Journal of Infrastructure, Policy and Development 2024, 8(15), 9767.
https://doi.org/10.24294/jipd9767

Article

The potential role of self-regulated learning as mediator in academic learning: A systematic literature review (2015–2024)

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CITATION

Chen J, Rameli MRM, Cao H, et al. (2024). The potential role of self-regulated learning as mediator in academic learning: A systematic literature review (2015–2024). Journal of Infrastructure, Policy and Development. 8(15): 9767. https://doi.org/10.24294/jipd9767

ARTICLE INFO

Received: 20 October 2024
Accepted: 14 November 2024
Available online: 13 December 2024

Abstract: The potential role of self-regulated learning as mediator has been deeply investigated by researchers in recent years. There is limited systematic literature review being done to investigate the role of self-regulated learning as mediator in the students' academic learning. Therefore, searching studies in the databases WOS (Web of Science), SCOPUS, APA (American Psychological Association) PsycInfo, and ERIC (Education Resources Information Center), the present study conducted a systematic literature review on 32 studies published between 2015 and 2024 to summarize what kind of psychological factors influence students' academic performance through self-regulated learning and assess the potential mediating role of self-regulated learning in this process. The results show that self-efficacy, emotions and motivation are significant predictors of academic achievement and self-regulated learning act as an important mediator in this relationship. An important implication was obtained that researchers can probe into the influence of specific dimensions of self-efficacy on learning performance through self-regulated learning and the influence of positive emotions such as resilience on learning outcomes with self-regulated learning as mediator.

Keywords: self-regulated learning; academic achievement; students; self-efficacy; emotions; systematic literature review

1. Introduction

Learning, as the continual growth and change in the brain architecture of human beings (Hoque, 2016), is essential for both academic and professional development of individuals. Specifically, the importance of self-initiated and self-managed learning has been increasingly emphasized in the world with rapid pace of social change (Bjork et al., 2013). Currently, having the ability to regulate one's own learning is regarded as the key to successful learning, and it is viewed by educational psychologists and policy makers (Boekaerts, 1999). Schools are also pay attention to the development of students' habits and skills in learning independently throughout their academic career and beyond (Baas et al., 2015; Boekaerts, 1999).

However, according to Winne and his colleagues' wide range of research on self-regulated learning, in general, learners learn less well than they might because they do not have correct and clear conceptions about innate mechanisms of learning, which result in their inefficient study (Winne, 2016). What is more, it is found that many students do not have a satisfactory ability to self-regulate their academic studying (Zimmerman, 2002). Therefore, the mechanism of self-regulated learning is a topic worthy of attention from educational researchers and teachers.

1.1. The definition of self-regulated learning

There are different definitions of self-regulation of learning. On the one hand, some relatively authoritative definitions are recognized by researchers. It is suggested that self-regulated learning refers to self-generated thoughts, feelings, and behaviours that are adapted to the attainment of personal goals (Zimmerman and Schunk, 1989; Zimmerman, 2000). It is a self-directive process, and learners can transform their mental abilities into academic skills by this process (Zimmerman, 2002). Similarly, Winne (1995) defined self-regulated learning as a self-directed process which is inherently constructive (Boekaerts, 1999). According to Pintrich (1995), there are three dimensions of self-regulated learning: Behaviour, motivation and affect, and cognition, which means that self-regulated learners are able to control their behaviour, motivation and affect, and cognition; they have some goals to accomplish; they must control their actions.

On the other hand, there are also some other views on the connotation of self-regulated learning proposed in recent years. For example, Hadwin et al. (2011) proposed that self-regulated learning means that students strategically plan, monitor, and regulate their cognition, behaviour, and motivation towards the completion of an academic task. Schunk and Greene (2017) thought that self-regulation refers to the ways that learners systematically activate and maintain their cognitions, motivations, behaviours, and affects to achieve their goals. Panadero (2017) suggested that self-regulated learning contains the cognitive, metacognitive, behavioural, motivational, and affective aspects of learning. In addition, it is recognized by Baas et al. (2015) that self-regulated learning refers to the ability that students take responsibility and control their learning activities.

Obviously, although different researchers have different views on the definition of self-regulated learning, there are some common features among these definitions. Firstly, most of the definitions mentioned above, as Zimmerman (1989) mentioned, commonly emphasize students' purposeful use of the specific processes, strategies, or responses to improve their academic achievement. Secondly, the significance of students' control of their behaviour, cognition, motivation, and affect in self-regulated learning process are stressed by most of definitions mentioned above. Finally, goal is an important motivated factor in self-regulated learning.

1.2. The potential role of self-regulated learning as a mediator

It is suggested that self-regulated learning is closely related to academic achievement. Zimmerman et al. (2023) suggested that students' planning, goal setting, and self-monitoring of their use of time during studying are significantly related to their academic achievement. Self-regulatory activities, mediating the relations between learners and their environments, can influence learners' academic achievements (Pintrich and Zusho, 2002; Schunk, 2005). What is more, phenomenologists believe that self-regulation, depending on the development of self-system knowledge structures, self-awareness, self-monitoring, self-evaluation, self-concepts and self-images, is responsible for the regulation of students' learning behaviours as well as their learning outcomes (McCombs, 2013).

There are quite a few empirical studies that have proven the viewpoint of self-regulated learning significantly influencing academic achievement. For example, Kashif and Shahid (2021) conducted a survey on 450 students and the result showed that self-regulation significantly impacted students' academic achievement. Students who have a high level of self-regulation got higher academic achievement. Taking 130 higher education English as a Foreign Language learners as research objects, Kırmızı (2015) found that high achieving students had higher levels of self-regulation, and the correlation analysis indicated that self-regulated learning are highly correlated with academic success. According to the analysis on the data collected from a sample of 480 students of final semester of Bachelor of Studies programs in the universities of Khyber Pakhtunkhwa, it is found that students' self-regulated learning significantly contributed to their academic achievement (Khan et al., 2020).

It has been proved that there are some predictors of self-regulated learning. For instance, Schunk (2013) argued that students self-regulate learning are determined by personal processes and these processes are predicted to be influenced by behavioural and environmental events. Similarly, it is suggested that epistemological beliefs contributed to students' use of self-regulated learning strategies (Koksal and Yaman, 2012; Metallidou, 2013). According to Bruso et al. (2020), learner differences in personality traits is also a significant predictor of the use of self-regulated learning strategies. At the same time, as mentioned above, plenty of studies suggested that self-regulated learning significantly influences academic achievement (McCombs, 2013; Pintrich and Zusho, 2002; Schunk, 2005; Zimmerman et al., 2023). Therefore, there is possibility that self-regulated learning can be a potential mediator in the learning process.

In addition, the potential role of self-regulated learning as mediator has been deeply investigated by researchers. During 1980s and 2000s, researchers probed into the methods of teaching students' self-regulation processes, the influence of self-regulation on students' academic achievement outcomes, and whether there are other variables such as learners' abilities and context that can influence students' self-regulated learning. The research model they proposed are: Intervention → Self-regulated Learning → Achievement outcomes. In this model, interventions are the factors that influence self-regulation, and self-regulation in turn can affect achievement outcomes (Schunk and Greene, 2017).

From the discussion above, self-regulated learning plays an important role in students' learning process. Self-regulation, as a mediating variable, can affect the path of the independent variable influencing students' academic performance, which largely provides essential reference for educators to improve teaching effectiveness and students' learning performance. Meanwhile, nowadays, it is proposed that in addition to focusing on the relationship between independent and dependent variable, researchers should also try to explain that relation in terms of mediating processes (Fiedler et al, 2011). However, to our knowledge, limited systematic literature review has been done to investigate the potential role of self-regulated learning as mediator in the students' academic learning. Therefore, the present study, by a systematic literature review over the last ten years, aims to summarize what kind of personal factor influence students' academic performance through self-regulated learning and assess the potential mediating role of self-regulated learning in this process.

2. Method

The present literature review refers to the guideline of the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-analyses) statement (Moher et al., 2009) and the tool used in this study is RevMan 5.3.

2.1. Search strategy and search string

Firstly, the WOS (Web of Science) and SCOPUS, which are two comprehensive and fundamental databases, were selected for the search of the present study. Secondly, since our study aims to explore the potential role of self-regulated learning as mediator in the students' academic learning through reviewing literature over the last ten years which belong to the field of psychology and education, we selected APA (American Psychological Association) PsycInfo which includes literatures from psychology and ERIC (Education Resources Information Center) which focuses on the literatures from education for our search task as well. In a word, there are totally four databases being employed for search: WOS, SCOPUS, APA PsycInfo, and ERIC. The key words for search are self-regulated learning, academic and learning. The following are the search string of different databases.

WOS search string: TI = (self-regulation) OR TI = (self-regulated learning) OR TI = (srl) AND TS = (mediat*) AND (((TS=(learning)) OR TS = (academic outcome)) OR TS = (academic performance)) OR TS = (academic) AND 2024 OR 2023 OR 2022 OR 2021 OR 2020 OR 2019 OR 2018 OR 2017 OR 2016 OR 2015 (Publication Years).

SCOPUS search string: ((TITLE (self-regulation) OR TITLE (self-regulated learning) OR TITLE (srl))) AND (TITLE-ABS-KEY (mediat*)) AND ((TITLE-ABS-KEY (learning) OR TITLE-ABS-KEY (academic outcome) OR TITLE-ABS-KEY (academic performance) OR TITLE-ABS-KEY (academic))) AND PUBYEAR > 2014 AND PUBYEAR < 2025.

APA PsycInfo search string: Title: Self-regulation OR Title: Self-regulated learning OR Title: Srl AND Keywords: learning OR Keywords: academic outcome OR Keywords: academic performance OR Keywords: academic AND Keywords: mediat* AND Year: 2015 To 2024.

ERIC search string: Self-regulated learning AND Performance AND Mediation since 2015 (last 10 years).

2.2. Eligibility criteria

Searching the literatures of the four databases by search string mentioned above is the first and initial step. The result of the initial searching should be further defined by authors of the presents study. Authors need to exclude any study that is irrelevant to the topic of the present study according to some criteria. Therefore, eight eligibility criteria were put forward. The specific criteria for excluding articles are as follows:

a) Not psychological factors influencing students' academic outcomes.
b) Not conducted towards school students.
c) Not quantitative research.
d) Not original data.

e) Not related to self-regulated learning or self-regulation in the context of academic learning.
f) Not written in English.
g) Full text is not accessible.
h) The outcome variable is not academic learning performance or outcome.

2.3. Study selection process

There were totally four steps in the study selection process (see **Figure 1**). The first step was to identify the studies of the chosen databases: WOS, SCOPUS, APA PsycInfo, and ERIC. According to the database searching result, 1318 of records were identified. Then, duplicates need to be excluded at the second stage and after duplicates removed, there were 1085 of records left. In the third step, the studies were screened and 971 of records that are irrelevant to the present study were excluded by title and abstract. In this step, 114 of studies was initially assessed as eligible. When it comes to the fourth step, studies were further screened and assessed based on the eight proposed eligibility criteria in this study. 82 of full-text articles that were not eligible were excluded. Finally, 32 of full-text articles were included for literature review of the present study.

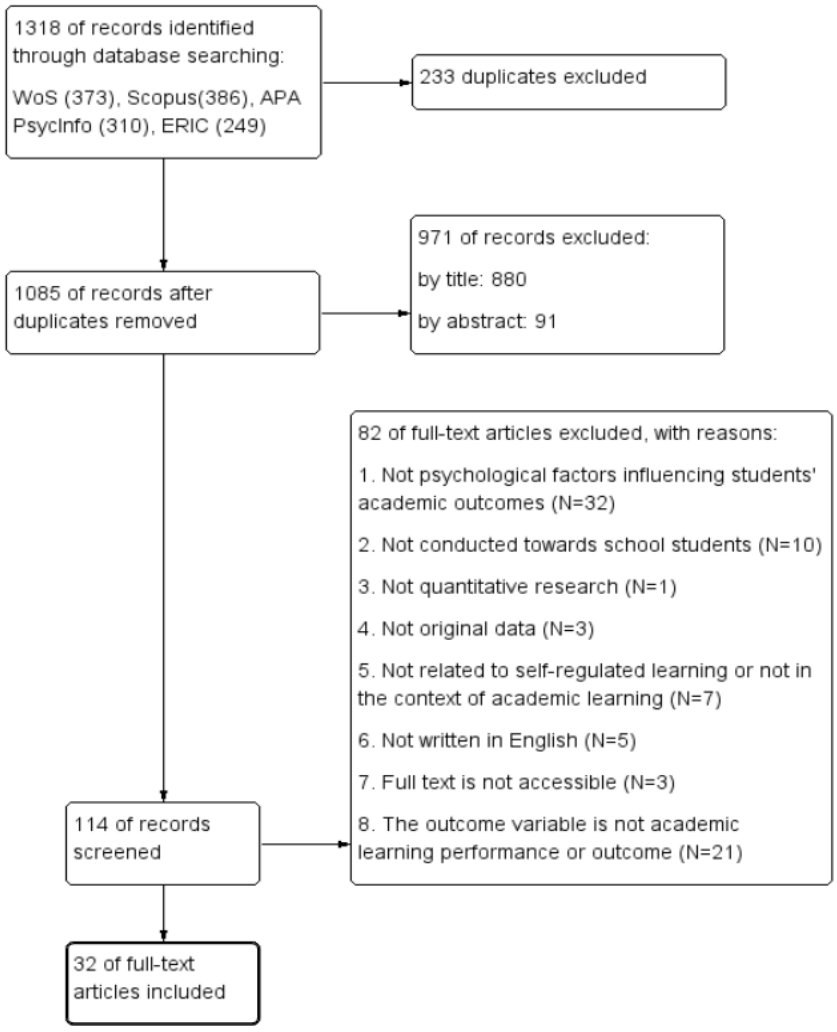

Figure 1. PRISMA flow diagram made by software RevMan 5.3.

2.4. Data extraction and analysis

Authors of the present study read and extracted information needed from each study, and then a table including specific information from each study was created. There are several aspects of extracted information from each study.

First, the basic information of studies. The authors' name and publication year of each study were noted for readers' reference.

Second, brief information about research introduction. Due to the fact that the present study is a literature review of quantitative research which take self-regulated learning as a mediator to investigate the influence of students' psychological factors on their academic performance, the information of aims, independent variable, dependent variable and mediator of each study are essential for reviewing. Therefore, authors of this study extracted the above information as well when reading and reviewing.

Third, information of research instruments of self-regulated learning. Scientific research would be impossible without instruments and instruments are important tool to collect data in psychological research (Sturm and Ash, 2005). The instrument or measure of mediator were extracted.

Fourth, information of research design. As quantitative research, each study reviewed has their own design for research to realize their research aims. Therefore, authors of the present study extracted the information of research deign such as number, gender, age of sample and it is cross-sectional or longitudinal study.

Finally, information of research result. Both statistical results and findings of each research were extracted which is an important part of each study. Statistical results display the objective quantitative results of the research, while findings are summary by authors after their analysis based on statistical results.

3. Results

The results of search and review of the included studies will be presented in this part, including the characteristics, methodology, evaluation of self-regulated learning and the results of testing the mediating role of self-regulated learning. The table of systematic review on included studies are shown in **Table A1** of Appendix.

3.1. Characteristics of included studies

The present study selected research published in the past 10 years (2015–2024) for systematic literature review. Among the 32 included studies, the vast majority were published in the past 5 years. Specifically, there are totally 23 studies published after 2020, with the highest number of studies published in 2023: A total of 10 studies publishowhed in 2023. This indicates that the study of self-regulated learning as a mediator affecting students' academic performance has been a hot topic in recent years.

The aim of all included studies is to explore the impact mechanism of students' personal factors on their academic performance, with self-regulated learning or self-regulation in learning as the mediating variable. The 32 included studies have investigated the impact of various factors on students' academic performance. Firstly, the influence of self-efficacy on students' academic performance has received high

attention. An et al. (2021); Derakhshan and Fathi (2024); ElSayad (2024); and Koh et al. (2022) aimed to investigate how students' self-efficacy related to academic influence their learning outcomes including their perceived learning, L2 speaking performance, academic success, English learning outcomes; Secondly, emotions are an important factor in students' learning activities. The impact of academic emotions, positive emotions including well-being, grit and English enjoyment as well as negative emotions including anxiety, stress and worry on academic achievement was explored (Abbott and Lee, 2023; An et al., 2021; Li et al., 2023; Morosanova and Fomina, 2017; Martin et al., 2022; Morosanova et al., 2023; Zheng and Li, 2016); Third, during learning process, variables related to motivation and management such as academic motivation, motivational regulation, resource-management and self-control are key factors as well, and their influence on learning outcomes was proved by Fourth, Musso et al. (2019); Morosanova et al. (2023); Rutherford et al. (2018); Tee et al. (2021); Teng and Zhang (2018); Trentepohl et al. (2023); Zhu et al. (2016) and Zheng and Li (2016) examined the influence of working memory and executive attention of the basic cognitive processes on academic performance. In addition to the variables mentioned above, there are many other variables being investigated such as big five personality traits, achievement goal orientations and so on (see **Table A1** of Appendix for details).

3.2. Methodology of included studies

Among these 32 included studies, the sample size of each study varied, with the maximum sample size of 3316 and the minimum sample size of 27. The vast majority of the sample sizes of these studies are between 100–499—a total of 18 studies; in addition, there are 9 studies with a sample size of over 500 and 5 studies with a sample size of less than 100. Most of the participants in these studies had an average age of 16 or older, with only one study having participants with an average age of 10 or younger. Moreover, most of these studies have adopted the cross-sectional design which is one of the most common study designs to collect research data and then help researchers find out the answer to their research questions (Olsen and St George, 2004), while only 2 studies adopted longitudinal design. There are 4 studies using both cross-sectional and longitudinal design (see **Table A1** of Appendix for details).

3.3. Measurement of self-regulated learning

Various scales or instruments were used to measure and evaluate the self-regulated learning variables among the 32 included studies. There are 9 studies (ElSayad, 2024; Lee, 2022; Martin et al., 2022; Ma and Ishak, 2024; Tee et al., 2021; Trentepohl et al., 2023; Zheng and Li, 2016; Zielińska et al., 2021; Zhu et al., 2016) using or referring to the questionnaire MSLQ (Motivational Strategies for Learning Questionnaire) developed by Pintrich and De Groot (1990). The MSLQ is originally designed to assess college students' use of different learning strategies and motivational orientations (Pintrich, 1991). The MSLQ consists of two sections: A motivation section which includes 31 items assessing students' goals, beliefs, and their anxiety in a course; and a learning strategies section which includes 50 items on students' use of cognitive and metacognitive strategies and student management of learning resources (Pintrich, 1991). The MSLQ is a reliable and useful tool that can

be adapted to research for various purposes (Duncan and McKeachie, 2005). Therefore, from the above discussion, it can be seen that the MSLQ is currently one of the most widely used instruments to measure self-regulated learning.

Three studies (Morosanova and Fomina, 2017; Morosanova et al., 2023; Morosanova et al., 2023) used the SRPLAQ (Self-Regulation Profile of Learning Activity Questionnaire) developed by Morosanova (2011). The SRPLAQ is designed to measure the level of learning self-regulation and different aspects of self-regulation related to achieving learning goals among students, including 9 scales: Planning, Modelling, Programming, Results Evaluation, Flexibility, Independence, Reliability, Responsibility, Social Desirability (Morosanova and Fomina, 2017). The psychometric evaluation results of the SRPLAQ were found to be satisfactory (Morosanova et al., 2016), and validity and reliability of the questionnaire scales were well demonstrated (Morosanova et al., 2018).

It is worth noting that in the 3 studies which studying online self-regulation learning, three different scales were used (Musso et al., 2019; Yeh et al., 2019; Zhou et al., 2021): OSLQ (Online Self-Regulated Learning Questionnaire) (Barnard et al., 2009), OMQ91 (Online Motivation Questionnaire) (Boekaerts, 2002) and SOL-Q (Self-Regulated Online Learning Questionnaire) (Jansen et al., 2017). Additionally, there are also many studies using the scales that focus on a specific aspect. For example, Teng and Zhang (2018) adapted the WSSRLQ (Writing Strategies for Self-regulated Learning Questionnaire) (Teng and Zhang, 2016) to measure students' self-regulation in English as foreign language writing task (see more details in **Table A1** of Appendix). In summary, there are many scales used to measure different kind of self-regulation in learning, and the MSLQ is one of the commonly used instruments.

3.4. The mediating role of self-regulated learning

According to the in-depth review on the 32 included studies, the mediating role of self-regulated learning in students' learning activities has been strongly tested and demonstrated. In this section, we will classify and elaborate on the research results of included studies based on the mediating of self-regulation in the relationship between different independent variables and academic outcomes.

First of all, the mediating role of self-regulated learning in the relationship between self-efficacy and academic outcomes. According to the mediation analysis results of ElSayad's (2024) study, the influence of academic self-efficacy on perceived learning was significantly mediated by planning ($\beta = 0.082$, $p < 0.001$), monitoring, ($\beta = 0.039$, $p < 0.05$)and regulating ($\beta = 0.149$, $p < 0.001$) which are three dimensions of metacognitive self-regulation. Derakhshan and Fathi (2024) proved that there is a positive correlation between self-efficacy and various aspects of L2 speaking performance ($\beta = 0.468$, $p < 0.001$). Self-regulation mediates the relationship between self-efficacy and L2 speaking performance ($\beta = 0.172$, $p < 0.01$). An et al. (2021) also got the similar conclusion. Students' self-efficacy significantly impacted SRL (Self-regulated learning) strategies ($\beta = 0.35$, $p < 0.001$) and in turn SRL strategies influenced English learning outcomes ($\beta = 0.29$, $p < 0.001$). What's more, it is suggested that both emotional and behavioural regulation significantly predicted the relationship between self-efficacy and GPA (Grade Point Average) for Asian

American, Latinx, and White students (Koh et al., 2022) based on the data analysis results: Self-efficacy → Emotional regulation (β = 0.62/0.62/0.64, p < .001) → GPA (β = −0.19/−0.34/−0.15, p < 0.01/p < 0.001/p < 0.05) (Asian American, Latinx and White students); Self-efficacy → Behavioural regulation (β = 0.62/0.64/0.68, p < 0.001) → GPA (β = 0.33/0.24/0.37, p < 0.001) (Asian American, Latinx, and White students).

Secondly, the mediating role of self-regulated learning in the relationship between emotions and academic outcomes. Zheng and Li (2016) explored how academic emotions influence students' academic achievement. According to the results of Sobel test, academic emotions positively affected academic achievements through the mediating effect of self-regulated learning strategies (Z = 2.12 > 1.96). On the one hand, it is proposed that positive emotions had an indirect effect on literacy achievement that was mediated through self-regulated learning (β = 0.21) (Abbott and Lee, 2023). Furthermore, An et al. (2021) emphasized the important role of English enjoyment, which is one of positive emotions, in English learning. English enjoyment positively influence self-regulated learning strategies (β = 0.45, p < 0.001) which in turn impact English learning outcomes (β = 0.29, p < 0.001). Morosanova et al. (2023) revealed the mediating role of self-regulation in determining psychological well-being and academic performance of young adolescents with the significant mediation results of psychological well-being influencing self-regulation general level (β = 0.54, p < 0.001） and self-regulation general level influencing academic achievement (β = 0.47, p < 0.001. Grit could predict students' engagement in self-regulated learning (R^2 = 0.387, p < 0.00) and students' self-regulated learning engagement possibly mediates the relation between academic achievement and grit (Martin et al., 2022). On the other hand, negative emotions are also proved to have indirect effect on students' academic achievement. Specifically, Li et al. (2023) examined that self-regulated learning was a mediator between stress and task performance (β = −0.088, p < 0.05) as well as between stress and contextual performance (β = −0.100, p < 0.05). In addition, worry had an negative impact on general level of self-regulation (β = −0.39, p = 0.0000) and self-regulation as a mediator, influenced students' exam results (β = 0.30, p = 0.000) (Morosanova and Fomina, 2017).

Thirdly, the mediating role of self-regulated learning in the relationship between motivation, management and academic outcomes. Zheng and Li (2016) proved that motivation positively affected academic achievements through the mediating effect of self-regulated learning strategies (Z = 2.47 > 1.96). At the same time, Morosanova et al. (2023) divided academic motivation into achievement motivation and cognitive motivation, and they confirmed the influence of achievement motivation on students' final project score through result evaluation in self-regulation (b = 0.160, p = 0.031) as well as influence of cognitive motivation on students' final project score through result evaluation in self-regulation (b = 0.172, p = 0.018). As for motivational regulation, Teng et al. (2018) examined its indirect effect on writing achievement through cognitive strategies (β = 0.11, p < 0.05) as well as metacognitive strategies (β = 0.12, p <0.05), while Tee et al. (2021) proved that behavioural (β = 0.185, p < 0.005) and cognition regulation (β = 0.038, p < 0.05) process mediated the relationship between motivational regulation and academic achievement. Trentepohl et al. (2023)

explored and confirmed the mediating role of resource management strategy use in the relationship between Resource-management strategy knowledge and academic performance. For example, time-management strategy knowledge positively influenced time-management strategy use ($\beta_a = 0.29$, $p = 0.009$) which the influences academic performance ($\beta_b = 0.36$, $p < 0.001$). The important mediating role of self-regulated learning strategies in the relationship between self-control and learning outcomes has been emphasized by Zhu et al. (2016).

Fourthly, the mediating role of self-regulated learning in the relationship between cognitive processes and academic outcomes. Musso et al. (2019) studied the effects of basic cognitive processes (working memory capacity and executive attention) on mathematics performance, and the mediating effects of specific self-regulated learning factors. The results indicated that subjective competence, which is a self-regulated learning component, acts as a mediator in the relationship between working memory capacity and mathematics performance ($\beta = 0.032$, $b = 0.061$) as well as between executive attention and mathematics performance ($\beta = -0.004$, $b = -0.055$). Similarly, Rutherford et al. (2018) found that executive function and math achievement are partially mediated through self-regulated learning, that is, executive function influenced self-regulated learning ($\beta = 0.22$, $p < 0.05$) and in turn, self-regulated learning impacted math grades ($\beta = 0.39$, $p < 0.05$).

Finally, the mediating role of self-regulated learning in the relationship between other predictors and academic outcomes. Psychological factors like psychological well-being, academic psychological capital, grit, mental health and so on are proved to have significant effect on students' academic outcomes through self-regulated learning. For instance, Wang et al. (2023) examined that the impact of mental health on academic outcomes was fully mediated by self-regulated learning with the paths of mental health influencing self-regulated learning ($\beta = -0.15$, $p < 0.01$) and self-regulated learning influencing academic performance ($\beta = 0.60$, $p < 0.01$) (see **Table A1** of Appendix for more details of results of each study).

4. Discussion

We have reviewed the studies published in recent ten years which focus on the mediating role of self-regulated learning in the relationship between students' personal psychological factors and their learning outcomes. According to the results of systematic review, self-regulated learning acts as an important role in students' learning activities and it is a significant mediator during their learning process.

4.1. Self-regulation as a method to promote learning performance

Teng and Zhang (2018) suggested that there was a positive and significant influence of motivational regulation strategies on writing test scores. What is more, it is proposed that self-regulation directly affected students' academic success, task performance, literacy achievement as well as exam results (Abbott and Lee, 2023; Morosanova and Fomina, 2017; Li et al., 2023; Zheng and Li, 2016; Morosanova et al., 2023). Therefore, to promote students' academic performance, one of the key points is improving the level of self-regulation. The present study suggests that there

are two paths to improve students' self-regulated learning: The dimensions of self-regulation and the predictors of self-regulation.

Firstly, the dimensions of self-regulation decide the general level of self-regulation. There are several dimensions that can be draw from the review above. According to the MSLQ (Pintrich, 1991) which is one of the commonly used and reliable instruments, students' goals, beliefs, their anxiety in a course, the use of cognitive and metacognitive strategies, and student management of learning resources are key components of their self-regulation ability. Another important measure—the SRPLAQ (Morosanova et al., 2011) also emphasized the important of students' learning goals. In addition, the aspects of planning, programming and results evaluation occupy an important place (Morosanova and Fomina, 2017), which is consistent with the opinion of three cyclical phases of self-regulatory process proposed by Zimmerman (2002) advocating the effects of goal setting, planning, self-observation, and self-reflection in self-regulation. Therefore, when it comes to the improvement of learning performance, teachers can start with helping students set appropriate goals, improving their beliefs as well as their ability of planning and managing to help students improve their self-regulation in learning.

Secondly, the level of self-regulation in learning can be determined by some predictors. From the 32 included studies that were reviewed in the present study, it can be concluded that self-efficacy (An et al., 2021; Derakhshan and Fathi, 2024; ElSayad, 2024; Koh et al., 2022), emotions (Abbott and Lee, 2023; An et al., 2021; Li et al., 2023; Martin et al., 2022; Morosanova et al., 2023; Morosanova and Fomina, 2017; Zheng and Li, 2016) and motivation (Morosanova et al., 2023; Zheng and Li, 2016) are three notable predictors of self-regulated learning. That means, the levels of self-efficacy, emotions and motivation are closely related to self-regulated learning. In teaching context, the self-efficacy, emotions and academic motivation of students are the aspects that teachers should observe, which will have an important and indirect impact on students' academic performance.

4.2. Strengths and limitations

The present study conducted a comprehensive search of studies that are exploring the mediating role of self-regulated learning in the context of academic learning in the databases WOS, SCOPUS, APA PsycInfo, and ERIC using scientific searching methods. Reviewers of this study finally included 32 studies that met the criteria for further reviewing by screening through the titles, abstracts, and main content of the searched studies. This study provides a systematic review of current studies on how psychological factors influence students' learning outcomes and assesses the mediating role of self-regulated learning in the process, which hence strongly supports the opinion that self-regulated learning acts as a mediator and directly influences learning outcomes. The results of reviewing with scientific nature have certain reference value.

However, this study has its limitations. On the one hand, some studies reviewed only have a relatively small number of samples which may result in unreliable conclusions. On the other hand, in some studies, authors only presented the results of data processing by software without providing detailed and clear descriptions of the

results, resulting in limited information we can obtain from them, which may affect the results of our literature review.

4.3. Implications for future research

A research trend can be seen from this review on 32 included studies. Since 2021, there are 4 studies (An et al., 2021; Derakhshan and Fathi, 2024; ElSayad, 2024; Koh et al., 2022) investigating the mechanism of self-efficacy influencing students' academic outcomes and the role of self-regulated learning during the process. In addition, the effect of aspects of emotions such as anxiety and stress (Li et al., 2023), worry (Morosanova and Fomina, 2017), enjoyment (An et al., 2021) on students' academic outcomes has also become a hot topic in recent years. Therefore, it is suggested that researchers can probe into the influence of specific dimensions of self-efficacy on learning performance through self-regulated learning and the influence of positive emotions such as resilience on learning outcomes with self-regulated learning as mediator.

5. Conclusion

Aiming to summarize what kind of personal factor influence students' academic performance through self-regulated learning and assess the potential mediating role of self-regulated learning in students' learning process, we conducted a systematic literature review. According to the results of reviewing, we concluded that self-efficacy, emotions and motivation are significant predictors of academic achievement and self-regulated learning is indeed a mediator in this relationship. The findings of this study highlight the importance of self-regulated learning in academic context, encouraging teachers help students cultivate the ability of using self-regulated learning strategies to enhance their learning performance by various methods. It is expected to provide valuable references for future research in this field.

Author contributions: Conceptualization, JC and MRMR; methodology, JC, MRMR, HC, RW and ZL; software, JC; validation, JC and MRMR; formal analysis, JC; investigation, JC, MRMR, RW and ZL; resources, JC; data curation, JC and MRMR; writing—original draft preparation, JC; writing—review and editing, MRMR; visualization, HC, RW and ZL; supervision, MRMR; project administration, MRMR; funding acquisition, MRMR. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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Appendix

Table A1. Systematic literature review.

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
1	Ma et al. (2024)	To look into the relationship between the big five personality traits and academic achievement and to investigate if cognitive strategy use and self-regulation have a mediation effect on these personality traits.	Independent Variable: Big five personality traits (extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience) Mediator: Cognitive strategy use and self-regulation Dependent Variable: Academic achievement	Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich and De Groot, 1990)	N = 430 Age: Above 18 (The second-, third- and fourth-year Chinese international students) Design: Cross-sectional	Direct effect: CON → CGPA (β = 0.052, p = 0.369) OPE → CGPA (β = 0.035, p = 0.518) Indirect effect (through SR): CON → CGPA (β = 0.046, p = 0.035) OPE → CGPA (β = 0.029, p = 0.034)	1) Self-regulation fully mediates the relation between conscientiousness and CGPA. 2) Self-regulation fully mediates the relation between openness to experience and CGPA.
2	Zhou et al. (2021)	To investigate the relationships between relatedness, online self-regulated learning (OSRL), perceived learning gains, and satisfaction among Chinese undergraduates during the COVID-19 pandemic	Independent Variable: Relatedness Mediator: Online self-regulated learning (OSRL) Dependent Variable: Perceived learning gains and satisfaction	Online Self-Regulated Learning Questionnaire (OSLQ) (Barnard et al., 2009)	N = 593 Gender: 23.43% M, 76.57% F Age: M = 19.98, SD = 1.45 Design: Cross-sectional	Regression model: R → PLG (β = −0.07, p > 0.05) R → SF (β = 0.01, p > 0.05) Indirect effect: R → OSRL → PLG (β = 0.69, p <0.001) R → OSRL → PLG → SF (β = 0.49, p < 0.001)	1) Relatedness was not associated with perceived learning gains or satisfaction. 2) There is a full mediating effect of OSRL on the relationship between relatedness and perceived learning gains 3) There is a serial mediating effect of OSRL and perceived learning gains on the relationship between relatedness and satisfaction

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
3	Musso et al. (2019).	To study the effects of basic cognitive processes on mathematics performance (MP), and the mediating effects of specific self-regulated learning factors (SRL).	Independent Variable: Basic cognitive processes such as working memory capacity (WMC) and executive attention (EA) Mediator: Self-regulated learning factors (subjective competence) Dependent Variable: Math performance	Online Motivation Questionnaire (OMQ91) (Boekaerts, 2002)	N = 575 Gender: 52.5% M, 47.5% F Age: 18 to 25 years old (M = 20.13; SD = 3.22) Design: Cross-sectional	Direct effect: WMC → MP ($\beta = 0.042$, $p < 0.001$) WMC → SC of SRL ($\beta = 0.032$, $p < 0.001$) SC of SRL → MP ($\beta = 0.283$, $p < 0.001$) EA → SC of SRL ($\beta = -2.070$, $p < 0.001$) Indirect effect: WMC → SC of SRL → MP ($\beta = 0.032$, $b = 0.061$) EA → SC of SRL → MP ($\beta = -0.004$, $b = -0.055$)	SRL component-subjective competence acts as a mediator in the relationship between cognitive processes (WMC and EA) and MP.
4	Luthans et al. (2022)	To seek a better understanding of how academic psychological capital and self-regulation are related to academic performance.	Independent Variable: Academic psychological capital Mediator: Self-regulation Dependent Variable: Academic performance/GPA	the 8-item self-regulation subscale of the Character Strengths Inventory (CSI) (Wright et al., 2017)	N = 124 Age: Undergraduate Major: Business students Design: Cross-sectional	Direct effect: Academic PsyCap → GPA ($\beta = 0.151$, $p = 0.030$) Academic PsyCap → SRL ($\beta = 0.806$, $p < 0.001$) Indirect effect: Academic PsyCap → SRL→ GPA ($\beta = 0.096$, $p = 0.017$)	1) There is a positive and significant relationship between Academic PsyCap and GPA. 2) The relationship between academic 3) PsyCap and self-regulation is positive and significant. 4) Self-regulation partially mediates the relationship between Academic PsyCap and GPA.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
5	Morosanova, Filippova and Fomina (2023)	To reveal the relationship between students' self-regulation competences, learning motivation and the peculiarities of research project implementation, and to identify the mediating role of self-regulation in the relationship between academic motivation and the final assessment of the project.	Independent Variable: Academic motivation Mediator: Self-regulation Dependent Variable: The final assessment of the project	Self-Regulation Profile of Learning Activity Questionnaire (SRPLAQ-M) (Morosanova et al., 2011)	N = 187 Gender: 59% M, 41% F Age: 15 to 16 years old Design: Cross-sectional	Regression model: Achievement Motivation → Final Project Score (β = 0.193, p = 0.009) General SR Level → Final Project Score (β = 0.233, p = 0.001) Indirect effect: Achievement Motivation → Result Evaluation → Final Project Score (b = 0.160, p = 0.031) Cognitive Motivation → Result Evaluation → Final Project Score (b = 0.172, p = 0.018)	1) Indicators of academic motivation and general level of the self-regulation are significant contributors to students' successful implementation of research projects. 2) Achievement motivation and cognitive motivation influence the success of students' project work implementation through the competence of results evaluation, which is one of the factors of self-regulation.
6	Morosanova et al. (2023)	To reveal the role of conscious self-regulation in determining psychological well-being and academic performance of young adolescents.	Independent Variable: Psychological well-being Mediator: Conscious self-regulation Dependent Variable: Academic achievement	Self-Regulation Profile of Learning Activity Questionnaire, SRPLAQ-M (Morosanova and Bondarenko, 2017)	N = 500 Age: 10 to 12 years old Design: Cross-sectional and longitudinal	Regression: Psychological well-being → self-regulation general level (β = 0.54, p < 0.001) → self-regulation general level →academic achievement (β = 0.47, p < 0.001) psychological well-being → academic achievement (β = 0.29, p < 0.001) Indirect effect: Psychological well-being → academic achievement (β = 0.007)	1) High academic performance is associated with a higher level of psychological well-being. 2) Self-regulation directly affects academic success. 3) Self-regulation mediates the influence of psychological well-being on academic success

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
7	ElSayad (2024)	To explore the impact of academic self-efficacy, student-student and student-lecturer interactions on the dimensions (planning, monitoring and regulating) of metacognitive self-regulation as well as perceived learning.	Independent Variable: Academic self-efficacy, student-student interaction and student-lecturer interaction Mediator: Dimensions of metacognitive self-regulation: planning, monitoring and regulating Dependent Variable: Perceived learning	The metacognitive self-regulation scale (Kuo et al., 2014; Pintrich et al., 1991)	N = 1675 Gender: 41.5 % M, 58.5 % F Age: 16 to 24 years old Design: Cross-sectional and longitudinal	Structural model analysis: Self-efficacy → Planning ($\beta = 0.394$, $p < 0.001$) Student–student interaction → Planning ($\beta = 0.175$, $p < 0.001$) Student–lecturer interaction → Planning ($\beta = 0.186$, $p < 0.001$) Self-efficacy → Monitoring ($\beta = 0.409$, $p < 0.001$) Student–student interaction → Monitoring ($\beta = 0.154$, $p < 0.001$) Student–lecturer interaction → Monitoring ($\beta = 0.214$, $p < 0.001$) Self-efficacy → Regulating ($\beta = 0.370$, $p < 0.001$) Student–student interaction → Regulating ($\beta = 0.286$, $p < 0.001$) Student–lecturer interaction → Regulating ($\beta = 0.198$, $p < 0.001$) Planning → Perceived learning ($\beta = 0.207$, $p < 0.001$) Monitoring → Perceived learning ($\beta = 0.095$, $p < 0.05$) Regulating → Perceived learning ($\beta = 0.403$, $p < 0.001$) Mediation analysis: Self-efficacy → Planning → Perceived learning ($\beta = 0.082$, $p < 0.001$) Student–student interaction → Planning → Perceived learning ($\beta = 0.036$, $p < 0.01$)	1) Academic self-efficacy positively influences metacognitive self-regulation dimensions (planning, monitoring, and regulating) 2) Student–student and student–lecturer interactions positively influence the dimensions (planning, monitoring, and regulating) of metacognitive self-regulation. 3) Perceived learning is significantly and positively impacted by metacognitive self-regulation dimensions 4) The influences of academic self-efficacy, student–student interaction, and student–lecturer interaction on perceived learning were significantly mediated by planning and regulating while monitoring only mediated the effects of academic self-efficacy and student–lecturer interaction on perceived learning.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
						Student–lecturer interaction → Planning → Perceived learning (β = 0.039, $p < 0.01$) Self-efficacy → Monitoring → Perceived learning (β = 0.039, $p < 0.05$) Student–lecturer interaction → Monitoring → Perceived learning (β = 0.020, $p < 0.05$) Self-efficacy → Regulating → Perceived learning (β = 0.149, $p < 0.001$) Student–student interaction → Regulating → Perceived learning (β = 0.115, $p < 0.001$) Student–lecturer interaction → Regulating → Perceived learning (β = 0.080, $p < 0.001$)	5)
8	Li and Zheng, (2016)	To examine the causal relationships among motivation, academic emotion, self-regulated learning strategies, and academic achievement in technology-enhanced learning environment.	Independent Variable: Motivation; academic emotions Mediator: Self-regulated learning strategies Dependent Variable: Academic achievement	Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991)	N = 238 Gender: 29% M, 71% F Age: 17 to 23 years old (M = 19) Design: Cross-sectional	Structural equation modeling: Motivation → self-regulated learning strategies (β = 0.63, $p < 0.001$) Academic emotion → self-regulated learning strategies (β = 0.26, $p < 0.001$) Self-regulated learning strategies → academic achievement (β = 0.17, $p < 0.01$) Sobel test: Motivation → learning strategies →academic achievement (Z = 2.47 > 1.96) Academic emotion → learning strategies → academic achievement (Z = 2.12 > 1.96)	1) Motivation and academic emotions significantly influenced self-regulated learning strategies. 2) Self-regulated learning strategies significantly affected academic achievement. 3) Motivation and academic emotions positively affected academic achievements through the mediating effect of self-regulated learning strategies.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
9	Teng and Zhang (2018)	To explore how motivational regulation functions within the SRL framework in influencing students' academic outcomes in EFL writing.	Independent Variable: Motivational regulation strategies Mediator: Self-regulated learning (SRL) strategies Dependent Variable: Writing achievement	The Writing Strategies for Self-regulated Learning Questionnaire (WSSRLQ) (Teng and Zhang, 2016)	N = 512 Gender: 39% M, 61% F Age: 18 to 24 years old (M = 21.45, SD = 1.09) Major: English-major students Design: Cross-sectional	Direct effect: Motivational regulation strategies → writing test scores (β = 0.17, p < 0.05) Motivational regulation strategies → cognitive strategies (β =0.31, p < 0.01) Motivational regulation strategies → metacognitive strategies (β = 0.45, p < 0.01) Motivational regulation strategies → social behavioral strategies (β = 0.23, p < 0.05) Cognitive strategies → writing performance (β = 0.34, p < 0.01) Metacognitive strategies → writing performance (β = 0.26, p < 0.05) Indirect effect: Motivational regulation strategies → cognitive strategies → writing performance (β = 0.11, p < 0.05) Motivational regulation strategies → metacognitive strategies → writing performance (β = 0.12, p <0.05).	1) There was a significant and positive effect of motivational regulation strategies on writing test scores. 2) Motivational regulation strategies significantly and positively influence SRL strategies (cognitive, metacognitive and social behavioral strategies). 3) Both cognitive strategies and metacognitive strategies had a significant direct effect on writing performance. 4) Both metacognitive and cognitive strategies were significant mediators of motivational regulation strategies on writing performance.
10	Martin et al. (2022)	To explore whether grit could predict students' engagement in SRL (cognitive, metacognitive, self-efficacy, intrinsic value, test anxiety, and motivation);	Independent Variable: Grit Mediator: Self-regulated learning (SRL) Dependent Variable: Academic achievement	44-item modified Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich and De Groot, 1990)	N = 134 Gender: 63% M, 37% F Age: 1% (< 18)； 35% (19–20)； 30% (21–22); 18% (23–24); 16%(> 24) Major: Civil engineering students Design: Cross-sectional	Regression model: Perseverance of effort (one dimension of Grit) → intrinsic value (one dimension of SRL) (R^2 = 0.261, p < 0.00) Perseverance of effort, current GPA range → self-efficacy (one dimension of SRL) (R^2 = 0.279, p < 0.00)	1) Perseverance of effort is a predictor for two dimensions of motivational beliefs associated with SRL (intrinsic value and self-efficacy). 2) cognitive strategy use is directly proportional to the students' perseverance of effort, consistency in their interests, and intrinsic value. 3) Perseverance of effort explained a significant amount of self-regulation variance.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
		to assess grit and SRL variability, gender, and students' current grade point average (GPA) range.				Perseverance of effort, consistency of interests (one dimension of Grit), intrinsic value (one dimension of SRL) → cognitive strategy use (one dimension of SRL) (R^2 = 0.364, $p <$ 0.00) Perseverance of effort → self-regulation (R^2 = 0.387, $p <$ 0.00) perseverance of effort, age → current GPA (R^2 = 0.179, $p <$ 0.00)	4) Students' current GPA range is directly proportional to their perseverance of effort, but inversely proportional to their age. 5) Initially, perseverance of effort predicts the current GPA; however, it was no longer a predictor after considering the SRL indicators. This difference suggests that students' SRL engagement possibly mediates the relation between academic achievement and grit.
11	Derakhshan and Fathi (2024)	To move beyond simply understanding individual effects of growth mindset, self-efficacy, and self-regulation by examining whether and how these variables collectively predict L2 speaking proficiency.	Independent Variable: Growth mindset, self-efficacy Mediator: Self-regulation Dependent Variable: L2 speaking	Self-Regulatory Control Scale for Language Learning (Tseng et al., 2017).	N = 251 Gender: 41% M, 59% F Age: 19 to 29 years old (M = 22.08, SD = 3.34) Design: Cross-sectional	Total effects: Growth mindset → L2 speaking (β = 0.465, $p <$ 0.001) Self-efficacy → L2 speaking (β = 0.468, $p <$ 0.001) Direct effects: Growth mindset → L2 speaking (β = 0.316, $p <$ 0.001) Self-efficacy → L2 speaking (β = 0.296, $p <$ 0.001) Self-regulation to L2 speaking (β = 0.435, $p <$ 0.001) Indirect effects: Growth mindset → self-regulation →L2 speaking (β = 0.149, $p <$ 0.01) Self-efficacy → self-regulation → L2 speaking (β = 0.172, $p <$ 0.01)	1) Fostering a growth mindset culture in the L2 classroom could improve the fluency and accuracy of students' L2 speaking. 2) There is a positive correlation between L2 self-efficacy and various facets of speaking performance and self-efficacy is a vital ingredient in the recipe for successful L2 learning. 3) Self-regulation is a mediator between growth mindset and speaking performance. 4) Self-regulation is a mediator between self-efficacy and speaking performance.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
12	Yeh et al. (2019)	To examine the underlying mechanism between goal orientations and academic expectation for online learners.	Independent Variable: Achievement goal orientations Mediator: SRL strategies; supportive online learning behaviors Dependent Variable: Academic expectations	Self-Regulated Online Learning Questionnaire (SOL-Q) (Jansen et al., 2017)	N = 93 Gender:10.8% M, 89.2% F Design: Cross-sectional	Measurement Models: MAP goals → SRL strategies (β = 0.61, p < 0.001) MAV goals → SRL strategies (β = −0.30, p < 0.05) SRL strategies → supportive online learning behaviors (β = 0.72, p < 0.001) Supportive online learning behaviors →expected grade (β = 0.40, p < 0.05) Sobel test: MAP goals → SRL strategies → supportive online learning behaviors (β = 0.22, p < 0.001) MAV goals → SRL strategies → supportive online learning behaviors (β = −0.11, p < 0.05) SRL strategies → supportive online learning behaviors → expected grade (β = 0.39, p < 0.05) Bootstrap method: MAP goals → SRL strategies → supportive online learning behaviors → expected grade (BootCI = [0.004, 0.339]) MAC goals → SRL strategies → supportive online learning behaviors → expected grade (BootCI = [−0.244, −0.001])	1) MAP goals had a positive impact on SRL strategies. 2) MAV goals was significantly and negatively related to SRL strategies. 3) SRL strategies had a strong and positive effect on supportive online learning behaviors. 4) Supportive online learning behaviors had significant and positive impact on students' expected grade. 5) SRL strategies mediated the positive effect of MAP goals on supportive online learning behaviors while the supportive online learning behaviors mediated the effect of SRL strategies on expected grade. 6) SRL strategies mediated the negative effect of MAV goals on supportive online learning behaviors, which, in turn, predicted expected grade.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
13	Li et al.(2023)	To examine how anxiety and stress impact the performance of Chinese doctoral students through self-regulated learning.	Independent Variable: Anxiety; Stress Mediator: Self-regulated learning Dependent Variable: Students' performance: Task performance and contextual performance	Eight items were used to measure self-regulated learning (Barnard et al., 2009)	N = 491 Gender:41.9% M, 58.1% F Age: 34.8% (aged 30 and younger); 65.2% (aged over 30) Design: Cross-sectional	Structural model: SRL → Task Performance (β = 0.703, t = 28.540, p < 0.01) SRL → Contextual Performance (β = 0.794, t = 41.641, p < 0.01) Anxiety → SRL (β = −0.095, t = 1.751, p > 0.01) Stress → SRL (β = 0.126, t = 2.182, p < 0.01) Mediation model: Stress → Task Performance (β = −0.083, t = 1.976) Stress →SRL → Task Performance (β = −0.088, p < 0.05) Stress → Contextual Performance (β = −0.067, t = 2.024) Stress →SRL → Contextual Performance (β = −0.100, p < 0.05)	1) There was a significant positive relationship existed between SRL and TP. 2) SRL significantly influenced the CP. 3) There was an insignificant negative relationship between anxiety and SRL. 4) The relationship between stress and SRL was significant and favorable. 5) SRL was a mediator between stress and performance (TP and CP).
14	Wang et al. (2023)	To examine the interplay between cognitive load and SRL and their joint roles in explaining clinical reasoning performance.	Independent Variable: Cognitive load Mediator: SRL behaviors: Performance-phase behavior Ratio (PR); the Self-reflection-phase behavior Ratio (SR) Dependent Variable: Diagnostic efficiency	The BioWorld system (Lajoie, 2009) log files	N = 27 Gender: 63% M, 37% F Age: M = 23, SD = 2.66 Design: Cross-sectional	T-test: 1) Macro-level (i.e., forethought, performance, and self-reflection): The ratio of SRL behaviors in the performance phase (PR) was significantly higher in high-load cases (M = 52.53, SD = 14.99) than that in the low-load cases (M = 41.23, SD = 12.92), t (79) = 3.10, p = 0.003. High-load cases (M = 32.06, SD = 15.14) led to a significantly lower ratio of SRL behaviors in the self-reflection phase than the low-load cases (M = 41.69, SD = 32.06), t (79) = −2.54, p = 0.013.	1) Students with a higher cognitive load had a significantly higher ratio of SRL behaviors in the performance phase but a significantly lower ratio of SRL behaviors in the self-reflection phase. 2) The micro-level SRL behaviors in the performance and self-reflection phases were affected by cognitive load levels. 3) Cognitive load negatively predicted diagnostic efficiency by influencing the ratio of SRL behaviors in the self-reflection phase.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
						2) Micro-level (Execution of performance phase and Hypothesis Evaluation of self-reflection phase): The ratio of Execution behavior was higher for the high-load cluster (M = 14.41, SD = 7.13) compared to the low-load cluster (M = 10.48, SD = 5.83), $t = 2.35$, $p = 0.21$, Cohen's d = 0.59. The ratio of Hypothesis Evaluation behavior was significantly higher in low-load cases (M = 24.80, SD = 14.14) than that in high-load cases (M = 16.53, SD = 12.95), $t = -2.15$, $p = 0.035$, Cohen's d = −0.59. Path analysis: Cognitive load → Performance-phase behavior Ratio (PR) ($\beta = 0.26$, $p < 0.01$) Cognitive load → Self-reflection-phase behavior Ratio (SR) ($\beta = -0.24$, $p < 0.05$) PR → Diagnostic efficiency ($\beta = 0.53$) SR → Diagnostic efficiency ($\beta = 0.88$, $p < 0.01$) Cognitive load → Diagnostic efficiency ($\beta = 0.04$) Cognitive load → Self-reflection-phase behavior Ratio (SR) → Diagnostic efficiency ($\beta = -0.21$, 95% CI [−0.46, −0.01]).	SRL behaviors in the self-reflection phase completely mediated the relationship between cognitive load and diagnostic efficiency.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
15	Wang and Kao (2022)	To examine the relationship between math and science academic achievement with cognitive style, self-regulated learning and working memory.	Independent Variable: Cognitive style Mediator: Self-regulated learning Dependent Variable: Academic achievement in math and science	Learning Process Inventory (LPI) (Gorden et al., 2007)	N = 191 Gender: 111 M, 80 F Age: M = 11.08, SD = 0.282 Design: Cross-sectional	• Cognitive style → Academic achievement in math and science ($\beta = 0.181$, $p < 0.01$) • Cognitive style → Self-regulated learning ($\beta = 0.194$, $p < 0.05$) →Academic achievement in math and science ($\beta = 0.306$, $p < 0.01$)	Self-regulated learning is a mediator in the relationship between cognitive style and academic achievement in math and science.
16	Rutherford et al. (2018)	To better understand how executive function and achievement maybe linked through Self-regulated learning in elementary school-aged children.	Independent Variable: Executive function; Working memory Mediator: Self-regulated learning Dependent Variable: Achievement	Item related to effort, planning and organization and attentiveness (Zimmerman, 1990; Zimmerman and Martinez-Pons, 1988)	N = 211 Gender: 49% M, 51% F Age: M = 9.04 Design: Cross-sectional	• Executive function → Self-regulated learning ($\beta = 0.21$, $p < 0.05$) → Math achievement ($\beta = 0.20$, $p < 0.05$) (Math CST Scores) • Executive function → Self-regulated learning ($\beta = 0.22$, $p < 0.05$) → Math achievement ($\beta = 0.39$, $p < 0.05$) (Math Grades)	Executive function and math achievement are partially mediated through SRL.
17	Núñez et al. (2023)	To determine the role of self-regulation in considering undergraduate engineering students' emotional intelligence and performance in online global classroom courses.	Independent Variable: Emotional intelligence Mediator: Self-regulation Dependent Variable: Performance in online global classroom courses	Five-item scale from Wong's and Law's study (2002).	N = 144 (students taking three different online courses from four international Latin American universities) Design: Cross-sectional	• Emotional intelligence → Self-regulation ($\beta = 0.284$, $z = 3.55$, $p < 0.01$) • Self-regulation → Student performance ($\beta = 0.404$, $z = 5.53$, $p < 0.01$) • Emotional intelligence → Student performance ($\beta = 0.266$, $z = 3.64$, $p < 0.01$)	Results of the mediation test affirmed that students' self-regulation partially mediated local and international students' emotional intelligence and academic performance.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
18	Gholizadeh and Rahimi (2023)	To examine the relationship between EFL learners' autocorrect use and their vocabulary size; and if their academic self-regulation mediates this association.	Independent Variable: Autocorrect use Mediator: Academic self-regulation Dependent Variable: Vocabulary Size	Academic self-regulation questionnaire (ASRQ) (Magno, 2010)	N = 101(Iranian EFL learners) Gender: Male students (grade 11) Design: Cross-sectional	• Autocorrect use → Academic self-regulation (a = 0.018) → Vocabulary size (b = 2.440) • Autocorrect use → Vocabulary size (c' =0.129)	Self-regulation mediates the relationship between autocorrect use and vocabulary size, suggesting that autocorrect use can lead to more knowledge of English words in the condition of deploying self-regulatory strategies.
19	Wang et al. (2023)	To examine whether self-regulated learning mediates the association between mental health and academic achievement among adolescents during the pandemic.	Independent Variable: Mental health Mediator: Self-regulated learning Dependent Variable: Academic achievement	Ten items from the Self-regulated Learning Scale (Zhang et al., 2008)	N = 1001 Gender: 514 M; 487 F Age: 13–20 years old (M = 17.00, SD = 0.78) Design: Cross-sectional	• Mental health → Self-regulated learning (β = −0.15, p < 0.01) → Academic performance (β = 0.60, p < 0.01) • Mental health → Academic achievement (β =0 .09, p = 0.06)	The effect of mental health on academic achievement was fully mediated by self-regulated learning.
20	Cleary and Kitsantas (2017)	To examine the relations among background variables (socioeconomic status, prior mathematics achievement), motivation variables (self-efficacy,	Independent Variable: Socioeconomic status, prior mathematics achievement Mediator: Self-efficacy and self-regulated learning Dependent Variable: Mathematics achievement	The Self-Efficacy for Self-Regulated Learning Scale is (Pajares and Graham, 1999; Pajares and Usher, 2008). The Self-Regulation Strategy Inventory–Teacher Rating Scale (SRSI-TRS) (Cleary and Callan, 2014).	N = 331 Grade: Sixth-grade students (n = 213, 64.4%); seventh-grade students (n = 118, 35.6%) Gender: 41% M; 59% F Design: Cross-sectional	• Prior achievement → Self-efficacy → SRL behaviours (95% CI [0.027, 0.093]) • Task interest → Self-efficacy → SRL behaviours (95% CI [0.11, 0.169]) • Self-efficacy → SRL behaviours → Mathematics performance (95% CI [0.021, 0.119]) • SES → SRL behaviours → Mathematics performance (95% CI [0.006, 0.075])	Both cognitive (i.e., self-efficacy) and behavioural (i.e., SRL) latent factors served as key mediators in the model, with each of these factors exhibiting unique effects on mathematics performance after controlling for prior achievement

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
		task interest, school connectedness), self-regulated learning (SRL) behaviors, and performance in middle school mathematics courses. Also, to examine the mediation roles of both self-efficacy and SRL behaviors.					
21	Chasetareh et al. (2023)	To investigated how perfectionism can be related to L2 learners' achievement with motivation and two aspects of self-regulated learning as possible mediators.	Independent Variable: Perfectionism Mediator: Self-regulated learning Dependent Variable: L2 Achievement	Self-regulated learning: Deep learning (six items) and persistence (four items) as two dimensions of self-regulated learning were assessed with 10 items from Sommet and Elliot (2017)	N = 495 (Iranian high school students) Gender: 41.2%M; 58.8% F Age: M= 16.22, SD = 0.98 (46.9% grade 10, 30.9% grade 11, and 22.2% grade 12) Design: Cross-sectional	• Rigid perfectionism → Two aspects of self-regulated learning → L2 achievement (β = 0.30, p = 0.008) • Rigid perfectionism → Deep learning → L2 achievement (β = 0.69, p = 0.004) • Rigid perfectionism → Persistence → L2 achievement (β = 0.39, p = 0.05) • Self-critical perfectionism → two aspects of self-regulated learning → L2 achievement (β = −0.12, p = 0.025) • Self-critical perfectionism → Deep learning → L2 achievement (β = −0.68, p = 0.004) • Self-critical perfectionism →Persistence → L2 achievement (β = −0.380, p = 0.047).	Both aspects of self-regulated learning, namely, deep learning and persistence could mediate the relationship between perfectionism and L2 achievement.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
22	Bempechat et al. (2018)	Is the relation between Chinese American adolescents' virtue-oriented learning beliefs and their academic achievement mediated by their SRL behaviors?	Independent Variable: Virtue-oriented learning beliefs Mediator: Self-regulated learning Dependent Variable: Academic achievement	Item derive from interviews	N = 32 (urban low-income, English-proficient Chinese American, second-generation) Age: 15 Design: Cross-sectional	• Virtue-oriented beliefs → Academic self-regulation (β = 0.62, p < 0.001) • Academic self-regulation → Academic achievement (β = 0.61, p < 0.01) • Virtue-oriented beliefs → Academic achievement (β = 0.05)	The use of SRL strategies mediated the relationship between their endorsement of virtue-oriented learning beliefs and their academic achievement
23	Abbott and Lee (2023)	To explore the complex interplay between beginning/basic level ESL literacy learners' positive and negative emotions towards learning through task-based portfolios and assessment, their SRL strategy use, and their literacy development.	Independent Variable: Emotions: Positive emotions and negative emotions Mediator: Self-regulated learning (SRL) Dependent Variable: Literacy achievement	An adapted questionnaire of the Student Learning Strategies Questionnaire (SLSQ) (Abrami and Aslan, 2007)	N = 379 Gender: 27% M, 71% F, 2% undisclosed Age: M = 39, SD = 11 Design: Cross-sectional	• Positive emotions → Negative emotions (β = 0.04, p < 0.05) • Positive emotions → Self-regulated learning (β = 0.55, p < 0.001) • Positive emotions → Literacy achievement (β = −0.44, p < 0.05) • Negative emotions → Literacy achievement (β = −0.37, p < 0.05) • Self-regulated learning →Literacy achievement (β = 0.37, p < 0.05) • Positive emotions → SRL → Literacy achievement (β = 0.21)	1) Positive emotions were positively related to negative emotions 2) Positive emotions alone significantly predicted self-regulated learning 3) Positive emotions， negative emotions and self-regulated learning were all statistically significant predictors of literacy achievement. 4) Positive emotions had an indirect effect on literacy achievement that was mediated through SRL
24	Koh et al. (2022)	To deepen the understanding of how self-efficacy is critical for ethnically diverse first-generation and	Independent Variable: Self-efficacy Mediator: Self-regulation: Emotional regulation and behavioral regulation Dependent Variable: Academic success: GPA, retention	1. Emotional regulation: Self-Rated Emotional Intelligence Scale (SREIS) (Brackett et al., 2006). 2. Behavioral regulation: adapted version of the selective primary control (SPC) subscale from Heckhausen et al.'s (1998) Optimization in Primary and Secondary Control (OPS) scale	N = 3316 Gender: 43% M, 57% F Age: M = 17.97, SD = 0.41 Design: Cross- sectional	1. Generation status Direct • Self-efficacy → GPA (β = 0.16/0.19, p < 0.001) (first-generation college students/continuing-generation college students)	1) self-efficacy has significant and positive relations with GPA for both first-generation and continuing-generation students. 2) self-efficacy has significant and positive relationship to retention only in first-generation st**udents**.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
		continuing-generation students' academic success, and to examine self-regulation as a coping strategy that can heighten the impact of self-efficacy on college success.				• Self-efficacy → Retention (β = 0.14, p < 0.05) (first generation students) Indirect • Self-efficacy → GPA (β = 0.27, p < 0.01) (first generation students) • Self-efficacy → Retention (β = 0.20, p < 0.01) (first generation students) • Self-efficacy → Emotional regulation (β = 0.70/0.55, p < 0.001) → GPA (β = −0.27/−0.21, p < .001) (first generation students / continuing-generation) • Self-efficacy → Emotional regulation (β = 0.70/0.55, p < 0.001) → Retention (β = −0.20/−0.17, p < 0.001/p < 0.05) (first generation students/continuing-generation) • Self-efficacy → Behavioral regulation (β = 0.64/0.61, p < 0.001) → GPA (β = 0.15/33, p < 0.05/p < 0.001) (first generation students / continuing-generation) • Self-efficacy → Behavioral regulation (β = 0.61, p < 0.001) → Retention (β = 0.21, p < 0.05) (continuing-generation students) 2. race/ethnicity Direct • Self-efficacy → GPA (β = 0.14, p < 0.01) (Asian American students and Latinx) • Self-efficacy → GPA (β = 0.24, p < 0.001) (White students) • Self-efficacy → Retention (β = 0.16, p < 0.01) (Latinx)	3) The total indirect effects of self-efficacy on GPA and retention through self-regulation constructs were not statistically significant regardless of generational status. 4) As for the indirect effects, each emotional and behavioral regulation significantly predicted the relationship between self-efficacy and GPA for first-generation and continuing-generation students. 5) Significant indirect effects of self-efficacy on retention via emotional regulation were found for first-generation and continuing-generation students. 6) The specific indirect effect of self-efficacy on retention via behavioral regulation was significant for continuing-generation students only. 7) The relationship between self-efficacy and emotional regulation, as well as the relationship between self-efficacy and behavioral are statistically significant and positive for all racial/ethnic groups.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
						Indirect • Self-efficacy → GPA (β = 0.22, p < 0.05) (Latinx students) • Self-efficacy → Emotional regulation (β = 0.62/0.62/0.64, p < 0.001) → GPA (β = −0.19/−0.34/−0.15, p < 0.01/p < 0.001/p < 0.05) (Asian American, Latinx and White students) • Self-efficacy → Emotional regulation (β = 0.62/0.62, p < 0.001) → Retention (β = −0.23/−0.22, p < 0.05/p < 0.01) (Asian American and Latinx students) • Self-efficacy → Behavioral regulation (β = 0.62/0.64/0.68, p < 0.001) → GPA (β = 0.33/0.24/0.37, p < 0.001) (Asian American, Latinx, and White students) Self-efficacy → Behavioral regulation (β = 0.64, p < 0.001) → Retention (β = 0.21, p < 0.05) (Latinx students)	8) Once emotional and behavioral regulation were added to the model, the association between self-efficacy and GPA for Asian American and White students and the association between self-efficacy and retention for Latinx students were no longer significant, reflecting full mediation. 9) There were neither full nor partial mediation effects of the relationship between self-efficacy and GPA for Latinx students. 10) The total indirect effects of self-efficacy on GPA and retention through self-regulation constructs were not statistically significant for any racial/ethnic groups. 11) Both emotional and behavioral regulation significantly predicted the relationship between self-efficacy and GPA for Asian American, Latinx, and White students. 12) Significant indirect effects were found for self-efficacy on retention via each emotional and behavioral regulation among Latinx students.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
							13) When examining the indirect effect of self-efficacy on retention via emotional regulation for Asian American students, differential significance levels of the indirect effect have been found: the *p*-value was not significant ($p = 0.05$), while the 95% CI was significant. Therefore, this significant indirect effect should be interpreted with caution.
25	Morosanova and Fomina (2017)	To find an empirical answer to the question: can the conscious self-regulation development not only directly affect the academic success level, but also serve as a mediator of the other psychological characteristics' influence on achievements.	Independent Variable: Worry Mediator: General level of self-regulation Dependent Variable: Exam results	Morosanova's Self-Regulation Profile of Learning Activity Questionnaire (SRPLAQ)	N = 231 Gender: 53% M, 47% F Age: 16-18 Grade: 11th (out of 11) grade of the Russian formal educational system Design: Cross-sectional	• Worry → General level of self-regulation ($\beta = -0.39$, $p = 0.0000$) → Exam results ($\beta = 0.30$, $p = 0.000$)	1) Higher level of worry will result in lower level of general self-regulation. 2) Higher level of general self-regulation will result in better exam results
26	Zielińska et al. (2021)	To explore how cognitive and metacognitive skills, primarily self-regulation, contribute to creativity in learning.	Independent Variable: Creative potential Mediator: Creative confidence; self-regulation Dependent Variable: Creative learning	The Polish version of Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991; 1993)	N = 1346 Gender: 46%M, 54%F Grade: 52% elementary, 48% middle school Design: Longitudinal	• Creative potential → Creative confidence → Self-regulation → Creative learning ($\beta = 0.01$, $p < 0.001$) • Self-regulatory strategies → Creative confidence → Creative learning ($\beta = 0.015$, $p < 0.001$)	1) Creative confidence and self-regulation mediate the relationship between creative potential and creative learning. 2) Self-regulatory strategies mediate the relationship between creative confidence and creative learning.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
27	Tee et al. (2021)	To examine a self-regulation model of mathematical reasoning performance and academic achievement based on Zimmerman's (1989) triadic analysis of self-regulation grounded in social cognitive theory.	Independent Variable: Motivational regulation Mediator: Behavioral regulation; cognition regulation; reasoning ability Dependent Variable: Reasoning ability; academic achievement	A questionnaire adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) (Artino, 2005) A questionnaire adapted from Wu (2005) Mathematical Reasoning Test adapted from the National Assessment of Educational Progress (NAEP) released items (National Center for Education Statistics, n.d.)	N = 248 Gender: 109 M, 139 F Grade: Eleventh-grade students Age: Between 17 and 18 years old Design: Cross-sectional	• Motivational regulation → Cognition regulation – Reasoning ability (β = 0.110, p < 0.05) • Motivational regulation → Behavioral regulation → Cognition regulation (β = .083, p < 0.05) • Motivational regulation → Behavioral regulation → Academic performance (β = 0.185, p < 0.005) • Motivational regulation → Cognition regulation → Reasoning ability → Academic performance (β = 0.038, p < 0.05) • Motivational regulation → Reasoning ability → Academic performance (β = 0.103, p < 0.005)	1) Cognition regulation mediates the relationship between motivational regulation and reasoning ability. 2) Behavioral regulation mediates the relationship between motivational and cognition regulations. 3) Behavioral and cognition regulation process as well as reasoning ability mediate the relationship between motivational regulation and academic achievement.
28	Trentepohl et al. (2023)	To test a mediation model derived from process theories of self-regulated learning, specifically examining whether students' knowledge about resource-management strategies	Independent Variable: RM (Resource-management) strategy knowledge Mediator: RM strategy use Dependent Variable: Academic performance	1. Time-management strategy use: Participants' reading count of words per minute of learning activity was used as a standardized value for their processing time per lesson. 2. Effort-regulation strategy use: Each of the online lessons ended with practice questions, and the corresponding value is the indicator that aimed at measuring students' effort even when faced with learning difficult	N = 106 Gender: 71.7% M, 28.3% F Age: M = 20.8 SD = 3.1 Design: Longitudinal and cross-sectional	• Time-management strategy knowledge → Time-management strategy use (β_a = 0.29, p = 0.009) → Academic performance (β_b = 0.36, p < 0.001) • Effort-regulation strategy knowledge → Effort-regulation strategy use (β_a = 0.30, p = 0.009) → Academic performance (β_b = 0.31, p = 0.006) • Help-seeking strategy knowledge → Help-seeking strategy use (β_a = 0.22, p = 0.022) → Academic performance (β_b = 0.49, p < 0.001)	1) This study concluded that students' strategic learning behavior mediates the effect of their strategy knowledge on academic performance. 2) This study highlighted the importance of turning knowledge into situational appropriate behaviors for positive learning outcomes. 3) Time management, effort regulation, and help-seeking were identified as particularly influential resource-management strategies in this context.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
		(independent variable) affects their academic performance (dependent variable) through the behavioral manifestation of these strategies (mediator).		or uninteresting lessons, inspired by items from established inventories (MSLQ) (Pintrich et al., 1991). 3. Help-seeking strategy use: The quality of task performance here was considered as a measure of the success of students' help-seeking skills. Students received one point for each correct response. These points were then converted into values for percentage correctness. This indicator was inspired by items from established inventories (LIST) (Boerner et al., 2005).		4) The use of objective behavioral data strengthens the validity of the findings, contributing to a more comprehensive understanding of self-regulated learning processes in higher education.
29	An et al. (2021)	To investigate Chinese university students' technology-assisted self-regulated learning (SRL) strategies and examine whether these technology-based SRL strategies mediate the relationships between English language self-efficacy, English enjoyment, and learning outcomes.	Independent Variable: Self-efficacy and English enjoyment Mediator: Self-regulated learning (SRL) strategies Dependent Variable: English learning outcomes	Technology-based SRL strategies were assessed with a newly proposed self-report questionnaire (TSRLSQ)	N = 525 Gender: 148 M, 377 F Age:17 to 25 (M = 20.50, SD = 7.97) Design: Cross-sectional	• English enjoyment → SRL strategies ($\beta = 0.45$, $p < 0.001$) →English learning outcomes ($\beta = 0.29$, $p < 0.001$)) • Self-efficacy →SRL strategies ($\beta = 0.35$, $p < 0.001$) → English learning outcomes ($\beta = 0.29$, $p < 0.001$)	1) The study highlighted the importance of technology-assisted SRL strategies in improving learning outcomes, emphasizing the roles of self-efficacy and enjoyment in fostering technology use. 2) It suggests that SRL strategies act as a crucial mediator connecting learners' perceptions and outcomes, underlining the potential benefits of technology integration in language learning contexts. Future research should explore the external validity of the scale and consider more variables such as prior learning experiences and technology willingness.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
30	Zhu et al. (2016)	To explore the influence of self-control (dispositional personality trait) and self-regulated learning (students' capability to use strategies towards learning goals) on learning outcomes within a blended course environment. The investigation focused on whether self-control's impact on outcomes was mediated by self-regulated learning and course participation.	Independent Variable: Self-control Mediator: Self-regulated learning strategies Dependent Variable: Learning outcomes	The items measuring the participants' self-regulated learning in the present study were based on the scales used by Pintrich et al. (1991; 1993), Pintrich and De Groot (1990), Lan et al. (2004), and Barnard et al. (2008).	N = 94 Grade: Second-year education (University) students Design: Longitudinal and cross-sectional	• Performance orientation Total effect accounted for in the PLS model 0.141 Direct effect (performance orientation to learning outcomes) 0.030 (21%) Indirect effect mediated through course participation 0.111 (79%) • Self-management Total effect accounted for in the PLS model 0.26 Direct effect (self-management to learning outcomes) 0.16 (62%) Indirect effect mediated through course participation 0.10 (38%) • Metacognitive Total effect accounted for in the PLS model 0.07 Direct effect (metacognitive awareness to learning outcomes) 0.0 Indirect effect mediated through course participation 0.07 • Intrinsic orientation Total effect accounted for in the PLS model 0.21 Direct effect (intrinsic orientation to learning outcomes) 0.21 Indirect effect mediated through course participation 0.0	The research supported the significance of self-control and self-regulated learning strategies for tertiary students' academic achievement in blended learning environments. It highlighted self-control's indirect influence through self-regulation and course participation as a mediator, underscoring the need for a comprehensive view of students' self-regulated learning in digital environments. Future studies may consider additional variables and longitudinal designs to strengthen these findings.

Table A1. (*Continued*).

N	Author	Aim of Study	Variables	Self-Regulatory Measure	Participants and Method Design	Statistical Results	Findings
31	Sari (2022)	To examine the direct impact of students learning on the academic performance of students in flipped classes.	Independent Variable: Student learning experience Mediator: Self-regulated learning; computer simulation Dependent Variable: Academic performance	Not mentioned	N = 256 Design: Cross-sectional	• Student LE → Academic Performance Original sample (O) = 0.519 M = 0.522 STDEV = 0.072 T statistics (|O/STDEV|) = 7.216 *P* values= 0.000 • Student LE → Computer Simulation → Academic Performance Original sample (O) = 0.270 M = 0.269 STDEV= 0.135 T statistics (|O/STDEV|) = 2.005 *P* values= 0.022 • Student LE →Self-Regulated Learning → Academic Performance Original sample (O) = 0.270 M = 0.269 STDEV = 0.135 T statistics (|O/STDEV|) = 2.005 *P* values = 0.022	1) Student learning experience can improve the academic performance of physics students. 2) Self-Regulated Learning as mediator in the relationship between learning experience and academic performance. 3) Computer simulation as mediator in the relationship between learning experience and academic performance.
32	Lee (2022)	To investigate the effect of adolescents' PAPS on future achievement with consideration of self-regulation, academic self-concept, and past achievement.	Independent Variable: Persistent academic possible selves (PAPS) Mediator: Self-regulation Dependent Variable: Future academic achievement	Motivational Strategies for Learning Questionnaire (MSLQ) (Pintrich and De Groot, 1990).	N = 102, 98, 98 Age: M = 14.58 years (SD = 1.77), 14.58 years (SD = 1.78), and 14.92 years (SD = 1.83) Design: Longitudinal	• PAPS→ Future academic achievement (Direct effect, *b* =−0.21, *t* (86) = −1.45, *p* = 0.150, 95% CI [−0.51, 0.08]) • PAPS → Self-regulation → Future academic achievement (*b* = 0.31, 95% BCI [0.14, 0.55])	PAPS alone could not significantly predict future grades. However, self-regulation changed the relationship to be significant, that is, self-regulation mediated the relationship between PAPS and future achievement.