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Research Paper

The association between self-regulated learning and writing achievement in a blended learning environment: The possible predictors

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Abstract
A comprehensive portrait of self-regulated learning (SRL), measured through multi-tools concurrently in a blended learning environment, remains relatively underexplored in the context of second language writing. The aims of the study were to examine the association between learners' SRL strategies assessed using multiple tools (SRL questionnaire, teacher rating, and error detection tasks) and writing achievement and to test the power of SRL strategies from different types of measurement tools in predicting students' writing achievement. The participants of the study were 104 undergraduate EFL students, who had experienced a blended learning environment. These participants were voluntarily recruited across four private universities in Indonesia. Correlation analysis was utilized to determine the associations among the variables, and a multiple regression analysis was employed to indicate the predictors of learners' writing achievement. The study revealed a significant, moderate level of interconnection between SRL strategies measured using multiple tools and writing achievement. However, only SRL strategies from teacher's rating significantly predicted writing achievement. Accordingly, the finding suggests that while various measures may demonstrate interrelations, the assessment of SRL strategies provided by teachers holds particular significance in predicting actual writing success. This study supports the assertation to include multi-faceted SRL measurement tools to comprehensively assess students' SRL.

Keywords: Blended Learning, Error Detection Task, Self-Report Questionnaire, Teacher Ratings, Self-regulation Writing

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1. Introduction

Writing is a complex process involving cognitive, metacognitive, and task managerial skills from generating ideas, outlining them, drafting, revising, editing, and publishing. Such a complex process requires abilities to regulate oneself and maintain motivation, key elements to writing success. Scholars have acknowledged that self-regulated learning (SRL) could enhance and predict students' writing achievement through activation of critical thinking and learning independently, as well as improvement of self-efficacy and learning motivation (Bai & Wang, 2021; Li, 2024; Teng & Huang, 2019; Wijaya, 2021).

As a high-level learning capacity, SRL integrates the triadic process which involves personal, behavioural, and environmental domains, permitting students to proactively employ a particular multi-dimensional process and strategic plans and adjustments to achieve learning objectives (Pintrich, 2000; Xu et al., 2023; Zimmerman, 1990). Consequently, high self-regulated learners are persistent, well-organized, motivated, and accountable for the learning task because they can design the learning goals and plans, empower the learning strategies, and make their reflection.

Research on SRL has been conducted across a range of learning contexts, including conventional, digital, and the combination between conventional and digital or known as blended learning, focusing on different SRL facets (Singh & Thurman, 2019; Xu et al., 2023; Yang et al., 2024). In a blended learning context, students can learn from multiple learning environments (virtually and physically) which they can choose according to their learning situations and preferences. Students' SRL in a blended learning can be optimized because blended learning offers more interactions, opportunities, and responsibilities for students to employ their cognitive and metacognitive skills (Nikolopoulou, 2023; Tsai, 2010).

Literature shows that students' SRL can be measured as an aptitude as well as an event. SRL as an aptitude depicts an individual's general characteristics which are commonly assessed through self-reported questionnaires, interviews, and teacher's judgment (Roth et al., 2016). Questionnaire, the most commonly used SRL instrument, yields information about learners' memories in applying their cognitive and metacognitive processes in a large-scale measurement (Roth et al., 2016; Xu et al., 2023), and this tool has recently been integrated with technology utilization. For example, an online self-regulated learning questionnaire (OSLQ) developed by Barnard et al. (2009), which consists of 24 items covering six subscale constructs of goal setting, environment structuring, time management, task strategies, help seeking, and self-evaluation, has been widely used in this digital era. Numerous studies have employed the OSLQ and revealed that the SRL students' learning outcomes correlated with technology acceptance (Apridayani et al., 2023; Lim et al., 2020; Supriyono et al., 2020; Zhu et al., 2016). Nevertheless, this instrument fails to capture students' detailed SRL and is unable to provide accurate and specific learning activities in the classroom because it depends only on individuals' evaluation (Cleary et al., 2020; Panadero et al., 2016; Pintrich, 2004; Schunk & Greene, 2017; Summers, 2012; Winne & Perry, 2000). This implies the need for exploring students' SRL with other instruments to elicit more comprehensive data.

Teachers' rating, another SRL aptitude measurement, enables teachers to rate the qualities of students' SRL strategies by directly observing their learning behaviors in the classroom. Zimmerman & Pons (1986) developed SRL interview to assess SRL strategies and behaviors in relation to seeking assistance and information, evaluating students' performance, organizing and transforming information or goal setting and planning. Several researchers have tested the validity of the tools (Miller et al., 2014;Torrington et al.,

2024; Vandevelde et al., 2017). Nonetheless, since self-report questionnaires (SRQs) and teacher ratings are generally employed to evaluate traits and procedures at a general level, students' learning behaviors depicting how they applied their SRL strategies remain unraveled when assessed through these aptitude measures. Thus, utilizing instruments exposing students' detailed SRL capability and endeavor in doing a particular task is required.

SRL as an event, in contrast, is a record of every single moment or specific situation done by students in doing learning tasks. SRL as an event can be assessed through several behavioral measures, including error detection tasks (Cleary et al., 2020; Schunk & Greene, 2017; Zimmerman, 2000). Error detection tasks enable teachers to monitor whether the errors are recognized and what students can do after identifying those errors. Studies have revealed that utilizing this measurement had significant and positive association with students' writing achievement and bridged the their engagement in the self-regulation cycle (Abedi et al., 2010; Zamora, Súarez, et al., 2018; 2018). Since different instruments have their own benefits and limitations, applying various instruments is essential to gain deep information of students' SRL and to ensure the validity of the instruments. Understanding interconnections among different SRL protocols could assist researchers to infer data from multiple measurement frameworks that can help capture the actual picture of learners' SRL. Nevertheless, assessing students' SRL using multi-channel data such as self-report questionnaire, teachers' rating, and error detection tasks in a blended learning environment within writing subject is relatively scarce.

Therefore, it is important to dig more deeply into students' SRL and to unveil the correlations and predicting power of SRL strategies measured through multiple SRL tools and students' writing achievement in a blended

learning environment. This investigation was shaped by the following research questions:

1) To what extent are learners' SRL strategies assessed through self-reported questionnaire, teacher rating, error detection tasks, and writing achievement related in a blended learning environment?
2) Which SRL tools (self-reported questionnaire, teacher rating, and error detection tasks) can provide a predicting power on students' writing achievement in a blended learning context?

2. Literature Review

2.1 Self-Regulated Learning

SRL is an internal drive navigating student to employ a certain self-regulated process, strategy, or response to achieve the learning objectives (Zimmerman, 1990). SRL capacity permits students to decide their own self-evaluation and monitoring; goal setting and strategic planning; strategy implementation and monitoring; and strategic outcome monitoring (Zimmerman; 1998). SRL process is divided into three cyclical phases such as forethought, performance, and self-reflection Zimmerman (2000). Forethought processes are applied by students before attaining a learning task exhibiting analysing task such as setting up the learning target and deciding learning plan; and nurturing their own-motivation belief involving self-efficacy and task interest processes. Next cyclical is performance stage where the processes are performed during the learning activity reflecting how students employ their own directed learning strategies (for example, strategies in doing a task, seeking support, and self-consequences) and own monitoring (such as metacognition observation, self-documenting). Lastly, the processes that take place after the learning process is called self-reflection In this stage, the

learning activity involving self-judgments and self-reactions (Follmer & Sperling, 2019; Zimmerman; 2000; Zimmerman & Schunk, 2011).

Other scholars (Winne & Hadwin, 1998) conceptualized SRL as a four-stage process, including defining the task; setting learning target and deciding learning plan; enacting study tactics and strategies; and metacognitively adapting studying for the future. These two conceptual processes can be considered as the core of effective learning because both involve cognitive, metacognitive, affective, motivational and behavioral learning processes that help students generate and activate various cognitive and metacognitive learning strategies and behaviors for successful learning (Funa et al., 2023; Xu et al., 2023; Zeidner et al., 2000; Zimmerman & Schunk, 2011; Zimmerman, 2000). Research indicates that students with well management of SRL process will be able to design their own learning strategies to achieve the learning goal (Zhu et al., 2016) and develop non-academic achievement (e.g. emotional engagement and behavior) as a result of activities associated with coping with learning problems, selecting and applying of appropriate strategies, evaluating of own performance, and independent learning.

In the context of writing, studies have proven that SRL skills influenced, correlated, and predicted student's writing achievement. For example, Eslami & Sahragard (2021) examined the effect of self-regulatory strategy instruction on 50 intermediates Iranian EFL learners' writing abilities. The findings showed that learners' writing skills were significantly impacted by their self-regulatory strategy. In addition, Abdulhay et al. (2020) investigated the association between Iranian EFL university students' goal orientation and their writing self-regulation. The finding of the study revealed that students' SRL goal orientation significantly correlated and predicted students' writing achievement.

2.2 Relationship between SRL Strategies and Writing Achievement

Students' SRL strategies have been extensively studied in relation to writing achievement. Research has shown that employing SRL strategies in writing can lead to various benefits such as improving critical thinking skills, enhancing autonomy, elevating motivation, self-efficacy, and ultimately improving writing skills (Li, 2024). Studies have also indicated that self-regulated reading-to-write (SR-R2W) is a beneficial predictor of writing competence (Bai & Wang, 2021; Rezaei et al., 2024). Furthermore, the utilization of self-regulated writing strategies has been linked to and enhanced EFL writing skills engagement and proficiency among undergraduates and secondary school learners (Modarresi, 2025; Teng & Huang, 2019).

The literature suggests that SRL plays a crucial role in improving writing performance. Self-Regulated Strategy Development (SRSD) has been shown to enhance various aspects of students' writing performance, including genre elements, quality of writing, knowledge of writing, approach to writing, motivation, and self-efficacy (Harris & Graham, 2016). Additionally, the implementation of self-regulated learning strategies has been found to significantly increase EFL learners' self-efficacy, motivation, and writing performances (Wijaya, 2021). Despite the existing research, there is a need for more studies investigating the predictive impact of self-regulated writing strategies on EFL writing expertise (Dharma & Adiwijaya, 2018).

2.3 Measuring SRL as Aptitude and Event

2.3.1 Self-Reported Questionnaire

SRL is a critical aspect of effective learning, encompassing a range of cognitive, metacognitive, and motivational strategies that students use to

manage their own learning processes. Several self-reported questionnaires have been developed to assess SRL, each focusing on different dimensions of this complex construct. The most known SRL questionnaire is Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich and De Groot (1990). The MSLQ assesses students' motivational orientations and their diverse learning strategies utilization. It includes scales for intrinsic and extrinsic goal orientation, task value, control of learning beliefs, self-efficacy, test anxiety, cognitive strategy use, and self-regulation. The MSLQ provides a comprehensive picture of how motivation and strategy use contribute to academic performance.

The second most known instrument is Self-Regulated Learning Interview Schedule (SRLIS) developed by Zimmerman and Martinez-Pons (1986). The schedule uses structured interviews to evaluate students' use of SRL strategies. The SRLIS focuses on specific strategies that students use across different phases of learning, such as setting up the learning target, deciding learning plan, monitoring and reflecting own performance. This tool provides qualitative insights into the processes that underlie SRL and has been widely employed in educational research to understand how students manage their learning in various contexts. Learning and Study Strategies Inventory (LASSI) was developed by Weinstein, Schulte, and Palmer (1987) and is designed to assess students' awareness about and use of learning and study strategies related to skill, will, and self-regulation. The LASSI includes ten scales: anxiety, attitude, concentration, information processing, motivation, selecting main ideas, self-testing, study aids, time management, and using academic resources. The LASSI helps educators identify areas where students may need support to enhance their self-regulation and study skills.

SRL questionnaires have also been developed in the context of online learning. In this context, the most prevalent instrument to examine SRL is the Online Self-Regulated Learning Questionnaire (OSLQ) (Xu et al., 2023; Roth et al., 2016). The OSLQ has 24-items scale with a 5-point Likert-type response format having values ranging from strongly agree (5) to strongly disagree (1). The OSLQ consists of six subscale constructs including: goal setting; environment structuring; time management; task strategies; help seeking; and self-evaluation (Barnard et al., 2009). The OSLQ aims to provide a tool for evaluating students' self-regulatory learning skills in both the online and blended learning environments.

2.3.2 Teacher Ratings

Teacher ratings are an important tool for assessing students' SRL strategies. These ratings provide an external perspective on students' learning behaviours and can complement self-reported measures by offering insights that students themselves might overlook or misrepresent. Several structured rating systems and scales have been developed to help teachers evaluate SRL strategies effectively. The Teacher Rating of Self-Regulation (TRSR) is a structured tool designed to assess students' SRL behaviours in classroom settings. Developed by Cleary (2006), the TRSR focuses on observable behaviours related to goal setting, strategic planning, self-monitoring, and self-reflection. Teachers use this scale to rate how frequently students exhibit these behaviors during learning activities. The TRSR provides valuable data on how students apply SRL strategies in real-time, enabling educators to identify areas where students may require further assistance or instruction.

The Classroom Strategies Scale (CSS), developed by Dembo and Seli (2004), is another tool that allows teachers to assess SRL strategies. The CSS includes items corelated with students' use of cognitive, metacognitive, and

resource management strategies. Teachers rate the frequency and quality of students' behaviors such as planning, organization, self-checking, and seeking help. This scale helps teachers to systematically observe and document students' SRL practices, providing a structured framework for evaluation. The Self-Regulation Strategy Inventory - Teacher Rating Scale (SRSI-TRS), developed by Cleary et al. (2014), is specifically designed for teachers to assess the SRL strategies of their students. The SRSI-TRS includes items that measure goal setting, strategic planning, self-monitoring, and self-evaluation. Teachers rate the frequency with which students use these strategies and how effectively they implement them. This scale provides detailed information about students' SRL behaviours from the teacher's perspective, contributing to a comprehensive understanding of their self-regulation skills.

2.3.3 Error Detection Tasks

Error detection tasks have also been employed to evaluate students' thoughts, processes, or behaviors during one task. Error detection tasks, SRL measurement in which the teacher provides materials with some errors and monitors whether the errors are recognized and what students do after identifying the errors. Various variations of error detection have been developed with respect to (a) the context within which students report errors and (b) measurements that reflect detection (monitoring) of errors and subsequent exercise of metacognitive control (Zimmerman, 2000; Winne & Perry, 2000). Utilizing this type of SRL measurement had a strong and positive association with students' writing performance (Zamora, Suárez, et al., 2018). Employing error detection as an instrument has widely been implemented by numerous researchers. For example, Zamora, Súarez, et al., (2018) who employed this instrument to measure the student errors identification capability by giving an assessment script with several aspects

that need to be considered each correct answer. The study findings show that error detection is an essential aspect affecting students' performance because it bridges the students' engagement in the self-regulation process. Thus, research examining the relationships among these SRL measurements; self-report questionnaire, teacher's rating, error detection within the context of blended learning in relation to students' writing achievement need more attention.

2.4 Association among SRL Questionnaire, Teacher Rating, Error Detection Tasks and Writing Achievement

Research in the field of SRL has explored various aspects related to its assessment and impact on academic achievement. Studies have successfully utilized questionnaires and interviews to predict students' academic outcomes based on their SRL strategies (Zimmerman, 2008). The validation of instruments like The Writing Strategies for SRL Questionnaire has been conducted to understand the multifaceted structure of SRL strategies in specific contexts such as English as a foreign language (EFL) writing (Teng & Zhang, 2016). Additionally, the association between executive functioning and SRL has been investigated, showing correlations between teacher-rated SRL and task-based inhibition and working memory in children (Davis et al., 2021).

The predictive validity of teacher rating scales, such as the Self-Regulation Strategy Inventory-Teacher Rating Scale (SRSI-TRS), has been examined in relation to student self-report measures of SRL, indicating convergence between teacher ratings and student perceptions of self-regulated learning (Cleary & Callan, 2013). Research have also emphasized the importance of feedback in promoting SRL strategies among students,

with feedback-seeking orientation positively associated with SRL writing strategies (Xu, 2021). Moreover, the role of technology tools, such as learning management systems and automated writing evaluation platforms, has been emphasized in assisting students in enhancing their SRL and writing performance (Yang-xi et al., 2021).

Despite these advancements, research gaps exist in the field of SRL concerning the need for empirical evidence to support conceptual associations, particularly focusing on various components of writing proficiency (Dong, 2023). There is a call for further investigation of the implication of SRL on learning achievement in online classes to aid teachers in enhancing students' performance in virtual learning environments (Tajudin et al., 2022). Moreover, disagreements persist regarding the effect of different measurements of SRL on learning achievement, indicating a need for more comprehensive and standardized approaches to assess SRL effectively (Rovers et al., 2019). In this research, we address this gap by investigating relationship between error detection task and self-reported SRL tools.

2.5 Measuring SRL in a Blended Learning Context

Measuring students' SRL has been evolved to the utility of ICT because of emerging online, digitally aided instruction. Many schools and institutions offer a blended learning approach for instruction. From this perspective, SRL measurement must be adapted so that it is in alignment with different types of learning: physical and digital learning. In a blended learning context, students SRL can be assessed through self-reported tools and task-based tools, depending on in what mode of learning the measurement takes place. The incorporation of technology and traditional learning mode enable students to employ their SRL strategies by involving human and non-human aspects. Human instruction covers student-teacher; students-student; and students-

expert. Additionally, for the non-human instruction is divided into students-tool; student-content; students- environment. (Hanna et al., 2000; Eggers at al., 2021).

Research on SRL in digital contexts has indicated that SRL has implication towards the students learning outcome (Al-Abdullatif, 2020; Nejati, 2022; Shih et al., 2019) and has strong correlation with students learning achievement and technology acceptance (Apridayani et al., 2023; Supriyono et al., 2020). Furthermore, in blended learning environment, students' metacognitive skills are well transferred through face to face interaction as well as from the distance affecting students' metacognitive abilities on their learning behaviour and achievement and aligned with students' task performance (Stebner et al., 2022; Torrington et al., 2024; Van Laer & Elen, 2019). Studying in two subsequent learning environment, virtual and hybrid, students' formative and summative assessment were significantly predicted by their SRL strategies such as self-efficacy, time management, and effort regulation (Broadbent et al., 2021).

Additionally, blended learning environment influences and connects with students' academic achievement, autonomy, attitude, and SRL skills (Chang et al., 2023; Chen, 2024; Funa et al., 2023; Kaptanoğlu & Kavanoz, 2024; Li et al., 2023; Müller & Mildenberger, 2021; Tong et al., 2022). The aforementioned studies shed light on the crucial implication of implementing blended learning approaches to elevate student interactions, learning outcomes, and SRL capacity. Nevertheless, to our knowledge, research focusing on investigating students' SRL in a blended learning context employing multiple tools is limited.

3. Methods

3.1 Research Design

To address the research questions, this research employed a correlational research design. Correlational study is a non-experimental research permitting researcher(s) to examine two or more variables and evaluate the associations among them (Ary et al. 2014; Asamoah, 2014). The goal of the research was to investigate the associations among multi tools of measuring SRL and students' writing performance in a blended learning environment, combining the classical interaction and digital leaning.

3.2 Participants

Initially, the participants of the study were 140 students. However, 36 students were excluded as some of their data were incomplete because they did not fully involve in each SRL measurement. Consequently, the total participants of the study were 104 undergraduate ELT students from four private universities in Indonesia, meeting the requirement of having had experience studying in a blended learning environment. In this research, blended learning was conducted through the incorporation of face-to-face interaction with various online learning, such as Google Classroom, WhatsApp, Google Meet, and Zoom Meeting. The participants were recruited based on their willingness to participate in the study. The convenience sampling technique was used due to the students and lecturers' availability and accessibility (Ary et al., 2014). Of the 104 participants, 70 were female students, and 34 were male, with the age range between 17 to 23 years, belonging to different cohorts.

3.3 Research Instruments

Various instruments were employed to obtain data on students' SRL strategies, and their writing achievement and they were considered to have a

normal distribution, as indicated by the result of the Kolmogorov-Smirnov test, where the significance levels for all of the scales (0.200) are higher than 0.05.

3.3.1 Online Self-Regulated Learning Questionnaire (OSLQ)

The OSLQ has 24-item scale with a 5-point Likert-type response format having values ranging from strongly agree (5) to strongly disagree (1). The OSLQ consists of six subscale constructs including: goal setting; environment structuring; time management; task strategies; help seeking; and self-evaluation (Barnard et al., 2009). The example of the items are (1) I set goals to help me manage studying time for my writing online courses; (2) I choose the location where I study to avoid too much distraction; (3) I allocate extra studying time for my writing online courses because I know it is time-demanding; (4) I prepare my questions before joining in the chat room and discussion. The OSLQ aims to provide a tool for evaluating students' SRL skills in both the virtual and blended learning environments. The benefits of utilizing the OSLQ is that it broadens SRL study to the digital learning area. Researchers can utilize the OLSQ to examine SRL skills and observe its transformation in the implementation of these skills within digital learning circumstances (Barnard et al., 2009). The OSLQ could be implemented to examine whether increases in students' SRL skills in online and blended courses and indicates that it is an acceptable measure of SRL in these two subsequent of learning environment (Barnard et al., 2009).

Numerous researchers have applied OLSQ to explore students' SRL in internet based and hybrid learning environment. For instance, Apridayani et al., (2023) used the OSLQ to delve into students' SRL. They reported that the SRL employed by students affected their learning outcomes. Supriyono et al. (2020) delivered OLSQ to obtain Indonesians' students SRL in relation to the

use of technology and found that there was a strong and positive connection between technology acceptance and students' SRL. Students' SRL was also measured through the use of OSLQ with peer learning in blended learning environment and indicated that peer learning is an important element which enhances students' SRL strategies (Lim et al., 2020).

3.3.2 Self-Regulation Strategy Inventory - Teacher Rating Scale (SRSI-TRS)

The Self-Regulation Strategy Inventory - Teacher Rating Scale (SRSI-TRS) was the second tool employed to obtain students' SRL strategies. This tool permits teachers to rate the merit of their students' SRL and foster relevant instruments (Dembo and Seli (2004). The judgment is directly observing the students, based on criterion-referenced, comparing students to others, and should be with understandable metrics (triangulation). Teachers were required to score individual students on each item based on a 5-point scale: 1 = never; 5 = always. Some items referred to students' direct use of a strategy such as searching teacher assistance and information, doing self-evaluation, setting goal, and planning. Studies have shown that this instrument have been widely used by researchers to evaluate students SRL. For example, (Vandevelde et al., 2017) applied this instrument to measures students' SRL strategies (e.g., during task performance) by scoring the students using 5-point Likert-type scale ranging from 1 (never) to 5 (always). Torrington et al., (2024) also explored students' SRL through this measurement type and reported that teacher assessments of the students' metacognitive skills aligned with task performance.

3.3.3 Error Detection Tasks

The third SRL tool employed in this study to delve into students SRL strategies was administering error detection tasks. To obtain the students' error detection task ability, we delivered an instrument in the form of a multiple-choice item test, which was adopted from the valid and reliable writing composition of the TOEFL test to assess the student's comprehension. The test administered to the students consisted of 25 multiple-choice options exploring their ability to recognize any errors that are useful and commonly used in composing a writing. For example: (1) The earlier the young players get the chance to play in international events, the best they will be in the future; (2) The thief who stole my watch was compelled to restore it back again.

3.3.4 Achievement Scores

Data about the students' writing performance was obtained from official document informing about the students' final writing score for the previous semester. These scores were *considered* reliable because it is a score aggregation among several types of writing tasks (e.g., daily, mid-term and final tests).

3.4 Data Collection Methods

The data was collected during a period of teaching and learning calendar from March to July 2024. Before starting collecting data on students' SRL strategies and their writing achievement, we arranged a meeting with the head of the English department to explain our research project and obtain research permission. Having had the permission, we met the lecturers of writing course, explained the research purposes, invited the students in the course, and obtained their agreement to participate in the study. To obtain data on students' SRL strategies, the online self-regulated learning

questionnaire (OSLQ) developed by Barnard et al. (2009) was adopted and delivered as a valid and reliable instrument because it has been widely employed by numerous scholars for measuring students' SRL in online and blended learning environments. The students were requested to fulfil the OSLQ freely and were informed that their response will remain confidential because their personal data will not be elaborated and reported. Additionally, we also provided some information explaining the purpose of the study, as well as explaining that refusing to participate would not affect their course grade. As the instrument was designed in online form, the questionnaire, along with the instructions and agreement for participating in the study, was administered to the participants by sending a link to a Google Form. The aggregation of the student's response was then used to determine the student's SRL measured through the OSLQ.

The second instrument utilized was the self-regulation strategy inventory—teacher rating scale (SRSI-TRS). This instrument was employed without any adaptation because it has been widely used in SRL studies. Before administering the instrument, we informed and explained the purpose of the study and requested the writing lecturers to participate in the study. After having agreed to participate in the study, we provided detailed explanations to writing course lecturers about the concept of SRL and how to rate their students throughout scheduled class hours. The lecturers were then requested to observe and score their students' activity by ticking the observation sheet based on their learning behaviour, indicating how they employed their SRL strategies during the writing class hour. The results of the teacher rating on each student were then accumulated to determine the students SRL skills.

The third SRL tool employed to obtain students' SRL was an error detection task. The instrument delivered was in the form of multiple-choice items taken from writing the composition of the TOEFL test. Participants were given a blank sheet on which they could present strategies to cope with the task. Students were instructed to identify the errors and make any revisions for each of the questions within 60 minutes. To measure this variable and to know the students' ability in recognizing the errors that have been made, the students' error detection results were then verified. From these data, we computed the proportion of errors detected correctly by the students, using the overall counted errors identified as a benchmark (Zamora, Suárez, et al., 2018). Lastly, to elicit students writing performance scores, the data was taken from the writing final score archived, informing students' writing scores for the previous writing course.

3.5 Data Analysis

The data obtained was managed and analysed by utilizing IBM SPSS Statistics (Version 24) predictive analytics software. Two statistical procedures were used to examine the associations and form among multi tools of SRL on writing achievement under a blended learning class environment. Multiple Pearson correlations were tested to discover whether or not there were connections among student self- reporting, teacher ratings, error detection during a blended learning class situation and writing achievement. A multiple regression analysis was employed to gain more comprehension of the possible predictors that could inform the variance in writing achievement.

4. Results

4.1 Relationship among SRL Questionnaires, Teacher Rating, Error Detection Tasks, and Writing Achievement

Prior to completing analyses, we examined the descriptive statistics, the correlation and regression analyses. The details of the findings are displayed in the tables. The first research objective was to find out the extent to which SRL self-reported questionnaires, teacher rating, error detection tasks, and writing achievement are related in a blended learning environment. Table 1 depicts the descriptive statistics of the SRL measurement tools and writing achievement.

Table 1.
Descriptive statistics of students SRL strategies and writing achievement

Measures	N	Mean	SD	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error
SRL Questionnaire	104	91.75	12.552	-.126	.237	-.542	.469
Teachers Rating	104	78.38	11.589	-0.745	.237	2.603	.469
Error Detection	104	57.82	23.765	-.048	.237	-1.119	.469
Writing Achievement	104	86.45	7.935	-1.022	.237	1.523	.469

Table 2.
Correlation among different types of SRL measures and writing achievement

	Writing Achievement	SRL Questionnaire	Teacher Rating
Writing Achievement	-		
SRL Questionnaire	0.173*	-	
Teacher Rating	0.574*	0.069	-
Error Detection task	0.187*	-0.105	0.365*

*p < 0.05

Pearson correlations were calculated to evaluate the interconnection among the SRL questionnaire, teacher ratings, error detection task, and students' writing achievement evaluated under a blended learning mode as presented in table 2. The finding exhibited that students' writing achievement had positive correlation with the three SRL instruments as indicated by the coefficient of each variable obtained was r = 0.17 (SRL questionnaire), r = 0.58 (teacher rating), and r = 0.18 (error detection). Surprisingly, among SRL instruments, a significant relationship only emerged between error detection task teacher rating (r = 0.365).

4.2 Predictors of Students' Writing Achievement

The second objective of the study was to examine which SRL tools (SRQ, teacher ratings, and error detection) can provide predicting power on students' writing achievement in a blended learning context.

Table 3.
Results of regression analysis with 3 independent variables

	B	SE	ß
(Constant)	48.433	6.238	
SRL strategies (Questionnaire)	0.084	0.052	0.133
SRL strategies (Teacher Rating)	0.388	0.060	0.567*
SRL strategies (Error Detection)	-0.002	0.029	-0.006

*p < 0.05, R = 0.589, R^2 = 0.347

Table 3 displays the result of the multivariate regression analysis, in which SRL strategies measured by SRQ, teacher rating, and error detection task) were included. Prior to regression analysis, regression assumptions were checked which indicated that data were normally distributed, no indication of problematic multicollinearity because the tolerance value for the

independent variables were = 0.976 for SQR, 0.855 for Teacher Rating, and 0.850 for Error Detection task. The regression analysis revealed that the model is significant in predicting students writing achievement F (3, 104) = 17.722, p = 0.000) accounted for 34.7% variance in writing achievement. However, among predicting variables, SRL strategies from teacher rating was the only significant predictor.

5. Discussion

This study sought to answer two research questions. The first RQ was to find out the extent to which SRL self-reported questionnaires, teacher rating, error detection tasks, and writing achievement are related in a blended learning environment. The second RQ was to find out which SRL tool (SRQ, teacher ratings, and error detection) can be best instrument in assessing SRL strategies that can significantly predict students' writing achievement in a blended learning context. Taking the first question into consideration, the result of the study indicates that students' writing achievement in a blended learning environment is significantly associated with SRL strategies, measured using self-report questionnaires, teacher ratings, and error detection tasks. This finding supports existing evidence on the efficacy of SRL strategies for helping students to improve academic performance (Teng & Qin, 2024). Research have documented that students with high self-regulated skills employ a range of SRL strategies to optimize their learning (Zimmerman, 2008). They engaged actively in recursive and cyclical SRL activities, from planning and setting up learning goals, monitoring learning processes, utilizing a range of strategies (e.g., cognitive, metacognitive strategies), and evaluating performance during episode of learning substantially contribute to their writing performance (Zeidner et al., 2000; Zimmerman, 2008). Research on learning engagement has also discovered a

strong connection between self-report questionnaires, writing performance, and engagement (Torrington et al., 2024) where SRL strategies have taken role as a strong mediator for students' learning engagement to influence writing performance (Teng & Yue, 2023; Teng & Qin, 2024).

Teacher ratings also significantly correlated with students' writing achievement (Torrington et al., 2024) because it permits teachers to observe the student's learning engagement and provide direct feedback. Students actively engaging in the classroom to optimize their SRL strategies—such as seeking information from multiple sources, asking for assistance from peers and teachers, and self-evaluating during classroom interactions—appears to enhance their writing competency. Additionally, this study also revealed that error detection had a strong relationship with students writing achievement. Students' ability to identify and revise errors facilitates the construction of coherent writing. Studies indicate that this tool is crucial and valuable for improving students' writing performance and learning engagement (Abedi et al., 2010; Lee, 1997; Zamora et al., 2018).

These results align with the broader literature on SRL, which consistently highlights the importance of SRL strategies in academic success across various educational contexts. For instance, Bai and Wang (2021) found that Hong Kong secondary students' use of SRL strategies significantly influenced their English writing performance, driven by their motivational beliefs. Similarly, Anthonysamy et al. (2020) reviewed a decade of research and concluded that SRL strategies are crucial in higher education, particularly in blended learning environments, where they contribute to both academic and non-academic outcomes. In Iran, Abedi et al. (2010) demonstrated that error correction and detection significantly impact EFL learners' writing achievements, paralleling the importance of SRL strategies in managing

writing tasks. Furthermore, research by Apridayani et al. (2023) on Thailand's students' SRL and anxiety in online English courses showed that effective SRL strategies can mitigate anxiety and enhance performance. These studies collectively indicate that the development of SRL skills is universally beneficial, transcending cultural and educational boundaries.

As for the second research question, with respect to findings related to predictor of writing achievement, only teacher rating was proven to be significant predictor of writing achievement. It not surprising finding because teacher ratings are considered to be more reliable and consistent measure of SRL strategies, compared to self-reported measures such as questionnaire (Zimmerman & Schunk, 2011; Roth et al., 2016; Callan & Cleary, 2013), or error detection task (Zamora et al., 2018). As external assessment, teacher rating provides more objective perspective regarding students' behaviours in real-time and within the specific context of classroom interactions and writing activities (Rovers et al., 2019). This direct observation allows teachers to assess a broader range of SRL strategies, including those that might not be fully captured through self-report questionnaires or error detection tasks, and evaluate how students plan, observe, and manage their writing processes, providing a comprehensive assessment of SRL in action (Paris & Winograd, 2003).

This holistic perspective often results in a more accurate prediction of writing achievement, as it considers the dynamic and multifaceted nature of SRL (Perry, et al., 2007; Sudina & Plonsky, 2021). Educators play a critical role in this process by providing SRL scaffolding, targeted feedback and support, helping students to refine and improve their SRL strategies, learning grit, and learning outcome. This aligns with previous empirical study that SRL training affect and enhance students' learning strategies and outcome,

particularly writing skill (Harris and Graham, 2016; Rezaee et al., 2018; Song & Kim, 2021).

6. Contribution, Limitations and Direction for Future Research

The study highlights the need for multi-faceted SRL measurement tools, such as self-report questionnaires, teacher ratings, and error detection tasks, which together provide a comprehensive assessment of students' SRL strategies and their impact on writing performance (Torrington et al., 2024; Zhao & Cao, 2023). This approach is supported by Cleary et al. (2020), who advocated for the use of SRL multiple protocols across different contexts to capture the dynamic nature of SRL processes. This suggests that students who actively engage in SRL strategies tend to exhibit better performance in their writing tasks. This work also contributes to SRL theoretical frameworks by (1) shedding light and strengthening the pivotal role of the ability to employ high SRL strategies as they contribute on undergraduate students' learning engagement and writing performance (Doo et al., 2021; Teng & Qin, 2024) and (2) documenting the correlation of various SRL measurements and examining the predictive of SRL strategies on students writing achievement particularly under a blended learning environment.

Despite its valuable insights, the study has several limitations. One key limitation is the reliance on small sample size of self-report questionnaires, which can be subject to biases such as social desirability and self-perception inaccuracies. While self-reports are useful for capturing students' perceptions of their SRL strategies, they may not always accurately reflect actual behaviours. Additionally, the study's focus on a blended learning environment may restrict the generalizability of the results to other educational condition, such as fully online or traditional classroom settings.

Another limitation is the potential variability in teacher ratings, which might be influenced by individual teacher biases or differing standards. Although calibration sessions and standardized rubrics can mitigate this issue, some level of subjectivity in teacher assessments is inevitable. Furthermore, the error detection task, while valuable, may not capture all dimensions of SRL strategies, particularly those that are more nuanced or context-specific (Abedi et al., 2010; Lee, 1997; Zamora et al., 2018).

Future research should aim to focus on these limitations by employing a more diverse set of SRL measurement tools that reduce the reliance on self-reports and incorporate more objective measures. For instance, incorporating observational methods or using digital tools to track real-time SRL behaviours could provide more accurate data. Additionally, expanding the study to include different educational contexts and diverse student populations would help to validate and generalize the findings. Further research could also explore the long-term impact of SRL strategy training on writing performance and other academic outcomes. Longitudinal studies would be particularly valuable in understanding how SRL strategies develop over time and how they influence academic achievement in the long run. Moreover, investigating the role of specific SRL strategies, such as goal setting, self-monitoring, and self-evaluation, could provide deeper insights into which aspects of SRL are most beneficial for writing performance (Teng & Zhang, 2023; Shen & Bai, 2024).

Finally, it would be beneficial to examine the interaction between SRL strategies and other factors, such as motivation, self-efficacy, and emotional regulation, to gain a more holistic understanding of how these elements collectively influence student performance. By focusing these areas, future research can contribute to the development of more effective educational

interventions that support students in becoming self-regulated learners and achieving their full academic potential.

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The authors hereby declare that there is no potential conflict of interest related to this article.

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