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A Systematic Review of Self-regulated Learning Models within e-Learning Environments

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Abstract— *Integration of technology in learning, such as Electronic-learning has become an indispensable segment in the field of education. Considering all the work done to further understand the learning processes unearths the need to review all the existing models of self-regulated learning that have been recognized and considered. This availability has led to the discussion of a comprehensive analysis and zooming in on novel features of recognized SRL models from available literatures covered from 2015–2022 in this paper. A systematic literature review based on six SRL models was conducted based on the characteristics that contribute to these models' appropriateness to E-learning. It was found that All SRL models have interoperation of cognitive and metacognitive activities, and their characteristics, processes, and components are similar. Henceforth, all the six presented SRL models can be used appropriately in an e-learning environment. However, SRL models, with the aid of digital technologies, may positively impact the learners' learning experience in the Philippines.*

Keywords— *E-learning:Self-regulated Learning:SRL:SRL models:SRL within the e-learning environment: Self-regulated Learning Models.*

I. INTRODUCTION

The coronavirus disease (COVID-19) pandemic caused enormous crises in all areas. In education, this has led to the wide-ranging closure of face-to-face activities of all educational institutions and resulted in the emergent transition from face-to-face to online learning.

E-learning has become a standard teaching approach. Presently, there is a recognized shift toward technology-supported learning, commonly known as e-learning, with most schools embracing e-learning for fully online courses or complementary to the face-to-face classes in a blended learning approach to cope with the challenge of a large backlog of students to be admitted (Hadullo, Oboko, & Omwenga, 2018; Luna, Castro, & Romero, 2017). This increases online learning courses (Bogarín, Cerezo, & Romero, 2018; Broadbent & Poon, 2015). Compared to traditional, classroom-based learning, one of the critical advantages of online learning is its flexibility concerning time and location while remaining practical and efficient (Weichhart, Stary, & Appel, 2018). e-Learning, or "online learning," is a ground-breaking evolution in the education industry. Compared to physical classroom teaching, where learners are confined together for a specific period, online learners are not restricted in managing their schedules and learning process, what time to study and how long to engage in learning. Achieving success in e-learning still depends on the learner's ability to control their learning process. (Nikolaki, Koutsouba, Lykesas, Venetsanou, & Savidou, 2017).

Self-regulated learning (SRL) is a theory through which learners take control of the learning process. Self-regulation as a composite concept interrelates between key learning constructs to be considered within a single framework rather than exploring these areas in isolation (Higgins et al., 2021). Self-regulated learners can take charge of managing their learning while assuming an active role in achieving their academic goals (Zimmerman, 1990). SRL is grounded on different theoretical models that provide frameworks for research studies on SRL. Research related to the benefits of SRL is of great importance to the teaching of effective learning, curricula design, and higher education more broadly. While aspects of the conceptual structure of SRL remain disputed, there is a consensus in the literature that self-regulated learners employ various metacognitive and motivational strategies that allow them to optimize their learning. The degree to which students metacognitively monitor and control their learning has been found to directly impact how they self-evaluate and subsequently modify their study regimes.

Thus, this study aims to reviews self-regulated learning models within e-learning environments systematically.

II. OBJECTIVES

This paper explores and analyzes how Self-regulated learning models can be best supported within e-learning environments, utilizing the systemic literature review method.

Specifically, this paper seeks to meet the following objectives:

1) Describe the different characteristics that contribute to the appropriateness of Self-Regulated Learning Strategies when applied in e-learning.
2) Determine which self-regulated learning models can potentially be best applied within an e-learning Environment.

III. METHODOLOGY

This paper utilized the systematic literature review method of investigation. In this method, the researcher addressed specific research questions; and then identified, appraised, selected, and synthesized viable research evidence and arguments pertinent to those questions. A systematic literature review means "research about research" and applies the same literature review process.

The Google Scholar search engine was used as the research tool in this investigation. This search engine was

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utilized because the search engine contains valid educational research repositories about self-regulated learning theory. Several combinations of key terms were used in browsing for appropriate literature to wit "Self-regulated learning models," "online learning environment, "systematic review, and "self-regulated learning strategies ."There were at least 100 potentially relevant hits in all search results using at least three combinations of the keywords chosen, and so the dataset was filtered to ten (10) manuscripts based on the following criteria: 1) the articles must be written in English; 2) they must be studied or conceptual manuscripts, and 3) they must be papers published in the last ten years locally or internationally.

IV. Results and Discussion

Due to the pandemic, online learning was introduced to the learners at a new level and paved the way for the so-called "new normal" in teaching and learning. Online learning provides opportunities for learners to use their skills in planning, monitoring, reflecting, and evaluating their learning process. In this new era in the field of education, self-regulated learning has been one of the processes to make learners be independent and take control of their knowledge. Self-Regulated Learning theory focuses on how learners can be active in class and maintain their learning habits relating to their social environment in formal and informal teaching. It is a conceptual scheme for understanding learning's cognitive, metacognitive, behavior, motivation, and affective aspects. Hence, different variables that may or may not influence learning, such as self-efficacy, willpower, and cognitive strategies, are studied in a detailed and holistic approach. Consequently, SRL has become one of psychology and education's most important research fields. Based on its popularity or a model often used and cited, there are six SRL models, which are as follows.

The Self-Regulated Learning Models

Zimmerman: A Socio-cognitive Perspective of SRL Grounded by Three Models

According to Zimmerman, self-regulation is the learners' beliefs about their capabilities to engage in appropriate actions, thoughts, feelings, and behaviors while monitoring and self-reflecting on their progress toward goal completion. As one of the first creators of SRL, he developed three SRL models. These SRL models are known as the Triadic models, the Cyclical Phases of SRL, which have three phases: forethought, performance, and self-reflection, and the Multi-level model.

The Triadic model shows the relationship and interaction of the person, behavior, and environment. It analyzes these three component processes and how they influence each other in increasing the student's academic achievement and ability. In this approach, these three components are utilized by the learners to assume their responsibility in their learning process. In a situation where one tries to solve a problem, one relies not only on their self-efficacy perceptions but also on environmental events such as the teacher's feedback and behavioral events like how accurately the problem can be solved.

Meanwhile, the Cyclical model of SRL describes the interrelatedness of metacognitive and motivational processes at the individual level. This model has three phases, forethought, performance, and self-reflection phase. In the forethought stage, the students analyze the task and plan and set goals on how to complete the tasks given. In the performance phase, the learners use different strategies to execute the learning tasks while they monitor their progress and the effectiveness of the techniques used to finish the task. Finally, in the self-reflection phase, learners evaluate their performance in completing the tasks, reflecting on the success and failure of completing tasks. These reflections can influence the learners' approach to complete similar future tasks, either positively or negatively.

The third model Zimmerman developed, also known as the Multi-Level model, comprises four stages from which learners acquire their self-regulatory competency (Zimmerman, 2000).

Boekaerts: Different Goal Roadmaps (Top–Down/Bottom–Up) and the Role of Emotions

Boekaerts is also one of the initial initiators of SRL. He focused his research on the student learning goals of SRL. Boekaerts was the first to implement steps to evaluate students' SRL motivation, and he introduced two SRL models.

First, she developed a structural model in which self-regulation was divided into six components, namely; (1) domain-specific knowledge and skills, (2) cognitive strategies, (3) cognitive self-regulatory strategies, (4) motivational beliefs and theory of mind, (5) motivation strategies, and (6) motivational self-regulatory strategies (Panadero, 2017). These components were organized, and two mechanisms were developed later: cognitive and affective/motivational self-regulation. The structural model has usually been utilized to gain more insight into domain-specific components of SRL, train teachers, construct new measurement instruments for research, and design intervention programs (Panadero, 2017)

Second, most of Boekaerts' publications intend to formulate a second SRL model, which is known as the Adaptable Learning Model. This model described the dynamic aspects of SRL and underwent evolution over the years; later on, it became known as the Dual Processing self-regulation model.

In the Dual Processing 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.

Winnie and Hadwin (Exploring SRL from a Metacognitive point of view)

The model, which Winne and Hadwin created, has a solid metacognitive perspective that identifies self-regulated students as actors who manage their learning through monitoring and utilization of (meta)cognitive strategies. Further, under this SRL model, learners assume responsibility for their learning while asserting the goal-driven nature of SRL and the effects of self-regulatory actions on motivation. It has been a widely used model, especially in research implementing computer-supported learning settings (Panadero, 2015). This model demonstrates a two-phase SRL

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process to accomplish a learning task. The first phase is planning, followed by a second phase which is the execution while monitoring the progress and making necessary adjustments if needed.

Efklides (Missing Part of Metacognition and SRL)

Comparing the Efklides model with others, it can be observed that it has a stronger metacognitive foundation than other SRL models, except Winne and Hadwin. Further, motivation and affective domain have a significant influence in this model. The Metacognitive and Affective Model of SRL (MASRL) has two levels.

First is the Person tier/level, also called the macro tier. This tier is a "traditional" view of SRL and understands students' characteristics. Efklides' model consists of cognition, motivation, self-concept, affect, will, metacognition in the form of metacognitive knowledge, and metacognition in the form of metacognitive skills. Efklides consider the Person tier to be top-down because it is organized based on student's goals for the assignment (Tran, 2021).

The second is the Task x Person level which describes the ability of the learner to apply specific SRL behaviors within a particular task. This tier, also known as the micro level, is where the interaction between tasks and students' characteristics and behaviors happens.

This model also describes the method students use in completing assignments given by the teacher, the phase with the most significant cognitive is when cognitive resources control activities (Kesuma et al., 2020).

Hadwin, Järvelä, and Miller (SRL in the Context of Collaborative Learning)

The SRL model found by Hadwin, Järvelä, and Miller discusses the related and influence of SRL in collaborative learning. Although this model has shown superiority in collaboration, some setbacks have also been observed, such as collaboration raising challenges and barriers to cognitive, motivation, and the environment (Kesuma et al., 2020). In addition, collaborative tasks require the learners to commit to one another and build a common foundation where they can share and complete tasks and share strategies to complete such tasks. In other words, each individual needs to share their learning rules (Share SRL-SSRL) (Kesuma et al., 2020). The crucial point in SSRL is that individual and social processes shall be developed and combined and cannot be reduced to the personal level.

Pintrich (Emphasis on Motivation in SRL)

The most significant contribution of the Pintrich model was pointing out the similar characteristics of the different SRL models, such as the opportunities provided to learners to set and plan goals and execute the plan to complete the task, monitor, control, and regulate internal and external factors for their learning process. Further, it was noted that all SRL models have criteria allowing learners to reflect on their progress and make necessary adjustments. These common attributes of SRL models were illustrated in this model.

This model identifies four areas that affect students' self-regulated learning. These areas are as follows: cognition, motivation, behavior, and context. These four factors are combined with the four phases: forethought planning and activation; the second phase of monitoring; the third phase of control; and the fourth phase of reaction and reflection. The two critical factors identified in the framework of this model, which Pintrich focuses on, are learning goals and motivations.

Self-regulated learning in an e-learning environment

The COVID-19 pandemic has augmented the existing trends of increasing the share of e-learning in education worldwide. As online learning places all control in the hands of online learners, they must take it upon themselves to plan, organize, monitor, self-reflect, and evaluate their learning processes (Bylieva et al., 2021). Several challenges have been identified as online learning has been utilized, from the availability of gadgets, internet connection, and other technicalities to more complex ones such as learners' readiness, behavior, attitude, and outlook in an e-learning environment. Henceforth, after providing resolutions to difficulties of creating, communicating, and providing technical support for e-learning, it became essential to take into account the level of technical competence, the psychological aspects of online learning, and the distinctiveness of learning in an electronic environment to the extent that fully e-education can completely replace conventional one (Bylieva et al., 2021).

As e-learning has been recognized as an alternative shift to support the need for a continuous learning process, technology played a pivotal role in adapting this technological shift of education, integrating e-learning into fully online academic programs or complementary to the face-to-face sessions in the blended learning approach. Many countries have utilized this resolution to control the academic backlog challenge due to the COVID-19 pandemic. This, in the end, increased the number of online learning courses (Bogarín, Cerezo, & Romero, 2018; Broadbent & Poon, 2015). The term "e-learning," which includes web-based systems such as massive open online courses (MOOCs) and learning management systems (LMS), has been of great help to instructors in distributing learning materials as much as allowing students to access the content and interact and obtain support during a learning episode (Delen & Liew, 2016).

Among the concepts associated with online learning is the utilization of self-regulated learning models. Successful SRL includes constant active engagement, adjustment, and readjustment of learning strategies, which depend on various factors. Studying in an online or electronic environment has been extra challenging for most learners because tasks previously designated to teachers have somehow passed on to the learners. Self-regulated learning envisions the learners setting their goals and executing them accordingly using different learning strategies. Consequently, learners assume responsibility for their learning while allowing them to monitor and evaluate their progress and reflect on the outcome or results of the completed tasks.

In an electronic learning environment where the teacher's presence is limited, learners have control and decide on their schedule and what techniques or approaches they would employ to make learning effective. In this regard, the ability of the learner to self-regulate their learning process is an essential

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factor in making online learning successful. Applying Zimmerman's SRL model to learning in the e-learning environment, the first phase will consist of learners identifying learning goals and developing a schedule to participate in the learning materials. Learning strategies will also be placed in this stage. Executing the plan, such as using the planned approach in the first phase, will be part of the second phase.

Further, monitoring of progress will also be part of it. The third phase will be the self-reflection phase, wherein learners will self-evaluate whether they have understood the concepts and met their learning goals. Consequently, their self-evaluations will determine the success or failure of the techniques they have employed and can be considered in their plans. Accordingly, supporting self-regulated learning strategies utilizing Zimmerman's SRL model can help learners better regulate their learning, enhancing their learning performance.

The foundation of SRL is based on the different theoretical models that outline particular research studies focused on how SRL is carried out within the learning process. Famous and commonly referred to as SRL models include Zimmerman's, Boekaerts', Winne and Hadwin's, Pintrich's, Efklides,' and Hadwin, Järvelä, and Miller's models. Comparatively, each of these models identifies the different stages, processes, and mechanisms that can be rolled into one self-regulated learning technique that can further be evaluated in a learning process. Some strategies are time management, metacognition, effort regulation, critical thinking, rehearsal, elaboration, organization, peer-to-peer learning, and help-seeking. These identified strategies, when partially or entirely utilized by learners, perform better than those with low-level SRL skills, indicating the need for supporting SRL in e-learning environments, especially LMS, which higher institutions of learning majorly use (Broadbent & Poon, 2015; Kizilcec et al., 2017; Littlejohn, Hood, Milligan, & Mustain, 2016). These strategies are considered to be measurable before, during, or after a learning process using instruments and methods specially designed for each SRL model.

Self-regulated learning promotion or intervention is described as an activity or event that can "trigger SRL development" within an online student during a learning episode. While SRL strategy measures seek to attain acceptable SRL levels for learners, interventions intended for SRL strengthen or stimulate the growth of the inherent SRL skills in learners (Triquet, Peeters, and Lombaerts, 2017). In a study conducted by Araka, Maina, Gitonga, and Oboko in 2020, it was concluded that while there are some challenges in measuring and promoting SRL strategies in online learning environments may be addressed through the implementation of education data mining (EDM) techniques. Effectively, the methods need to be deployed on e-learning systems such as the popular learning management systems, which most higher learning institutions use to offer both blended and online courses to learners. Adapting these techniques aligned with the SRL models could make learning more accessible and efficient for the learners.

V. Conclusion

Upon the conduct of a systematic review of literature on self-regulated learning models, this paper concludes that SRL models benefit learners in an e-learning environment to practice taking control and assuming responsibility for their learning process. All SRL models have shown interoperation of cognitive and metacognitive activities, and their characteristics, processes, and components are similar.

Henceforth, this paper concludes that any of the six presented SRL models can be used appropriately in an e-learning environment. However, other tools such as EDM may promote SRL to make the learning more effective. Further, SRL models, with the aid of digital technologies, will positively impact the learners' learning experience.

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