

Examining the Utilisation of Learning Techniques and Strategies Among Pedagogy Students : Implications for Self-Regulated Learning

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Abstract: Self-regulated learning is a multifaceted process that involves cognitive, metacognitive, motivational, affective, and behavioural components. These components are interconnected and influenced by contextual factors that shape the overall learning experience. Self-regulated learning empowers students to take control of their learning by utilising effective learning techniques, engaging in metacognitive processes, and fostering motivation and self-efficacy beliefs. The goal of the article is to explore the importance of self-regulated learning in enhancing students' academic performance and fostering a deep understanding of the learning material. Specifically, this research article explores the utilisation of learning techniques and strategies (LTSs) among pedagogy students, investigating their patterns and preferences for self-studying. The analysis of survey responses from a sample of 76 pedagogy students revealed that the most commonly used LTSs are rereading, note-taking, memorising, and highlighting. The utilisation of LTSs that are empirically considered effective, such as distributed practice, practice testing, and elaborative interrogation, was found to be extremely low. Moreover, the study revealed a lack of comprehensive training in learning techniques and strategies in pedagogy programmes, suggesting that current teachers are not adequately trained to create optimal classroom contexts for developing flexible self-regulatory skills in students. The findings highlight that by incorporating these practices into curriculum, future educators can empower their students to become active learners

who select the appropriate strategies and reflect on their learning process. This paper contributes to an understanding of self-regulated learning and the implications of self-regulated learning for educational practices.

Keywords: self-regulated learning, learning techniques and strategies, metacognition, motivation, self-efficacy.

Introduction

Learning is the process of acquiring knowledge, skills, understanding, or attitudes through experiences, study, or instruction. It involves the modification of behaviour, cognition, or emotion, and it can occur through various means, including observation, practice, repetition, and reflection (Goldstein, 2015; Sternberg & Sternberg, 2017). As such, learning is essential for growth and development, and it plays a crucial role in enabling individuals to adapt to changing circumstances and environments. It can occur in a wide range of contexts, from formal education settings such as schools and universities, to informal settings such as the workplace, home, and community (Hager, 2012).

The current complex society in which humans exist requires individuals to continuously acquire and update their knowledge. The exponential growth of knowledge and the rapid development of technology have dramatically altered the availability of information, generating the need for new methods to handle and process it (Dignath & Buttner, 2008). As a result, formal education, which is mainly limited to the early stages of life, quickly becomes outdated. Consequently, the need for lifelong learning has become imperative. As noted by Winne (2005), extensive research has been conducted to enhance learning effectiveness in response to new demands for learners' core competencies. To address this need, the concept of self-regulated learning has emerged and become a dominant construct in contemporary educational psychology (Dignath & Buttner, 2008; Winne, 1995).

The Roots of Self-Regulated Learning

The theory of self-regulated learning, rooted in cognitive psychology, traces back to Albert Bandura's theory of social-cognitive learning. Central to Bandura's theory (1977) is the concept of reciprocal determinism, which proposes that learning is influenced by a dynamic interplay of behavioural, personal, and environmental factors. Behavioural factors encompass

previous performance, while personal factors encompass attitudes and beliefs that, in turn, impact behaviour and learning outcomes. Environmental factors, on the other hand, involve aspects such as instructional quality, teacher feedback, access to information, and support from peers or parents (Schraw et al., 2006). The reciprocity principle inherent in self-regulated learning proves highly effective, as the feedback system encourages students to enhance their performance and motivates them to seek more efficient learning strategies (Zimmermann, 2000).

In terms of the theory of reciprocal determinism, each of the three factors, behavioural, personal, and environmental, influences the other two (Schraw et al., 2006; Zimmermann, 1989; 2000). As Bandura (1986) explains, the model does not assume symmetry in the reciprocity of the factors, meaning that one factor may have a stronger influence than the others. For instance, environmental factors may have a stronger impact than behavioural or personal factors. Self-regulated learning occurs when learners can strategically use personal processes to regulate behaviour and the environment (Zimmermann, 1989; 2000).

Self-Regulated Learning

Self-regulated learning (SRL) is a cyclical and dynamic process (Bjork et al., 2013). Schunk and Zimmerman (2007) and Zimmerman (2008) refer to self-regulated learning as self-directive processes and self-beliefs that allow learners to transform their mental abilities into academic performance skills. Self-regulated learning is proactive, meaning that students use various processes to acquire academic skills such as setting goals, selecting and deploying strategies, and self-monitoring their performance. This is in contrast to a reactive event that occurs to students as a result of impersonal forces.

Pintrich (2000) and Zimmerman (2001) describe self-regulated learning as an active, purposeful, and constructive process in which learners set goals and make plans before starting to learn, monitor, and regulate their learning, motivation, behaviour, and cognition and then reflect on their learning process and outcomes. Boekaerts (1999) refines the meaning of self-regulation as the ability to develop knowledge, skills, and attitudes that can be transformed from one learning context to another and from learning situations to leisure and work contexts. Contextual factors like parents, teachers, and learning environments are important for developing flexible, adaptive learning strategies (Puustinen & Pulkkinen, 2001). Therefore, self-

regulated learning is a fundamental conceptual framework for understanding cognitive, motivational, emotional, and behavioural aspects of one's own learning process (Panadero, 2017).

Self-regulated learning allows students to take control of their resources and improve their performance across various learning activities (Jansen et al., 2019; Xu et al., 2023, Zimmerman & Schunk, 2011). Self-regulated learners are those who control their own learning and adjust their strategies to align with their needs (Zimmerman, 1990). In particular, SRL is not a cognitive characteristic, such as intelligence or a learning ability, but a vital component of effective learning. It is a self-directive process that enables individuals to convert their cognitive abilities into learning skills (Zimmerman, 1998). Central to this process is the ability to monitor oneself, motivate oneself to accomplish a learning task and to persist in learning, self-assess one's own learning, and change one's learning habits if needed. To acquire knowledge or skills, individuals employ multiple strategies, including various techniques for obtaining, organising, and altering information, as well as utilizing various memory aids that support the encoding and retrieval of information from memory (Zimmermann & Martinez-Pons, 1986). Research has shown that individuals with superior self-control tend to learn more efficiently and report higher levels of academic satisfaction (Pintrich, 2000; Zimmerman, 2000).

According to Bjork et al. (2013), an effective learner is self-directed and possesses an understanding of the functional architecture that characterises human learning and memory. Additionally, effective learners have knowledge of activities and techniques that can enhance the storage and subsequent retrieval of information and procedures, are able to monitor their learning process and control their learning activities accordingly, and have awareness of biases that may interfere with their judgements about whether learning will support later retention of information. Zimmerman (2000) suggests that although only a small number of students are able to use self-regulation effectively when learning, those who possess better self-regulation skills are able to learn in a manner that requires less effort while gaining a greater amount of information.

Zimmerman's (2000) model of self-regulated learning distinguishes three phases involved in the self-regulated learning process. The first phase, known as the forethought phase, encompasses beliefs and processes that occur before actual learning. This phase includes two main components, namely task analysis (which involves planning and strategising for learning) and self-motivation beliefs (which stem from individuals' beliefs about their

personal effectiveness and their ability to achieve their goals). The second phase, the performance phase, involves self-control. This pertains to the processes that occur when an individual is actively engaged in learning and self-observation, which is responsible for monitoring one's learning process. Finally, the self-reflection phase includes a self-judgement component in which learners evaluate their learning performance and a self-reaction component that describes the feelings and impressions that arise in learners. To summarise, Zimmerman's model suggests that individuals who possess effective self-regulation skills are able to learn more efficiently and effectively. Figure 1 graphically summarises the model (Zimmerman, 2000).

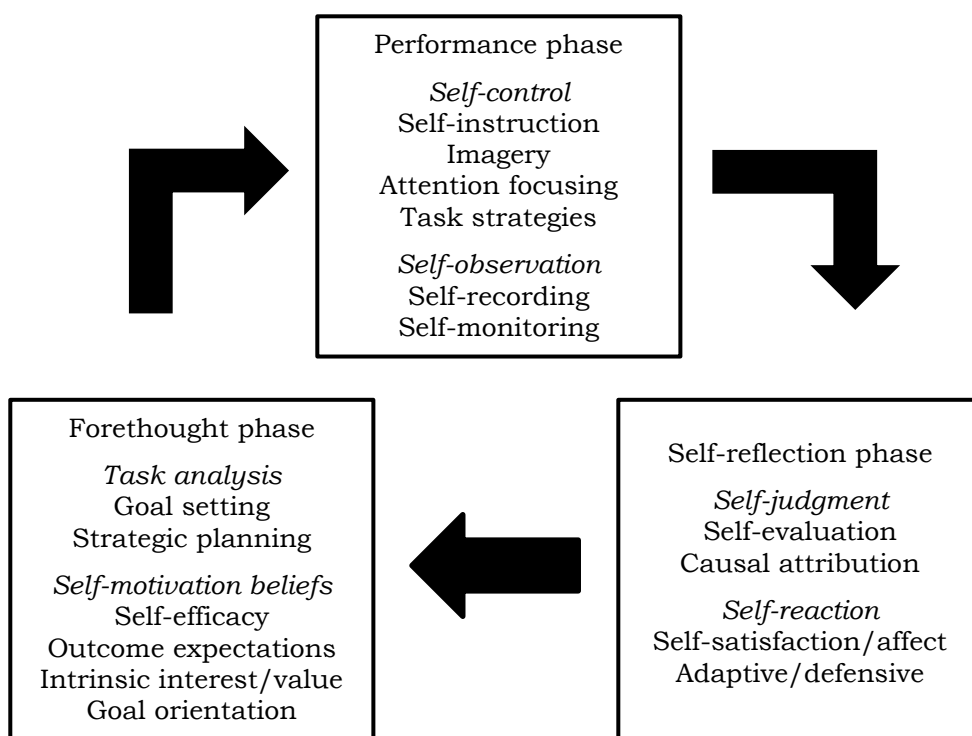


Figure 1: The model of self-regulated learning proposed by Zimmerman (2000).
Note: The cyclical phases and subprocesses of SRL (Zimmerman, 2000).

Components of Self-Regulated Learning

Self-regulated learning is commonly conceptualised as comprising three primary components: cognitive, metacognitive, and motivational (Butler & Winne, 1995; Boekaerts, 1999; Schraw et al., 2006; Zimmermann, 2000). Efklides (2011) incorporated affect into the process of SRL, emphasising that

the emotions experienced by learners can significantly shape their motivation to study. These components work synergistically to facilitate effective learning in the learning context (Puustinen & Pulkkinen, 2001). The cognitive component ensures the acquisition and retention of knowledge, while metacognition enables students to reflect on and regulate their own cognitive processes as well as evaluate ongoing learning.

Motivation, with its influence on goal setting and persistence, plays a vital role in sustaining students' engagement and effort throughout the learning process. Emotions play a role in influencing motivation and the selection of learning techniques. By integrating and balancing these components, individuals can enhance their self-regulatory capacities, optimise their learning experiences, and achieve greater academic success (Schraw et al., 2006). Moreover, while the majority of SRL models typically do not explicitly incorporate context as a component of SRL, it is important to recognise that the specific context of the learner might exert an influence on the selection of particular strategies (Puustinen & Pulkkinen, 2001). Further paragraphs will provide a more detailed description of each component.

The Cognitive Component

The cognitive component involves learning techniques and strategies, problem solving, and critical thinking (Schraw et al., 2006). Weinstein et al. (2011) suggest that the origins of learning techniques and strategies can be traced back to the era of cavemen and cavewomen. Anthropologists believe that cave paintings were used by people to remember time cycles, such as the arrival of heavy rains and the migration of animals that could be used for food. The ancient Greeks are well-known for having invented mnemonics, or artificial memory aids. Before the advent of modern writing tools and formats, they used mnemonics to help them recall things, like the key points they wanted to include in a speech.

In general, learning techniques and strategies are considered tools for achieving study goals and performing a variety of different functions, from coding to the overall processing of information, and they therefore play a fundamental role in learning (Dunlosky et al., 2013). They facilitate learners' engagement, help with efficient remembering and the comprehension of concepts and study information, and prevent the rapid forgetting of learned material (Anderson, 1985; Weinstein & Mayer, 1986). According to Zimmerman (1990), learners must have knowledge of learning techniques and strategies, apply them, and experiment with them in

different contexts to achieve their desired outcomes. Only practical experience can enable learners to assess which learning techniques and strategies are appropriate for specific situations and which lead to the desired outcomes. It is ideal for effective strategies to be taught to learners from primary school, where they can recognise and choose the most appropriate strategy based on the help and feedback from their teachers, depending on the type of task given, and change it if deemed ineffective (Weinstein et al., 2011).

Dunlosky et al. (2013) conducted an extensive analysis exploring the efficacy of various learning techniques commonly used by students. Their findings highlight the varying levels of effectiveness exhibited by different learning techniques and strategies. Notably, they argue that certain popular and easy-to-use techniques, despite providing a subjective sense of efficiency and sufficient short-term information recall, may not be as effective at fostering long-lasting knowledge acquisition. These frequently utilised techniques include practices such as rereading materials, highlighting text, summarising (note-taking), and the use of keywords or imagery. These learning techniques and strategies are intuitively adopted and do not require specific training for implementation. By contrast, there exists a set of learning techniques that demonstrate high effectiveness, particularly in terms of the comprehension and long-term retention of study material, but these strategies remain underutilised by learners. This group of learning techniques includes retrieval practice, also known as self-testing, and distributed practice. In addition, techniques such as elaborative interrogation, self-explanation, and interleaved practice have shown promising levels of effectiveness. It should be noted that employing these learning strategies requires a certain level of instruction and practice to become familiar with their underlying principles and functioning. Also, the utilisation of a particular learning technique or strategy may be connected to the specific context in which the learning occurs (Říčan, 2016).

Problem-solving encompasses the systematic approach to overcome obstacles to achieve a desired goal. The scope of problems can vary, ranging from straightforward issues that address a single concern to complex challenges involving multiple interconnected elements requiring resolution (Frensch & Funke, 2014, Urban & Urban, 2023). Bransford and Stein (1993) propose a set of common stages within the problem-solving process, which include problem recognition, problem definition, strategy development, the organisation of available knowledge and resources, progress monitoring, and the evaluation of solution effectiveness. Gick (1986) draws a distinction between schema-driven problem solving, which

entails a more direct implementation of strategies, and search-based problem solving, where strategies are implemented following a search process.

Problem-solving strategies are inherently more complicated than cognitive strategies (Schraw et al., 2006). According to Mayer (1992), problem-solving strategies serve as guiding methods in the problem-solving process, although they may not guarantee a solution. The range of available strategies is extensive, and their application depends on the nature of the problem. Well-defined problems are characterised by specific end goals and clearly expected solutions, and they require different strategies than ill-defined problems, which lack well-specified objectives and possess vague initial information (Schacter et al., 2009; Urban & Urban, 2023). Among widely utilised general problem-solving strategies are problem decomposition, planning, and solving by analogy (Gick, 1986).

Critical thinking as such includes numerous definitions. Walker (2003) highlights a common thread among these definitions, which is the emphasis on the active engagement of individuals in the thinking process. In addition, critical thinking involves evaluating, analysing, and interpreting information, as well as scrutinising the inferences and assumptions associated with that information. Although educators highly value students who demonstrate critical thinking, the disposition for critical thinking is not always inherent in all students (Walker, 2003). Educational research across various subjects and academic levels has identified specific skills that contribute to the overall ability to think critically. These skills include identifying analogies and relationships between different pieces of information, assessing the relevance and validity of information for structuring and solving problems, and generating and evaluating solutions or alternative approaches to problem solving (Potts, 1994).

Critical thinking encompasses various strategies that aid in the development of a thoughtful and analytical mindset. According to Beyer (1985) and Heick (2021), some of the most fundamental strategies include “questioning assumptions,” whereby individuals can uncover underlying beliefs or biases that may influence their thinking. The use of “how” and “why” questions allow for a deeper examination of the reasoning and premises behind arguments or statements. The next strategy is “investigating sources of information” by examining the information source’s expertise, potential biases, and the evidence provided, so that individuals can make informed judgements about the information’s validity. Another strategy is “considering opposing viewpoints,” which is done by engaging

with diverse viewpoints so that individuals can gain a broader understanding of complex topics and challenge their own preconceived notions. Finally, by using the strategy of “critically analysing one’s own thinking” individuals continuously evaluate their own assumptions and logical reasoning, seek to improve their own thought processes, and identify potential flaws or biases in their own arguments. Both problem-solving strategies and critical-thinking strategies require high levels of metacognitive abilities (Magno, 2010; Urban et al., 2023).

The Metacognitive Component

Metacognition, which entails knowledge and skills that enable learners to comprehend and evaluate their own thinking, plays an important role in the learning process. The term “metacognition” was first used by Flavell in 1979 and described it as having awareness of one’s own cognitive processes or being conscious of and comprehending one’s own thoughts. Today, metacognition is seen as including knowledge of one’s own cognitive processes as well as monitoring and evaluating newly learned information and regulating the learning process (Hacker, 1998). According to research, metacognition is not a single, consistent phenomenon (Craig et al., 2020). Metacognitive knowledge and metacognitive control, or regulation, are generally considered to be the two fundamental parts of metacognition (Craig et al., 2020; Schraw & Dennison, 1994).

What we know about our own knowledge is referred to as knowledge about cognition. It has three primary characteristics: First, it consists of declarative knowledge, which means understanding one’s own abilities, performances, tasks, and learning strategies and techniques. Second, it comprises procedural knowledge, which refers to “knowing how” to carry out a specific activity or employ a specific learning technique. Third, it contains conditional knowledge, which explains why and when a certain technique or approach should be used (Paris et al., 1984). How well one can manage their own learning is referred to as control of cognition, which is typically considered to have four components: planning, monitoring, regulation, and evaluation. Setting goals, choosing effective learning strategies, activating prior knowledge, and allocating resources are all aspects of planning. Monitoring entails evaluating one’s cognitive processes while performing a task or during learning; it affects regulation, which explains behavioural changes like strategy alterations when learning or the termination of learning (Nelson & Narens, 1994).

Individuals evaluate their own performance, and this affects how they learn in the future through their choice of an effective learning strategy. Moreover, the way students monitor and regulate their emotions impacts judgements and feelings about their learning, which then influences their allocation of mental effort and resources (Efklides, 2011) and further influences their motivation and self-efficacy (Schraw et al., 2006; Schraw & Moshman, 1995).

The Motivational Component

Motivation refers to beliefs about one's abilities and skills and comprises attitudes that influence the use and development of cognitive and metacognitive abilities (Schraw et al., 2006). For a student to use effective cognitive strategies that may be more difficult to employ, he or she must be sufficiently motivated to do so. High motivation influences academic performance and leads to cognitive involvement with the task (Pintrich & De Groot, 1990). Borkowski (1992) suggested that cognition and metacognition have a bidirectional relationship with motivation, as meaningful cognitive actions generate motivational outcomes that further enhance self-regulatory behaviours.

Self-efficacy is a well-established motivational construct in educational psychology and a crucial component of most self-regulated learning models (Murphy & Alexander, 2000). According to Bandura (1977, 1990), self-efficacy is the belief individuals have in their ability to increase their motivation, mobilise cognitive resources, and perform actions necessary to control a particular task. In academic settings, self-efficacy refers to students' belief in their ability to perform certain academic tasks at a particular level (Schunk & Ertmer, 2000). Strong self-efficacy beliefs are important because people who believe in their abilities tend to rely on themselves when faced with challenging situations (Bandura, 1990; Winne & Hadwin, 2008; Zimmerman & Schunk, 2011).

Pajers (1996) states that students with higher levels of self-efficacy are more likely to take on challenging tasks compared to those with lower levels of self-efficacy. Positive self-efficacy beliefs lead to better performance by increasing dedication, effort, and persistence (Pintrich, 2003). Self-efficacy is fostered by personal achievements that allow learners to compare themselves to others. If learners lack confidence in their ability to achieve a particular goal, they are unlikely to be motivated to pursue it. On the other hand, learners with high self-efficacy tend to set ambitious goals and are

motivated to understand the material they need to learn (Bandura, 1990; Pintrich, 2000).

The Present Study

In the last decade, the research focus on self-regulated learning (SRL) has shifted from students to training teachers in supporting their students' self-regulation of learning (Dignath & Veenman, 2021). Effective strategy instruction (Pressley & Harris, 1990), which plays a crucial role in learning, aligns with this shift. Strategy instruction involves a systematic approach to equipping learners with a diverse range of cognitive and metacognitive tools and learning techniques and strategies (LTSs). These strategies not only aid students in comprehending the subject matter but also facilitate the establishment of connections between topics and promote the acquisition of enduring knowledge.

Despite the existence of evidence-based LTSs that have been shown to enhance long-term learning outcomes, students predominantly rely on techniques and strategies that are considered less effective (Dirkx et al., 2019; Hartwig & Dunlosky, 2012; Karpicke et al., 2009; Kornell & Bjork, 2007). The present study aims to investigate the utilisation of learning techniques and strategies among Slovak students of pedagogy as well as the sources of knowledge from which these students became acquainted with these learning techniques and strategies. Research in the field of SRL (Dignath & Veenman, 2021) shows that it is important to instruct students about effective learning and strategies in order to develop their declarative knowledge. Kramarski (2018; see also Kramarski & Kohen, 2017) considers it vital that preservice teachers and instructors already be familiar with and utilise these techniques. This research problem underscores the need to examine the sources of information and training on LTSs available to pedagogy students in Slovakia, as well as their awareness and understanding of effective learning strategies.

The study set several goals to address the research problem. Firstly, it aims to explore the learning techniques and strategies (LTSs) commonly used by Slovak pedagogy students during their self-study. This analysis will provide a comprehensive understanding of the students' learning practices and the prevalence of different LTSs. Secondly, the study seeks to investigate the students' preferences regarding LTSs, identifying the techniques they find most effective for their learning. Additionally, the study will examine the sources of information about LTSs that pedagogy students rely on. Lastly,

the study will explore the extent of training received by pedagogy students that specifically relates to learning techniques and strategies.

To investigate the aforementioned goals, the study poses several research questions:

1. What learning techniques and strategies are commonly employed by Slovak pedagogy students during their self-study?
2. Which LTS do they prefer most?
3. Which LTSs do pedagogy students consider the most effective for learning?
4. What are the primary sources of information about LTSs utilised by pedagogy students?
5. To what extent have pedagogy students received training specifically focused on learning techniques and strategies?

Methods

Participants

Participation in the study was limited to individuals enrolled in either an undergraduate or a graduate study programme in pedagogy at Slovak universities. Outliers were retained and included in the subsequent data analyses, while participants were only excluded if they provided mocking answers or left the questionnaires incomplete. The final sample consisted of 76 participants (including 72 females), who were recruited from eight major universities in Slovakia to ensure the inclusion of a diverse range of perspectives and experiences.

Measures and Procedure

The questionnaire containing two section was administered online through Google Forms, adhering to the ethical standards of the American Psychological Association (APA). First, participants were informed of the study's purpose and their voluntary participation. Second, participants filled in their demographic information and details about their study programme.

In the second section, participants responded to several open-ended questions. The decision to use open-ended questions aligns with the methodology advocated by Dirkx et al. (2019) and Karpicke et al. (2009), who

assert that utilising open-ended queries provides participants with more room to articulate the techniques they genuinely employ. This approach does not limit answers to a predefined set of options and thereby enables a more authentic reflection of the strategies employed.

Additionally, it prevents participants from selecting techniques that appear familiar in a provided set of options, and this fosters a more insightful exploration of their practices (Zepeda & Nokes-Malach, 2021). The open-ended questions in the present study focused on the general use of learning techniques and strategies for studying based on the findings of Hadwin et al. (2001) that two study contexts (reading for learning and studying for examinations) shared the most study techniques. The questionnaire took approximately ten minutes to complete.

Open-ended questions:

1. Which learning techniques and strategies do you use most frequently when studying?
2. From the learning techniques and strategies which you have listed, can you choose one which you use most often?
3. Which learning technique do you consider most beneficial for learning?
4. How did you become familiar with the LTSs that you use?
5. Have you received any special training focused on LTSs (beyond lectures) while at university?

Analytical Approach

In order to analyse the open-ended responses provided by participants, a theory-driven coding scheme was employed. Both authors developed this coding scheme by referring to the ten Learning Techniques (LTSs) described by Dunlosky et al. (2013) and to survey studies conducted by Dirkx et al. (2019), Hartwig and Dunlosky (2012), and Kornell and Bjork (2007). The coding process was carried out by the first author, while the second acted as an auditor, ensuring consistency and accuracy in the coding decisions.

The LTSs listed by participants were examined, noting that participants could mention more than one LTS. For each participant, the presence or absence of a specific learning technique was coded using binary values (0 indicating that they do not use the technique and 1 that they do use the technique). The frequencies of the use of each particular LTS were then determined by counting the number of participants who reported using it.

These frequencies were then converted into percentages, providing a measure of the prevalence of each learning technique within the participant sample.

All statistical analyses were performed in R version 4.2.2 (RCore Team, 2022) using RStudio, an integrated development environment (RStudio Team, 2020). We used the following R packages: dplyr version 1.0.2 (Wickham et al., 2020) and DescTools version 0.99.20 (Signorell et al., 2017).

Results

We carried out a descriptive analysis, which aligns with the methodology employed in earlier studies within this domain, such as the approaches adopted by Dirkx et al. (2019), Karpicke et al. (2009), and Morehead et al. (2015). Regarding the actual “*utilisation*” of LTSs during self-study, the analysis revealed that the most commonly employed techniques were rereading (65.8%), note-taking (50%), memorising (39.5%), and highlighting (34.2%). By contrast, the results indicate that only a small proportion of participants reported using distributed practice (5.3%), practice testing (10.5%), elaborative interrogation (13.2%), or self-explanation (14.5) compared to the aforementioned LTSs.

Examining the participants’ “*most preferred*” LTS, it is interesting to note that, as observed in the case of the commonly employed techniques, the most preferred techniques were rereading (22.3%), memorising (19.7%), highlighting (19.7%), and note-taking (17.1%). In contrast, distributed practice (3.9%), elaborative interrogation (3.9%), and self-explanation (3.9%) were only marginally preferred and practice testing was not preferred by any pedagogy students at all. These findings suggest that the participants’ first choice of technique is different from the LTSs that are empirically considered effective.

Regarding the question of which LTS is considered the “*most effective*,” participants identified memorising (22.4%), rereading (19.8%), and highlighting (9.2%) as the most effective studying techniques. The findings from first set of hypotheses indicate that Slovak pedagogy students not only predominantly utilise LTSs that are empirically considered less effective for long-term learning but also consider them to be the most useful learning techniques.

Table 1: The reported usage, preference, and effectiveness of different learning techniques.

	Reported as used (%) <i>N</i> = 76	Reported as the most preferred LTS (%) <i>N</i> = 76	Considered as the most effective LTS (%) <i>N</i> = 76
Rereading ⁶	65.8 (50)	22.3 (17)	19.8 (15)
Taking notes	50.0 (38)	17.1 (13)	5.3 (4)
Memorising	39.5 (30)	19.7 (15)	22.4 (17)
Highlighting	34.2 (26)	19.7 (15)	9.2 (7)
Using multiple sources	25.0 (19)	2.6 (2)	2.5 (2)
Elaborative interrogation	13.2 (10)	3.9 (3)	7.9 (6)
Mnemotechniques	26.3 (20)	1.0 (1)	6.6 (5)
Self-explanation	14.5 (11)	3.9 (3)	5.3 (4)
Practice testing	10.5 (8)	– (–)	2.6 (2)
Mind maps	15.8 (12)	1.3 (1)	1.3 (1)
Distributed practice	5.3 (4)	3.9 (3)	7.9 (6)
Learning in a group	1.3 (1)	– (–)	1.3 (1)
Summarisation	1.3 (1)	– (–)	– (–)
Analogies/real-life examples	2.6 (2)	1.3 (1)	1.3 (1)
Repeated listening	1.3 (1)	– (–)	– (–)
Interleaved practice	– (–)	– (–)	– (–)
Other/nothing	5.3 (4)	2.6 (2)	6.6 (5)

Participants' responses on what was their source of information about types of LTSs were categorised into six groups: school (including primary, secondary, and university), acquaintances (close family, friends), personal interest (searching on the internet, reading books), personal experience (trial and error, determining what works for oneself), no information about LTSs (lack of prior knowledge), and other (responses such as do not remember or consider LTSs unimportant).

Descriptively, the findings indicate: the most frequently reported source of knowledge about learning techniques and strategies was personal experience (48.7%), which was followed by school (19.7%), personal interest (17.1%), and family (9.2%). Finally, 2.6 % of pedagogy students reported having no knowledge about learning techniques and strategies and 2.6% reported other sources. These results suggest that only one-fifth of students received information about LTSs from educational institutions (school), which is alarming in the context of students of pedagogy.

Moreover, we also asked participants whether they had undergone any kind of prolonged training regarding learning techniques and strategies. Only 6.6% of pedagogy students reported having undergone such training.

⁶ Under rereading we included the following answers: rereading learning materials, reading aloud, rereading and memorising, reading aloud and memorising.

The results also indicate that the majority of students relied on their own experience and personal interest as the primary sources. Therefore, it is not surprising that they choose techniques that are easy to apply and require no prior training.

Discussion

Intervention studies have demonstrated the effectiveness of strategy instruction in supporting self-regulated learning (SRL; Dignath & Büttner 2008; Urban et al., 2023). Building upon this knowledge, our investigation sought to examine the utilisation of learning techniques and strategies (LTSs) among preservice students in Slovakia. By exploring the use of LTSs, we aimed to gain insights into the learning practices and preferences of these students, as well as their sources of information and the extent of training they have received on LTSs. As future educators, they will play a crucial role in guiding and supporting their own students' learning processes. By understanding and utilising effective learning strategies themselves, pedagogy students will serve as role models and effectively promote self-regulated learning in the classroom (Kramarski & Michalsky, 2009).

Our study found that although students reported utilising a wide range of LTSs, the majority of students reported using a specific group of LTSs. Unfortunately, the LTSs they utilised, favoured, and considered the most beneficial for learning were the ones that have been empirically proven as less effective for text comprehension and long-term retention and as useful only for remembering explicit information from the text (Dunlosky et al., 2013; Kornell & Bjork, 2007). These techniques included rereading, memorisation, highlighting, and note-taking, with each of these LTSs reported as being frequently used by between 30% and 60% of participants. Almost 70% of participants also reported one of these LTSs as their most preferred LTS. The learning techniques and strategies that are empirically considered effective, by contrast, such as practice testing, distributed practice, and elaborative interrogation, were reported as used by only a marginal share of participants. Moreover, only 8% of participants reported one of these learning techniques as their most preferred learning techniques.

Regarding the learning techniques and strategies that the participants considered to be the most beneficial for learning, the results showed that above 40% of participants considered rereading or memorising to be the most beneficial techniques. This was followed by highlighting, elaborative

interrogation, and distributed practice. In terms of elaborative interrogation and distributed practice, the results indicate that some students know about the benefits of these LTSs, but they do not use them predominantly. Interesting results were found in the case of note-taking. While pedagogy students commonly utilise this technique and for around 17% of students this is the most preferred LTS when studying, only 5% of students considered it to be the most beneficial learning technique.

All in all, our results are quite understandable and justified by the current environment at Slovak schools and universities. As Zápotočná (2021) pointed out, at Slovak schools there is still an emphasis on the memorisation of information, and exams and tests primarily assess the ability to recall memorised information. It is therefore no wonder that rereading, memorising, highlighting, and note-taking are widely used and the most preferred techniques among pedagogy students, since these LTSs support the recall of already learned facts. A meta-analysis (Jansen et al., 2019) suggests that interventions focusing on self-regulated learning improve achievement, and strategy instruction (Pressley & Harris, 1990) plays an important role in SRL interventions. Therefore, it is important to equip pedagogy students with knowledge about effective learning strategies. It empowers them to become more effective educators, enhances their own learning outcomes, and enables them to create engaging and supportive learning environments for their future students, which will be based on text comprehension and self-regulated learning.

In this context, it is worth noting that only a small proportion of pedagogy students have received extensive training that specifically emphasises learning techniques and strategies. This finding highlights a significant gap in pedagogy education, where students entering the field of education are not adequately trained in evidence-based instructional practices. Efforts should be directed towards curriculum development and teacher training programmes that address this gap and that can provide pedagogy students with the necessary knowledge and skills to promote effective learning.

Moreover, the main source of information about the LTSs utilised by pedagogy students was personal experience. By contrast, only one-fifth of the participants reported school as the source of their knowledge about LTSs. These findings indicate that educational institutions play a limited role in providing comprehensive training on LTSs, which is particularly alarming in the context of students pursuing a pedagogy degree. The lack of formal training on effective learning techniques and strategies leaves

students to rely on their own experiences and personal interests, potentially perpetuating the adoption of less effective LTSs.

Practical Implications

The insights of our research article have important implications for educational practice. Most generally, understanding the cognitive, metacognitive, and motivational components of self-regulated learning can inform the design and implementation of effective teaching and learning strategies. More specifically, educators should incorporate evidence-based learning techniques into their instructional practices. By teaching students about effective learning techniques and strategies such as retrieval practice, distributed practice, elaborative interrogation, self-explanation, and interleaved practice, teachers can empower students to make informed choices about their learning methods. Providing explicit instruction and guidance on when and how to use these techniques can enhance students' comprehension, retention, and transfer of knowledge across different contexts (Dignanth & Veenman, 2021; Urban et al., 2023).

Furthermore, educators should also emphasise the development of metacognitive skills to enable students to monitor, regulate, and evaluate their learning processes. Teachers and instructors can guide students in setting clear learning goals, selecting appropriate learning strategies, planning their learning, and monitoring their progress. Encouraging students to reflect on their learning experiences and learning outcomes, as well as participate in self-assessment, helps them become aware of their strengths and areas for improvement.

Limitations

This study had a limited sample size, which could impact the generalisability of the findings to a broader population of pedagogy students. The results may be specific to the context and characteristics of the participants, and caution should be exercised when extrapolating the findings to other student populations. Moreover, when the results of different studies are compared, it becomes evident that the contextual framing of the questions influences the reported frequency of strategies. This underscores how important it is for researchers assessing students' use of strategies to carefully consider the nature of the questions they pose (Zepeda & Nokes-Malach, 2021) and the domains they are researching (Dumas, 2020).

Furthermore, our data are based on self-reports of participants, which may not necessarily reflect their actual study behaviours. Despite participants having no reason to provide intentionally misleading information, it is possible that they may have forgotten important details or techniques that they frequently use (recall bias). Therefore, the validity of the data obtained should be interpreted with caution.

Future Directions

Conducting intervention studies to promote the adoption of evidence-based LTSs among pedagogy students would be beneficial. These studies can evaluate the effectiveness of educational interventions, such as workshops, training programmes, and online resources, in enhancing pedagogy students' awareness, knowledge, and application of evidence-based LTSs.

Longitudinal research designs can provide valuable insights into the stability and change in LTS utilisation patterns, preferences, and sources of information among pedagogy students over an extended period. By tracking students' LTS choices and their subsequent academic performance, researchers can better understand the long-term effects of LTSs on learning outcomes.

Conflict of Interest

The authors declare that they have no conflicts of interest.

References

- Anderson, R. C., Hiebert, E. H., Scott, J. A., & Wilkinson, I. A. G. (1985). *Becoming a nation of readers : The report of the Commission on Reading*. National Academy of Education.
- Bandura, A. (1977). Self-efficacy : toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215.
- Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of social and clinical psychology*, 4(3), 359–373.
- Bandura, A. (1990). *Self-efficacy : The Exercise of control*. New York : Worth Publisher.
- Beyer, B. K. (1985). Critical thinking : What is it? *Social Education*, 49, 270–276.
- Björk, R., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning : Beliefs, techniques, and illusions. *Annual Review of Psychology*, 64(1), 417–444.

- Boekaerts, M. (1999). Self-regulated learning : Where we are today. *International Journal of Educational Research*, 31(6), 445–457.
- Borkowski, J. G. (1992). Metacognitive theory : A framework for teaching literacy, writing, and math skills. *Journal of Learning Disabilities*, 25(4), 253–257.
- Bransford, J. D., & Stein, B. S. (1993). The IDEAL problem solver : A guide to improving thinking, learning, and creativity. Worth Publishers.
- Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning : A theoretical synthesis. *Review of Educational Research*, 65(3), 245–281.
- Craig, K., Hale, D., Grainger, C., & Stewart, M. E. (2020). Evaluating metacognitive self-reports : Systematic reviews of the value of self-report in metacognitive research. *Metacognition and Learning*, 15, 155–213.
- Dignath, C., & Büttner, G. (2008). Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. *Metacognition and Learning*, 3, 231–264.
- Dignath, C., & Veenman, M. V. J. (2021). The role of direct strategy instruction and indirect activation of self-regulated learning – Evidence from classroom observation studies. *Educational Psychology Review*, 33(2), 489–533.
- Dirkx, K. J. H., Camp, G., Kester, L., Kirschner, P. A. (2019). Do secondary school students make use of effective study strategies when they study on their own? *Applied Cognitive Psychology*, 33, 952–957.
- Dumas, D. (2020). Strategic processing within and across domains of learning. In D. L. Dinsmore, L. K. Fryer, M. M. Parkinson (Eds.), *Handbook of strategies and strategic processing : Conceptualization, intervention, measurement, and analysis* (pp. 11–28). Routledge.
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques : Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14(1), 4–58.
- Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning : The MASRL model. *Educational Psychologist*, 46(1), 6–25.
- Flavell, J. H. (1979). Metacognition and cognitive monitoring : A new area of cognitive-developmental inquiry. *American Psychologist*, 34(10), 906–911.
- Frensch, P. A., & Funke, J. (2014). *Complex problem solving : The European perspective*. Psychology Press.
- Gick, M. L. (1986). Problem-solving strategies. *Educational Psychologist*, 21(1–2), 99–120.
- Goldstein, E. B. (2015). *Cognitive psychology : connecting mind, research, and everyday experience* (4th edition; student edition). Cengage Learning.
- Hacker, D. J. (1998). Definitions and empirical foundations. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 15–38). Routledge.
- Hadwin, A. F., Winne, P. H., Stockley, D. B., Nesbit, J. C., & Woszczyna, C. (2001). Context moderates students' self-reports about how they study. *Journal of Educational Psychology*, 93(3), 477–487.

- Hager, P. J. (2012). Formal learning. In N. M. Seel (Ed.), *Encyclopedia of the sciences of learning* (pp. 1314–1316). Springer.
- Hartwig, M. K., & Dunlosky, J. (2012). Study strategies of college students : Are self-testing and scheduling related to achievement? *Psychonomic Bulletin & Review*, 19(1), 126–134.
- Heick, T. (2021, May 6). *60 Critical Thinking Strategies for Learning*. TeachThought. <https://www.teachthought.com/critical-thinking/critical-thinking/>.
- Jansen, R. S., Van Leeuwen, A., Janssen, J., Jak, S., & Kester, L. (2019). Self-regulated learning partially mediates the effect of self-regulated learning interventions on achievement in higher education : A meta-analysis. *Educational Research Review*, 28, 100292.
- Karpicke, J. D., Butler, A. C., & Roediger, H. L. III (2009). Metacognitive strategies in student learning : Do students practice retrieval when they study on their own? *Memory*, 17, 471–479.
- Kornell, N., & Bjork, R. A. (2007). The promise and perils of self-regulated study. *Psychonomic Bulletin & Review*, 14, 219–224.
- Kramarski, B. (2018). Teachers as agents in promoting students' SRL : Research and implications. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (pp. 223–239). Routledge.
- Kramarski, B., & Kohen, Z. (2017). Promoting preservice teachers' dual self-regulation roles as learners and as teachers : Effects of generic vs specific prompts. *Metacognition and Learning*, 12(2), 157–191.
- Kramarski, B., & Michalsky, T. (2009). Investigating preservice teachers' professional growth in self-regulated learning environments. *Journal of Educational Psychology*, 101(1), 161–175.
- Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and Learning*, 5, 137–156.
- Mayer, R. E. (1992). *Thinking, problem solving, cognition*. (2nd edition). New York : W. H. Freeman and Company.
- Morehead, K., Rhodes, M. G., & DeLozier, S. (2015). Instructor and student knowledge of study strategies. *Memory*, 24(2), 257–271.
- Murphy, P. K., & Alexander, P. A. (2000). A motivated exploration of motivation terminology. *Contemporary Educational Psychology*, 25(1), 3–53.
- Nelson, T. O., & Narens, L. (1994). Why investigate metacognition? In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition : Knowing about knowing* (pp. 1–25). The MIT Press.
- Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research*, 66(4), 543–578.
- Panadero, E. (2017). A review of self-regulated learning : Six models and four directions for research. *Frontiers in Psychology*, 8, 422.
- Paris, S. G., Cross, D. R., & Lipson, M. Y. (1984). Informed strategies for learning : A program to improve children's reading awareness and comprehension. *Journal of Educational Psychology*, 76(6), 1239–1252.
- Pintrich, P. R. (2000). Multiple goals, multiple pathways : The role of goal orientation in learning and achievement. *Journal of Educational Psychology*, 92(3), 544–555.

- Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology*, 95(4), 667.
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82(1), 33–40.
- Potts, B. (1994). Strategies for teaching critical thinking. *Practical Assessment, Research, and Evaluation*, 4(3), 1–5.
- Pressley, M., & Harris, K. R. (1990). What we really know about strategy instruction. *Educational Leadership*, 48(1), 31–34.
- Puustinen, M., & Pulkkinen, L. (2001). Models of self-regulated learning : A review. *Scandinavian Journal of Educational Research*, 45(3), 269–286.
- Řičan, J. (2016). *Metakognice a metakognitivní strategie jako teoretické a výzkumné konstrukty a jejich využití v moderní pedagogické praxi*. (Metacognition and metacognitive strategies as theoretical and research constructs and their use in modern pedagogical practice) Hněvín.
- Schacter, D. L., Gilbert, D. T. and Wegner, D. M. (2009). *Psychology*. 2nd edition. Worth Publishers.
- Schraw, G. & Dennison, R. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology*, 19, 460–475.
- Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, 7(4), 351–371.
- Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education : Metacognition as part of a broader perspective on learning. *Research in Science Education*, 36, 111–139.
- Schunk, D. H., & Ertmer, P. A. (2000). Self-regulation and academic learning : Self-efficacy enhancing interventions. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 631–649). Elsevier.
- 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.
- Signorell, A., et al. (2017). *DescTools : Tools for descriptive statistics*. R package version 0.99.20.
- Sternberg, R. J., & Sternberg, K. (2017). *Cognitive psychology*. (7th edition) Cengage Learning.
- Urban, K., & Urban, M. (2023). How can we measure metacognition in creative problem-solving? Standardization of the MCPS scale. *Thinking Skills and Creativity*, 49, 101345.
- Urban, M., Urban, K., & Nietfeld, J. L. (2023). The effect of a distributed metacognitive strategy intervention on reading comprehension. *Metacognition and Learning*. Advanced online publication.
- Walker, S. E. (2003). Active learning strategies to promote critical thinking. *Journal of Athletic Training*, 38(3), 263–267.
- Weinstein, C., Acee, T. W., Jung, J., & Dearman, J. K. (2011). Strategic and self-regulated learning for the 21st century : The merging of skill, will and self-

- regulation. In B. Morrisson (Ed.), *Independent language learning : Building on experience, seeking new perspectives* (pp. 41–54). Hong Kong University Press.
- Weinstein, C., & Mayer, R. (1986) The Teaching of Learning Strategies. In M. Wittrock (Ed.), *Handbook of research on teaching* (pp. 315–327). Macmillan.
- Wickham, H., François, R., Henry, L., Müller, K., (2020). dplyr: A Grammar of Data Manipulation. R package version 1.0.2. <https://CRAN.R-project.org/package=dplyr>.
- Winne, P. H. (1995). Inherent details in self-regulated learning. *Educational Psychologist*, 30(4), 173–187.
- Winne, P. H. (2005). A perspective on state-of-the-art research on self-regulated learning. *Instructional Science*, 33(5/6), 559–565.
- Winne, P. H., & Hadwin, A. F. (2008). The weave of motivation and self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning : Theory, research, and applications* (pp. 297–314). Lawrence Erlbaum Associates Publishers.
- Xu, Z., Zhao, Y., Liew, J., Zhou, X., & Kogut, A. (2023). Synthesizing research evidence on self-regulated learning and academic achievement in online and blended learning environments : A scoping review. *Educational Research Review*, 100510.
- Zápotočná, O. (2021). Tradície a problematické stránky vyučovania čítania a písania v slovenskom vzdelávacom prostredí. (The traditions and problematic aspects of teaching reading and writing in the Slovak educational environment) In J. Miklovičová, & J. Valovič (Eds.), *Čitateľská gramotnosť : Výsledky slovenských žiakov v štúdiu PISA 2018. Tematická správa* (pp. 43–51). NÚCEM.
- Zepeda, C. D., & Nokes-Malach, T. J. (2021). Metacognitive study strategies in a college course and their relation to exam performance. *Memory & Cognition*, 49(3), 480–497.
- Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81(3), 329–339.
- Zimmerman, B. J. (1990). Self-regulated learning and academic achievement : An overview. *Educational Psychologist*, 25(1), 3–17.
- Zimmerman, B. J. (1998). Academic studying and the development of personal skill : A self-regulatory perspective. *Educational Psychologist*, 33(2–3), 73–86.
- Zimmerman, B. J. (2000). Self-efficacy : An essential motive to learn. *Contemporary Educational Psychology*, 25(1), 82–91.
- Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal*, 23, 614–628.
- Zimmerman, B. J., & Schunk, D. H. (Eds.). (2001). *Self-regulated learning and academic achievement : Theoretical perspectives*. Routledge.
- Zimmerman, B. J., & Schunk, D. H. (2011). Self-regulated learning and performance : An introduction and an overview. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 1–12). Routledge/Taylor & Francis Group.