Self-Regulated Learning Recognition and Improvement Framework

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The Asian Conference on Education 2020
Official Conference Proceedings

Abstract
Self-regulated learning (SRL) is a learning approach whereby learners actively set learning goals, then monitor, control their learning progress, and finally reflect on their learning performance. In the last four decades, SRL has drawn attention from researchers, schools, and universities that aim to equip their learners with self-study ability. With the development of distance learning and e-learning technologies, SRL has become a crucial ability for learners. Profoundly, in the last several months, the strike of COVID-19 has isolated students, teachers and dramatically challenged the current learning and teaching approaches; COVID-19 seems to force learners to self-regulate their own study without options. Understanding SRL maturity is necessary for the educational growth and knowledge fulfillment of individuals. Although there have been increasing studies and models about how SRL works and is measured, it still remains a challenge for research on the principles on which SRL exists and operates and the foundation for SRL intervention for improvement. Aiming for these principles, we propose the SRL Recognition and Improvement Framework, which is constructed on the foundation of metacognition and cognition, the philosophical habit of the mind, and existing SRL models and measurement methods, to support the process of recognizing one's SRL maturity level and improving SRL ability. Based on the solid principles, the framework will provide a reference point to assess the validation of SRL models and to design procedures, methods, exercises for supporting individuals to evaluate their SRL ability and improve it.

Keywords: Self-Regulated Learning, SRL, SRL Ability, SRL Maturity, SRL Recognition, SRL Character, SRL Habit, SRL Improvement, Self-Regulation, Framework, Cognition, Metacognition, Mind

Introduction

Consciously or not, we all want further education. Almost all of us desire broad and deep knowledge and have a passion for life-long learning. In the internet era, we can bypass space and time constraints to approach high-quality educational programs. Thus, we can choose to learn the subjects in which we are interested. However, it poses another great challenge. Since we learn in our own paths, we might neither always have instructors nor direct guidance; thus, we must know how to learn effectively. In other words, we need to become self-regulated learners. Profoundly, in the last several months, the strike of COVID-19 has isolated us – students as well as teachers - and dramatically challenged the current learning and teaching approaches; COVID- 19 seems to force us to self-regulate our learning without options.

With the above background that introduces us to self-regulated learning, let us start the path of SRL recognition and improvement framework development with the question: What is it mean that we self-regulate our learning?

Self-regulated learning (SRL) is a crucial way of leading oneself in education. SRL is not a new thesis. It originated from ancient times, is known as the human's ability of self-consciousness (Smith, 2020), and has continuously grown in research over the last four decades. Professor Barry Zimmerman, the leading figure in Self-regulated learning, defines that *"Self-regulated learning involves metacognitive, motivational, and behavioral processes that are personally initiated to acquire knowledge and skill, such as goal setting, planning, learning strategies, self-reinforcement, self-recording, and self-instruction"* (Barry J Zimmerman, 2015, p. 541).

Boekaerts, also a profound contributor in SRL research, expresses that the ability to control and direct one's learning is the most noticeable characteristic of a self-regulated learner (Boekaerts & Cascallar, 2006). In other words, SRL is a learning approach whereby learners actively set learning goals, then monitor, control their learning progress, and finally reflect on their learning performance.

SRL research has gained breakthrough discoveries of models, methods for measuring and improving SRL ability (Panadero, 2017; Panadero et al., 2016). However, different researches investigate SRL from only a single insufficient perspective, such as social-cognitive, psychological, or metacognitive viewpoints. Hence, there is confusion about applying these models and gaining benefits from them in practice. To argue and develop reliably universal SRL related strategies and models, we must build the SRL related strategies and models on a sound foundation and principles. For that reason, this research introduces an SRL framework based on which ones' SRL maturity levels can be adequately measured, and then ones receive appropriate exercises, advice, and supports to improve their SRL ability.

Research Objectives

We specify this research into three research questions:
RQ1: What factors construct SRL ability?
RQ2: What are the measurement units of these SRL factors?

These questions articulate the essence of SRL. The factors are principles that cause SRL to come into existence and grow in maturity. The factors will be the SRL framework's building blocks from which SRL recognition and improvement activities are developed.

RQ3: What intrinsically and extrinsically motivate individuals to self-regulate their learning?

This question shows the motivations that start from individuals themselves and that trigger from the outside world, promoting them to self-regulate their learning. Answers to this question provide an essential source of SRL improvement methods.

In the next section, this paper will review the current SRL models for their outstanding contributions and the missing pieces, which encourage introducing the SRL recognition and improvement framework. The process of developing the framework is then illustrated in detail. The authors will conclude with the benefits and potential application of the proposed framework.

Literature review

The outstanding achievements of research on SRL are the SRL models, each of which describes the operation of SRL at individuals from a specific viewpoint. Panadero (2017) described, analyzed, and compared several popular SRL models to the extent of their underlying theories, processes, and empirical evidence about the application and associated measuring tools. We would like to journey through six outstanding SRL models to analyze the viewpoints from which the models are constructed.

Winne's model of SRL

Professor Phillip H. Winne's research on SRL provides a view of SRL from a metacognitive perspective, which is demonstrated in his following model (see **Figure 1**). Winne and Hadwin's model (1996) emphasizes the role of metacognition in the self-regulation of cognitive tactics and strategies. This model demonstrates a 2-phase SRL process to accomplish a learning task. The first phase is planning, and the second phase is executing the plan, monitoring the progress, and making the adaptation. Though sharing the same SRL patterns, individual learners' SRL ability differs in 5 points; they are *(i)* domain knowledge that the individual has accumulated from his or her educational background and history, *(ii)* knowledge of tactics and strategies, which is a reservoir of learning methods and techniques, *(iii)* performance of tactics and strategies which are the proficiency of applying learning techniques, *(iv)* regulation of tactics and strategies that monitor how well ones learn and make appropriate adaptations, and *(v)* global dispositions which are pathways to learn.

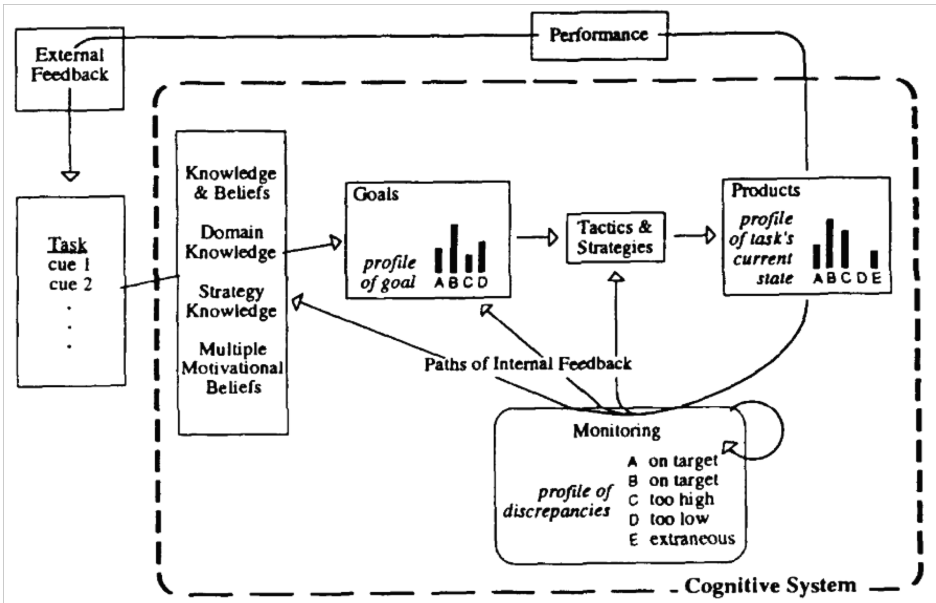

Figure 1. Winne's model of SRL (Winne, 1996)

Boekaerts's dual processing model and six-component model

Professor Boekaerts' research on SRL can be dated back to the 1980s. Her research mainly investigates the role of goals and self-esteem in SRL (Boekaerts & Niemivirta, 2000). Boekaerts introduces 2 SRL models, the six-component model of SRL and the dual processing model.

In the Boekaerts' dual processing model (see **Figure 2**), the SRL pattern is determined by a learner's selection of goals; and there are two main pathways of goals: the growth of knowledge and skills and the well-being self-esteem. Depending on the level between those pathways, learners will gather, align resources, and self-regulate their learning to balance learning performance and self-esteem (Boekaerts & Cascallar, 2006).

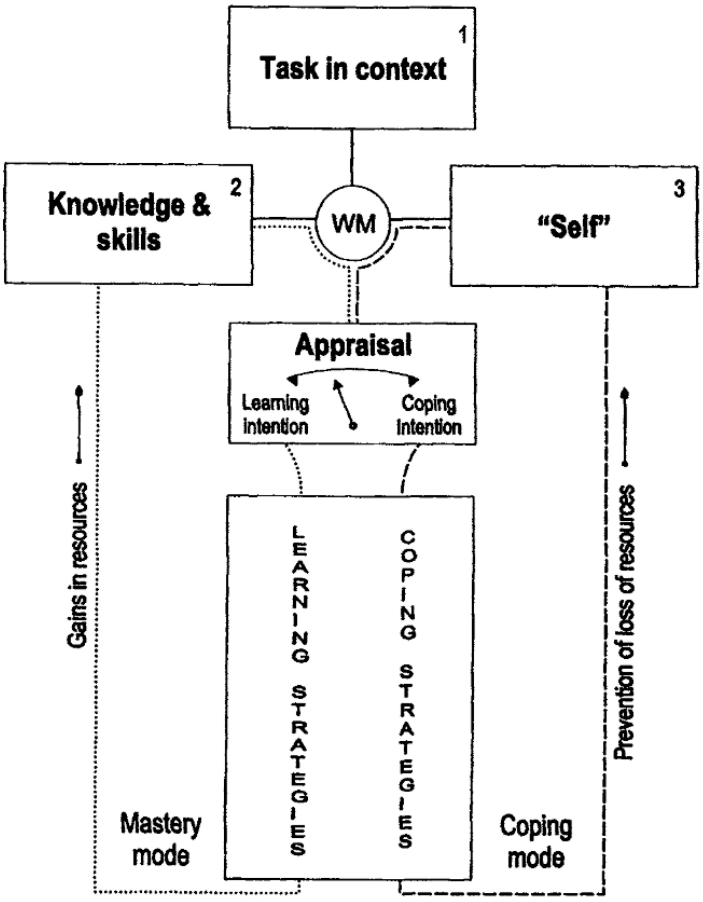

Figure 2. Boekaerts' Dual Processing Model (Boekaerts & Niemivirta, 2000)

Boekaerts' six-component model of SRL (see **Figure 3**) views SRL as the interoperation of cognition and motivation throughout the aspects of goal setting, strategy use, domain knowledge (Boekaerts, 1996). In this model, cognition and motivation function simultaneously when self-regulated learners set goals, prepare cognitive and motivational strategies, and recall prior related knowledge to learn new knowledge, which is domain-specific, effectively.

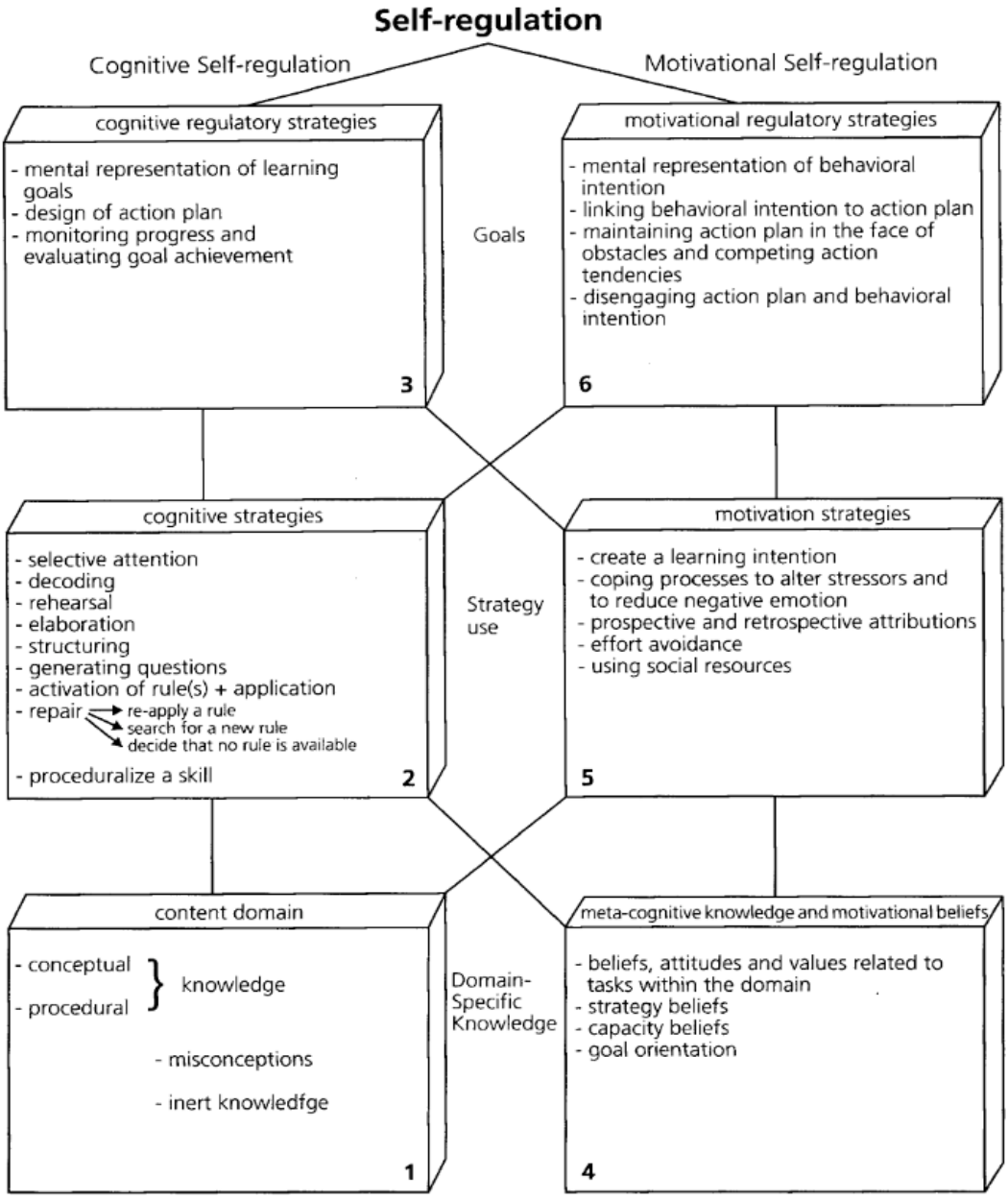

Figure 3. Boekaerts' six-component model of SRL

Pintrich's Framework of Phases and Areas for SRL

Pintrich's crucial contribution to SRL research is that he points out the common attributes shared by all existing SRL models, which are the following:

Self-regulated learners are active in terms of setting learning goals, reviewing prior knowledge, preparing cognitive strategies and learning environment for their learning process,

Self-regulated learners have the potential to monitor, control, and regulate internal and external factors of the learning process,

All SRL models have criteria against which self-regulated learners reflect their progress in order to adjust their learning progress,

Self-regulatory activities are the means that self-regulated learners apply to reach their learning goals (Pintrich, 2000).

Pintrich illustrates these common attributes in his SRL framework (see **Figure 4**), called the framework of Phases and Areas of SRL (Pintrich, 2000). The framework comprises four phases of SRL, which are forethought planning and activation, monitoring, control, reaction and reflection, and regulation activities on each phase in the areas of learners' cognition, motivation, behavior, and context. Running throughout the framework and joining self-regulatory activities are learning goals and motivations (Pintrich, 2000), the two key factors that Pintrich pays special attention to in his explanation of the framework.

	Areas for regulation			
Phases	Cognition	Motivation/affect	Behavior	Context
1. Forethought, planning, and activation	Target goal setting	Goal orientation adoption	[Time and effort planning]	[Perceptions of task]
	Prior content knowledge activation	Efficacy judgments	[Planning for self-observations of behavior]	[Perceptions of context]
	Metacognitive knowledge activation	Ease of learning judgements (EOLs); perceptions of task difficulty		
		Task value activation		
		Interest activation		
2. Monitoring	Metacognitive awareness and monitoring of cognition (FOKs, JOLs)	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	
3. 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	
4. Reaction and reflection	Cognitive judgments	Affective reactions	Choice behavior	Evaluation of task
	Attributions	Attributions		Evaluation of context

Figure 4. Pintrich's Framework of Phases and Areas for Self-Regulated Learning (Pintrich, 2000)

Zimmerman's cyclical phase model

Professor Zimmerman is one of the pioneer SRL researchers and mainly bases his SRL models on professor Albert Bandura's well-known socio-cognitive theory (Bandura, 1989).

Viewing self-regulation as a result of the intertwine among an individual's consciousness, behaviors, and the environment where he or she is working on a particular task, The cyclical phase model emphasizes the process aspect of SRL. It illustrates the paths of interaction between learners, learning tasks, and the learning environment in a specific context defined by learning contents and environment settings.

Among Zimmerman's SRL models, the most popular is Zimmerman's cyclical phase model. The model demonstrates that individuals self-regulate their learning via a 3-stage process (Barry J. Zimmerman, 2000) **(**see **Figure 5)**. The process starts with the

forethought phase, in which learners begin their learning journey by analyzing learning tasks, setting learning goals, planning cognitive strategies, and motivating themselves into learning. Then, the learners proceed to the performance phase, where they put their learning plan into action with conscious self-control over how they learn and a self-observation over how well they have been learning. Finally, the learners wrap up their learning with the self-reflection phase in which they judge the learning journey by comparing the learning performance against the goals set in the first phase, analyzing factors that contribute to learning achievements, and in which they seek adjustments and alternative approaches to help them learn more effectively and productively.

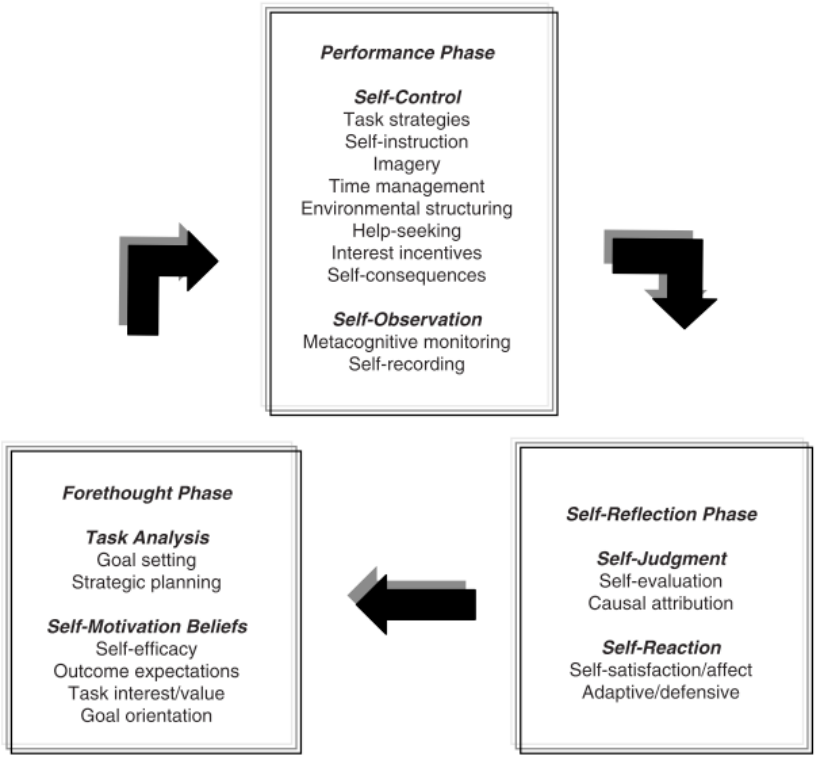

Figure 5. Zimmerman's cyclical phase model (B.J. Zimmerman & Moylan, 2009)

Efklides's Metacognitive and Affective model of SRL

One of the latest SRL models is the Metacognitive and Affective model SRL (MASRL) of professor Efklides (see **Figure 6**), which illustrates the intervention of metacognition, motivation, and affect into the SRL process when an individual learns specific tasks.

Efklides (2011) demonstrates that an individual's SRL manifests at two levels; one is the Person level, which is a general SRL level or about SRL characteristics of an individual revealing regardless of learning contents or context, and the other is Task x Person level, which is about the ability the individual to apply specific SRL behaviors within a particular learning task. When individuals, following the MASRL model, are engaged in a learning task, their Person level sets learning goals and establishes top-down self-regulation based on their metacognitive knowledge, metacognitive experiences, and metacognitive skills (written as MK, ME, MS in **Figure 6**). Those metacognitive strategies have been accumulated and built up into

the learners' SRL traits. In the Task x Person level, their cognitive strategies are regulated in a bottom-up self-regulation manner to meet the task requirements and reorganize the Person level.

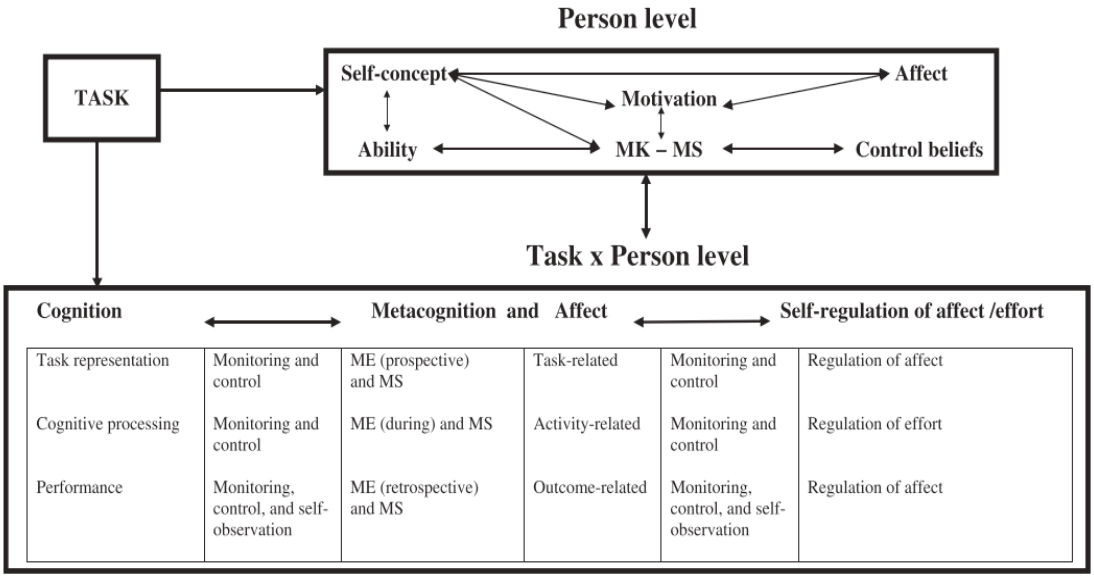

Figure 6. Metacognitive and Affective model of SRL (Efklides, 2011)

From the models mentioned earlier, each of them presses SRL on specific angles from process orientation to components orientation, from metacognition to motivation. They demonstrate how individual learners self-regulate their learning but have yet fundamentally explained why such an SRL process can lead to learning efficiency. Furthermore, starting from a specific perspective, the models might not provide a comprehensive ground on which SRL ability is evaluated.

The development of SRL Recognition and Improvement Framework

Principle of the mind

To be generic, reliable, and time-withstanding, the SRL framework must be laid on principles of the mind. The mind has two faculties (see **Figure 7**): the intellect, whose functionality is to understand knowledge, and the will, whose functionality is to drive the intellect and to choose to achieve knowledge (McInerny & O'Callaghan, 2018). The intellect operates as we cognize the world and its knowledge via what we usually call cognition. The activities that signify the operation of the intellect are analyzing, judging, abstracting certain target knowledge. Specific behaviors of the intellect can be recognized via Bloom's taxonomies (Krathwohl, 2002). The will operates as we are aware of our learning process.

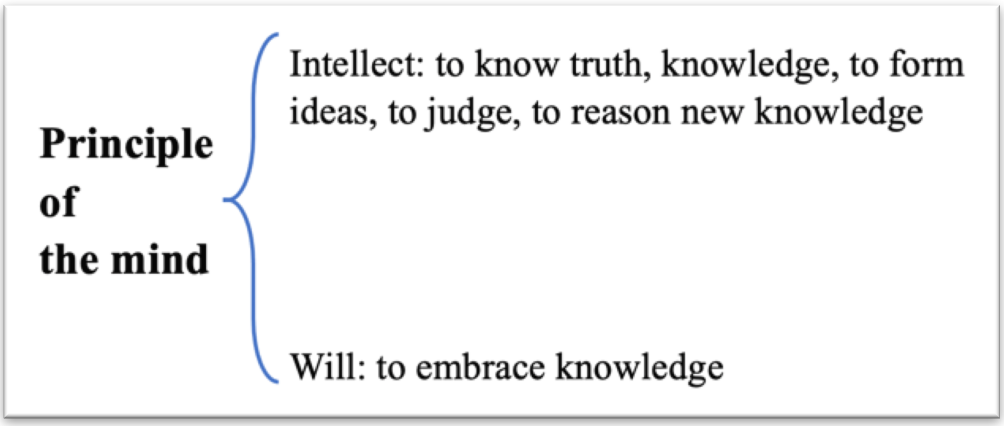

Figure 7. Two faculties of the mind

This statement gets clear when we compare the unconscious way a child learns with the conscious way a graduate learns. In either case, both absorb knowledge; however, a child does not recognize his or her in-progress growth of knowledge while an adult does recognize it. A sign for the recognition of the learning process is that adults doubt, reason over the new knowledge, and adjust their learning approach while children tend to assent new knowledge and follow instructions. To obtain intricate knowledge, one needs to be aware of his or her learning process in order to control their cognitive activities. In order words, the stronger one is aware of his or her will and uses it, the more fulfillment one has towards knowledge. The will manifests itself via metacognition.

The philosophical habit of the mind

Whether we have noticed, our mind has a habit of desiring to know. The more we know the world, the more we realize that the extension of knowledge is beyond our current understanding, and the more we desire to know. This routine is, as Saint John Henry Neuman (John Henry Newman, 1852, as cited in Tillman, 1990) puts it, the philosophical habit of the mind (see **Figure 8**). Thanks to this habit, we know more about the world, assimilate knowledge, and apply it for evaluation, creation of a variety of fields of science, art, literature, and so forth. The philosophical habit of the mind manifests in our learning process, and most clearly, when we are the regulator of our own learning process, which is self-regulated learning.

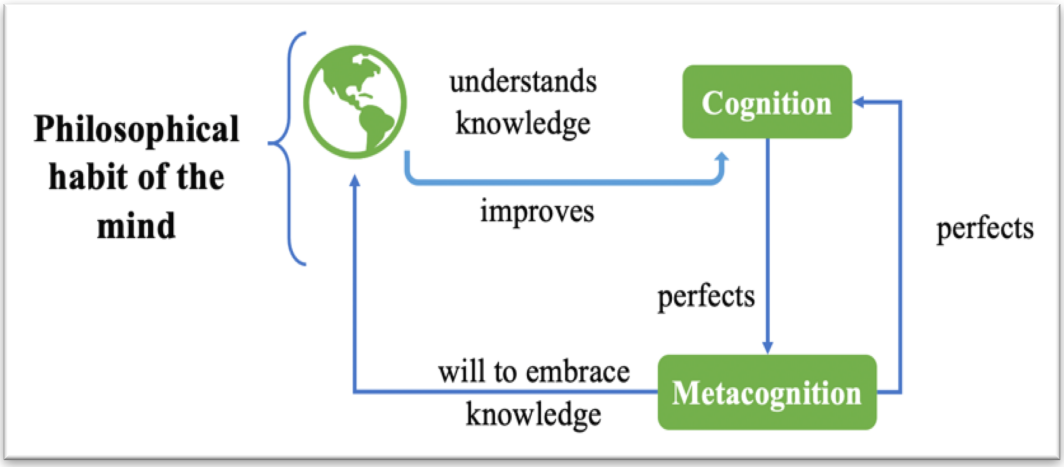

Figure 8. The philosophical habit of the mind

SRL is a conscious learning approach by which one plan, manage, and reflect on their learning process. Looking at its characteristics, we can see that SRL operates on the inter-operation of cognition and metacognition, which follows the principles of the mind.

Causes of SRL

SRL is a learning pattern that operates on the principles of the mind. Why does it exist? Everything must have reasons for its existence; otherwise, it has no use, cannot be recognized or improved. How can we recognize and evaluate our SRL? What causes SRL into existence? It is recognized based on two types of causes (see **Figure 9**): intrinsic causes, which construct the essence of SRL, and extrinsic causes, which explain the sources of SRL and the end goals where SRL leads us (Shields, 2020). The intrinsic causes contain the formal cause that defines SRL structure and the material cause that personalizes the individual's SRL quality. The extrinsic causes comprise the efficient cause that explains where SRL comes from and the final cause that shows how SRL grows to its end goal.

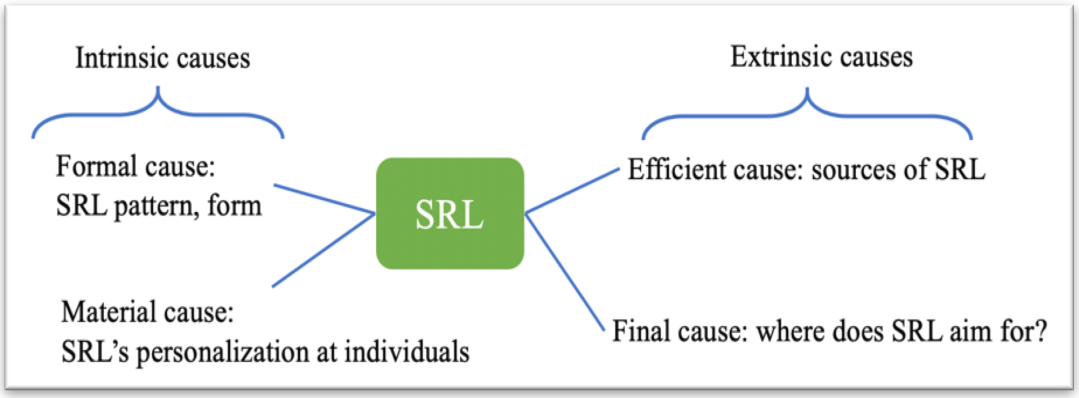

Figure 9. Four causes of SRL

When one determines and realizes these four causes of SRL, one knows how to improve SRL ability and fully benefits SRL.

Principles of SRL

Starting from 2 faculties of the mind, their inter-operation, which molds into SRL learning pattern, we can form the principles of SRL (see **Figure 10**). As stated in a sentence, SRL is grounded in the operation of the mind, grows with the development of the mind, has a nature designed to reach the goal of understanding, and personalizes to each learner.

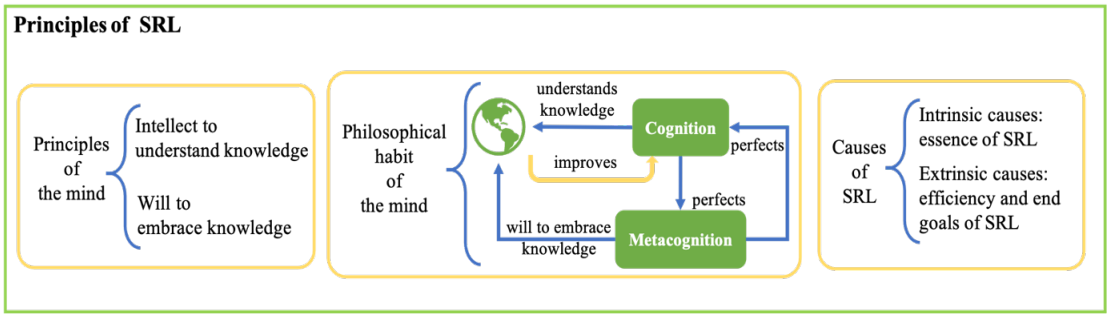

Figure 10. Principles of SRL

SRL Recognition and Improvement Process

Over the last two decades, there has been a wide range of research on SRL measurement and intervention for improving SRL. There are two SRL measurement approaches: SRL trait and SRL context-based skills. SRL trait describes the SRL character of a learner in general. SRL context-based skills illustrate a learner's ability to apply specific SRL skills in particular learning tasks.

SRL has been measured traditionally by data from self-reports, interviews, and questionnaires, which are usually known as the offline form of measure, and in recent years by data from learning behavior observation, which is known as the online form of measure. S. F. E. Rovers et al., in their review of SRL measurement methods, show that the offline form tends to give insight into learner's overall level of SRL while the online form evaluates specific SRL strategies (Rovers et al., 2019). These two forms of SRL measure, though often analyzed separately, are related to each other. The offline form describes a learner's SRL character, while the online form illustrates the learner's ability to apply specific SRL skills in particular learning tasks. In order that the SRL measurement provides accurate and meaningful data for SRL intervention and improvement purpose, there is a need for a firm theoretical model, grounding, or framework of SRL strategies so that the nature of SRL can be understood at the principle level and the SRL intervention can be offered to learners to support them from that fundamental basis (Araka et al., 2020; Rovers et al., 2019).

Interventing learners' learning process to improve their SRL ability is the purpose of all the SRL measurement activities. SRL intervention has been conducted via two approaches, one is that teachers help learners with specific learning tasks, and the other is that teachers provide learners with metacognitive feedback and the learners then reflect and make adaptation to their learning process (Araka et al., 2020). In the former, the assistance the learners receive is personal and related to concrete learning tasks. In the latter, the assistance is a kind of reminders and tips about learning methods. Relating to the SRL measurement approaches mentioned in the previous section, the former intervention is performed after the data collected from the online

form of intervention while the latter intervention uses the data from the offline form of intervention. The former approach is usually applied in traditional school settings. In e-learning environments, the latter approach is provided with the support of educational data mining and learning analytics tools (Araka et al., 2020).

One's SRL ability is recognized by one's SRL character, which comprises one's SRL characteristics and habits of regulating his or her learning. Derived from the principles of SRL, the SRL character is fivefold: *(i)* ***wisdom,*** which is the ability to see the start and the end, *(ii)* ***knowledge,*** which is the ability to use prerequisite knowledge to acquire new knowledge, *(iii)* ***understanding*** which is the ability to apply cognitive strategies, *(iv)* ***counsel*** which is the ability to seek helps and reflect, and *(v)* ***fortitude***, which is the ability to persevere during hard times. The more consistency the SRL character demonstrates, the more maturity the SRL ability is. The development of SRL character is constructed via SRL habits, which are the habits of applying cognitive and metacognitive strategies, tactics, and skills to the learning process. For that reason, the improvement of the SRL ability begins with habituating learning strategies, both cognitively and metacognitively (see **Figure 11**).

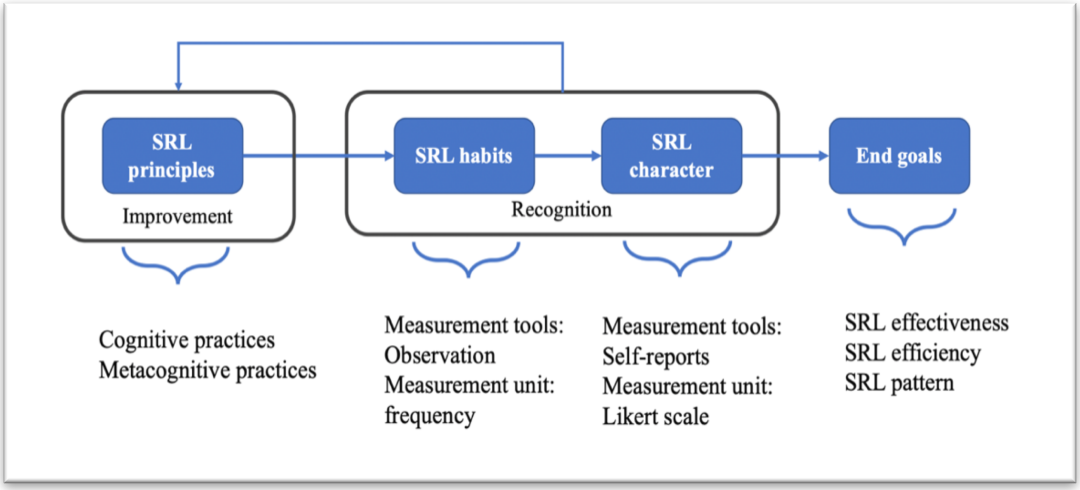

Figure 11. SRL Recognition and Improvement Process

Conclusions: the SRL Recognition and Improvement Framework

To establish a stable foundation for the SRL framework, we have traced the existence of SRL from the basic principle of the mind and its operation. We then have walked through reasons for the existence and development of SRL. And we have demonstrated the process by which an individual's SRL can be qualitatively and quantitively recognized and improved. Setting the SRL recognition and improvement process on the principles of SRL, we introduce the SRL Recognition and Improvement Framework (abbreviated as SRL framework), as shown in **Figure 12**.

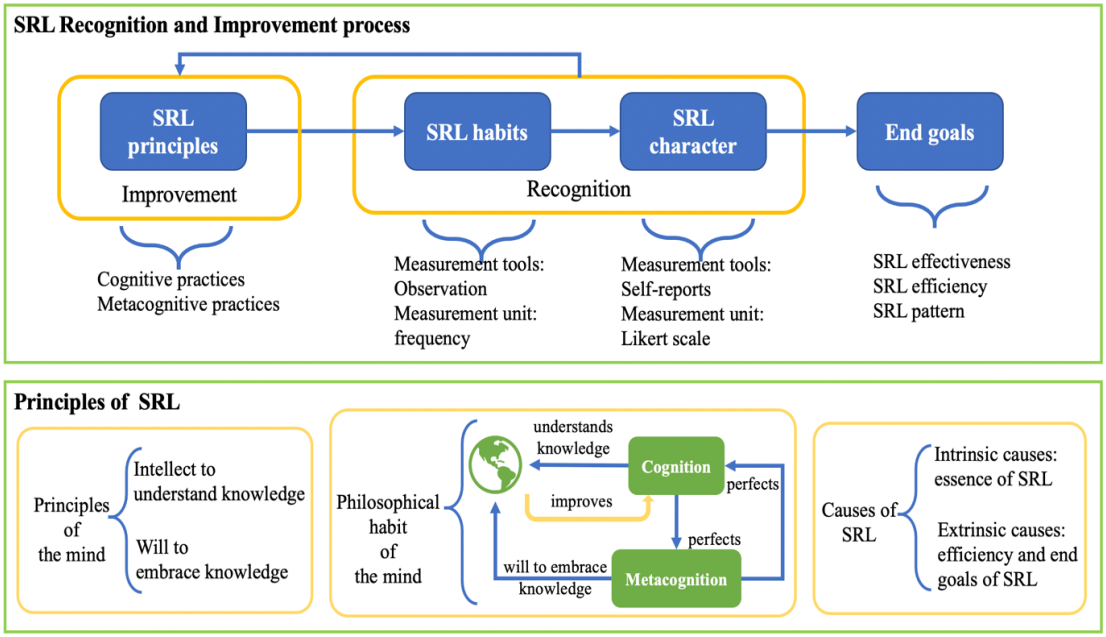

Figure 12. SRL Recognition and Improvement Framework

Let us return to the research questions. The SRL framework provides the following answers.

RQ1: What factors construct SRL ability?

SRL is an entity that actually exists and operates on the basic functionalities of the mind; therefore, its ability can be explained by specifying the causes of SRL for each learner. In general, the factors constructing SRL ability are the source, form, the goal, and the pattern of SRL at each learner. Each learner has his or her educational background, learning experiences, personality and therefore has his or her path or source of SRL development. SRL operates to enable individuals to approach knowledge effectively and efficiently; hence, it possesses a form for achieving that aim. Since SRL does not end for itself but supports the learner to a goal in knowledge achievement, the goals to which SRL is directed also shape the SRL ability. Finally, individuals develop their cognitive and metacognitive strategies differently and shape their SRL habits and character in different paths; thus, the SRL pattern is then personalized to each individual. Thus, SRL converges in the form but varies according to individuals' background, learning goals, and cognitive and metacognitive habits.

RQ2: What are the measurement units of these SRL factors?

SRL ability reveals via a learner's SRL habits and character, which are currently evaluated by learning behavior observation and different types of self-reports. Frequency of behavior application should be as the measurement unit for learning behaviors, and for measuring the quality of self-reports, such measurement scales as Likert scale is reasonable.

RQ3: What intrinsically and extrinsically motivate individuals to self-regulate their learning?

Although motivation is one of SRL's critical components (Efklides, 2011), a learner may find it unintriguing or unnecessary to develop the SRL ability since the benefits that SRL delivers are vaguely visible. However, understanding SRL from the principles of the mind, a learner can be motivated to self-regulate his or her learning extrinsically by progress to knowledge and intrinsically by the perfection of the intellect and will, cognition and metacognition.

The purpose of this SRL framework, as we stated, is not to replace the existing SRL models, which play a crucial role in guiding and shaping SRL from an idea into concrete components and processes. This SRL framework provides a reference point to argue the appropriate scope where the SRL models can apply.

To demonstrate this purpose, let us briefly review the above SRL models from this SRL framework viewpoint. Reflecting on the principles of the mind, all SRL models above shows the interoperation of cognitive and metacognitive activities, though some SRL models pay more attention to metacognition or motivation while the others focus on cognition. Checked against causes of SRL, some SRL models illustrate the SRL form as processes, components; the other shows SRL elements to personalize SRL toward individual learners. All SRL models somehow describe the intrinsic causes of SRL, but they have not discussed extrinsic causes of SRL, which play a directive role for the SRL improvement approaches. Viewed from different perspectives and unified within this SRL framework viewpoint, applying these SRL models following a particular arrangement will help learners comprehend their SRL ability cognitively and metacognitively, and show them the quality of their SRL character and the frequency of their SRL habits.

In summary, throughout this paper, we have walked through several popular SRL models, journey the path of the mind, and ended with a framework based on simple but solid principles of the mind to illustrate the process to recognize and improve SRL ability. The SRL framework is beneficial for use as a reference point to assess the validation of SRL models and to design procedures, methods, exercises for supporting individuals to evaluate their SRL ability and improve it. Since this framework is developed via arguments, future work must involve applying the framework to design empirical SRL recognition and improvement tools, programs, and exercises. Such empirical evidence will demonstrate the validity of the framework.

Acknowledgments

The authors wish to express gratitude and thanks to Japan Advanced Institute of Science and Technology and Research Center for Advanced Computer Infrastructure for sponsoring this research and providing valuable insights and feedback.

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