadi, G. (2005). *Comprehensive in Teaching Mathematics*. Osama Publishing and Distribution House. Source in Arabic [هادي، غ. (2005). *الشامل في تدريس الرياضيات*. الأردن: دار أسامة للنشر والتوزيع.]

Harding, S. M. (2018). Self-regulated learning in the classroom. As part of the Realising the Potential of Australia's High Capacity Students Linkage Project.

Hardini, I., & Widayati, W (2023). The influence of students' problem-solving understanding and their mathematics learning results. *Frontiers in Education*, 8, 1088556. https://doi.org/10.3389/feduc.2023.1088556

Harskamp, E. G., & Suhre, C. J. M. (2006). Improving mathematical problem solving: A computerized approach. *Computers in Human Behavior*, 22(5), 801–815. https://doi.org/10.1016/j.chb.2004.03.023

Hemmler, Y. M., & Ifenthaler, D. (2024). Self-regulated learning strategies in continuing education: A systematic review and meta-analysis. *Educational Research Review*, 45, Article 100629. https://doi.org/10.1016/j.edurev.2024.100629

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235-266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Hogbin, C. (2020, November 9). 6 simple (but effective) instructional strategies for mathematics. *3P Learning*. Retrieved from https://www.3plearning.com/blog/instructional-strategies-math/

Huang, J., Cai, Y., Lv., Z., Huang, Y., & Zheng, X. (2024). Toward self-regulated learning: Effects of different types of data-driven feedback on pupils' mathematics word problem-solving performance. *Frontiers in Psychology*, 15, Article 1356852. https://doi.org/10.3389/fpsyg.2024.1356852

Hwang, S., & Son, T. (2021). Students' Attitude toward Mathematics and its Relationship with Mathematics Achievement. *Journal of Education and E-Learning Research*, 8(3), 272–280. https://doi.org/10.20448/journal.509.2021.83.272.280

Iilonga, H. K., & Chirimbana, M. (2024). Errors Made by 8th Grade Students while Solving Mathematical Word Problems. *Journal of Research in Science and Mathematics Education*, 3(3), 120–129.

Indah, F., Pratama, P., Kristiyanto, A., & Widyastono, H. (2021). Character values of third grade slow learners in character education at the inclusive elementary school. *JPI (Jurnal Pendidikan Indonesia)*, 10(2), 345–352. https://doi.org/10.23887/JPI-UNDIKSHA.V10I2.28838

IOPN (n.d.). Learning theories: Understanding how people learn. *University of Illinois Urbana-Champaign*. Retrieved January 6, 2025, from https://iopn.library.illinois.edu/pressbooks/instructioninlibraries/chapter/learning-theories-understanding-how-people-learn/

Ismail, I., Norazah, M. N., Din, R., Abdul Rahim, A. A., & Che Rus, R. (2015). Design and development performance-based into mobile learning for TVET. Procedia – *Social and Behavioral Sciences,* 174, 1764–1770. https://doi.org/10.1016/j.sbspro.2015.01.835

Jabsheh, A. (2024). Behaviorism, cognitivism, and constructivism as the theoretical bases for instructional design. *Technium Education and Humanities*, 7, 10–28. https://doi.org/10.47577/teh.v7i.10576

Jatileni, C. N., & Neshila, F. K (2024). Examining the challenges that seventh grade learners face in understanding mathematics word problems: A case study of Ovikange primary school. *Namibia Educational Reform Forum Journal*, 32(2), 63–73. Retrieved from https://journals.nied.edu.na/index.php/nerfj/article/view/151

Jiang, P., Zhang, Y., Jiang, Y., & Xiong, B. (2022). Preservice mathematics teachers' perceptions of mathematical problem solving and its teaching: A case from China. *Frontiers in Psychology*, 13, Article 998586. https://doi.org/10.3389/fpsyg.2022.998586

Johnson, D. J., & Myklebust, H. R. (1967). *Learning disabilities: Educational principles and practices*. Grune & Stratton. https://eric.ed.gov/?id=ED021352

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1991). *Cooperative learning: Increasing college faculty instructional productivity*. ASHE-ERIC Higher Education Report No. 4. The George Washington University, School of Education and Human Development.

Johnston, A. (2023, April 5). Math in real life– Strategies for planning lessons involving real-world contexts. *Sadlier*. Retrieved from https://www.sadlier.com/school/sadlier-math-blog/math-in-real-life-strategies-for-planning-math-lessons-involving-real-world-contexts

Jonassen, D. H. (2010). *Learning to solve problems: A handbook for designing problem-solving learning environments*. Routledge.

Jovanovic, D., & Matejevic, M. (2014). Relationship between rewards and intrinsic motivation for learning: Researches review. *Procedia – Social and Behavioral Sciences*, 149, 456–460. https://doi.org/10.1016/j.sbspro.2014.08.287

Kang, S. H. K. (2016). Spaced repetition promotes efficient and effective learning: Policy implications for instruction. *Policy Insights from the Behavioral and Brain Sciences*, 3(1), 12-19. https://doi.org/10.1177/2372732215624708

Karagiannakis, G., Baccaglini-Frank, A., & Papadatos, Y. (2014). Mathematical learning difficulties subtypes classification. *Frontiers in Human Neuroscience*, 8, 57. https://doi.org/10.3389/fnhum.2014.00057

Karlen, Y., Hirt, C. N., Jud, J., Rosenthal, A., & Eberli, T. D. (2023). Teachers as learners and agents of self-regulated learning: The importance of different teacher competence aspects for promoting metacognition. *Teaching and Teacher Education*, 125, 104055. https://doi.org/10.1016/j.tate.2023.104055

Jud, J., Karlen, Y., & Hirt, C. N. (2024). Linking teachers' and students' motivation for self-regulated learning: Is there a signal and how is it transmitted? *Metacognition and Learning*, 19, 939–965. https://doi.org/10.1007/s11409-024-09393-y

Karlen, Y., Hertel, S., Grob, U., Jud, J., & Hirt, C. N. (2024). Teachers matter: Linking teachers and students' self-regulated learning. *Research Papers in Education*, 1(1), 1–28. https://doi.org/10.1080/02671522.2024.2394059

Keeton, K. (2024, September 23). 20 effective math strategies to approach problem-solving. *Third Space Learning*. https://thirdspacelearning.com/us/blog/math-strategies-for-problem-solving/

Kenschaft, P. C. (2014). *Math power: How to help your child love math, even if you don't*. Dover Publications. https://store.doverpublications.com/0486491810.html

Khattab, N. 2008, *Teaching thinking for students with learning disabilities*. Yazouri Group for Publication and Distribution. Source in Arabic [خطاب، ن. (2008). *تعليم التفكير للطلاب ذوي صعوبات التعلم*. مجموعة اليازوري للنشر والتوزيع.]

Kizilcec, R. F., Pérez-Sanagustín, M., & Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. *Computers & Education*, 104, 18–33. https://doi.org/10.1016/j.compedu.2016.10.001

Kloosterman, P. & Kougan, M. C. (1994). Students' beliefs about learning school Mathematics. *Elementary School Journal*, 94, 375-388.

Koehler, T., & Sammon, J. (2023, March 1). A math word problem framework that fosters conceptual thinking. *Edutopia*. Retrieved January 2, 2025, from https://www.edutopia.org/article/strategy-teaching-math-word-problems/

Köhler, W. (1947). *Gestalt psychology: An introduction to new concepts in modern psychology*. Liveright Publishing.

Kong, L., & Lin, M. (2023). The role of self-regulated learning in the digital age. *Journal of Educational Technology*, 15(3), 45–59. https://doi.org/10.1234/jet.2023.15.3.45

Kramarski, B., & Gutman, M. (2006). How can self-regulated learning be supported in mathematical e-learning environments? *Journal of Computer Assisted Learning*, 22(1), 24-33. https://doi.org/10.1111/j.1365-2729.2006.00157.x

Krulik, S., & Rudnick, J. A. (1996). *The new sourcebook for teaching reasoning and problem solving in junior and senior high school*. Allyn & Bacon.

Labusch, A., Eickelmann, B., & Vennemann, M. (2019). Computational thinking processes and their congruence with problem-solving and information processing. In S. C. Kong & H. Abelson

(Eds.), *Computational thinking education* (pp. 65–78). Springer. https://doi.org/10.1007/978-981-13-6528-7_5

Lau, W. W. F. (2021). Pre-service mathematics teachers' professional learning in a pedagogy course: Examining changes in beliefs and confidence in teaching algebra. *Mathematics Education Research Journal*, 33(2), 223–239. https://doi.org/10.1007/s13394-019-00285-y

Lee, C. & Chen, M. (2015). Effects of Polya questioning instruction for geometry reasoning in junior high school. *Eurasia Journal of Mathematics, Science and Technology Education*, 11(6), 1547–1561. https://doi.org/10.12973/eurasia.2015.1419a

Likuru, L. C., & Mwila, P. M. (2022). Overcrowded classrooms: Effect on teaching and learning process in public secondary schools in Ilemela Municipality, Tanzania. *Asian Journal of Education and Social Studies*, 30(2), 74–82. https://doi.org/10.9734/ajess/2022/v30i230744

Little, D., Ridley, J., & Ushioda, E. (Eds.). (2003). Learner autonomy in the foreign language classroom: Teacher, learner, curriculum, and assessment. Authentik Language Learning Resources.

Lo, C. O., & Feng, L.C. (2020). Teaching higher order thinking skills to gifted students: A meta-analysis. *Gifted Education International*, 36(2), 99–117. https://doi.org/10.1177/0261429420917854

Maloney, E. A., Schaeffer, M. W., & Beilock, S. L. (2013). Mathematics anxiety and stereotype threat: Shared mechanisms, negative consequences and promising interventions. *Research in Mathematics Education*, 15(2), 115-128.

Mammadov, S., & Schroeder, K. (2023). A meta-analytic review of the relationships between autonomy support and positive learning outcomes. *Contemporary Educational Psychology*, 72, 102235. https://doi.org/10.1016/j.cedpsych.2023.102235

Marchiș, I. (2012). Self-regulated learning and mathematical problem solving. *The New Educational Review*, 27(1), 195–208.

Mattock, P. (2019). *Visible maths: Using representations and structure to enhance mathematics teaching in schools.* Crown House Publishing. https://www.crownhouse.co.uk/visible-maths

MC Ekeh (2023). Enhancing mathematics word problems for young learners using storytelling pedagogy. *Journal for Educators, Teachers and Trainers*, 14(4). 278-289.

McCarthy-Curvin, A., Buddo, C., & George, L. (2021). Problem solving within the mathematics classroom: Challenges and recommendations. *Journal of Education and Development in the Caribbean*, 19(2), 75–111. https://doi.org/10.15388/ioi.2022.02

McCormick, N. J., Clark, L. M., & Raines, J. M. (2015). Engaging students in critical thinking and problem solving: A brief review of the literature. *Journal of Studies in Education*, 5(4), 100. https://doi.org/10.5296/jse.v5i4.8249

McLeod, S. (2024, August 5). Piaget's theory and stages of cognitive development. *Simply Psychology*. https://www.simplypsychology.org/piaget.html

Mohamed, D.A., & Kandeel, M.M. (2023). Playful learning: Teaching the properties of geometric shapes through pop-up mechanisms for kindergarten. *International Journal of Education in Mathematics, Science, and Technology (IJEMST*), 11(1), 179-197. https://doi.org/10.46328/ijemst.2921

National Council of Teachers of Mathematics (NCTM) (2016). *Reimagining the mathematics classroom: Creating and sustaining productive learning environments.* NCTM. https://www.nctm.org/Store/Products/Reimagining-the-Mathematics-Classroom/

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* National Council of Teachers of Mathematics.

Novotna, J. (2004). Students' levels of understanding word problems. In H. Fujita, Y. Hashimoto, B. R. Hodgson, P. Y. Lee, S. Lerman, & T. Sawada (Eds.), *Proceedings of the Ninth International Congress on Mathematical Education* (pp. 184–185). Springer. https://doi.org/10.1007/1-4020-7910-9_43

Nursyahidah, F., Saputro, B. A., & Rubowo, M. R (2018). Students' problem-solving ability based on realistic mathematics with ethnomathematics. *Journal of Research and Advances in Mathematics Education*, 3(1), 13–24. http://journals.ums.ac.id/index.php/jramathedu

OECD (2022). *PISA 2022 results: Romania*. Retrieved from https://gpseducation.oecd.org/CountryProfile?primaryCountry=ROU&topic=PI&treshold=10

Olivares Díaz, M., Lupiáñez, J. L., & Segovia, I. (2020). Roles and characteristics of problem solving in the mathematics curriculum: A review. *PNA*, 15(1), 1-23.

Olugbenga, S., & Olaniyan, O. (2022). *Improving the conditions of teachers and teaching in rural schools across African countries*. UNESCO-IICBA.

Papadopoulos, I., & Kyriakopoulou, P. (2022). Reading mathematical texts as a problem-solving activity: The case of the principle of mathematical induction. *C-E-P-S Journal*, 12(1), 35–53. https://doi.org/10.26529/cepsj.881

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, 36(2), 89–101.

Pearce, D. L., Bruun, F., Skinner, K., & Lopez-Mohler, C. (2013). What teachers say about student difficulties solving mathematical word problems in grades 2-5. *International Electronic Journal of Mathematics Education*, 8(1), 3–19. https://doi.org/10.29333/iejme/271

Piaget, J. (1970). *The science of education and the psychology of the child*. Orion Press.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). Academic Press. https://doi.org/10.1016/B978-012109890-2/50043-3

Pintrich, P. R. (1995). Understanding self-regulated learning. *New Directions for Teaching and Learning*, 1995(63), 3-12. https://doi.org/10.1002/tl.37219956304

Pólya, G. (1945). *How to solve it*. Princeton University Press

Posamentier, A. S., & Krulik, S. (2016). *Effective techniques to motivate mathematics instruction* (2nd ed.). Routledge

Posamentier, A. S., & Schulz, W. (Eds.) (1996). *The art of problem solving: A resource for the mathematics teacher*. Corwin Press.

Powers, M. N. (2017). *Self-Regulated Design Learning: A Foundation and Framework for Teaching and Learning Design*. Taylor & Francis.

Radio România Internațional (2024, July 4). National assessment results. *Radio România Internațional*. Retrieved January 2, 2025, from https://tinyurl.com/47ent3rh

Ribeiro, D. (2023, July 17). *Mathematics and its role in day-to-day living. A Mathematician's View of the World*. https://medium.com/a-mathematician-view-of-the-world/mathematics-and-its-role-in-day-to-day-living-3160d9412f07

RPMS Team. (2024). *Romanian Primary Mathematics Study (RPMS): Final baseline study report.* British Council.

Sacks, A. (2013, October 1). The problem-solving power of teachers. *Educational Leadership*, 71(2). ASCD. https://ascd.org/el/articles/the-problem-solving-power-of-teachers

San Pedro, S. Z., & Moore, R. (2023). *Investigating Factors Associated with Student Use of Digital Tools for Learning*. ACT Research. https://www.act.org/content/dam/act/unsecured/documents/R2265-Student-Use-of-Digital-Tools-for-Learning-03-2023.pdf

Savina, E. (2021). Self-regulation in preschool and early elementary classrooms: Why it is important and how to promote it. *Early Childhood Education Journal*, 49(4), 493–501. https://doi.org/10.1007/s10643-020-01094-w

Schoenfeld, A. H. (1985). *Mathematical problem solving.* Orlando, Academic Press.

Schoenfeld, A. H. (2016). *Mathematical problem solving*. Academic Press.

Schraw, G., Kauffman, D. F., & Lehman, S. (2006). Self-regulated learning. In L. Nadel (Ed.), *Encyclopedia of Cognitive Science* (pp. 1063–1073). John Wiley & Sons. https://doi.org/10.1002/0470018860.s00671

Schunk, D. H. (2004). *Learning Theories: An Educational Perspective* (4th ed.). Pearson Education.

Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60, Article 101832. https://doi.org/10.1016/j.cedpsych.2019.101832

Schunk, D. H., & Zimmerman, B. J. (1998). *Self-regulated learning: From teaching to self-reflective practice*. Guilford Press.

Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy and self-regulation of reading and writing through modeling. *Reading & Writing Quarterly*, 23(1), 7–25. https://doi.org/10.1080/10573560600837578

Schunk, D. H., & Zimmerman, B. J. (2008). *Motivation and self-regulated learning: Theory, research, and applications*. Routledge.

Science Education Resource Center (SERC). (2024). What is self-regulated learning? *Carleton College*. https://serc.carleton.edu/sage2yc/self_regulated/what.html

Seifi, M., Haghverdi, M., & Azizmohamadi, F. (2012). Recognition of students' difficulties in solving mathematical word problems from the viewpoint of teachers. *Journal of Basic and Applied Scientific Research,* 2(3), 2923-2928.

Sepeng, P., & Madzorera, A. (2014). Sources of difficulty in comprehending and solving mathematical word problems. *International Journal of Educational Sciences*, 6(2), 217–225. https://doi.org/10.1080/09751122.2014.11890134

Sian, K. J., Shahrill, M., Yusof, N., Ling, G. C. L., & Roslan, R. (2016). Graphic organizer in action: Solving secondary mathematics word problems. *Journal on Mathematics Education*, 7(2), 83–90. https://doi.org/10.22342/jme.7.2.3546.83-90

Skinner, Kim & Pearce, Daniel & Barrera IV. (2016). Literacy Difficulties of Elementary Students when Solving Mathematical Word Problems. *Literacy Practice and Research*. 41. 29-36.

Smart, C. J. (2002) *Higher Education: Handbook of theory and research*. Springer Netherlands.

Smith, C. J. (2016). *The effects of math anxiety and low self-efficacy on students' attitudes and interest in STEM* (Doctoral dissertation, University of Southern California). ProQuest Dissertations & Theses Global. https://eric.ed.gov/?id=ED597431

Smith, C., & Morgan, C. (2016). Curricular orientations to real-world contexts in mathematics. *The Curriculum Journal*, 27(1), 24–45. https://doi.org/10.1080/09585176.2016.1139498

Sosa-Gutierrez, F. Vilca Apaza, H. M., Valdivia-Yábar, S. V. & Condori-Castillo W. W. (2024). Critical Thinking and Teaching Mathematics: An Analysis from Education. *International Journal of Religion,* 5(9), 958 – 976. https://doi.org/10.61707/94v23344

Sousa, D. A. (2011). *How the brain learns* (4th ed.). Corwin Press.

Supap, W., Naruedomkul, K., & Cercone, N. (2010). Computer Support for Mathematical Word Problem Solving – Guided by Thai Teachers' Views. *In Proceedings of the 2nd International Conference on Computer Supported Education* (pp. 245-250). https://www.scitepress.org/papers/2010/27823/27823.pdf

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257-285. https://doi.org/10.1016/0364-0213(88)90023-7

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction*, 4(4), 295-312. https://doi.org/10.1016/0959-4752(94)90003-5

Tang, T., Vezzani, V., & Eriksson, V. (2020). Developing critical thinking, collective creativity skills, and problem solving through playful design jams. *Thinking Skills and Creativity*, 37, Article 100696. https://doi.org/10.1016/j.tsc.2020.100696

Taylor, S (2021). The modification of Boerkaert's (1999) model of self-regulation to include younger learners. *Frontiers of Contemporary Education*, 2(1), 22. https://doi.org/10.22158/fce.v2n1p22

Teng, L. S. (2022). Self-regulated Learning and Second Language Writing: Fostering Strategic Language Learners. Springer International Publishing.

Thevenot, C. (2017). Arithmetic word problem solving: The role of prior knowledge. In D. Geary, D. Berch, & K. Mann-Koepke (Eds.), Acquisition of complex arithmetic skills and higher-order mathematics concepts (Vol. 3, pp. 47–66). Academic Press. https://doi.org/10.1016/B978-0-12-805086-6.00003-5

Tong, D., Loc, N. (2017). Students Errors in Solving Mathematical Word Problems and their Ability in Identifying Errors in Wrong Solutions. *European Journal of Education Studies*, 3(6). P226-241

Usher, E. L., & Schunk, D. H. (2018). Social cognitive theoretical perspective of self-regulation. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (pp. 19–35). Routledge/Taylor & Francis Group. https://doi.org/10.1093/oxfordhb/9780195399820.013.0002

Valle, A., Nuñez, J., & Cabanach, R. (2008). Self-regulated profiles and academic achievement. *Psicothema*, 20, 724–731. http://www.psicothema.com

Van Dooren, W., Verschaffel, L., & Onghena, P. (2003). Pre-service teachers' preferred strategies for solving arithmetic and algebra word problems. *Journal of Mathematics Teacher Education*, 6, 27–52. https://doi.org/10.1023/A:1022109006658

Van Merriënboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. Educational Psychology Review, 17(2), 147–177. https://doi.org/10.1007/s10648-005-3951-0

Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: A survey. *ZDM Mathematics Education*, 52(1), 1–16. https://doi.org/10.1007/s11858-020-01130-4

Vessonen, T., Dahlberg, M., Hellstrand, H., Widlund, A., Korhonen, J., Aunio, P., & Laine, A. (2024). Task characteristics associated with mathematical word problem-solving performance among elementary school-aged children: A systematic review and meta-analysis. *Educational Psychology Review*, 36, Article 117. https://doi.org/10.1007/s10648-024-09954-2

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Wang, Y., Kuo, C. C., & Wu, S. M. (2019). Creative and problem-solving thinking of gifted and talented young children observed through classroom dialogues. *Universal Journal of Educational Research*, 7(12), 2677–2692. https://doi.org/10.13189/ujer.2019.071215

Waswa, D. W., & Al-kassab, M. M. (2023). Mathematics learning challenges and difficulties: A students' perspective. In D. Zeidan, J. C. Cortés, A. Burqan, A. Qazza, J. Merker, & G. Gharib (Eds.), Mathematics and computation. *IACMC 2022* (Vol. 418, pp. 497–506). Springer. https://doi.org/10.1007/978-981-99-0447-1_27

Wertheimer, M. (2017). *Max Wertheimer and Gestalt theory*. Taylor & Francis.

Winne, P. H., & Perry, N. E. (2000). Measuring self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 531–566). Academic Press. https://doi.org/10.1016/B978-012109890-2/50045-7

Wolters, C. A. (2003). Understanding procrastination from a self-regulated learning perspective. *Journal of Educational Psychology*, 95(1), 179–187. https://doi.org/10.1037/0022-0663.95.1.179

Yadav, S. (2020). Role of mathematics in the development of society. *SSRN Electronic Journal*, 6(4). https://doi.org/10.2139/ssrn.3683457

, X., Zhou, Y., Zhang, K., & Cui, G. (2023). Perceived teacher enthusiasm and professional commitment: The mediating role of boredom and learning engagement. *Psychology Research and Behavior Management*, 16, 1149–1163. https://doi.org/10.2147/PRBM.S400137

Yeasmin, M. (2023). Mathematics is everywhere – Connecting with other disciplines. *International Journal of Applied Research*, 3(6), 750–754. https://www.researchgate.net/publication/371013477_Mathematics_is_everywhere_-Connecting_with_other_disciplines

Yilmaz, K. (2011). The cognitive perspective on learning: Its theoretical underpinnings and implications for classroom practices. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 84(5), 204–212. https://doi.org/10.1080/00098655.2011.568989

Yüksel-Şahin, F. (2008). Mathematics anxiety among 4th and 5th grade Turkish elementary school students. *International Electronic Journal of Mathematics Education*, 3(3), 179192.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81(3), 329–339. https://doi.org/10.1037/0022-0663.81.3.329

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1), 166–183. https://doi.org/10.3102/0002831207312909

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41(2), 64-70. https://doi.org/10.1207/s15430421tip4102_2

Zimmerman, B. J. (2011). *Handbook of self-regulation of learning and performance*. Routledge.

Zimmerman, B. J., & Schunk, D. H. (Eds.). (2001). *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed.). Routledge. https://doi.org/10.4324/9781410601032

Zimmerman, B. J., & Schunk, D. H. (2011). *Handbook of self-regulation of learning and performance*. Routledge. https://doi.org/10.4324/9780203839010

Zsoldos-Marchiș, I (2014). 10–11 year old pupils' self-regulated learning and problem-solving skills. *Review of Science*, *Mathematics and ICT Education*, 8(1), 5–27. https://pasithee.library.upatras.gr/review/article/view/2175/2279

Zsoldos-Marchiș, I. (2015). Changing pre-service primary-school teachers' attitude towards Mathematics by collaborative problem solving. *Procedia – Social and Behavioral Sciences*, 186, 174–182. https://doi.org/10.1016/j.sbspro.2015.04.100

Zumbrunn, S., Tadlock, J., & Roberts, E. D (2015). *Encouraging self-regulated learning in the classroom: A review of the literature*. VCU Educational Motivation and Self-Regulation Lab. https://doi.org/10.13140/RG.2.1.3358.6084