

Running head: CREATING FLE TO SUPPORT SRL

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CREATING A FLEXIBLE LEARNING ENVIRONMENT
TO SUPPORT THE STUDENT'S SELF-REGULATION
MA thesis

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Abstract

The purpose of this paper is to present the process of creating a flexible learning environment for a sixth grader who has been developing a negative attitude to schooling and to learning in general. A literature analysis was carried out to define the concepts of self-regulated learning, flexible learning environment and their mutual influence. Throughout the 33-week study, the learning environment underwent changes: ineffective and/or irrelevant tools were eliminated, and more efficient ones were brought in. It was attempted to measure the student's self-regulation as an aptitude and as an event, collect qualitative and quantitative data and triangulate them. The findings showed a positive dynamic in self-regulation more significant in the first half of the research period.

Keywords: learning environment, flexible learning environment, self-regulated learning, individual student, homeschooling.

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Introduction

The topic of the study appeared naturally and was based on my personal experience. The participants of the study were me and my 13-year old daughter who has been struggling in school and developing a negative attitude not only to schooling but to learning in general. As a parent, I was worried about the fact that my child tried by all means to avoid any learning tasks, neglected her school homework, and wanted to attend the school as little as possible. This situation became noticeable by the end of the fourth grade and had clear tendencies to increase. Problems and conflicts with classmates, teachers or school administration were excluded from possible causes, the child did not suffer from any health problems, psychologists recommended not to put pressure on the child and, if possible, allow her not to attend school so that she would stop perceiving the school as an inevitable evil. Teachers spoke of her as a thoughtful student who loves to argue, her grades remained right above average, but the less she attended school and did her homework, the less knowledge she acquired. My first attempts to rectify the situation were aimed at shifting the learning environment by enrolling to alternative schools. But as the student's native language was Russian and the family was currently living in Lithuania, other schools' languages of instructions were Lithuanian, English or French. In other words, I was going to put the struggling learner in the environment somehow more complicated for her than the state school with Russian-Lithuanian language of instruction. Therefore, instead of looking for the most suitable environment for her, I decided to redirect my efforts into creating such an environment and focus on developing the child's learning self-regulation skills so that in the future she was able to gain knowledge in different learning environments. The idea of homeschooling appeared one year prior to the research (the student's 5th grade) and the following year was spent on theoretical preparation. During the pre-acquaintance with the theory of educational processes, the importance of self-regulation of learning became clear, moreover, the conviction arose that in the state school these skills were not given due attention. This idea was expounded, for example, by Zimmerman: "Although these studies have clearly revealed how self-regulatory processes lead to success in school, few teachers currently prepare students to learn on their own" (Zimmerman, 2002, p. 64). Zimmerman claims that self-regulated learning is the way for the students to compensate for their individual differences in learning and transform their mental abilities into academic skills (Zimmerman, 2001-2002). The student's behavior and her attitude to learning suggested the absence of this particular skill. It was likely that the roots of the problem laid deeper, for example, in the accumulation of negative experience with regard to educational tasks. However, it seemed logical that if the

student had an ability to manage her experience and learning efforts, she could have self-created a more positive attitude toward learning and reached a better academical success. So, it was decided to create a flexible learning environment that would aim to support the student's self-regulation. The environment would have to take into account the students characteristics and meet her needs for scaffolding her self-regulation. To monitor the possible progress relevant instruments had to be found and used. So, the theoretical overview of the self-regulation theory was conducted, the concept of the learning environment was defined and the connection between those two was established and described in the first part of this paper. The literature review also provided the methods to measure the level of self-regulation in learning which were described and used in the second part of the study. The concept of self-regulated learning is associated with the learner's autonomy, its foundations are laid in early childhood and if properly supported, the skill would develop throughout school years and refinement in the future (Germeroth & Day-Hess, 2013; Thomas, Muls, De Backer, & Lombaerts, 2019). However, the initial situation of this study – the child's reluctance to learning – is not seldom. Most of the researchers studying this phenomenon use samples that equal to groups, classes, set of classes. The sample of the present study is one individual that provides an opportunity to reach a more in-depth understanding of the processes and analyze more data related to the task from the perspective of an individual. Due to the fact that the process of learning is individual, such a personal approach may contribute to the general system of knowledge about self-regulation. In any case, the fact of the high importance of the study for this particular student, her family, and even her future life-long learning shall not be disputed.

1. The importance of self-regulated learning in the lifelong learning perspective

Back in 1996 UNESCO Commission on Education for the 21st century wrote that learning must go “beyond the traditional distinction between initial and continuing education” and the concept of lifelong learning (LLL) emerges as one of the keys to our successful future (Delors, et al., 1996). Today we are not able to predict what knowledge will be needed in the future, so the learning can and should occur through a life time (Knapper & Cropley, 2000). The researchers claim that fostering lifelong learning is a topic of high relevance for current educational policy”. (Lüftenegger, et al., 2012) and “from kindergarten until retirement age self-regulation as well as self-regulated learning is necessary because the demands of the environment change rapidly in our times” (Klug, Ogrin, Keller, Ihringer, & Schmitz, 2011, p. 52)

The concept of LLL is inextricably linked to the self-regulation. For example, in the study of the effectiveness of educational tools to support self-regulated learning Skinner and her colleagues stated that self-regulated learning skills are a core to lifelong learning. (Skinner, et al., 2015). Some scholars affirm that the system School-University-Job-Retirement has stopped working, and to keep up with the changing environment we need to learn during the whole career with various jobs (e.g. Knapper & Cropley, 2000; Mawas, et al., 2017). Learning should be Life wide and occur in multiple format: formal and informal contexts: school, home, work, etc. “Lifelong and Lifewide Learning are key elements for the prosperity, especially in a knowledge society” (Mawas, et al., 2017, p. 662). Today we are not able to predict what knowledge will be needed in the future, so the learning can and should occur through a life time (Knapper & Cropley, 2000). This idea is supported by many scientists and, for example, Sharples (2000) confirms that the basic premise of Lifelong Learning is that it is not feasible to equip learners at school, college or university with all the knowledge and skills they need to prosper throughout their lifetimes. Obviously to be able to learn through life regardless the pressure of educational institutions, people need to possess ability to regulate their learning. They also need to be able to direct themselves through learning process, set goals, monitor their achievements etc.

The idea of a learner as an actor of educational process mainly arose in the 1960s when the focus in psychology shifted from conditioning of learning toward cognition and produced major realignments in views of human learning, motivation, and achievement. Thereby the scholars moved their attention onto intrinsic learning processes of an individuum. In 1970-1980s metacognition and social cognition theories started to become more and more influential. Learners were no longer considered as passive recipients of information; they became active seekers and processors (Schunk, 2008). As a result, a new perspective on students' individual differences began to emerge. Struggling with learning was attributed to a lack of awareness of personal limitations and to an inability to compensate them, so the importance of metacognitive self-awareness to those limitations became clear (Zimmerman, 2002). And the results of new directed studies led researchers to attribute individual differences in learning to students' lack of self-regulation. At that time the first theories and models of Self-Regulated Learning (SRL) were created (e.g. Bandura, 1986; Slate & Charlesworth, 1988; Zimmerman, 1989; Borkowski & Muthukrishna, 1992; Pintrich, Smith, Garcia, & McKeachie, 1991; Winne, 1996). The researchers shifted their focus onto the studying process as well as onto the procedures, routines and activities that could support learners. For instance, Shapiro in his study on self-monitoring procedures stated that simply asking students to self-record several aspects of their

learning, such as the completion of assignments, often resulted to "spontaneous" improvements (Shapiro, 1984). Social cognitive researchers studied the effects of teacher modeling and instruction on students' goal setting and self-monitoring. (Zimmerman, 2002). These effects implied that students' metacognitive (i.e., self) awareness could enhance their self-control in learning. Eventually, learners' skills and abilities have stopped to be an exhaustive explanation for student achievement and the effect of self-awareness and self-directed learning was recognized and accepted. Of course, when a learner lacks fundamental skills, self-awareness itself is insufficient, but it can produce a readiness that is essential for personal change (Zimmerman, 2001). SRL was regarded "as a necessary prerequisite for life-long learning" (Klug, Ogrin, Keller, Ihringer, & Schmitz, 2011, p. 51).

2. The concepts of self-regulated learning

The concept of self-regulated learning (SRL) is one of the most reliable and well-studied concepts of a learner's metacognitive processes that foster learning. It emerged from within educational psychology research in 1980s and became increasingly popular since then. Panadero claims SRL "an extraordinary umbrella" (Panadero, 2017, p. 422) which covers various concepts that influence a learning process, such as self-efficacy, volition, cognitive strategies. The importance of SRL is highly appreciated among researchers in education and educational psychology. Research on SRL learning began as an outgrowth of psychological investigations into self-control among adults and its development in children. It was suggested that factors such as self-regulation and motivation were important. SRL broadened its scope beyond the emphasis of a performance of previously learned actions to LLL perspective. Today SRL is seen by scholars as a mechanism to explain achievement differences among students and as a means to improve achievement (Zimmerman, 2001). SRL proved to be a separate self-sufficient area of study which includes, for example, self-regulatory principles to academic studying and other forms of learning, motivational beliefs and their effects on study results, the role of self-efficiency in social and environmental context of learning and others. Below several well-recognized SRL theories are listed and briefly explained, and their corresponding models created by the most quoted scholars are provided. Also, it was attempted to excerpt the authors' vision on the environment supporting SRL.

Zimmerman. Socio-Cognitive perspective of SRL

One of the pioneers in SRL studies was Zimmerman who is, according to Panadero (2017), one of the most prolific SRL writers. Zimmerman considers SRL as a learners' ability to be

metacognitively, motivationally, and behaviorally active participants in their own learning process. Zimmerman claims SRL to be not determined merely by personal processes; but be assumed to be influenced by environmental and behavioral events in reciprocal fashion (Zimmerman, 1989)

His first SRL model (1989) was based on social cognitive approach to SRL and introduced interaction between three forms of self-regulation: Behavioral, Environmental and Covert (see Appendix 1). Zimmerman stated that self-regulation involves triadic processes that are proactively and reactively adapted for the personal goals. For example, Behavioral self-regulation involves self-observing and adjusting performance processes; Environmental self-regulation refers to observing and adjusting environmental conditions; and Covert self-regulation means monitoring and adjusting cognitive and affective states. The feedback is playing important role in this triadic circle, because the feedback from prior performance influences the current efforts. Also, the student's accuracy and constancy of self-monitoring influence his effectiveness and the nature of self-beliefs. The need for constancy is pointed out separately because personal, behavioral, and environmental factors are constantly changing during the learning process and the learner has to adjust himself to these changings to be more effective. Due to changeable personal, environmental and behavioral conditions, these triadic feedback loops must be open to give the learner an ability to proactively increase his performance by, for instance, raising goals and seeking more challenging tasks.

In his later studies, Zimmerman moved his focus to the effective models of self-regulation. The basis for the new perspective was, for example, established by Winne (1997) who stated that any person attempts to self-regulate his or her functioning to gain personal goals. In that perspective, Zimmerman raised a question what distinguishes effective and ineffective forms of self-regulation. He has been empirically studying the structure of the most effective self-regulated processes, for example, interviewing experts who are known for their self-discipline and success. As a result, the model of Cyclical phases of self-regulation (Appendix 2) was created (Schunk & Zimmerman, 1998). The model consists of three looped phases: Forethought, Performance or volitional control, and Self-reflection. In that model Forethought refers to influential processes that set the stage for performance; Performance or volitional control refers to processes that occur during action; and Self-reflection involves cognitive processes after the effort and self-reflection influences forethought, which make the self-regulatory cycle completed.

Later studying metacognition and motivation intersection in collaboration with Moylan, Zimmerman has improved his model of Cyclical phases of self-regulation (Zimmerman &

Moylan, 2009). There are the same three interconnected stages of the process: Forethought, Performance Phase and Self-reflection (Appendix 3). However, it worth to note that the major differences have been made in the Performance Phase: Volitional control has been deleted from the topic, but in the body of the phase appeared such structural elements as Metacognitive monitoring, Time management, Environmental structuring, Help-seeking, Interest incentives and Self-consequences. Thus, the first Zimmerman's model represents the three domains of self-regulation and their interconnection and the later ones models the cyclical self-regulatory phases. From that three models I would like to specifically distinguish that according to Zimmerman (1) environmental aspects are inseparable from SRL and structuring environment is one of the SRL stages; (2) the process of self-regulation is cyclical, and one phase influences another one: forethought affects performance, performance affects self-reflection and self-reflection affects forethought; and (3) self-regulation involves a lot of intrinsic self-processes on every level. Hence to make a significant change in self-regulation processes a person needs to pay attention to all the aspects of self-regulation and this idea can be transferred onto SRL.

Schmitz. Learning states

The works by Schmitz and his colleagues can be put under Zimmerman's model umbrella. However, they have changed the names of the three phases which in their version became Pre-action Phase, Action Phase and Post-action Phase; the content of the phases was also changed, but the essence of the three phased cyclical model was left untouched and there are still many similarities and parallels in the content. I may say that Schmitz and his colleagues has paraphrased Zimmerman's model according to their focus.

According to Schmitz and his colleagues, SRL is a process that can be describes as a sequence of states (Schmitz, Klug, & Schmidt, 2011). By learning state Schmitz and his colleagues meant learning behavior that is measured in a particular situation at a particular point of time, they claimed that "a single learning state includes, for example, the completion of assigned material at a single point in time. In such a learning session, various aspects of self-regulated learning may be relevant for students. The single learning state is their learning behavior measured at a particular point of time in this special situation" (Klug, Ogrin, Keller, Ihringer, & Schmitz, 2011, p. 52). Each state starts when the student begins his learning session and ends when he finishes. The state proceeds from the Pre-action phase, in which learning task and situation are the sources for setting goals, developing attitudes towards learning and gaining self-efficacy for managing tasks. The Action phase brings the importance of student's

performance, which includes e.g. regulation, effort, time and attention management. In the final Post-action phase, the student metacognitively and affectively reacts to the learning outcomes.

Hereby Schmitz assigned a significant role to the student's self-monitoring and self-control that can be visualized using self-reported diaries. In their study Schmitz and his colleagues concentrated on the theoretical proposal that gives a major emphasis to the role of self-monitoring in SRL (Schmitz, Klug, & Schmidt, 2011). Another substantial research by Schmitz and colleagues showed that training on SRL was effective in improving both competence of self-regulated learning and objective measures of performance. They also found the way to improve efficiency of SRL training by its distribution through web-based training to university students. (Bellhauser, Loesch, Winter, & Schmitz, 2016).

Boekaerts. The role of emotions

Boekaerts was like Zimmerman one of the earliest authors on SRL. According to Panadero (2017) she is also the most quoted author of SRL theories. Her first SRL model – structural – included six components: (1) domain-specific knowledge and skills, (2) cognitive strategies, (3) cognitive self-regulatory strategies, (4) meta-cognitive knowledge and motivational beliefs, (5) motivation strategies, and (6) motivational self-regulatory strategies (Boekaerts, 1996b). They were structured into two basic mechanisms of SRL: cognitive self-regulation and affective/motivational self-regulation. So, the model provided detailed description of SRL structure and it was widely used by educational practitioners as the framework for teachers' training, new measurement construction and design intervention programs (Panadero, 2017). Another Boekaerts' model (which is also widely used) represented layers of SRL and provided the alternative view on SRL as deepening levels of regulations: (1) self - choice of goals and recourses; (2) learning processes; (3) processing modes – choice of cognitive strategies (Boekaerts, 1999).

Boekaerts was not only interested in modelling SRL structure, but studied learning, its regulation and influencing aspects. She agreed with Schmitz that cognitive self-regulation can be taught and that students who apply them achieve better results. However, she argued that a person can be able to self-regulate on one occasion but may not be able to do so on another occasion, despite the acknowledged benefits. She pointed out that SRL can be domain-specific and it relies mainly on prior experience related to that domain (Boekaerts, 1997). This aspect is tightly connected with the role of emotions. In her Model of adaptive learning Boekaerts (1996a) presented Dynamic internal working model with is constantly digest information from three recourses: perception of the learning situation, domain-specific knowledge and skills and

student's self-system (including their goal hierarchy). According to the model, appraisal of the three recourses leads either to Coping strategy (Coping mode) or learning strategy (Mastery mode). So, positive or negative emotions arising in relation to the task affect student's appraisal hence result to choosing Mastery or Coping mode. In her later work, Boekaerts continued to study SRL as a generic term. She named identification, interpretation, and appraisal processes "the gateways to self-regulation" (Boekaerts & Niemivirta, 2000). She considered SRL as the dual process, and she saw it as a process of finding the balance between goals of learning goals to protect the ego (Boekaerts, 2000-2011). This idea was reflected in the Dual processing self-regulation model (see Appendix 4) which mirrors the learner's choice between two pathways: the growth or the well-being pathway (Boekaerts & Corno, 2005). To reach personally valuable goals students start activity in the growth pathway because they are ready to put energy in its pursuit. In contrast, students focused on their well-being, initiate activity in the well-being pathway; they use energy to prevent negative events from occurring.

Boekaerts was the first to use situation-specific measures to evaluate motivation and SRL. She studied and fixated the level of self-efficiency, recorded participants' thoughts and feelings during the learning situation aiming to connect their motivational beliefs, metacognitive strategies with the learning task. Boekaerts emphasized the key role positive and negative emotions play in SRL (Panadero, 2017). According to Boekaerts, during the learning episode the student chooses among two possible modes: Coping mode or Mastery mode (Boekaerts, 1996a) which in the latest works were called 'Well-being pathway' and 'Growth pathway', respectively (Boekaerts, 2011). The learner makes this choice based on personal appraisal of the task and the learning situation in general. Boekaerts argued that if the learning situation is initially appraised by a student as a peril to his or her well-being, negative cognitions and emotions can be triggered, such as anxiety, irritation, disappointment. It could happen, for example, because the task is considered as a difficult one, or because the students feel unsupported in his attempt. This kind of negative feelings initiates activities into the well-being pathway straight away. Which means the student stays in his well-being mode, not in the growth mode. This well-being pathway refers to strategies that protect students from threat, harm, or loss, e.g., avoidance, denial, giving up, or distraction (Boekaerts, 2011). Boekaerts concluded that positive or negative feelings toward a task affect effort allocation and effort management and make a student choose between Coping or Mastery mode. It was theorized that each learning situation triggers specific connotations, because it impinges on a learner's personal struggles and weaknesses. This connection was graphically presented as links between the appraisal process and the contents of a dynamic internal working model. However, it is

obvious that Mastery mode or Growth pathway is more desirable, hence we need to aim to foster its emergence. To do so we need to make the student to “switch modes”, or in other words to avoid Coping mode which he or she unconsciously selects as a result of intrinsic appraisal of the situation as a peril or disturbance to well-being. In her papers Boekaerts has repeatedly emphasized the importance of emotions in the learning process (Boekaerts, 1996a; Boekaerts, 2011; Boekaerts & Niemivirta, 2000). In one of her SRL models, namely Six component model, Boekaerts considers SRL as a cooperation of two basic mechanisms: cognitive self-regulation and affective/motivational self-regulation (Boekaerts, 1997). These processes involve ‘cognition about cognition’ abilities. The following author explored SRL precisely from a metacognitive perspective.

Winne and Hadwin. SRL as a metacognitive event

Investigating how students adapt to accomplish their goals more efficiently, Winne and Hadwin (1998) described the phases of the SRL process. According to their description, a student firstly scopes the environment to understand what features can affect his learning, then sets learning goals and plans how to accomplish them, performs learning strategies, and optionally adapts the experience answering the question ‘why is it good for me?’ Winne also claimed that students aim to achieve their goals with greater outcomes and happiness (Winne, 2004). Creating their model of SRL, Winne and Hadwin were inspired by Information processing theory (IPT) – a theoretical framework of how people think, reason, and learn (Siadat, Gašević, & Hatala, 2016). According to this theory, human cognition is viewed as analogous to the operation of a computer system. IPT overlaps with major theoretical concepts in cognitive psychology and works with such learning attributions as, for example, student’s attention, meaningfulness of the learning task, proper organization of the learning process, ways to memorize material and automaticity (Slate & Charlesworth, 1988). Thanks to its close connection with IPT, Winne and Hadwin’s model has been widely used in research implementing computer supported learning settings (Panadero, Klug, & Järvelä, 2015).

According to Winne and Hadwin (1998), SRL is identified in terms of events and can be contingently divided into four phases which learners are free to shift among: (1) developing a perception of a task which include memories about similar tasks, features, current situation etc.; (2) goal setting and planning, (3) inaction studying plans and tactics, and (4) meta-cognitively adapting studying techniques. If the learner has self-regulated skills, he metacognitively monitors his achievements and makes adjustments throughout Phases 1 to 3. Phase 4 is regarded as optional and implicates that the learner will pause and reflect on the features of the

Phases 1 to 3 (Winne, 2010). According to Winne (1997; 2010), the events in each phase have a common architecture which by first-letter acronym makes COPEs: Conditions, Operations, Products, Evaluations, and Standards. He considers SRL as operations that lead to creating products (knowledge acquisition, task achievement, test results). The context for operations is created under the influence of external and internal conditions. Hereby Winne concludes, firstly, SRL is contextual, and secondly, context evolves as learners regulate learning (Winne, 2010). The author believes that self-regulation is present in every human activity, but it might be undeveloped. More successful students are able to start the process of SRL skills acquisition without external control and can easily improve their learning themselves. So SRL is inherently considered to be metacognitively regulated behavior that allows students to cope with the task, choose the right tactics and adjust their action according to new conditions.

In his works Winne also investigated the ways to measure SRL (Winne & Perry, 2000; Winne 2010). He suggested that SRL has dual qualities as an aptitude and as an event (1997), distinguished the two ways of measuring SRL according to the chosen approach and listed seven well-known protocols to measure SRL (Winne & Perry, 2000). Self-report questionnaires, structured interviews and teacher judgments help to investigate SRL as an aptitude – “a relatively enduring attribute of a person that predicts future behavior” (Winne & Perry, 2000, p. 534). Besides, SRL can also be measured as an event. Winne characterized this approach as “a snapshot that freezes activity in motion, a transient state embedded in a larger, longer series of states unfolding over time” (Winne & Perry, 2000, p. 534). To measure SRL as an event he suggested such instruments as think-aloud protocols, error detection tasks, and observation of SRL traces and students’ performance. The SRL model proposed by Winne and Hadwin (1998) affords to imply both approaches: phases 1 to 2 are more related to SRL as an aptitude, whereas phase 3 – task performance – provides data to measure SRL as an event (Winne & Perry, 2000). Additionally, Winne argued that as researchers cannot access cognitive operations, they may aim to access the products of these operations, for example, highlighting phrases in the text, making notes etc. He claimed traces – observable representations of cognitive, metacognitive and motivational events – are keys to more fully modeling SRL processes.

Despite the fact that self-reported data is not the most reliable way to assess student’s level of SRL, insofar as we study metacognitive processes we cannot avoid or not take into account student’s self, which can include self-observation, self-consideration, self-efficiency etc. (e.g. Bandura, 1986; Boekaerts & Niemivirta, 2000; Borkowski, Chan, & Muthukrishna, 2000; Pintrich, 2000; Zimmerman, 2002; Efklides, 2008). The next scholar is well-known for

creating a self-report questionnaire that is widely used to measure students' motivation level and SRL skills.

Pintrich. General Framework for SRL. MSLQ

Pintrich played a significant role in studying SRL and creating SRL concept. He was one of the first to research and revise the relationship between SRL and motivation. According to Pintrich, SRL is an active and constructive process in which a learner set goals, monitor, regulate and control his cognition, motivation and behavior guided and constrained. He stated that “learners are assumed to construct their own meanings, goals, and strategies from the information available in the “external” environment as well as information in their own minds (the “internal” environment)” (Pintrich, 2004, p. 387). As a result of his studies, Pintrich created a general framework for SRL which includes cognitive, motivational, sensory, and biological individual processes. The framework consists of four phases: (1) forethought, planning, activation; (2) monitoring; (3) control; (4) reaction and reflection (Pintrich, 2004, p. 390). Also, Pintrich distinguished the areas for self-regulation (cognition and metacognition, motivation and affect, behavior, context) which together with the phases can be considered as sixteen-domain model of SRL (see Appendix 5). The four columns represent four different areas for regulation that a student can attempt to monitor, control, and regulate. The tripartite division of different areas of psychological functioning is presented by the first three Areas of Regulation: Cognition, Motivation/Affect. The Context column reflects the importance of not only personal but social context in SRL model. Pintrich also states that “regulation is not a domain, and hence is not a separate category of strategy use, but that regulation cuts across the four domains” (Pintrich, 2004)

Being a strong empiricist, he believed in the importance of measurement in a scientific research as well as the importance of evaluating student's progress in SRL. In early 1980s Pintrich and his colleagues began developing an instrument for assessing students' motivation and learning strategies. Early versions of the MSLQ were used to evaluate the effectiveness of “Learning to Learn” course for college undergraduates. Today the third and the final version of MSLQ is used that has been perfected and polished for over 10 years (Duncan & McKeachie, 2005). It is hard to overestimate the value of MSLQ which has been used in various target groups to address the nature of motivation and learning strategies; to help to distinguish motivational constructs and evaluate effects of instructions on SRL skills and motivation. The structure of MSLQ will be examined more attentively in the part of Methodology.

The Pintrich's SRL model with the four regulation areas, and each of the areas can be distinguished and evaluated using MSLQ. The work of Pintrich and his team seems to be extraordinarily valuable, because they provide us not only with a reliable theoretical model of SRL but also with a relevant instrument to track students' progress. The next author is one of the Pintrich's followers.

Efklides. Metacognitive and affective approach to SRL

Based on the previous SRL models (i.e. Zimmerman's, Winne and Hadwin's, and Pintrich's), Efklides stated that SRL is composed of three interacting components: metacognition, motivation and affect. Additionally, she distinguished the three facets hence three levels of functioning of metacognition: metacognitive experiences (ME), metacognitive knowledge (MK) and metacognitive skills (MS) (Efklides, 2008). Considering SRL, ME refers to bottom-up (habitual or automatic) regulation, whereas motivational factors favor a top-down (controlled) process. Control and regulation can be facilitated or constrained by the availability of resources and affective factors. Efficient SRL requires accurate monitoring input for the decision, the appropriate strategies at disposal, metacognitive ways of responding prevail over habitual (or automatic) ones (Efklides, 2008). Based on these findings, Efklides created the Metacognitive and Affective Model of Self-Regulated Learning – MASRL (2011). As the name suggests, it mostly explains intrinsic metacognitive processes of a student performing a task, and MASRL extends previous SRL models by integrating metacognition with affect and motivation. Efklides claims self-regulation is a broader framework than metacognition and considers metacognition within the concept of self-regulation. According to Efklides, SRL is taking place on two levels. Personal level (or macrolevel) “is operative when one views a task resorting mainly on memory knowledge, skills, motivational and metacognitive beliefs, and affect” (Efklides, 2011, p. 10); it is structured around student's goals for the task. The second one is Task x Person level (or microlevel), where the actions that take place are less conscious and person-oriented as student's attention and energy are focused on the task performing and move from general learning goals to more specific ones. Efklides claims that metacognitive knowledge (MK) can contribute to self-regulation either directly – Person level) or indirectly through affect – Task x Person level (Efklides, 2014).

Among others, MASRL represents the way of enhancing effective strategies. According to Efklides, strategy use is triggered by task characteristics, prior knowledge (skills) of strategies, metacognitive knowledge of strategies, metacognitive experiences that inform on processing demands, and, finally, motivation and affect that inform on the value of strategy use

and provide the energy needed for the exercise of control and strategy use (2011). It is also stated that students need to be motivated (Person level) for strategy use. MK about effort also differs from one student to another. For some learners, effort would have cognitive outcome, for some – affective, because for the first group of students, effort would have positive connotation and mean achieving their goals, whereas for others effort would associate with negative bodily symptoms such as exhaustion, discomfort, and inefficiency. For the latter the preferred strategy would be early abandoning of effort or avoiding effort altogether. In that case choosing the right level of the task difficulty and task instructions play significant role in enhancing effective metacognitive strategies and gaining positive MK and ME. If we look at MASRL from the environmental perspective, we can conclude that the environment is mainly presented by the “Task” section; and as it was mentioned above, the right level of task difficulty, customized effort, availability of recourses can play significant role in SRL. To make the learning process efficient we need to be able to monitor our effort, know appropriate strategies and have enough recourses to perform them, respond to the task metacognitively and not affectively.

Borkowski. Process Oriented Model

Similar to Efklides, Borkowski and his colleagues paid attention to the complexity of the tasks. They created a Process Oriented Model of Metacognition and a concept of Good Informational Processing within the Model (Borkowski, Chan, & Muthukrishna, 2000). He and his colleagues described self-regulation as a metacognitive ability to be taught and developed. They schematically described the stages of metacognition development, which are (a) Specific strategic knowledge, (b) Multiple strategies and performance, (c) Executive functioning and strategy use which is the beginning of SRL, (d) Motivational correlates and causes of strategy use, and eventually (e) Cognitive, motivational and self-system components of metacognition (Borkowski, Chan, & Muthukrishna, 2000). According to Borkowski, self-regulation emerges when learners become able to choose appropriate strategies, monitor their performance and continue to develop through general strategy knowledge accumulation, enhancing mental competencies and attributional beliefs, deployment of a sense of self-efficacy and gaining feedback. The feedback is assumed to have an important role in shaping personal–motivational states as it affects the process of choosing effective learning strategies in the future (Borkowski, Chan, & Muthukrishna, 2000).

Borkowski and his colleagues outlined 10 major characteristics that define a learner who is a "Good Information Processor" (Borkowski & Muthukrishna, 1992). Good Informational

Processor (GIP) stands for an effective and self-efficient student who, among other things, knows various number of useful learning strategies and is able to choose the right one(s) for the learning task, is focused on further development of his abilities, have intrinsic motivation, realizes that failure is essential for success-hence, has a history of being supported in all of the above by parents and society (Borkowski & Muthukrishna, 1992). Borkowski and his colleagues (2000) claimed that a very rare student mirrors the conceptualization of GIP, so the process-oriented model of metacognition was created as a useful framework and a long-range goal for facilitating acquisition of metacognitive skills. They started from “a primitive view of the strategy use performance relationship” (Borkowski, Chan, & Muthukrishna, 2000, p. 6) and proceeded up to the complete model of cognitive, motivational, and self-system components of metacognition (see Appendix 6). There were five diagrams presented in which every next one complements and extends the previous one. This process of gradual completion of the model mirrors the process of the student’s SRL and motivation development, although the SRL itself is mentioned only in the third outline, the first two stages are the key to its occurrence. The stages reflected in five diagrams are the following. 1. *Specific Strategy Knowledge*. The student is initially taught to use a learning strategy and with assistance learn how and where to use it. 2. *Multiple strategies and performance*. The number of attributed specific strategies is growing. The student is able to choose the most convenient strategies for the learning specific task. 3. *Executive functioning and strategy use*. This is the stage where, according to Borkowski SRL begins. The student gradually develops the capacity to select appropriate strategies and to fill in knowledge gaps by monitoring performance. In other words, higher-order executive processes and a sense of self-efficacy manifest. 4. *Motivational correlates and causes of strategy use*. Attributional beliefs appear there, hence we can notice further deployment of SRL and individual strategic performances. 5. *Cognitive, motivational, and self-system components of metacognition* is the final and complete model which includes all the domains of the earlier stages plus Self-knowledge, Domain-specific knowledge, Feedback and the extension of Personal-Motivational states.

So, for Borkowski and his colleagues SRL emerges when learners become able to choose appropriate strategies and monitor their performance and continue to develop through general strategy knowledge accumulation, enhancing mental competencies and attributional beliefs, deployment of a sense of self-efficacy and gaining feedback and experience. It is an executive metacognitive process that can be taught and developed (Borkowski, Chan, & Muthukrishna, 2000). They also claimed that “parents and teachers – and the learning environments they create – are pivotal to the development of an integrated metacognitive

system” (Borkowski, Chan, & Muthukrishna, 2000, p. 27). Hence the exclusive role of parents’ and teachers’ support was highlighted.

3. SRL models generalization

To summarize the above-described theoretical frameworks, it can be concluded that notwithstanding the models of SRL vary, they all illustrate the complexity of SRL, consider its cognitive and metacognitive essence, attempt to show its multilevel, include motivational and self-efficacy components, suggest ways to affect it, hence the way to improve SRL skills. The concept of SRL itself appeared thanks to the shift of focus onto the learner as an actor of a learning process; and this idea is supported by all the authors mentioned above. Worth to mention that SRL can only be considered in the context of the learning tasks, this is an applied skill to be improved in the learning process. In addition, some authors stress out the importance of formative feedback, positive experience, and a tutorial support.

Zimmerman considers SRL as a learners’ ability to fully participate and influence his own learning process. He pays great attention to environment features and refers to SRL as to cyclical process of interconnection between forethought, performance and self-reflection. Schmitz with colleagues enriched Zimmerman’s model and brought in the theory of importance of self-monitoring and proved that SRL skills can be taught and learned. Boekaerts like Zimmerman provided several models looking at SRL from different perspectives. Among other theories she considers SRL to be domain-specific and relied on prior experience. She also studied the role of emotions and argued that positive or negative feelings make the student choose either Coping mode (Well-being pathway) or more preferable Mastery mode (Growth pathway). Winne and Hadwin brought in Information processing theory and studied SRL as an event each phase of which can be proposed as Conditions, Operations, Products, Evaluations, and Standards (COPES). On the one hand, SRL is contextual, and on another hand, context evolves as learners regulate learning. To paraphrase, the environment influences the learner as well as learner can influence environment. Pintrich distinguished phases and areas for SRL and created the framework that helps learners and teachers to reveal the slots to be improved. According to Pintrich SRL is not a domain, it has four phases and goes across 4 areas. Pintrich’s MSLQ is a convenient self-report instrument to measure students’ motivation and self-regulation. The environment in Pintrich’s model is represented by the ‘Context’ column which consists of Perception, monitoring, changing and evaluating task/context. In MSLQ there are scales assessing students’ peer learning abilities and Time/Study Environment. The two levels of Efklides’ SRL model are ‘Person’ and ‘Task x Person’. Task itself is the initiator of

the processes on either level. The appropriate task initiates effective strategies and enriches the students' SRL encouraging them to react metacognitively and not affectively. And finally, according to Borkowski, student can be called a self-regulated learner if he knows, uses effective strategies and continuously accumulate his knowledge; and parents and teachers can help the student by creating an appropriate learning environment. Borkowski's row of five models visualizes the process of creating SRL: gradual complication of the models gives an idea of what to start with and where to proceed to aim to facilitate the student's SRL.

Overall, supposedly the reason for such wide diversity in models is not the difference between the essences of the concepts of SRL, but the difference between the perspectives from which the authors look at SRL. This statement can be supported by the fact that, for example, Zimmerman and Boekaerts have published several different models of SRL for different purposes. For example, Zimmerman in his papers relies on his 'Three key forms of self-regulation' (1989), Multilevel training model (2000), as well as on 'Phases and subprocesses of self-regulation' (2003). Whereas Boekaerts created Model of adaptable learning (1996a), Six-component model of SRL (1996b), and Layered Model of SRL (1999) and use them to illustrate different approaches to SRL and to show SRL from different perspectives. Self-regulation is a comprehensive concept. It can be seen from the cognitive capacity perspective and consider knowledge, beliefs, perceptions, and from the affective capacity perspective and consider moods, feelings and emotions. And for better understanding of SRL the acknowledge of its comprehensiveness is needed, as well as studying the interactions between affective and cognitive processes (Pintrich P. R., 2000; Zimmerman, 2002; Boekaerts, 2011; Efklides, 2008; Schunk, 2008; Klug, Ogrin, Keller, Ihringer, & Schmitz, 2011; Panadero, 2017; Mahendiran & Kumar, 2017).

4. Learning environment

Below the concept of the learning environment (LE) is defined. Firstly, from a perspective of the SRL models that were described above and then the various dimensions of LE are brought out, described and the examples of LE features of every dimension are provided.

1.1. Environment as a part of SRL models

Environmental factors, in a greater or lesser extent, exist in every model of SRL. All of the authors consider the environment as an affective factor and agree that SRL is a contextual process. Zimmerman considers environmental structuring one of the domains of SRL; he describes it as statements which indicate student's efforts to select or arrange the physical

settings to make learning easier and gives the examples of such thoughts, e.g., “I isolate myself from anything that distracts me”; “I turned off the radio so I can concentrate on what I am doing” (Zimmerman, 1989, p. 337). In the same paper he claims that the self-regulated student would proactively manipulate with the learning environment in case to eliminate disruptive noise, arrange adequate lighting, comfortable place to write; then the student would monitor and change his arrangements if needed. Further the continued use of this structured environmental setting would depend on perceptions of its effectiveness. Zimmerman also stressed out that learning strategies can be initiated from the environment (e.g. through instruction). However, at the initial stage they would not be labeled self-regulated, they would become so as soon as they came as a result of personal key processes, for example, goal-setting and self-efficacy perceptions (Zimmerman, 1989). Schmitz who completed Zimmerman’s three phase model considered environment has its influence in the Pre-action phase as well as in the Post-action phase. In the Pre-action phase environment provides a learner with task and situation for the learning state and in the Post-action phase the outside feedback can affect student’s self-reflection and/or provide directions for future development. For Boekaerts environment is a potential source for positive or negative emotions, which are assigned to play a significant role in learning incomes (Boekaerts, 2011). She also underlines the importance of self-set learning tasks (Boekaerts & Niemivirta, 2000), which can be considered as a sign of effecting environment. In Winne and Hadwin’s (1998) SRL models the environment is presented by external feedback and task conditions such as resources, instructional cues, time, social context. Winne’s model has a strong metacognitive perspective that recognizes self-regulated students as active and managing their own learning process and also their learning environment via monitoring and the use of, mainly, (meta)cognitive strategies. SRL is also considered in terms of individual difference factors, such as domain knowledge, knowledge of tactics and strategies, performance of tactics and strategies, regulation of tactics and strategies, and global dispositions. In Winne’s (1996) and Winne and Hadwin’s (1998) SRL models the environment plays significant role and is presented by external feedback and task conditions such as resources, instructional cues, time, social context. Hereby Winne concludes, firstly, SRL is contextual, and secondly, context evolves as learners regulate learning (2010). In Pintrich’s model a learner is constrained and conducted by his goals and environment; and learner’s interaction with environment is presented mainly by monitoring changing task and context conditions (2000). Efklides with her focus on the thrust of the student’s goals set two levels of SRL and shows two different ways of environmental effects: on the macro- and microlevel. Firstly, the student is reacting on a task according to his previous experience,

knowledge, attitude and secondly on the microlevel the student is mostly concentrating on performing more specific tasks in ‘here and now’ situation. And finally, Borkowski and Muthukrishna argued the major of SRL skills can be developed and reshaped by aimfully planned classroom and homebased learning environment.

Above it was attempted to ‘extract’ the authors views on the environment part of their models. Below in Table 1 there are presented (1) authors of the models, (2) list of items that present the environment in each model, and (3) specified roles of the environmental features in SRL context.

Table 1. Presence of the Environment in SRL models

Author	Environment is presented by	The role of environment
Zimmerman (1989)	Task Physical settings and conditions Instructions including learning strategies	Facilitates learning process through comfortable physical settings Initiates processes of gaining knowledge (e.g. about learning strategies)
Schmitz (2011)	Task Situation Feedback	Initiates learning state Is the source for setting goals, developing attitudes towards learning and gaining self-efficacy for managing tasks
Boekaerts (2011)	Task-in-Context Instructions Social context	Perception of the learning situation hence choice between coping or growth modes
Winne (1996) Winne & Hadwin (1998)	Task and its conditions (recourses, instructions, time, social context) External feedback and evaluations	Initiates SRL process Influences cognitive conditions Affects choice of studying tactics and strategies Affects performance
Pintrich (2000)	Task and context Study environment Peer learning Extrinsic goals	Leads to task and context perception Can initiate monitoring of task and context, their evaluation, the decision to change or to regenerate the task and/or to change or to leave context
Efklides (2011)	Task	Initiates the affective or metacognitive levels of SRL Leads to the preferred strategy choice Makes a student to move from general learning goals to more specific ones
Borkowski (2000)	Task Interactive strategy instructions Feedback	Initiates gaining specific strategy knowledge and perfection of strategy use Shapes personal-motivational states Provides the context for training Supports SRL

Several SRL models were revised and an attempt to capture what value the authors put into the concept of ‘environment’ was made. Aiming to generalize these viewpoints, it can be considered that (1) environment as the Task is presented in every SRL model; (2) in some models environment also implies to the task context, social context, physical conditions, recourses, external feedback and instructions; (3) self-regulated learner not only monitors environment and reflects on it, but also modifies it; (4) from the other hand, changing environmental conditions to more appropriate and friendly ones positively affects student’s SRL. However, to approach the topic of this paper it could be useful to define and characterize the concept of learning environment (LE) as such.

1.2. Learning environment that supports SRL

Dictionary of Psychology (2018) defines environment as “the aggregate of external agents or conditions - physical, biological, social, and cultural - that influence the functions of an organism. The physical environment may be measured in terms of temperature, air pressure, noise, vibration, atmosphere, or sources of nutrients, which in turn may be specified by a range of values (e.g., a temperature scale)”. Learning environment (LE) means applying this definition in narrower term – from a learning perspective. By Hiemstra’s (1991) definition, LE is all the physical surroundings, psychological or emotional conditions, and sociocultural influences that can affect learning. LE can refer to an educational approach, cultural context, or physical setting in which teaching, and learning occur. LE also encompasses the culture of school or class including the ways students, teachers, and administrators communicate and interconnect (Hiemstra, 1991). Other definitions of LE follow the same idea of describing different conditions that can affect learning and mostly mention three layers of LE: physical learning space, cognitive conditions, and social and psychological background (e.g. McRobbie & Tobin, 1997; Cleveland, 2011; Aksovaara & Maunonen-Eskelinen, 2013). LE is also considered to be a combination of the physical (or virtual) space and the social, cognitive and emotional circumstances in which learning takes place (O'Regan, 2007). The definitions of LE are rather comprehensive and non-specific. So basically, LE implies *anything* that can affect educational enterprise in terms of places, facilities, relations, aptitudes etc.

Dimensions of LE

As it was mentioned above, LE has many dimensions: physical, virtual, cognitive, emotional and social, and each of the dimensions has its own cluster of factors, which are described in detail below.

Physical dimension of LE implies to physical characteristics of the learning space, such as noise, light, heat, cold, radiation, as well as room design, furniture arrangements, and availability of instruments and didactic materials. Design of physical learning spaces must follow the principles of ergonomics as well as meet the requirements of the educational institutions and support their vision of learning. Brown also concludes that before designing any learning space educators need to create ‘a vision for learning’, which helps organize all participants in the design and implementation of LE and leads to effective result (Brown M. , 2019). Learning spaces are complex and vary greatly because they are institutional in scope - their implementation involves the institution's culture, tradition, and mission.

Virtual LE is a collection of digital tools which enable the online learning process, its management, provide a delivery mechanism, student tracking, assessment, and access to resources (Olaniyan & Graham, 2014). Brown considers that we should understand virtual space in its widest sense, meaning we have to refer not just to synchronous, highly interactive functions (such as chat, blogs, and wikis) but also to asynchronous functions such as e-mail and discussion threads (Brown M. , 2019). Narrower definition of Virtual LE is provided, for example, by Oxford University (2016), which defines virtual LE as a system for delivering learning materials to students via the web; and cites Moodle as an example of the virtual LE. Virtual LE can be spontaneous as well as deliberate, synchronous or asynchronous, formal and informal. In the virtual learning spaces the number of participants and their relationships can shift rapidly (Brown J. S., 2000). Virtual LE expands the concept of traditional literacies – reading, writing, speaking and listening – and provides multiple other ways for learning engagement: abstract, textual, visual, musical, social and kinesthetic (Brown J. S., 2000). Oblinger (2008) listed possibilities to expand learning opportunities: virtual worlds, remote instrumentation, augmented reality, mapping mashups, data visualization. She claimed that virtual LE opens “opportunities for new pedagogies, interactions, and connections, particularly since wireless technology makes it possible for almost any place to be a learning space” (Oblinger, 2008, p. 27).

Virtual LE correlates to *electronic learning (e-learning)* and *mobile learning (m-learning)* which from a learner’s perspective have a very close meaning. E-learning and m-learning correspond to the concept of distant education by means of electronic devises. E-learning and m-learning offer learning possibilities independent of time and place (Sönmez, Göçmez, Uygun, & Ataizi, 2018). The distinguishing aspect is that m-learning applies for portable small technology tools like mobile phone or tablet, while e-learning uses all learning and teaching technologies, including mobile learning ones. M-learning applications generally

reach the learner via e-learning means. The difference become more significant if we look at these concepts from a perspective of a technology designer. E-learning implies usage of computers and laptops, big screens and learners tethered to their desks, and there are no issues for including high-quality videos, audios and images into the course. In turn, m-learning involves smartphones and tablets, its keywords are on-the-go, portability, and ready accessibility. The designers are challenged by the necessity to create lessons that can be easily downloaded and run without disruptions, and think about intuitive and fast interface which allows students to focus on learning, not navigating through the system (Nedungadi & Raman, 2012; Aura Interactiva , 2018). Both e-learning and m-learning are now becoming an important part of education and are a greater part of Virtual LE. Oblinger urges us to maximize the benefits of a virtual LE and strive to design space around learning rather than instruction, create socially catalytic spaces, involve users in the design of spaces (Oblinger, 2008). Virtual LE opens a lot of possibilities for teachers, students and learning analytics. Thanks to virtual LE the role of a teacher or instructor shifts to the role of a learning facilitator, the role of director of learning changes to the role of a learning guide. However, learners still require structure within their online learning environment which involves ‘teaching presence’ (Garrison, D., Anderson, T., 2003). Continuing the idea of necessity of teaching presence in virtual LE, Vaughan and his colleagues (2013) considered teaching presence as a complex phenomenon which goes beyond face-to-face teaching and implies a teacher to collaboratively design, facilitate and direct educational experience. (Vaughan, Cleveland-Innes, & Garrison, 2013).

Cognitive/emotional/social environment refers to the cluster of factors associated with what the learner and teacher bring to the situation and what is their engagement with the learning/teaching process. O'Regan (2007) stressed that this cluster depends on personal qualities and experiences, beliefs about learning, goals, values and expectations. In the same paper O'Regan also mentioned that for a teacher it is important to be mindful of the various dimensions of LE and strive to shape those over which we have control, because this is the way to make teaching and learning processes more efficient (O'Regan, 2007). It can be added that when we are talking about underage learners, we have to take into account their parents'/guardians' personality as well. Responsible parent can trigger children's involvement in learning process. Parents' involvement leads to a children's increment of the learning outputs (Yusup & Mansora, 2016).

The more relevant and regular features of each LE dimension are shown in the Table 2.

Table 2. Different Dimensions of LE

	Dimension of LE	Cluster of factors (examples)
1	Physical	Environmental physics: noise, light, heat, cold, radiation, vibration body systems: hearing, vision, sensations Room design, furniture arrangements Availability of instruments and didactic materials
2	Virtual	Any online activity and resource used for learning purposes, including virtual learning environments, network search tools, virtual worlds, remote instrumentation, augmented reality, mapping mashups, etc.
3	Cognitive	Knowledges, skills, mental abilities, learning strategies
4	Emotional	Previous experiences, test anxiety, a climate of encouragement, mood
5	Social	Family situation, social standing, friendships, leadership and teamwork skills, etc.

The Table 2 shows some examples of factors that can affect the students' learning performance, even though very few of the listed factors can be controlled and/or changed by a teacher or a student himself. The first two environmental dimensions - physical and virtual - are the most pliable, and the further from the top – the more difficult is to have an impact on the factors shown.

5. Mutual influence of SRL and LE

As it was stated above, a self-regulated learner can affect his or her learning environment to make it more convenient for learning purposes (e.g. Zimmerman, 1989; Pintrich, 2000; Schmitz, Klug & Schmidt, 2011). On the other hand, LE influences the student and this fact was confirmed by many scholars (e.g. Bandura, 1986; Zimmerman, 1989; Boekaerts, 1996a; Schunk & Zimmerman, 1998; Hanrahan, 1998; Pintrich, 2000; Hattie & Timperley, 2007; Efklides, 2011; Brand-Gruwel, Kester, Kicken, & Kirschner, 2014). Below the phenomenon of mutual influence of SRL and LE will be considered in two ways: from the theory of SRL and revising of several papers about the impact of LE.

A great contribution to the study of the mutual influence of SRL and LE belongs to Zimmerman and his colleagues. Zimmerman and Martinez-Pons (1986) indicated the correlation between the level of learner's SRL skills and his ability to influence LE. They stated

that learners with high level of SRL skills use such strategies as environmental structuring (e.g. creating a study area), seeking assistance (for example, from teachers or more experienced students), seeking or reviewing additional information. On the other hand, as it was stated before LE affects student's SRL skills, e.g. self-efficacy. Zimmerman (1989) specified LE influences that affect personal self-efficacy: importance of enactive experience, modeling of effective self-regulation strategies, verbal persuasion, direct assistance from teachers, other students, adults, literary and other symbolic forms of information such as diagrams, pictures, and formulas, structure of the learning context. Each of the described influences is assumed to be "reciprocally interactive with personal and behavioral influences" (Zimmerman, 1989, p. 336). Self-regulated learners are able to mobilize their personal influences, strategically regulate their behavior and the immediate learning environment. Self-regulated learners are assumed to understand the impact of the environment on them and know tactics to improve LE factors to support their learning process (Zimmerman, 1989).

Another author who considers managing LE as an inseparable part of SRL is Pintrich (1991; 2002). He distinguishes resource management strategies as a special cluster of SRL and claims it a necessary ability: "students must be able to manage and regulate their time and their study environments" (Pintrich, Smith, Garcia, & McKeachie, 1991, p. 25). On the other hand, Pintrich recognizes LE as an influential factor. For example, Motivation/Affect area of SRL is relevant to Task value and Test anxiety (Pintrich, 2004), hence the content of tasks and tests may influence the student's motivation and self-efficacy. Perception, monitoring, changing and evaluation of a task and its context are also considered an important area of SRL. The student's behavior may also be affected by the time provided and/or physical environment the student is put in (Pintrich, 2004).

Taking into account the facts that LE and SRL are interconnected, it is possible to assert that some particular changes in LE can encourage learner's self-regulation skills. Johnson and Lomas (2005) also pointed out the importance of the LE and claimed that well-designed learning spaces will foster good practice in education, e.g. will encourage contact between student and faculty, develop reciprocity and cooperation among students, use active learning techniques, give prompt feedback, emphasize time on task, communicate high expectations, respect diverse talents and ways of learning. In other words, efficient LE will encourage active participation in the learning process, co-operation and mutual respect between all the participants, learning strategy exchange and acquisition, hence SRL skills. However, according to Borkowski, SRL appears only after the learner enlarged and enriched his specific strategy knowledge and developed capacity to select appropriate strategies (Borkowski, Chan, &

Muthukrishna, 2000). Hence the initial level of student's SRL skills must be taken into account. To give students the opportunity to develop SRL skills from any level we need a flexible learning environment in which a student can follow their own optimal learning path (Brand-Gruwel, Kester, Kicken, & Kirschner, 2014). The concept of flexible learning environments has proved to be a sufficient instrument to support SRL and will be discovered more attentively below.

Relevant studies about the impact of LE on students' SRL

In the context of the current study several relevant papers were revised where the authors studied the impact of LE on students' motivation and SRL skills. For example, Hanrahan in her research about the effect of learning environment factors on students' motivation and learning (1998) distinguished such aspects of LE as the importance of planning learning activities, value of all students' learning activities, students' participation in decision-making about the curriculum. However, she doubted the value and a possible positive impact of students in the larger decisions, for example, about content or methods of assessment, especially in the LE where the level of student' personal participation in the classroom discussion is low.

Such authors as Kember, Ho, and Hong (2009) also confirmed the impact of LE on students' motivation and learning outcomes. They stated that a broadly based teaching and learning environment can significantly affect student's attitude to learning and named eight key characteristics the teachers should apply aiming to positively influence student's motivation: to establish interest, allow students to choose courses, establish relevance, enhance learning activities, teach for understanding, assess learning activities, create close teacher–student relationships and pay attention to sense of belonging between classmates. The authors argued that to enhance students' learning, it is necessary to take a holistic view of the teaching and learning environment which students experience.

Cleveland (2011) studied the effects of the flexible learning spaces (physical dimension of LE) on student's self-regulation and concluded that, for example, the furniture layout, noise levels, tools configurations and technology types assisted learners to direct their actions. He suggested that physical and virtual learning spaces should be supported to co-exist and virtual/online environments should be addressed in the physical LE, because their union would enhance increasing students' learning skills.

Wong with colleagues conducted a systematic review on researches about supporting SRL in online learning environments (Wong et al, 2018). They concluded that it is essential to take into account human factors, i.e. the prior knowledge, level of compliance, initial

motivation, metacognitive regulation and others. They also stated that the choice of the ways to support learner's SRL have to be accounted for the fact that "each learner benefits differently from each support (e.g., prompts, feedback, and integrated support system)". Wong with colleagues suggested that to optimize learning on an individual level it is important to integrate human factors and learning theories into the development of online learning, and to meet this goal technology can be harnessed to adapt instructional methods and learning environments.

All the researchers mentioned above emphasized the impact of LE on students' level of performance. On the one hand, they considered different aspects of LE, e.g. student's participation (Hanrahan, 1998), teacher-student relationships (Kember, Ho, & Hong, 2009), the importance of flexible learning spaces (Cleveland, 2011), individualization of the learning process (Wong, et al., 2018). On the other hand, they all recognized the importance of LE and proved its effects on students' SRL. The researches stated the importance of individualization and a significant impact of human factors on student's learning. Additionally, it can be concluded that the effectiveness of learning environments was a product of how well the environment aligned with particular pedagogies, curricula, assessment practices, and social factors (Cleveland, 2011). So, all the LE dimensions (physical, virtual, cognitive, emotional and social) have the ability to influence the student's SRL and the more LE matches the particular learning purposes, the more effect it can have.

6. The concept of a flexible learning environment

Flexible learning environment (FLE) is one of the examples of how LE can be adapted to the student's needs. Revising the definitions of FLE, Woodman (2016) concluded that flexibility of LE can then be divided into four categories: time, space, use, and movement. Time flexibility means the ability to change over a certain period of time. Space relates to the manipulation of elements of LE to create different spatial arrangements. Use flexibility means changing the way the space is used without altering the space itself and refers, for example to different pedagogical activities within the same space. And finally, movement flexibility relates to the ability for education actors to change their positions within the learning space. It is important to understand the directions of possible changes in the FLE concept to be able to adjust the LE according to the student's needs. Brand-Gruwel with colleagues (2014) defined flexible learning environment (FLE) as the environment which provides an opportunity for learners to follow their own learning path given by formal learning goals. In contrast to FLE, the authors also mentioned the adaptive learning environment where not only learning trajectory but also all the learning materials are personalized and provided by the system. The system referred to a

teacher, a trainer, an intelligent agent or tutor etc. Brand-Gruwel with colleagues argued that if the system adapted the materials and trajectory, the learner would not need to develop SRL skills in such environment. On the contrary, FLE enables learners to select learning materials, choose their learning path based on the learning goals formulated by the system. The concept of designing FLE is based on the Informed Self-directed learning model (ISDL) by Kicken, Brand-Gruwel, and Van Merri Merriënboer (2008). Aiming to describe FLE the authors distinguished three components that support SRL: (1) learning tasks with metadata, (2) development portfolio, and (3) an advisory model. The inclusion of advisory model was based on the findings that learners needed to be ‘explicitly supported’ in developing SRL skills.

Learning task with metadata means that a task is provided with additional information concerning task objectives, the level of difficulty, necessary skills, topic sequence, deadlines etc. According to Brand-Gruwel and colleagues (2014), learners should be supported in selecting tasks according to their level of performance. Too many choices with too little guidance obstruct the decision-making process and can lead to even negative effects.

Development portfolio refers to a collection (electronic or paper-based) of students’ progress reports and reflections and is used for formative assessment purposes (Kicken, Brand-Gruwel, & Van Merrienboer, 2008). The learner should be familiar with assessment criteria, and such criteria should be specific and related to the learning goals and tasks. The goals for future learning also can be part of the portfolio.

Advisory models implement the idea of providing students with a supportive advice. To give advice a teacher may use different advisory models: (1) a procedural advisory model that provides feedback on student’s SRL skills; (2) feedforward that informs learners which task could be a better choice; and (3) strategic advisory that provides students with assessment in terms of the accuracy and effectiveness and also shows directions for improvement.

As it was mentioned above Woodman (2016) defined FLE as a four-facet (time, space, use and movement) changeable environment and Brand-Gruwel with colleagues considered FLE as a collection of three components (tasks, portfolio, advisory models) that could be shifted according to a learner’s needs. Similar to SRL models the different approaches to define the concept are shown here: the first one is more connected to the dimensions of LE and the second one correlates with the major SRL models mentioned above (e.g. Winne, 1996; Zimmerman, 1989; Pintrich, 2000; Borkowski, 2000; Boekaerts, 2011, Efklides, 2011). Notwithstanding the fact that FLE aims to support SRL, it is important that students receive support explicitly on the acquisition of SRL skills, because FLE, as any LE, is much more efficient when students possess self-regulation skills and can change environmental

characteristics according to their needs. Brand-Gruwel and her colleagues (2014) listed four well-known interventions that support SRL: (1) process worksheets provide step-by-step description of the task approach, (2) prompts refer to any hints that help to perform the task, (3) modelling means demonstrating the process of carrying out the task together with thinking aloud by an expert, and (4) feedback. Hattie and Timperley (2007) defined feedback as “information provided by an agent (e.g. teacher, peer, book, parent, self, experience) regarding aspects of one’s performance or understanding”. Heick (2018) listed ten characteristics of a “highly effective learning environment” to support teachers in creating effective LE. Among others he mentioned the usage of a variety of learning models, learning personalization by a variety of criteria, persistent, transparent, and never punitive assessment, diverse criteria for success, constantly modeled learning habits and constant and creative opportunities for practice and growth. All these characteristics can be implied to FLE.

It can be concluded that, firstly, LE could and should be considered in several dimensions, some of which are more subject to change than others. Secondly, LE and SRL mutually affect each other, hence for the learner with low self-regulation a suitable, friendly and effective LE is much more crucial than for a self-regulated learner who is more capable of changing environmental aspects to meet his learning goals. Thirdly, SRL skills acquisition is a domain-specific process, and in that case, the importance of the appropriate, adequate and correctly formulated task comes to the fore. And additionally, it is stated that SRL skills acquisition must be supported by a formative assessment and advisory models as well as by providing worksheets, prompts, modeling, and feedback. In the context of the current study, due to inability to change education tasks FLE was chosen as the most suitable model which allows actors of the educational process to be flexible in terms of time, space, use and movement (Woodman, 2016).

It was hypothesized that changes in the LE can lead to the increase of the learner’s SRL skills. The purpose of this study can be identified with the following research questions:

- What features of FLE can support the student’s SRL?
- What features of FLE are not supportive for the student’s SRL and how those features can be changed?
- What FLE was created during the research period?
- Do the student’s SRL skills improve since the intervention?

Below the methods and the backgrounds of the current study will be approached.

Methods and Methodology

1. Background of the study and the sample

The steps of the present study can be described as follows: (1) measure the initial level of SRL skills of the student, (2) move the learning process into the FLE, (3) gradually change FLE features according to the student's abilities and needs, (4) observe and trace SRL activities and (5) rate the level of SRL after the intervention and compare results with the initial level. The sample of the within-case analyses (Miles & Huberman, 1994, p. 90) was a sixth grader and the research object was her SRL. The researcher's goal was to contribute to an in-depth understanding of the concept of SRL and the ways to foster it externally creating FLE around the student's learning needs.

1.1. High sensitivity

To better understand the student's learning needs the student's personality has to be taken into account. In particular, the student can be considered as a highly sensitive child (HSC) according to the questionnaire for parents published by Aron (e.g. 2019). Among others the questionnaire consists of such statements like "notices the distress of others", "learns better from a gentle correction than strong punishment", "asks lots of questions", "startles easily", "bothered by noisy places", "complains about scratchy clothing", "notices subtleties" etc. (Aron, 2019). Aron stresses high sensitivity is not an illness or syndrome and calls it an inborn temperament or style which is inherent in about twenty percent of humans and almost all animals. She claims this property represents a strategy of taking into account as many possibilities before making a move (Aron, 2002). It is also noted that HSCs possess sensory processing sensitivity (SPS) which is proposed to be a greater sensitivity (or responsivity) to environmental stimuli (Aron, Aron, & Jagiellowicz, 2012). Additionally, Aron explains four aspects that are peculiar to HSC: "Depth of processing, being easily Overstimulated, being both Emotionally reactive generally and having high Empathy in particular, and being aware of Subtle Stimuli", altogether they make acronym DOES (2014, p. 2). These facts are confirmed with another study. Acevedo with colleagues studied the neural activations of highly sensitive people and confirmed that people with SPS are more affected by positive or negative facial images than people who do not belong to that category. To distinguish SPS people the questionnaire by Aron was used (Aron & Aron, 1977). The research confirms that awareness and responsiveness are fundamental traits of high-sensitive people and shows how their brain

mediates greater attunement and action planning in order to respond to the environment and social contexts in particular (Acevedo, et al., 2014).

If we assume that the student belongs to those twenty percent of HSCs who are particularly sensitive to environmental conditions, it can also be expected that learning environment (LE) could have a relatively higher effect on the student's learning outcomes than on 80 percent of her classmates, so LE could be considered as an even more powerful and influential force to maintain or suppress the student's learning. Therefore, changing LE conditions could positively impact learning aspects, including SRL.

1.2. The concept of FLE in homeschooling

Taking into account the inability to make significant changes in the LE of the state school, it was decided to (1) try homeschooling for one school year, and (2) to pass the annual certification and to be officially transferred to the next grade. To do that the student needed to follow the state school curriculum and get the 6th grade certification on all school subjects by the end of the school year 2018-2019. The case study to research the student's learning process in the FLE and the development of her SRL skills was held from September 3, 2018 until April 28, 2019. Due to the conditions to follow the state school curriculum, all the learning tasks were preset. Hence the concept of FLE was considered the most practical and corresponding to the case because FLE assumes that the learning tasks are fixed, but to meet their learning goals students and teachers are able to choose the most suitable pedagogical approaches, tools, and advisory models (Brand-Gruwel, Kester, Kicken, & Kirschner, 2014). Observing the student during the learning tasks the tutor aimed to line up the most suitable ways of teaching the new material, assist the student with learning technics and develop FLE according to the student's characteristics, abilities, knowledge, and skills. As these aspects were unstable and changeable, it was necessary to focus on the present situation in each learning episode, take into account the student's mood, present well-being, attitude to the subject and to the topic, previous knowledge, previous experience as well as other student's particularities.

2. Design of the research

The purpose of this case study was to create and describe the learning environment to support the student SRL skills; hence, to describe the conditions of the LE that can positively impact the student's SRL. It was attempted to assess the level of the student's SRL skills before and after the intervention and describe and substantiate the approaches of the process of creating FLE. The events relevant to the case were highlighted, fixated, described and analyzed, their

chronological narrative was provided with the focus on the individual student and her perception of the events was sought to understand. The author of the paper was involved in the case study as a researcher, a tutor¹, and a parent. The researcher's journal was kept portraying the richness of the case from the researcher's/tutor's perspective. All these aspects correlate to the definition of the case study approach mentioned by Hitchcock and Hughes (1995). The tripled role of the researcher/tutor/parent can be considered both advantageous and disadvantageous. On the one hand, combining the roles of a parent, a tutor and a researcher provided an opportunity to observe the student and collect data 24/7, make tactics corrections timely, interpret the student's behavior and read her emotions more accurately. It also gives an access to a better understanding of the student's academic strengths and weaknesses and provide an opportunity to easily monitor her progress. But on the other hand, the tripled role implies personal estimates and judgments which may affect the student and the results of the research more than if the roles of a parent, a tutor and a researcher were separated. However, the study on an individual and/or a perception is one of the research types where the role of the researcher may be empathetic, the researcher can be an insider and have shared perspective (Mardis, Hoffman, & Rich, 2014).

Additionally, according to Cohen and his colleagues the present study can be considered as a sensitive research, because it potentially poses a threat to the participants and implies intrusion into private spheres and personal feelings (Cohen, Manion, & Morrison, 2007). Moreover, Cohen and his colleagues advise the researchers to consider any educational research being far from "a neat, clean, tidy, unproblematic and neutral process" and regard it as a process "with actual and potential sensitivities" (Cohen, Manion, & Morrison, 2007, p. 131). In the current case this statement is very true. This study is sensitive for the researcher and the student researched due to potential personal threat to their privacy. To level those issues the name of the student is not revealed, the student's agreement was received before starting the study, and she was informed about the fact of the research, its purpose and the process of data collection.

3. Measurements

As the research was focused, firstly, on estimating student's SRL skills, appropriate and recognizable methods for measuring SRL were needed to choose. Methods in educational

¹ I defined myself a tutor following the definition given by English Oxford Living dictionary – "A private teacher, typically one who teaches a single pupil or a very small group"

research refer to wide range of approaches to gather data which could be used as a basis for interpretation, explanation and prediction (Cohen, Manion, & Morrison, 2007).

According to Winne and Perry (2000), SRL can be measured as an aptitude and as an event. When SRL is measured as an aptitude, a single measurement aggregates over multiple SRL events. In this case, we attempt to measure the ability to perform SRL mostly ex-post, and the results vary within individuals over relatively long time periods, across different tasks and different facets of SRL (reference needed). The instruments for measuring SRL as an aptitude are questionnaires, structured interviews, teacher ratings. The second approach is to measure SRL as an event. In that case, SRL as phenomenon can be divided into three levels: (1) occurrence – the start of metacognitive monitoring, (2) contingency – ‘if-then’ form of a cognitive tactic, and (3) partnered contingency – several if-then contingencies are structured into a single ensemble.

SRL-as-event measurement always happens within a particular period of time which normally equals to one learning episode. Winne and Perry (2000) provide several examples of the tools to assess SRL as an event: think-aloud protocols, error-detection tasks, trace methodologies, observations of performances. To get the most complete picture possible both approaches were used. To estimate SRL as an aptitude and to be able to navigate through different SRL facets more attentively I use the questionnaire Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich and his colleagues (Pintrich, Smith, Garcia, & McKeachie, 1991). To track SRL traces in each learning session such protocols as observations of performances were used. The most significant events as well as the student’s expressed thoughts and feelings and the tutor’s conclusions were recorded in the researcher’s diary.

3.1. Motivated strategies for learning questionnaire (MSLQ)

MSLQ is a well-known and widely used self-report questionnaire which was created by the team of researchers who were initially aiming to evaluate the effectiveness of “Learning to Learn” class (Pintrich, P.R., Smith, D.A.F., Garcia, T., McKeachie, W.J., 1991). Self-report questionnaire is a test, measure, or questionnaire that relies on the individual's own report of his behaviors, beliefs, or attitudes. Such kind of research came into pedagogy from psychology where they were commonly used as a major way to collect valuable and diagnostic information about a person (Salters-Pedneault, 2018). MSLQ is a self-report instrument designed “to assess student’s motivational orientations and their use of different learning strategies” (Pintrich, Smith, Garcia, & McKeachie, 1991, p. 3). There are total of 81 items in the MSLQ version published in 1991, all of them are divided in two sections: motivational and learning strategies.

In the motivation scale there are as the following factors: intrinsic goal orientation, extrinsic goal orientation, task value, control beliefs about learning, self-efficacy for learning and performance, test anxiety. In the learning strategy scale, there are: rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, help seeking. The questionnaire is designed as a self-report, and it takes about 20-30 minutes to answer all the questions. Students are supposed to rate themselves on a seven-point Likert scale from 'not at all true of me' to 'very true of me'. MSLQ reflects a domain-specific view on SRL (Pintrich, 2000) and detects the areas of weaknesses in each of SRL domains (Panadero, E., Klug, J., Järvelä, S., 2015). In the current case this measurement protocol was useful and convenient, because it provided the initial state of the student's SRL skills level, let the researcher to indicate the weakest areas and track changes according to MSLQ factors. MSLQ was used to measure the level of SRL at baseline, and after 3 and 6,5 months.

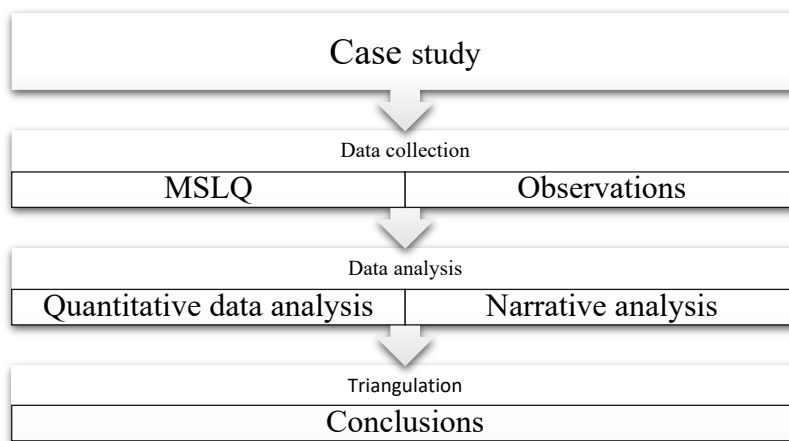
Additionally, to MSLQ that provided quantitative data, SRL traces were tracked and analyzed, and this approach gave both quantitative (growing number of traces) and qualitative (the essences of the traces) data. Observations of performances and the student's verbally expressed thoughts and feelings provided information about the student's attitudes and feelings.

3.2. Narrative analysis

In order to combine the results of qualitative and quantitative protocols a narrative analysis was used. Some of the researchers (Moen, 2006; Clandinin, 2007; Mardis, Hoffman, & Rich, 2014) claimed narrative analysis to be one of the most suitable qualitative research methodologies to understand the individual. Narrative analysis methods provide the participant's view of the experience by putting together data gathered from real life usually in chronological order (Elçi & Devran, 2014). As a result of a narrative analysis the researchers would have a story based on the collected data. The narrative highly depends on the individual and on the environment the research took place as well as the researcher's personality and his or her relationships to the participants (Mardis, Hoffman, & Rich, 2014). In education field narrative research is used gradually (Elçi & Devran, 2014), and teachers, learners and researchers consider to be the characters as well as storytellers 'in their own and other's stories' (Connelly & Clandinin, 1990, p. 2). In addition to the shared storytelling inherent to the narrative approach, Moen (2006) mentioned that "one of the main characteristics of narrative research is the collaboration process between the researcher and the research subjects" (p. 61). In the present research narrative approach was used to collect and analyze the events related to the process of SRL.

In order to combine the results, a narrative analysis of the SRL traces, student's attitude, behavior were collected using observations, and it was attempted to combine narrative with MSLQ results. According to Cohen, Manion and Morrison (2007), this multi-method approach (or triangulation) is the way to avoid possible bias or discords in the researcher's picture of the reality being investigated. Also, using method combinations may help to avoid mistakes, smooth imperfections of each method and get the bigger picture in the end.

Figure 1. Design of the research



The set of qualitative and quantitative data with a combination of two approached to measure SRL (as an event and as an aptitude) may provide more detailed picture of any changes in the student's SRL status, and give the researcher more detailed and in-depth understanding not only about SRL process but also about how FLE influence this process.

Findings and data analysis

1. Quantitative data

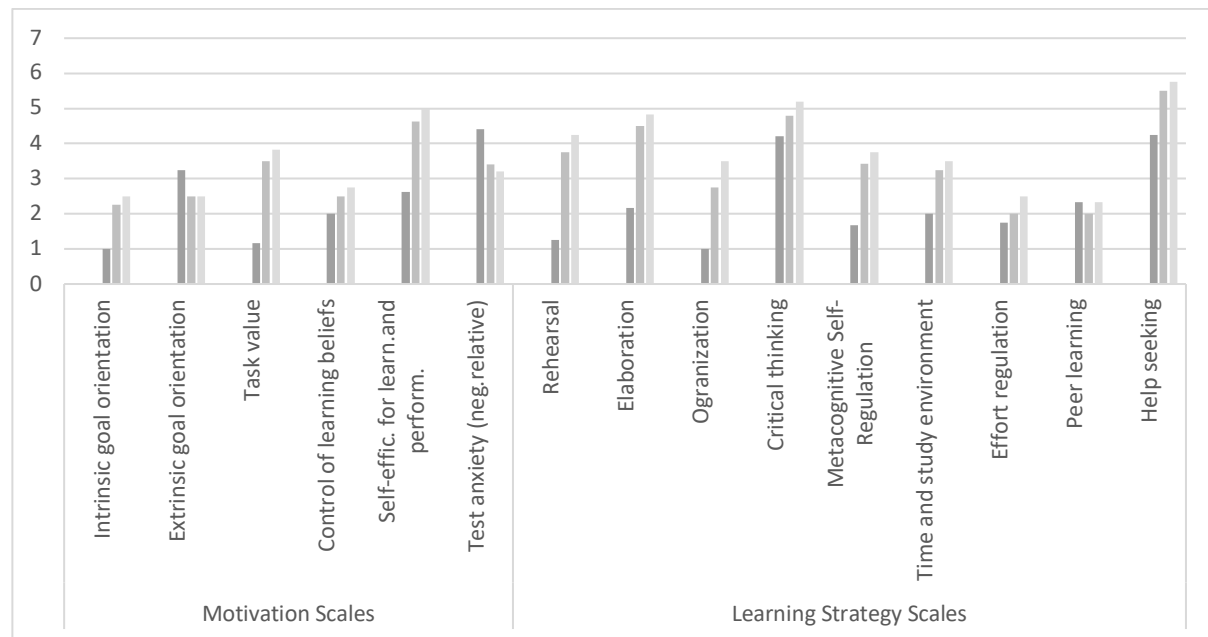
Below the quantitative data collected during the research is explained and analyzed. Firstly, data gathered from MSLQ is surveyed and visualized. Secondly, additional quantitative data is presented.

1.1. MSLQ analysis

MSLQ lets the researcher collect data of the student's SRL level, track its progress, and compare the results. The questionnaire was used three times – the initial baseline was measured on October 10, the midterm level on January 10, and the final level on April 28.

The usage of MSLQ provided the researcher an opportunity to analyze the results of 15 factors which can be seen in the Figure 2. Each triple bar section indicates the measurements of every 15 factors by dates: the bar on the left corresponds to the measurements made on 10/10/2018, in the middle – on 10/01/2019 and on the right – on 28/04/2019.

Figure 2. The changes of factors through three measures



In the Motivation scales amid rising figures can be seen in such domains as Intrinsic goal orientation, Task value, Control of learning beliefs and Self-efficacy. Also, the reduction of the Extrinsic goal orientation and Test anxiety section can be noticed. According to Pintrich and his colleagues (1991), Extrinsic goal orientation refers to the external reasons for participation in the learning tasks, e.g. grades, rewards, competition, evaluation by others. Together with the rising numbers of the Intrinsic goal orientation scale the decrease in the Change in extrinsic goal orientation can be considered as a motivational focus shifted from extrinsic to intrinsic, which can be evaluated as a sign of SRL skills growth (Pintrich, 2000).

The lowering values in Test anxiety were also considered to be the positive sign correlating to the growing SRL skills of the student, because according to Pintrich and his colleagues, “test anxiety has been found to be negatively related to expectancies as well as academic performance” (Pintrich, Smith, Garcia, & McKeachie, 1991, p. 15). Test anxiety consists of two components: cognitive and emotional. The former refers to negative thoughts that disrupt performance, and the latter – to “effective and physiological arousal aspects of anxiety” (Pintrich, Smith, Garcia, & McKeachie, 1991, p. 15). Thus, comparing the values of

three measures it can be concluded that there was overall positive dynamic in the Motivation scales section. The same positive dynamic was observed in the Learning strategy scales. This part of MSLQ indicates the student's ability to use different cognitive and metacognitive strategies and, in addition, monitor the student's ability to manage different learning resources (Pintrich, Smith, Garcia, & McKeachie, 1991). The indicators of all 15 factors are shown in the Figure 4 and the values of changes are indicated there in percentages. The most significant ones are highlighted in the **Table 3**.

Table 3. MSLQ Numbers and Progress

	Scale name/Date	10/10/2018	10/01/2019	%	28/04/2019	%
Motivation Scales	Intrinsic goal orientation	1,00	2,25	125%	2,50	11%
	Extrinsic goal orientation	3,25	2,50	-23%	2,50	0%
	Task value	1,17	3,50	200%	3,83	10%
	Control of learning beliefs	2,00	2,50	25%	2,75	10%
	Self-efficacy for learning and performance	2,63	4,63	76%	5,00	8%
	Test anxiety (negatively relative)	4,40	3,40	-23%	3,20	-6%
Learning Strategy Scales	Rehearsal	1,25	3,75	200%	4,25	13%
	Elaboration	2,17	4,50	108%	4,83	7%
	Organization	1,00	2,75	175%	3,50	27%
	Critical thinking	4,20	4,80	14%	5,20	8%
	Metacognitive Self-Regulation	1,67	3,42	105%	3,75	10%
	Time and study environment	2,00	3,25	63%	3,50	8%
	Effort regulation	1,75	2,00	14%	2,50	25%
	Peer learning	2,33	2,00	-14%	2,33	17%
	Help seeking	4,25	5,50	29%	5,75	5%

Thus, the most significant increase in indicators was recorded in the period from 10/10/2018 to 10/01/2019 and the factors of the rapid dynamic were (1) Intrinsic goal orientation, (2) Task value, (3) Rehearsal, (4) Elaboration, (5) Organization, and (6) Metacognitive self-regulation. It is worth to mention that during the second research period (10/01/2019 – 28/04/2019) the numbers did not rise as much as in the first one, where the values of some indicators increased by 200%. The highest growth in the second period reached 27% (Organization) and 25% (Effort regulation). The length of the periods between the

measurements is 92 and 108 days, so notwithstanding the fact that the second period was longer, the indicators showed less progress in numbers.

1.2. Analysis of the positive and negative SRL traces

During the research time the student's learning activities were observed and recorded.

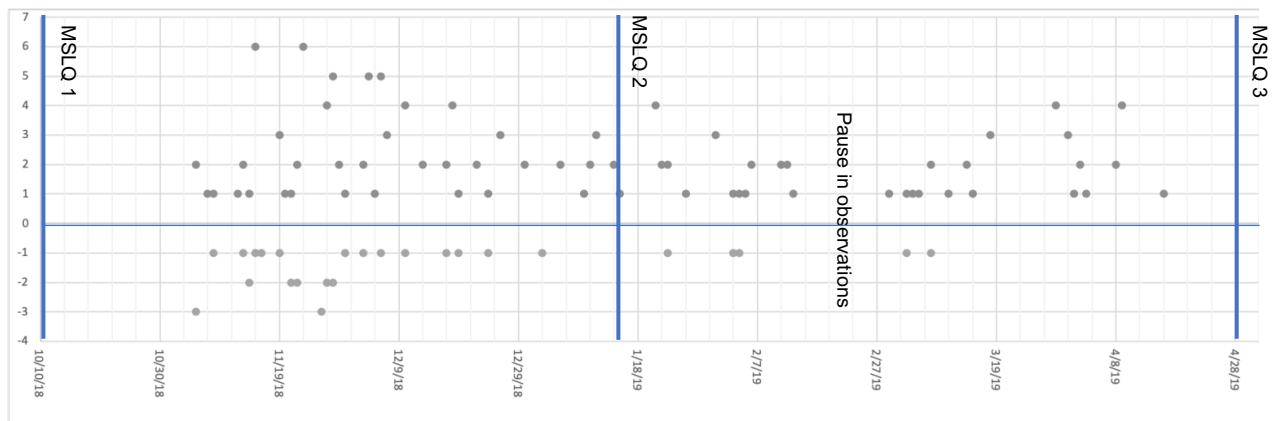
According to the observations, the student had several learning behavior patterns some of which in terms of SRL can be regarded as negative and some – as positive. The examples of the negative patterns are

- The student refuses to start the task and is not able to explain her reluctance;
- The student does not understand the task and is not able to specify what is unclear ("I understand nothing");
- The student evaluates the task in advance as 'impossible' based not on its meaning, but on the text size or on the area of the computer screen occupied by the task.

All these examples demonstrate the learner's Effort regulation that depicts her ability to control her effort and attention in the case of distractions and complicated tasks (Pintrich, Smith, Garcia, & McKeachie, 1991). The examples of the positive patterns are listed below and their links to MSLQ factors are indicated according to Pintrich and his colleagues (1991):

- The student schedules her daily tasks and aims to follow the schedule, which refer to managing and regulating Time and study environment;
- The student rereads incomprehensible text – Rehearsal skills;
- When the task is not clear at the start, the student aims to distinguish the unknown words or concepts and search for them in the additional recourses (student books or internet), which may be denoted as Help seeking strategies.

Such traces were periodically tracked, recorded and counted by the tutor. The results can be seen in the diagram below (Figure 2). The diagram shows the amount of negative (below zero) and positive (above zero) patterns in the timeframe from 05/11/2018 to 28/04/2019. A rather big amount of positive and negative patterns can be marked at the start of the research and then gradually decrease of the negatives and even their disappearance at the end of the research period can be seen. Three thick vertical lines indicate the dates MSLQ questionnaire was used. The gap between 15/02/2019 and 27/02/2019 is associated with a pause in observations. It was presumed that all the negative traces can be referred to Effort regulation factor.

Figure 2. Positive and negative traces of SRL

In the diagram, we can see the negative traces are massive in the first period of measurements and they are disappearing in the middle of the second period. It complements the results of MSLQ – the rise of Effort regulation was 14% in the first period and 25% in the second period when it was considered one of the highest growths. All of the positive traces refer to Learning Strategy Scales, so, firstly, it can be concluded that the strategy skills are more visible to the researcher than motivation factors of SRL. Secondly, there is a slowdown in rising of the MSLQ figures in the second period and a similar situation can be noticed from the diagram of the SRL traces.

Generally, it can be concluded that in terms of quantitative data, observations were only a supporting tool and the major contribution was made by MSLQ data. However, the results of the observations confirmed the results gathered by MSLQ.

2. Qualitative data

Narrative analysis was used for the period 03/09/2018 – 28/04/2018, which equals to 33 weeks. Learning episodes, the researcher/tutor observations, the student's behavior patterns and attitudes (collected mostly from speak-alouds) were taken into account and it was attempted to compound the data and analyze them narratively on a weekly basis.

Week 1. At the start of the research period the process of creating FLE was seen to be based on the e-learning resource *Interneturok* (www.interneturok.ru) that provided the ability to follow the state school curriculum and pass the annual testing online. *Interneturok* can be considered as a virtual learning space of the FLE (Garrison, D., Anderson, T., 2003; O'Regan, 2007; Oblinger, 2008). The recourse consists of the list of the lessons on all of the basic school subjects for the 6th grade: Russian language, Literature, English language, Mathematics, History, Social studies, Geography, Biology. Each lesson covers one topic of each subject and

consists of (1) video lecture (about 20 min) and its written synopsis, (2) multiple entry tests, (3) general test that affects the grade and (4) written homework which needs to be scanned and send for grading (Figure 3).

Figure 3. Online lectures and online tests



The schedule was the following: Russian, Literature, English, Mathematics and History – once a week, Social studies, Geography and Biology – once in two weeks. On average, the implementation of all tasks of each lesson took about 3-5 hours. The resource also provided the statement of grades and an opportunity to chat with teachers in case the student or the tutor have any questions about the learning tasks.

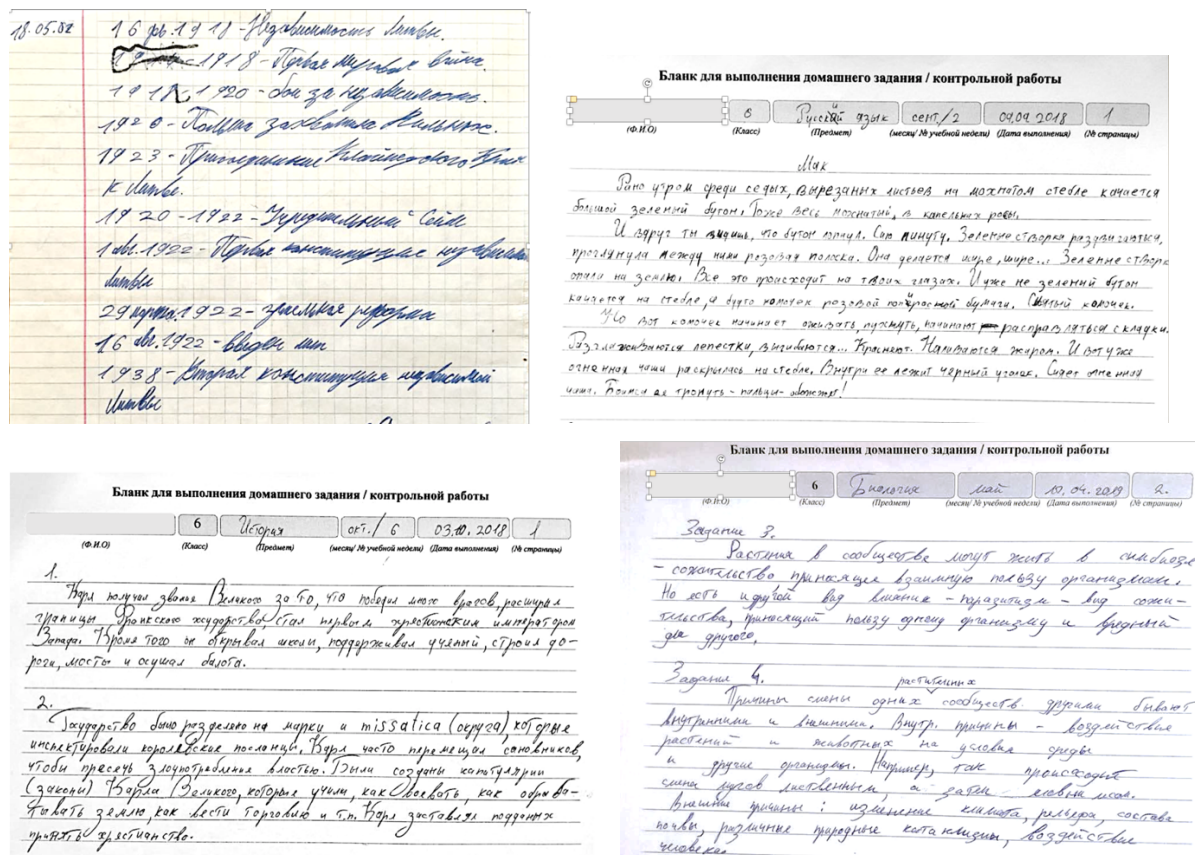
However, the first week showed that the online system has some critical issues. Firstly, most of the online lectures were not captivating for the student and it was difficult for her to keep the attention. Sometimes the test questions were ambiguous, or their meaning was not clear.

Notwithstanding the issues with the online system, the student said that she “liked this way of studying better”, because she can stop the teacher whenever she wants and have a break.

In the first week of studying the student decided to challenge herself “I need to work on my handwriting – I don’t like it; I need a new one”.

Weeks 2-3. The daily routine was formed. It was possible for the tutor to more or less truly predict how much time the homework will take. The student finished her ‘new handwriting’ challenge (Figure 4) and claimed, “I did it because there was no hurry and I could take my time”.

Figure 4. Handwriting



Top left – 02/05/2018, top right – 09/09/2018, bottom left – 03/10/2018, bottom right – 10/04/2019

In the first week working on her handwriting, the student mostly wrote in block letters, then in a month her writing became prompter and smoother and not so much developed within the next seven months but gained its own style. If the student's handwriting can be considered a part of her educational process, the act of changing her handwriting may be assumed as a sign of SRL because it presumed goal raising, action planning, activities (handwriting samples, self-assessment, rehearsal and self-training), collecting feedback and looping the process (e.g. (Winne, 1997; Schunk & Zimmerman, 1998). At this time the tutor diagnosed lack of such learning strategies as verbal elaboration and inference (mostly appearing in math tasks) and started their implementation.

Weeks 4-5. The observations showed the student started to plan her studying activities, firstly, for a day, then for a week and lately for longer periods. The process started from the daily plan. The student looked at the learning tasks, tried to predict how much the tasks would take and if she would need any additional materials to complete the assignments. Then the student started

to look through the schedule for a week and tried to optimize her tasks, for example, checked the contents of the tasks and put them in a more logical order according to their subject, topic, predicted lead time. At the end of the period she decided she needed some additional physical activities and lessons apart from the school program and initiated volleyball lessons and French language lessons.

Weeks 6-10. MSLQ was filled for the first time. There were some significant changes in the FLE. Firstly, it was noticed both by the tutor and by the student that listening to the lecturer is the least productive way to remember and understand new learning material. Preference was given to visualized materials, virtual as well as physical. Emphasis was placed on educational documentaries, lectures with compulsory visualizations, physical learning space was complemented with a globe and maps, ready-made charts and schemas and hand-made mind-maps, schemas and tables that were drawn with the tutor help and supervision during the lessons. Secondly, it was observed that if the student is given more time on the topic and works one topic at a day, she understands the theme better, remembers more new material and feels more confident doing her homework afterward. In order to follow the goal to switch topics less, it was decided to change from a weekly homework plan to a monthly homework plan. Thirdly, it was attempted to find as many connections as possible within the different subjects and different topics. For example, history events were always tied to geographical objects, Russian grammatical forms were marked in speeches and texts, the numbers of flower petals were connected to the topic of multiplicity in mathematics etc.

Weeks 11-17. In this period mind-maps, mostly hand-made were widely used. Attempts to use some software to draw mind-maps failed. It seemed this approach worked better when the drawing is hand-made. Timelines also help to orientate in historical events. Generally, the student's attitude towards learning changed for better. Some positive signs of interest in the learning tasks were registered: "Russian language homework was easy", "Crusades are not that boring", "Ok, let's count what was their speed if they walked 6 miles in 3 days". The last example was noteworthy because the student was ready to bring in mathematics into history task. Before she was avoiding any extra math exercises.

Weeks 18-22. MSLQ was filled for the second time. On the one hand, the student showed more interest in her marks and looked for her mistakes to understand why the mark was lower than expected. On the other hand, she claimed she never would be interested in school subjects,

check deadlines and make effort to success. Such an emotional reaction that lasted for about 3 weeks, could probably be the result of a lower mark the student got for the homework in social studies she had put a lot of effort to. The fact that in this period the student was left unsupervised for 10 days could be another possible reason for her dissatisfaction – she was left alone with her negative thoughts.

Weeks 23-28. In this period the student was forced to take part in the course “How to write essays”. However, the student enjoyed the out-of-school studies (French language, essay writing) more than school subjects, despite the fact that French lessons, in the student’s opinion, “look more like school” and she did not will to take the Essay course. The author of the Essay course let the student choose the topic within the essay type (narration, description, reasoning). This possibility to choose worked very well on the student. She willed to write, explain and prove her opinion to others, got emotional while writing on topic that was interesting for her (“Will a computer replace a book”).

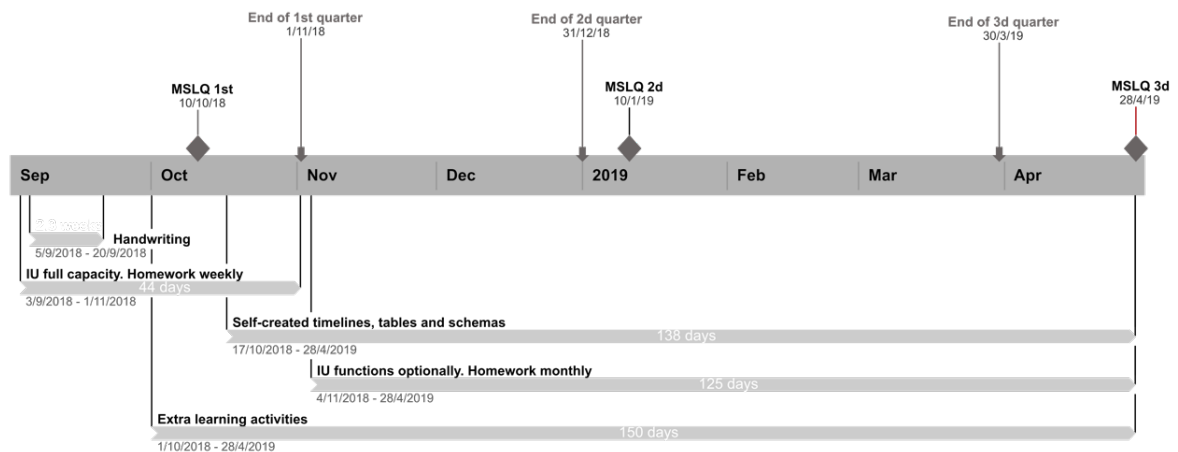
Weeks 29-30. The student wished to do some assignments in advance. The tutor realized that the student was taking criticism more easily: debated, asked additional questions and aimed to understand the situation better. Before it was difficult to discuss her errors because of the student’s emotions – she got nervous, sad and even desperate. Now formative discussion was possible. The student was able to do most of her homework without any assistance.

Weeks 31-33. MSLQ was filled for the last time. It seems highly important to be able to check what has been done and what else to do. The student was revising the list of homework to be done and this routine helped her to get into a working mood. Recently the student got annoyed and disappointed with non-formative feedbacks such as “well-done”, “good job” or “keep it up”. She asked “What is the reason to double the good grade with words that explain nothing? I would like to know what they like specifically”. The student went through the amount of work done during the research period; she looked through the paper homework and through the topics set in the online school recourse and self-assessed her work. In her own words, “That was a lot I have gone through”, “It amuses me how much I did not know at the start of the year”, “I wonder how much more they do at school” and “Surprisingly, I remember at least something I studied at the start of the year unlike in my school time”. These speeches may be considered as SRL signs, because the student willed to look back at her work, thought about her work in comparison with non-homeschoolers, self-checked her knowledge in some subjects.

During the research period the student got some feedback from the tutor, but it only referred the subjects' topics and how well the student mastered the new topic and completed the homework. According to Zimmerman (1989) the feedback is needed in order to give the learners ability to proactively increase their performance. The importance of a formative feedback was supported by Borkowski and his colleagues, who stated the important role of the feedback in the process of choosing effective learning strategies (Borkowski, Chan, & Muthukrishna, A Process-Oriented Model of Metacognition: Links Between Motivation and Executive Functioning, 2000). In that case, such general assessment as “good job” provides minimum information about what particularly was good. Unfortunately, the online resource the student used for attestation did not provide any formative feedback during the whole period of the research. There is some criticism of the online LE the student used during the research period. Probably, the lack of any information or feedback about the whole amount of work the student did during the research, prompted the student to self-assess herself.

The main events during the research period are shown as a timeline in the Figure 5.

Figure 5. Generalized timeline of the research period



Below I am going to be more detailed about the online resource that was used as a virtual LE at the start of the research period and then its role was reduced to the resource for learning topics detection and attestation.

3. Adjusting virtual LE

At the start of the research it was supposed to fully follow the schedule and the content of the online school course *Interneturok*. The resource was chosen by the tutor according to several criteria: capability to provide annual attestation online, relatively big number of users, long been on the market, quick responses from the administration, reasonable price, intuitive interface. All of these aspects proved to be true. However, the content of the learning tasks and communication with the teachers appeared to be a problem. The content problem had two levels. Firstly, the general state school program which was broken down into subjects with no overlapped topics. There is a typical week schedule:

English language	Vocabulary. Rooms and furniture
Russian language	Nouns, their formation, writing and use.
History	Empire of Karl the Great (8 th -9 th cent.)
Geography	World Ocean
Biology	Roots, shoots, and buds
Literature	Works of Russian poet Pushkin (19 th cent.)
Social studies	What is a human?

The subjects were held independently from each other, so the student was gaining fragmental knowledge instead of a whole picture, and those fragments of information not connected to each other were easy to forget. The second level of the content problem was the online system itself. Sometimes the task was not clear, sometimes the lesson and the homework did not match. The online school did not provide an opportunity to communicate with teachers orally. As there were several teachers of every subject working in shifts, the letter written to one teacher could be answered by another person the next day and the third answer came from the third person. It was difficult to communicate this way and not having a concrete person to rely on made the process mechanical and impersonal. The resource did not provide formative feedback, so this function fully moved on the tutor. Communication with the teachers of *Interneturok* was naturally reduced to a minimum and, accordingly, the use of the online platform was reduced only to homework and certification. This online school did not meet the requirements for providing formative feedback (Brand-Gruwel, Kester, Kicken, & Kirschner, 2014), designing space around learning rather than instructions (Oblinger, 2008), or providing teaching presence (Vaughan, Cleveland-Innes, & Garrison, 2013). It was decided to expand virtual LE and add new recourses, i.e. *Google* (supportive materials on any subject), *Khan academy*, *Mathantic*, *Uchi.ru* (mathematics), *Home school of literacy* (Russian language), *BBC*, *Discovery*, *Youtube* channels (history, geography, biology), *Arzamas Academy* videos and lectures (history, geography, Russian language).

To conclude, at the end of the research period the FLE has undergone some significant changes. All four categories of possible changes listed by Woodman (2016) were used to meet the student's preferences (see Table 4).

- 1) Time. Firstly, moving to homeschooling brought in more flexible daily routine (week 1). Secondly, the weekly schedule was modified when possible, and the order of the lessons was changed to make connections between the topics (weeks 6-10). Thirdly, the weekly homework schedule was changed to a monthly one to have more flexibility in changing order of the topics (weeks 6-10).
- 2) Space. Homeschooling provided a very different physical learning space (comparing to the state school). Also, the student was much freer in manipulation of elements of LE (physical as well as virtual).
- 3) Use. This means, for example, applying different pedagogical activities. And reducing lecture time, implementing of visual materials, teaching a strategy of mind-mapping (weeks 6-10) can be considered as examples of use flexibility.
- 4) Movement – changing positions within the learning space. There were a lot of free movements during the learning task and this concerned body positions, physical space, going outside, learning while taking a bus etc.

Table 4. Changes in LE

	State school (prev. year)	Homeschooling Weeks 1-6	Homeschooling Weeks 7-33
Time	Fixed	1-2 lessons a day 20 min. lectures Online tests daily	1-2 topics a day Homework monthly
Space	Fixed	Relied on the online school resource	Flexible, mostly visualized materials
Use	Fixed	Supervised	Supervised
Movement	Fixed	Free	Free

The learning goals were set by the system, but the path to each learning goal was paved according to the learner's needs and preferences. It was aimed to bring in as many approaches to support the student's SRL and avoid those that are not supportive. According to observations, during the research period the following approaches proved to be ineffective:

- plain lecture format with no supportive materials during the talk;

- daily switch in topics;
- unconnected topics across the subjects;
- lack of direct contact with the subject teachers
- non-formative assessment and feedback.

It was attempted to minimize the ineffective factors and saturate FLE with more effective approaches, such as

- visualized materials for acquaintance with a new topic, material processing, rehearsal;
- longer periods for studying each topic, attempts to connect it with other subjects and look at the topic from different angles;
- ability to choose the today's topic and the topics' and subjects' order.

Besides adjusting learning materials, efforts of the tutor were focused at the advisory models, such as teaching the student various learning strategies and feedforwards (Kicken, Brand-Gruwel, & Van Merriënboer, 2008). Consequently, 33 weeks of studying in FLE can be connected to the improvement of the student's SRL skills which was confirmed by quantitative and qualitative data analysis.

Discussion and conclusion

In this paper, it was attempted to describe the learning environment that was created and adopted according to the student's needs aiming to support the student to gain self-regulation skills. Within the research, some issues of the virtual LE and school schedule were explored as well as the student's individuality and her preferred learning paths. An attempt to describe the issues and the changes in the LE was made. The choice of the topic was dictated by the common knowledge in the importance of life-long learning and SRL as a key factor to successful learning. As Zimmerman (2002) wrote, struggling with learning should be more attributed to a lack of metacognitive awareness, not personal limitations in intelligence or diligence, so the studies should be more concentrated on the students' inadequate level of self-regulation skills. Observing the learner with a lack of desire to learn, I decided to proceed with the case study on developing her SRL skills by changing LE features. To assess the student's achievements in gaining SRL skills I used instruments to collect both qualitative and quantitative data about her SRL level and attempted to triangulate them in order to reach a more complete picture.

Firstly, the literature review was conducted to explore the concept of SRL. The importance of SRL in a rapidly changing world was stated, and descriptions of SRL theories by

the most cited authors were presented. Then it was attempted to formulate the concept of the environment from the SRL theories' perspective. It was found out that there are multiple definitions of SRL, and each author describes it as a comprehensive concept which includes not only cognitive but also an affective capacity of an individual as well as his or her previous learning experience and knowledge. Not only there are various SRL theories, but some of the authors (e.g. Zimmerman and Boekaerts) use different SRL models according to the purposes of the model implementation. Each model refers to the environment as an external factor(s) that can influence SRL, additionally it can be concluded that such an external factor as a learning task exists in every model mentioned above. After investigating SRL models by various authors, the concept of LE was defined and it was stated that the most suitable LE for the case is FLE which implies to the changes in such environmental factors as time, space, use and movement. It was hypothesized that external changes in FLE can positively affect the student's SRL, and the results of the case study showed the improvement in the student's SRL level, which is likely a result of the FLE that the student was operating in.

The findings supported Zimmerman's ideas about SRL as a cyclical process where LE features are a part of the circle (e.g. Zimmerman, 1989; Zimmerman, 2000). For example, as soon as the student got used to the new way of learning and felt more energy, she decided to expand her LE by including additional courses (weeks 4-5), so, it can be considered that homeschooling influenced the learner's attitude towards learning which resulted in the expansion of the LE. Another set of environmental changes affected duration and content of learning states (Schmitz, Klug, & Schmidt, 2011). Some of changes in the Forethought-Performance-Self-reflection loop (Zimmerman & Moylan, 2009) or Preaction-Action-Postaction loop (Schmitz, Klug, & Schmidt, 2011) were noticeable from weeks 2-3 when the student was mastering her handwriting and then the positive changes continued to appear during the whole research period. The student's ability to select resources for task performance (Preaction phase) enriched in weeks 4-5. Action phase was changed (with help from the tutor) by implementing new learning strategies (since week 2). Changes in Postaction phase and the student's need in formative feedback became noticeable starting from weeks 2-3. To assist the student with gaining special strategy knowledge the tutor was guided by Borkowski's Process-oriented model (Borkowski, Chan, & Muthukrishna, 2000). The changes in learning acts performance also appear to support Winne's theory about SRL as a four-phase event: task perception – planning – action – metacognitive reflection (Winne, 2010). The fact of growth in metacognitive reflection was supported by MSLQ measures (Pintrich, Smith, Garcia & McKeachie, 1991) which indicated 105% increase in Metacognitive self-regulation. To create a

more profound understanding, it was attempted to follow Winne's investigations (Winne & Perry, 2000; Winne, 2010) and measure SRL both as an aptitude (MSLQ) and as an event (observations and narrative research). The choice between Well-being pathway and Growth Pathway (Boekaerts, 2011) was noticeable in the first two weeks, especially in math tasks. Throughout the research period, the student stopped avoiding math lessons and they became a part of her weekly learning routine without any visible negative attitude. To sum up the findings, it can be suggested that changes in LE may affect the student's attitude toward learning tasks.

During the research period, all of the four factors of FLE (time, space, use and movement) underwent changes. However, the learning task – the common environmental representative in most of SRL models – was a pre-set factor in FLE.

If we bring in the theory by Efklides (2011; 2014), it can be suggested that in FLE where learning tasks are pre-set, the development on the microlevel of SRL (Task x Person) is to some extent limited by the 'task' part. Efklides states that strategy use, among other aspects, is triggered by task characteristics. However, the data reported here appear to support the idea that if the environment is flexible hence the student is able to choose strategies, duration of task performance, additional materials, but not the task, the student's SRL skills may still be able to grow noticeably and not strategy use is triggered by task characteristics, but contrariwise – task characteristics (even its ambiguous wording) can initiate the process of gaining a new strategy.

The observations and the results of MSLQ suggested that there may be a link between the features of the learning environment and the student's level of SRL skills. On the other hand, in the previous studies it was stated that a self-regulated learner (Zimmerman, 2002) or a good information processor (Borkowski & Muthukrishna, 1992) is able to affect the learning environment, and the evidences from this study supported the statement – at the second half of the research period the student attempted to influence LE by suggesting the order of the tasks, asking for feedback, choosing the most reliable learning resources. Additionally, during the study, the student's learning patterns were examined, and resultative learning approaches were chosen and implied. To do this the Process-oriented model by Borkowski and his colleagues was used (Borkowski, Chan, & Muthukrishna, 2000), and the tutor efforts were directed to the choice of an appropriate task and teaching specific strategy knowledge. In teaching strategies, the suggestions by Brand-Gruwel and her colleagues (2014) were used, such as step-by-step description of the task approach, prompts for task performance, and cooperative student-tutor performance.

A possible implication of these findings is that notwithstanding the inability to change the learning tasks, FLE provides various opportunities to support the student's SRL by implementing, for instance, flexible physical and virtual LE, adjustable timetable, and various advisory models.

The triangulation of data showed an increase in the student's SRL after the intervention in comparison with the initial level. However, these findings cannot be extrapolated to all homeschool students, because not only the sample was limited to one individual, but the researcher also combined the roles of a tutor and a parent. Such a special position provided the researcher with greater data access and a better understanding of the student's needs, and on the other hand, made the researcher tightly involved in the learning process. That might have affected the results of the research. According to Boekaerts (1997), a student's ability to self-regulate depends on the prior experience and she also highlighted the role of emotions in every learning occasion. In the case study, the emotions and mother-daughter connections may play a significant role and also affect the results that could be very different from the results that the student would show with a non-relative tutor. So, the findings must be interpreted with caution and their extrapolation is hindered. In spite of this, the importance of the research for these particular actors of the learning process cannot be denied. It provided a more in-depth understanding of the theory of self-regulation, SRL processes, the concept of FLE, and gave the actors materials and instruments to evaluate and support SRL. The study showed an increase in the student's SRL level and this fact may be connected to the FLE processes the student was involved in. Comparing the concept of FLE where the learner can choose his own learning path *within formal learning goals* and the environment where the learning goals, materials and trajectory *are adapted to the learner by the system*, Brand-Gruwel argues, that in the latter case, the learner cannot develop the needed SRL skills unless the system *allows* him some flexibility in choosing materials and ways to learn (Brand-Gruwel, Kester, Kicken, & Kirschner, 2014). Hence, according to Brand-Gruwel and her colleagues, pre-set learning tasks and possibility to choose a trajectory to reach them are more supportive for the student's SRL than learning tasks and trajectory adapted to the learner by the system. The findings of the present study suggest that the student's SRL level can markedly increase in the environment with preset learning tasks that can be considered as an indirect confirmation of the ability of FLE to initiate and support the student's SRL skills.

However, the question of the quality of the learning tasks may not be abandoned. The observations within the present study appear to support the idea that learning tasks in different subjects should be combined and cross-referenced, since this way the student would have a

more complete picture of the world, which allows her to attract knowledge from different areas to solve current learning tasks. At the start of the research period it was difficult for the tutor to find cross-subject connections (weeks 1-5), so the situation demanded more flexibility in time factor, and it was decided to transfer from weekly to monthly schedule (weeks 6-10).

Overall, the major changes in FLE were made in the first half of the 33-week research period (see Table 3, Table 4 and Figure 2). In the second part of the research period, most of the developments and innovations from the first period were implemented and continued to be used. There were some enhancements but there were not any significant changes in FLE. This fact can probably explain a more significant growth of the second MSLQ results which was held on the 18th week compared to the growth from the 2nd and the 3rd MSLQ (week 33).

Comparing the results of the 1st MSLQ with the results of the 2nd MSLQ we can see such figures as, for example, a 125% increase in Intrinsic goal orientation or 200% in Task value. But the biggest percentage differences between the results of the 2nd and the 3rd turns are 27% for Organization and 25% for Effort regulation (**Table 3**). The data appear to support the assumption that proper changes in FLE can catalyze increase in the student's SRL skills, but when the environment is more or less stable, the rate of positive changes is noticeably reduced. In this case, the changes in the LE were due to the transition to homeschooling and the rejection of nearly all the ineffective approaches to learning. The totality of these changes was quite significant: only the training tasks remained similar to the old times, the environment underwent changes in time, space, use, movement. In other conditions, for example, in a school class, it would be simply impossible to change the environment so significantly. Also, all the changes aimed to meet the student's needs and preferred ways to learn. And it was possible only because the student was the only one in the study. So, the study reproduction would be possible only with the same sample size – one learner. However, such study of an individual learner, her preferences and the most suitable FLE seems to be valuable, because by the end of the present study not only the increase in the student's SRL skills was noticeable, but a generally better attitude towards learning, better physical and psychological conditions. Similar studies with an attentive look at one individual could help educators to find out more about effective and ineffective methods of teaching, pay attention to the learners' individuality, and possibly create more individualized curriculum. The results of the study could argue for necessity of such a way to master the school curriculum as homeschooling.

Homeschooling itself remains a poorly studied area at least in Russia, and a shorter version of the framework of the study could help to fill this gap. For example, the researcher could urge homeschool parents to cooperate, provide instruments to measure the initial and

achieved level of SRL, recommendations for adjusting LE, and then support, analyze and generalize actions of a parent or a tutor to create FLE. The research period could be about 4-6 months because thanks to the present study this period can be claimed as minimal and sufficient to assess changes. The study may be considered as an argument for homeschooling in general. For this particular student, the transition from the state school to homeschooling was the right choice, so as it may be for many other students, for example for those who belong to that 20% of highly-sensitive people (Aron, 2019). It can support the idea to keep homeschooling as an accessible option and alternative to a state school.

Additionally, based on the experience of interaction with the online school resource some recommendations could be formulated for online school course creators. Firstly, it was obvious that a 6-grader was not able to handle the learning process single-handedly so the teaching presence (Vaughan, Cleveland-Innes, & Garrison, 2013) was necessary. Secondly, as the student learns individually and at home, he or she must have an opportunity not only communicate with the teachers face-to-face but be able to communicate with the course mates. *Interneturok* only provided poor communication with teachers via e-mails or online chats once a week and there was no way at all to communicate with the classmates, discuss topics, cooperate or to do joint projects. Another issue was a formative feedback, or rather its absence. With a shortage of direct teacher-student contact, feedback may be placed on the tutor, but in that case, there could be contradictions between the educational task set by the teacher, its implementation by the student and the evaluation of this performance by the tutor. As a result, confrontations may appear when the student with the tutor was on one side and the teachers with the learning tasks – on the other side. It can be assumed that if the student in our study did not have a tutor by her side, there would be a great probability that relying only on this online school she would not be able to simply learn the school curriculum not to mention develop her SRL skills. By this statement I am not attempting to boost my value as a tutor. I want to highlight the extreme value of a person-to-person contact during the learning process. Moreover, the student should not be the only recipient of formative feedback – other actors of the learning process can benefit from feedback. Hence, we should not fully rely on technology, provide a learner with a depersonalized learning resource and interact with him only by collecting and assessing his homework as it was organized in the online school. This way students SRL skills are not supported and possibility of their growth is questionable. The learning system should provide more opportunities to discuss learning tasks and work on them collaboratively.

Despite the fact that the ability to self-regulate the learning process is an intrinsic metacognitive process, extrinsic changes, namely changes in the learning environment features, are able to influence it. The findings of the present study suggest that being put in the FLE the student increased her SRL skills. On the other hand, it could be hypothesized that an unsuitable LE can suppress developing one's learning self-regulation. In our rapidly changing world, SRL skills have become a vital necessity. Facing the need to constantly improve our skills on the one hand, and the ability to learn via technology-enriched resources on the other hand, we need to be able to regulate our learning guided by our own motives. The study suggests that SRL can be initiated, taught and supported externally, and also advises the educators to pay more attention to the environment features that support students' SRL.

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Author's declaration

I hereby declare that I have written this thesis independently and that all contributions of other authors and supporters have been referenced. The thesis has been written in accordance with the requirements for graduation theses of the Institute of Education of the University of Tartu and is in compliance with good academic practices.



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List of references

- Acevedo, B. P., Aron, E. N., Aron, A., Sangster, M., Collins, N., & Brown, L. L. (2014). The highly sensitive brain: an fMRI study of sensory processing sensitivity and response to others' emotions. *Brain and Behaviour*, 580-594.
- Aksovaara, S., & Maunonen-Eskelinen, I. (2013). *A learning environment to support the joy of learning*. Jyväskylä: Central Finland's ELY Centre. Retrieved from <https://oppimateriaalit.jamk.fi/ajatusliikkuu/in-english/article-a-learning-environment-to-support-the-joy-of-learning/>
- APA Dictionary of Psychology*. (2018, 03 27). Retrieved from American Psychological Association: <https://dictionary.apa.org/environment>
- Aron, E. N. (2014, 2 1). *Highly Sensitive Child. The Author's Note*. Retrieved from Higly Sensitive Person: http://hsperson.com/pdf/Authors_note_HSC.pdf
- Aron, E. N. (2019). *The Highly Sensitive Person*. Retrieved from hsperson.com: <https://hsperson.com/>
- Aron, E. N., & Aron, A. (1977). Sensory-processing sensitivity and its relation to introversion and emotionality . *Journal of Personality and Social Psychology*, 345-368.
- Aron, E. N., Aron, A., & Jagiellowicz, J. (2012). Sensory processing sensitivity: a review in the light of the evolution of biological responsivity. *Personality and Social Psychology Review*, 262-282.
- Aura Interactiva . (2018, 03 13). *Understanding The Difference Between eLearning and mLearning*. Retrieved from Shift Disruptive eLearning: <https://www.shiftelearning.com/blog/difference-between-elearning-and-mlearning>
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs: Prentice-Hall.
- Bellhauser, H., Loesch, T., Winter, C., & Schmitz, B. (2016, July). Applying a web-based training to Foster self-regulated learning – Effects of an intervention for large numbers of participants. *The Internet and Higher Education*(31).
- Boekaerts, M. (1996a). Coping with stress in childhood and adolescence . In E. N. Zeidner M., *Handbook of Coping: Theories, Research, Application* (pp. 452-484). New York: Wiley.

- Boekaerts, M. (1996b). Self-regulated learning at the junction of cognition and motivation. *European Psychology*, 100-112.
- Boekaerts, M. (1997, June). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning and Instruction*, 7(2), 161-186.
- Boekaerts, M. (1999). Self-regulated learning: where we are today. *International Journal of Educational Research*, 445-457.
- Boekaerts, M. (2011). Emotions, emotion regulation, and self-regulation of learning. In e. B. Schunk, *Handbook of Self-Regulation of Learning and Performance* (pp. 408-425). New York: Routledge.
- Boekaerts, M., & Corno, L. (2005). Self-Regulation in the Classroom: A Perspective on Assessment and Intervention. *Applied Psychology: An International Review*, 199-231.
- Boekaerts, M., & Niemivirta, M. (2000). Self-regulated learning: finding a balance between learning goals and ego-protective goals. In M. P. Boekaerts, *Handbook of self-regulation*. San Diego, CA: Academic Press.
- Borkowski, J. G., & Muthukrishna, N. (1992). Moving metacognition into the classroom: 'working models' and effective strategy teaching. (eds),. *Promoting Academic Literacy: cognitive research and instructional innovation*.
- Borkowski, J. G., Chan, K. S., & Muthukrishna, N. (2000). A Process-Oriented Model of Metacognition: Links Between Motivation and Executive Functioning. *Issues in the Measurement of Metacognition*.
- Brand-Gruwel, S., Kester, L., Kicken, W., & Kirschner, P. A. (2014). Learning Ability Development in Flexible Learning Environments. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop, *Handbook of Research on Educational Communications and Technology. Fourth Edition* (pp. 363-372). New York: Springer Science+Business Media.
- Brown, J. S. (2000). Growing up digital: how the web changes work, education, and the ways people learn. *The Magazine of Higher Learning*, 32:2, 11-20, 32(2), 11-20.
- Brown, M. (2019). *Learning Spaces*. Retrieved from Educause:
<https://www.educause.edu/research-and-publications/books/educating-net-generation/learning-spaces>

- Clandinin, D. J. (2007). *Handbook of narrative inquiry: Mapping a methodology*. Thousand Oaks, CA: Sage.
- Cleveland, B. W. (2011). *Engaging spaces: Innovative learning environments, pedagogies and student engagement in the middle years of school*. The University of Melbourne, Faculty of Architecture, Building and Planning .
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education. Sixth edition*. London and New York: Routledge.
- Connelly, F. M., & Clandinin, D. J. (1990). Stories of Experience and Narrative Inquiry. *Educational Researcher*, 19(5), 2-14.
- Delors, J., Al Mufti, I., Amagi, I., Carneiro, R., Chung, F., Geremek, B., . . . Nanzhao, Z. (1996). *Learning: the Treasure within*. Paris: UNESCO Publishing.
- Duncan, T. G., & McKeachie, W. J. (2005). The Making of the Motivated Strategies for Learning Questionnaire. *Educational Psychologist*(40), 117-128.
- Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-and co-regulation *European Psychologist*, 13, 277-287. *European Psychologist*(13), 227-287.
- Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: the MASRL model. *Educational Psychology*(46), 6-25.
- Efklides, A. (2014). How Does Metacognition Contribute to the Regulation of Learning? An Integrative Approach. *Psychological Topics*(23), pp. 1-30.
- Elçi, A., & Devran, B. C. (2014). A Narrative Research Approach: The Experiences of Social Media Support in Higher Education. *International Conference on Learning and Collaboration Technologies* . Researchgate.
- Garrison, D., Anderson, T. (2003). *E-learning in the 21st century: a framework for research and practice*. London: Routledge Falmer.
- Germeroth, C., & Day-Hess, C. (2013). *Self-regulated learning for academic success*. Alexandria, VA USA: ASCD.
- Hanrahan, M. (1998). The effect of learning environment factors on students' motivation and learning . *International Journal of Science Education*, 737-753.

- Hattie, J. A., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 81-112.
- Heick, T. (2018, 03 21). *The Characteristics Of A Highly Effective Learning Environment* . Retrieved from TeachThought: <https://www.teachthought.com/learning/10-characteristics-of-a-highly-effective-learning-environment/>
- Hiemstra, R. (1991). Aspects of Effective Learning Environments. *New Directions for Adult and Continuing Education*(50), 5-12.
- Johnson, C., Lomas, C. (2005, July/August). Learning space: learning and design principles. *EDUCAUSE Review*, 16-28.
- Kember, D., Ho, A., & Hong, C. (2009, 12 02). Characterising a teaching and learning environment capable of motivating student learning. *Learning Environments Research*.
- Kicken, W., Brand-Gruwel, S., & Van Merriënboer, J. J. (2008). Design and evaluation of a development portfolio: How to improve students' self-directed learning skills. *Instructional Science*, 453-473.
- Kicken, W., Brand-Gruwel, S., & Van Merriënboer, J. J. (2008). Scaffolding advice on task selection: A safe path toward self-directed learning in on-demand education. *Journal of Vocational Education and Training*, 223–239.
- Klug, J., Ogrin, S., Keller, S., Ihringer, A., & Schmitz, B. (2011). A plea for self-regulated learning as a process: Modelling, measuring and intervening. *Psychological Test and Assessment Modeling*, 50(1), pp. 51-72.
- Knapper, C., & Cropley, A. J. (2000). *Lifelong Learning in Higher Education*. London: Kogan Page.
- Lüftenegger, M., Schober, B., Schöot, R. v., Wagner, P., Finsterwald, M., & Spiel, C. (2012). Lifelong Learning as a goal - Do autonomy and self-regulation in school result in well prepared pupils? *Learning and Instruction*, 22(1), 27-36.
- Mahendiran, N., & Kumar, B. K. (2017). Impact of Self-Regulated Learning on Teaching-Learning Process among Teacher Educators in Tiruvannamalai District. *International Journal of Environmental & Science Education*, 12(7), 1623-1632.
- Mardis, M. A., Hoffman, E. S., & Rich, P. J. (2014). Trends and Issues in Qualitative Research Methods. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop, *Handbook of*

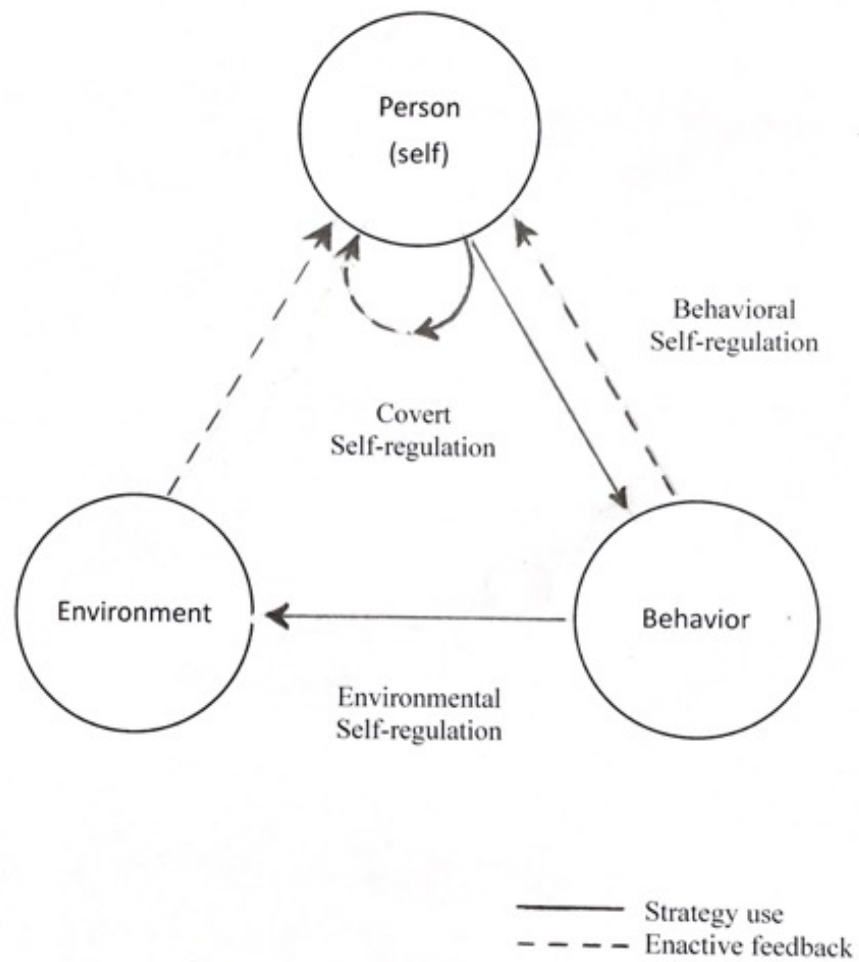
- Research on Educational Communications and Technology*, New York 2014 (pp. 173-193). New York: Springer Science+Business Media.
- Mawas, N. E., Gilliot, J.-M., Garlatti, S., Serrano-Alvarado, P., Skaf-Molli, H., Eneau, J., . . . Pentecouteau, H. (2017). *Towards a Self-Regulated Learning in a Lifelong Learning Perspective. CSEDU 2017 : 9th International Conference on Computer Supported Education - Specia*. Porto: 9th International Conference on Computer Supported Education - Special Session Lifelong Learning 1,.
- McRobbie, C., & Tobin, K. (1997). A social constructivist perspective on learning environments. *International Journal of Science Education*, 193-208.
- Moen, T. (2006). Reflections on the Narrative Research Approach. *International Journal of Qualitative Methods* 2006, 5(4), 56-69.
- Nedungadi, P., & Raman, R. (2012, August). A new approach to personalization: integrating e-learning and m-learning. *Educational Technology Research and Development*, 60(4), 659–678.
- Oblinger, D. G. (2008). Growing up with Google. What it means to education. *Emerging Technologies for Learning*, 3, 11-29.
- Olaniyan, M., & Graham, D. (2014). Media Streaming for Technological Innovation in Higher Education. *Handbook of Research on Transnational Higher Education*, 22.
- O'Regan, K. (2007, 02 20). *Sessional Teaching Program. Learning Environments*. Adelaide: The University of Adelaide . Retrieved from University of Adelaide. Learning & Teaching: <https://www.adelaide.edu.au/learning/teaching/sessional/>
- Oxford University. (2016). *Learn about Virtual Learning Environment/Course Management System content*. Retrieved from Online resource centres: <https://global.oup.com/uk/orc/learnvle/>
- Panadero, E. (2017). A Review of Self-regulated Learning: Six Models and Four Directions for Research . *Frontiers in Psychology*, 422.
- Panadero, E., Klug, J., & Järvelä, S. (2015). Third wave of measurement in the self-regulated learning field: when measurement and intervention come hand in hand. *Scandinavian Journal of Educational Research*(60), 723-735.

- Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In P. P. eds Boekaerts M., *Handbook of Self-Regulation* (pp. 452-502). San Diego: Academic Press.
- Pintrich, P. R. (2004, December). A Conceptual Framework for Assessing Motivation and Self-Regulated Learning in College Students. *Educational Psychology Review*, 16(4), pp. 385-407.
- Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1991). *A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ)*. Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning.
- Sönmez, A., Göçmez, L., Uygun, D., & Ataizi, M. (2018). A Review of Current Studies of Mobile Learning. *Journal of Educational Technology & Online Learning*, 1(1), 13-27.
- Salters-Pedneault, K. (2018, November 05). *The Use of Self-Report Data in Psychology*. Retrieved from [www.verywellmind.com](https://www.verywellmind.com/definition-of-self-report-425267): <https://www.verywellmind.com/definition-of-self-report-425267>
- Schmitz, B., Klug, J., & Schmidt, M. (2011). Assessing self-regulated learning using diary measures with university students. In S. D. Zimmerman B. J., *Handbook of Self-regulation of Learning and Performance* (pp. 251-266). New York: Routledge.
- Schunk, D. H. (2008). Metacognition, Self-Regulation, and Self-Regulated Learning: Research Recommendations. *Educational Psychology Review*, 463-467.
- Schunk, D. H., & Zimmerman, B. J. (1998). *Self-Regulated Learning: From Teaching to Self-Reflective Practice*. New York: Guilford Press.
- Shapiro, E. S. (1984). Self-monitoring procedures. In T. H. Ollendick, & M. (. Hersen, *Child behavior assessment: Principles and procedures* (pp. 184-165). New York: Pergamon.
- Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & Education*(34), 177-193.
- Siadat, M., Gašević, D., & Hatala, M. (2016). Trace-based microanalytic measurement of self-regulated learning processes. *Journal of Learning Analytics*(3), 183-214.
- Skinner, D. E., Saylor, C. P., Boone, E. L., Rye, K. J.-B., Berry, K. S., & Kennedy, R. L. (2015). Becoming Lifelong Learners: A Study in Self-Regulated Learning. *Journal of allied health*, 44(3), 177-182.

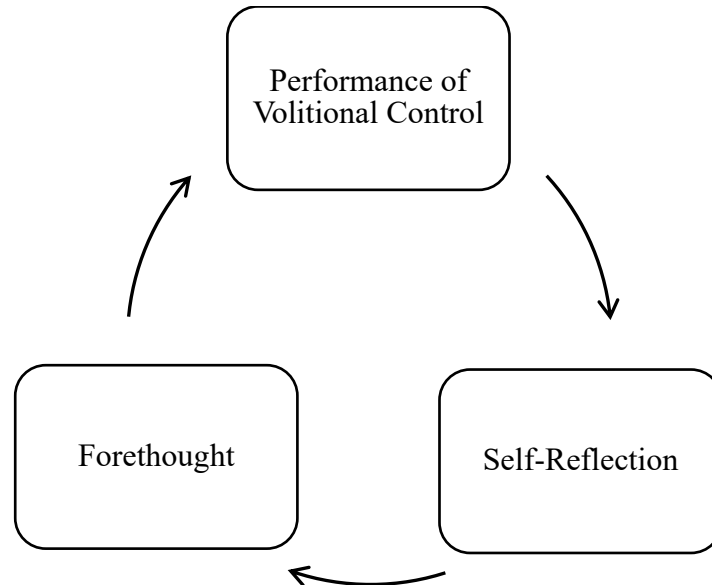
- Slate, J. R., & Charlesworth, J. R. (1988). *Information Processing Theory: Classroom Applications*.
- Thomas, V., Muls, J., De Backer, F., & Lombaerts, K. (2019). Exploring self-regulated learning during middle school: views of parents and students on parents' educational support at home. *Journal of family studies*.
- Vaughan, N. D., Cleveland-Innes, M., & Garrison, D. R. (2013). *Teaching in Blended Learning Environments. Creating and Sustaining Communities of Inquiry*. Edmonton: AU Press.
- Winne, P. H. (1996). A metacognitive view of individual differences in self-regulated learning. *Learning and Individual Differences*, 8(4), 327-353.
- Winne, P. H. (1997). Experimenting to bootstrap self-regulated learning. *Journal of Educational Psychology*(88), 397-410.
- Winne, P. H. (2004, March 4). *Dr. Phil Winne Professor, Faculty of Education*. Retrieved from Simon Fraser University: <http://www.sfu.ca/education/faculty-profiles/pwinne.html>
- Winne, P. H. (2010). Improving Measurements of Self-Regulated Learning. *Educational Psychologist*, 267-276.
- Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated engagement in learning. *Metacognition in Educational Theory and Practice*, 227-304.
- Winne, P. H., & Perry, N. E. (2000). Measuring Self-Regulated Learning. In M. Boekaerts, P. R. Pintrich, & M. (. Zeidner, *Handbook of Self-Regulation* (pp. 531-566). Academic Press.
- Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G.-J., & Paas, F. (2018). Supporting Self-Regulated Learning in Online Learning Environments and MOOCs: A Systematic Review. *International Journal of Human-Computer Interaction*(35), 4-5.
- Woodman, K. (2016). Flexibility in Learning Spaces and Learning. In K. (. Fisher, *The Translational Design of Schools* (pp. 51-79). Rotterdam: Sense Publishers.
- Yusup, N. B., & Mansora, A. A. (2016). The Influence of Parents Support and Its Relationship with Students Achievement in English Education. *International Conference on Education and Regional Development 2016. Cross-Cultural Education for Sustainable Regional Development* . Bandung, Indonesia: CERD 2016.

- 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. (1989). A social cognitive view of self-regulated academic learning. *Educational Psychology*, 81, 329-339.
- Zimmerman, B. J. (1989, September 1). A Social Cognitive View of Self-Regulated Academic Learning. *Journal of Educational Psychology*, 81(3).
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. P. Boekaerts, *Handbook of self-regulation* (pp. 13-39). San Diego, CA: Academic Press.
- Zimmerman, B. J. (2001). *Theories of Self-Regulated Learning and Academic Achievement: An Overview and Analysis*. New York: Routledge.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner. *Theory into Practice*, 41(2).
- Zimmerman, B. J., & Moylan, A. R. (2009). Self-Regulation: Where Metacognition and Motivation Intersect. In J. D. D. J. Hacker, *The educational psychology series. Handbook of metacognition in education* (pp. 299-315). New York: Routledge/Taylor & Francis Group.
- Zimmerman, B.J., Campillo, M. (2003). Motivating Self-Regulated Problem Solvers. In J. S. Davidson, *The Nature of Problem Solving* (p. 239). New York: Cambridge University Press.

Appendix 1. Triadic model of SRL (adapted from Zimmerman, 1989, p. 3)



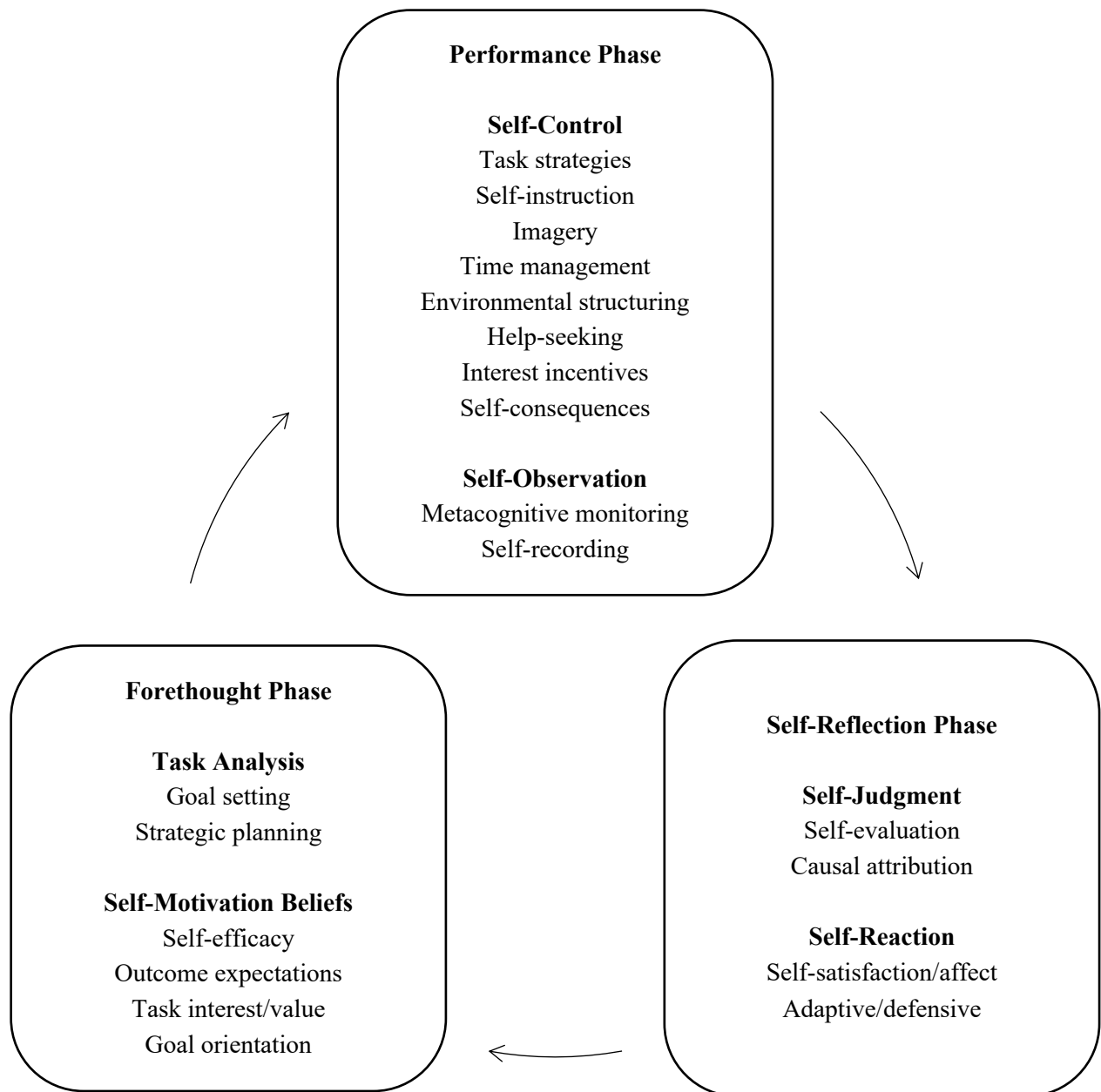
Appendix 2. Cyclical phases model of SRL (adapted from Schunk & Zimmerman, 1998, p. 3).



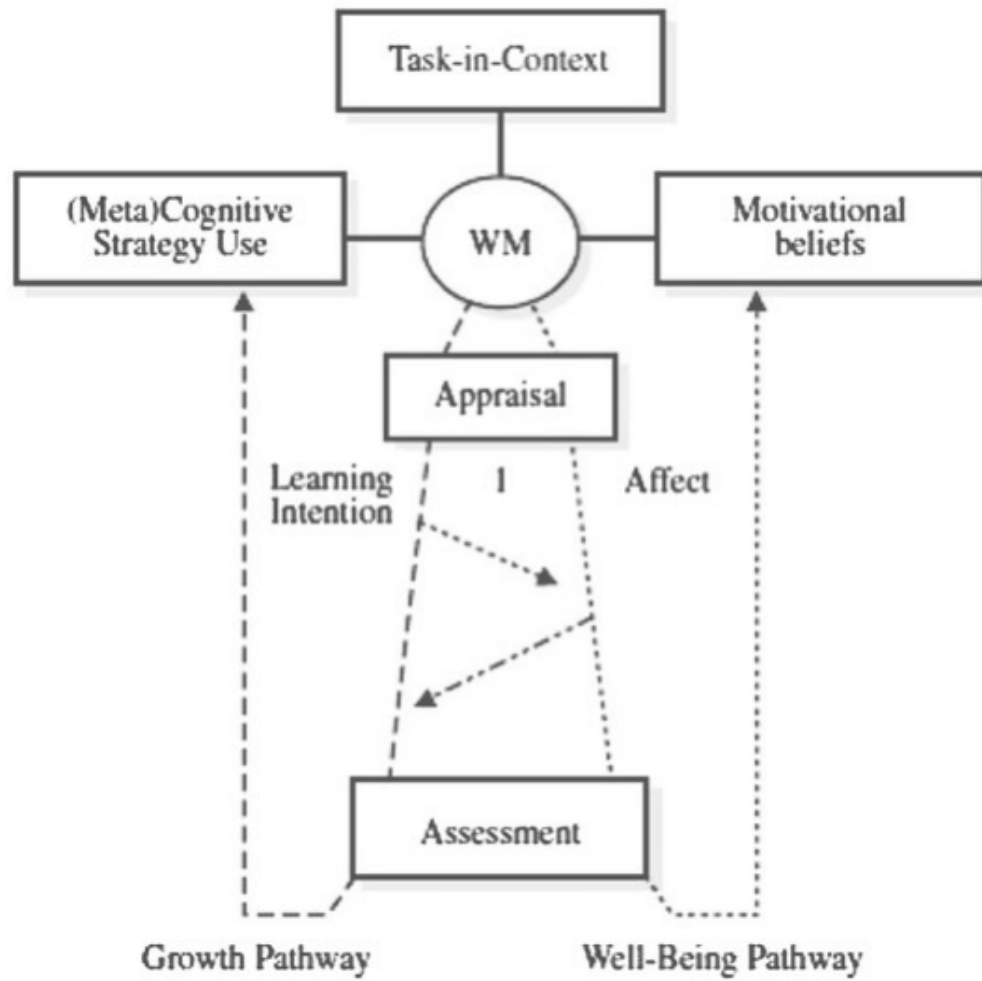
Cyclical self-regulatory phases (adapted from Schunk & Zimmerman, 1998, p. 4).

Forethought	Performance/volitional control	Self-reflection
Goal setting Strategic planning Self-efficacy beliefs Goal orientation Intrinsic interest	Attention focusing Self-instruction/imagery Self-monitoring	Self-evaluation Attributions Self-reactions Adaptivity

Appendix 3. Improved model of cyclical phases of self-regulation (adapted from Zimmerman & Moylan, 2009, p. 300).



Appendix 4. Dual processing model of SRL (adapted from Boekaerts, 2011)

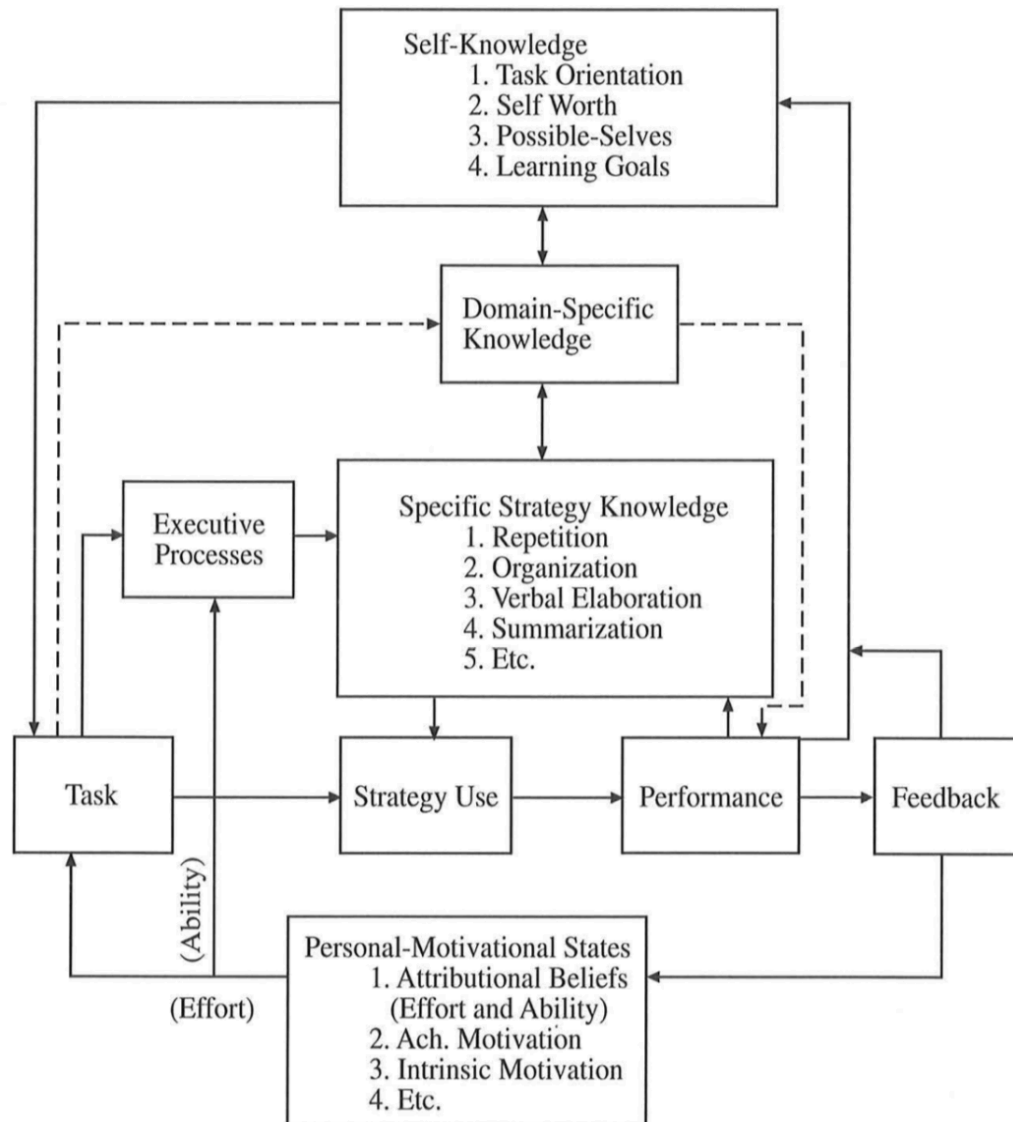


WM – working model

Appendix 5. Phases and areas for self-regulated learning (adapted from Pintrich, 2004, p. 390).

Phases and relevant scales	Areas for regulation			
	Cognition	Motivation/Affect	Behavior	Context
<i>Phase 1</i> Forethought, planning and activation	Target goal setting	Goal orientation adoption		
	Prior content knowledge activation	Efficacy judgments	Time and effort planning	Perceptions of task
	Metacognitive knowledge activation	Perception of task difficulty	Planning for self-observations of behavior	Perceptions of context
		Task value activation		
		Interest activation		
<i>Phase 2</i> Monitoring	Metacognitive awareness and monitoring of cognition	Awareness and monitoring of motivation and affect	Awareness and monitoring of effort, time use, need for help	Monitoring changing task and context conditions
			Self-observation of behavior	
<i>Phase 3</i> Control	Selection and adaptation of cognitive strategies for learning, thinking	Selection and adaptation of strategies for managing, motivation, and affect	Increase/decrease effort	Change or renegotiate task
			Persist, give up	Change or leave context
			Help-seeking behavior	
<i>Phase 4</i> Reaction and reflection	Cognitive judgments	Affective reactions		Evaluation of task
	Attributions	Attributions	Choice behavior	Evaluation of context
<i>Relevant MSLQ Scales</i>	Rehearsal Elaboration Organization Critical thinking Metacognition	Intrinsic goals Extrinsic goals Task value Control beliefs Self-efficacy Test anxiety	Effort Regulation Help-seeking Time/Study environment	Peer learning Time/Study environment

Appendix 6. Cognitive, motivational, and self-system components of meta cognition. The complete model (adapted from Borkowski, Chan, & Muthukrishna, 2000, p.10).



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