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Learning and practicing simultaneously: the synergistic effect of online self-assessment diaries and teacher self-assessment instruction on learning and growth mindset

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ABSTRACT

Self-assessment (SA) interventions show promise for enhancing learning and motivational outcomes, yet their effectiveness varies considerably depending on implementation approaches. This randomised controlled experiment examined whether combining teacher instruction with student SA diaries creates synergistic effects beyond either approach alone. Over 10 weeks, 118 Grade 10 students were assigned to four conditions: SA Diary only, SA Instruction only, SA Diary + Instruction, or Control, with English language learning achievement and growth mindset as outcomes. Results revealed that only the combined SA Diary + Instruction condition yielded significant improvements in objective learning outcomes and growth mindset compared to other conditions. Neither SA instruction nor SA diaries alone produced benefits relative to control. Multilevel analysis of 1,068 diary entries showed the combined intervention consistently promoted higher growth mindset throughout the intervention period. These findings suggest that learning SA principles and practicing SA skills simultaneously is crucial for intervention efficacy. Implications and limitations are discussed.

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Self-assessment; self-assessment diary; self-assessment instruction; English language learning outcome; growth mindset

1. Introduction

Self-assessment (SA) has emerged as a crucial component in educational practices, offering students the opportunity to actively engage in their learning process and develop critical metacognitive skills (Andrade & Valtcheva, 2009; Panadero et al., 2016; Yan, 2022). Recent meta-analyses have demonstrated the positive impact of SA on students' academic performance and cognitive-affective outcomes across various educational contexts (Panadero et al., 2020; Yan et al., 2022). SA is intricately linked with self-regulated learning, enabling students to set goals, monitor progress, and adapt strategies to achieve desired outcomes (Panadero et al., 2017; Zimmerman & Schunk, 2011). However, the effectiveness of SA interventions varies considerably, depending on their design and implementation (Brown & Harris, 2013; Yan et al., 2022). Two prominent

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approaches for fostering SA skills are teacher instruction, which provides scaffolding and guidance (Hattie & Timperley, 2007), and SA diaries, which offer a consistent platform for reflection and self-monitoring (Schmitz & Perels, 2011; Yan et al., 2020). While both approaches show promise, their relative efficacy and potential synergistic effects remain understudied, particularly in secondary education.

This study aims to address this gap by conducting a randomised controlled experiment to examine the effectiveness of three different SA interventions: teacher instruction, SA diary, and a combination of both. The research focuses on their impact on students' learning performance, SA practices, and growth mindset, which is an important yet understudied outcome in SA research. Growth mindset, conceptualised as the belief that abilities can be developed through effort and learning (Dweck & Yeager, 2019), has been associated with various positive educational outcomes, including academic achievement and resilience (Burnette et al., 2012; Yeager et al., 2019). However, whether SA practices influence growth mindset remains largely unexplored. Employing an experimental design with pre- and post-tests, this study seeks to extend the understanding of how different SA interventions influence achievement and mindset. The findings can inform educational practices and policies, particularly in the implementation of SA strategies in secondary schools, and contribute to our theoretical understanding of the mechanisms through which SA impacts learning and growth mindset (Black & William, 2018; Panadero et al., 2018).

1.1. The self-assessment process

Various conceptualisations of SA exist in the literature, yet scholars have a growing consensus that SA is a complex, multi-phase process (Andrade & Valtcheva, 2009; Sargeant et al., 2010; Yan & Brown, 2017). This process-oriented approach views SA as a way for students to improve their self-judgement skills over time, moving beyond static grading (Boud et al., 2018). Yan and Brown (2017) introduced a cyclical process model of SA involving three key actions: (1) determining assessment criteria, (2) self-directed feedback-seeking from external and internal sources, and (3) self-reflection. When engaging in SA, students first decide upon the assessment criteria they will use to assess themselves. Then, they seek out feedback on their performance, which may come from external sources such as peers and instructors (seeking external feedback through inquiry; SEFI) or learning materials and previous work (seeking external feedback through monitoring; SEFM). Internal feedback, on the other hand, arises from the student's own emotional and physical responses to their performance (seeking internal feedback; SIF). With this feedback, students deliberate on their learning strengths and weaknesses (self-reflection; SR). Through this reflective process, learners form evaluations of their work, which are refined over time.

Recent research has further explored how students engage in self-assessment in practice, with the SEFEMO model (Self-Feedback Model) offering complementary insights into self-assessment profiles among secondary and higher education students (Panadero et al., 2024). This model conceptualises self-assessment as a process of generating self-feedback, emphasising that effective self-assessment involves not only evaluation but also the active generation of constructive feedback for oneself. The SEFEMO model identifies specific observable actions during self-assessment, including reading

task instructions, estimating performance quality, assessing work using criteria at varying levels of sophistication, and potentially redoing the task based on self-evaluations.

Importantly, the SEFEMO model distinguishes between different self-assessment profiles, with more sophisticated assessors demonstrating greater strategic flexibility and deeper engagement with assessment criteria. This developmental perspective suggests that, on the one hand, secondary school students may require more structured support than adult learners to progress from basic self-evaluation to sophisticated self-feedback generation. On the other hand, they may demonstrate greater competence in conducting autonomous self-assessment activities compared to younger learners, such as primary school students. While our study was primarily guided by Yan and Brown's (2017) cyclical process model, the SEFEMO model provides additional theoretical justification for why combining teacher instruction with diary practice may be particularly effective for adolescent learners who are still developing their self-assessment expertise. This theoretical framework helps make the usually complex and unclear process of SA easier to understand, which allows teachers to intentionally teach explicit and specific SA skills. Hence, in the current study, we adhered to these frameworks for operationalising SA. We construed SA as 'a process during which students collect information about their own performance, evaluate and reflect on the quality of their learning process and outcomes according to selected criteria to identify their own strengths and weaknesses' (Yan & Brown, 2017, p. 1248).

1.2. Self-assessment and academic achievement

Recent meta-analyses show that SA has a positive impact on students' academic performance ($g = 0.585$; Yan et al., 2022; Yan et al., 2021). The benefits of SA can be explained by its relationship with self-regulated learning (SRL) and learning motivation. Essentially, SRL is about students taking charge of their learning: setting goals, putting plans into action, checking their progress, and adapting their approach to achieve their targets (Zimmerman, 2000). When learners know what quality work looks like and have a sensible judgement of their own work, they're better equipped to hone in on what they really need to focus on, making their learning journey more targeted and fruitful (Baas et al., 2015; Boud et al., 2013).

SA occurs at all phases of SRL (i.e., the preparatory, performance, and appraisal phases; Harris & Brown, 2018; Yan, 2020). Students need SA to evaluate the appropriateness of learning goals and strategies, monitor the learning process, make judgements about their own work, and inform the action plan to attain the goal (Black & Wiliam, 1998; Butler & Winne, 1995). Hence, SA offers plenty of learning opportunities for SRL that can benefit learning outcomes.

Meanwhile, SA shifts students from passive participants to active contributors in evaluating their learning, sparking a sense of control, personal investment, and reduced reliance on teachers to tell them how they're doing (Black & Wiliam, 1998; Brown & Harris, 2013). By diving deep into SA, students also build confidence in their ability to tackle the tasks at hand (Panadero et al., 2016). Drawing on self-determination theory (SDT; Ryan & Deci, 2017), when students feel more in control and competent, their motivation to learn naturally increases, which, in turn, boosts their academic achievement.

In this study, we focused on English Language Learning (ELL) as our domain of interest. Self-assessment has particular relevance for language learning contexts, where continuous reflection on communicative competence is essential for development (Butler & Lee, 2010). Unlike some content areas with more definitive right/wrong answers, language learning involves complex, integrated skills across reading, writing, speaking, and listening domains. Recent research has shown that SA effectiveness varies across subject domains, with language learning showing moderate to strong effects (Mendoza et al., 2022, 2023). In ELL contexts specifically, SA can foster metacognitive awareness of language use, helping students monitor their comprehension, identify communication gaps, and develop strategies. The cognitive and metacognitive processes involved in language learning may differ from those in mathematics, sciences, or arts, potentially affecting how self-assessment influences learning and mindset development. Additionally, English language learning in multicultural contexts represents a second language acquisition scenario with distinct motivational and cultural dynamics that may influence how students respond to self-assessment interventions.

1.3. Self-assessment and growth mindset

Mindset emerges as an important yet understudied factor potentially influenced by SA practices. Mindset, also known as implicit theory of intelligence, refers to an individual's fundamental beliefs about the malleability of intelligence or abilities (Dweck & Yeager, 2019; Yeager & Dweck, 2020). Students with a growth mindset perceive intelligence as developable through effort and effective strategies, while those with a fixed mindset view intelligence as well as other skills and characteristics as largely static. The cultivation of a growth mindset has gained increasing attention due to its positive associations with various educational outcomes, including academic achievement, SRL, and psychological well-being (Burnette et al., 2022; Claro et al., 2016; Costa & Faria, 2018; Mendoza & Yan, 2023, 2025; Schleider et al., 2015; Sisk et al., 2018; Yeager et al., 2019).

Self-assessment practices hold the potential to promote a growth mindset, as both concepts involve identifying strategies to enhance student performance based on current levels (Black & Wiliam, 2018; Dweck & Yeager, 2019). Theoretically, SA approaches that emphasise the learning process and strategy development may foster the belief that learning abilities are adaptable and that desirable outcomes can be achieved through effort and effective strategies. By focusing on progress towards improved performance, SA may cultivate a growth mindset among students (Sanchez et al., 2017). The learning benefits associated with SA may further reinforce this belief, highlighting the importance of effort and strategy use.

The relationship between self-assessment and growth mindset operates through specific cognitive mechanisms. SA creates cognitive dissonance when students document concrete progress from effort and strategy use, challenging fixed mindset beliefs about static abilities (Hayes & Williams, 2020). Additionally, SA fosters attributional retraining by directing attention to process-focused rather than ability-focused judgements (Dweck, 2017). Through repeated tracking of strategy effectiveness, students develop evidence-based understanding of the causal relationship between approaches and outcomes,

directly challenging assumptions that success depends primarily on inherent ability (Efklides, 2018).

1.4. Convergent effects on learning and motivation

The intersection of SA effects on both achievement and mindset creates a potentially powerful synergy for learning. When students engage in systematic self-assessment, they simultaneously develop metacognitive awareness of their learning processes and gather experiential evidence of their capacity for improvement. This dual effect may explain why SA interventions often produce benefits that extend beyond immediate performance gains to include enhanced motivation and persistence. From a theoretical perspective, this convergence suggests that effective SA practices create an upward spiral where improved self-regulation leads to better performance, which reinforces growth beliefs, which in turn motivate continued strategic effort.

Empirical evidence in this field is emerging, with several studies providing initial support for the relationship between SA-related practices and growth mindset. Yan et al. (2021) found that formative assessment strategies, particularly sharing learning progressions and providing feedback, were positively (albeit weakly) related to a growth mindset in Confucian heritage cultures. Lou and Noels (2020) observed that students engaging in regular self-regulation of their language skills were more likely to adopt a growth mindset towards language learning ability. Schmidt et al. (2015) found that students receiving process-focused feedback, a key component of effective SA, were more likely to adopt a growth mindset compared to those receiving person-focused feedback. Still, to the authors' knowledge, no study has directly examined the relationship between SA interventions and growth mindset development. Further research is needed to elucidate the mechanisms by which SA might influence both cognitive and motivational outcomes and to determine the most effective SA practices for fostering this dual benefit across diverse educational contexts.

1.5. Teacher SA instruction and students' SA diaries to promote self-assessment

While SA interventions can enhance students' academic achievement, learning strategies, and affective outcomes across various educational contexts, their effectiveness hinges on design and implementation. Some interventions show negligible or even negative effects (Brown & Harris, 2013; Yan et al., 2022). Cultivating beneficial SA practices among students remains a significant challenge (Yan et al., 2020), as these skills typically require explicit instruction and practice (Yan, 2022).

1.5.1. Teacher instruction in developing students' self-assessment

Consistent evidence demonstrates the value of teacher instruction in developing students' ability to learn independently and think critically. This aligns with Vygotsky's Sociocultural Theory, which posits that learners achieve higher levels of understanding when provided with scaffolding from more knowledgeable others within their Zone of Proximal Development (Vygotsky, 1978). Teachers play a crucial role in helping students become self-regulated learners (Tsuda & Nakata, 2013; Mendoza & Yan, 2021a). Brown and Harris (2014) suggest that

SA skills can be taught using specific methods like self-rating checklists and rewards for achieving goals. Rivas et al. (2022) describe a methodology that gradually transfers learning control to students, progressing from teacher-guided instruction to autonomous application. However, teachers face challenges in fostering student engagement, as some struggle with motivating students to set personal learning goals and integrating SA into lessons, which can diminish intrinsic motivation (Bullock, 2011). Students may view teacher-initiated SA tasks as rote routines rather than opportunities for self-directed learning (Bourke, 2016).

1.5.2. Self-assessment diary in developing students' self-assessment

Another method to foster meaningful SA is through diaries. SA diaries offer students a consistent platform to interact with assessment standards and feedback, developing their ability to make long-term evaluative judgements (Tai et al., 2018). This practice leverages the reactivity effect, where maintaining written records can prompt desirable behavioural changes (Shapiro, 2014). Diaries facilitate self-monitoring, the deliberate tracking of one's thoughts, emotions, and actions (Klug et al., 2018; Schmitz & Perels, 2011), which can enhance learning even for automatic behaviours. Practically, diaries don't intrude on classroom time and require minimal teacher involvement, increasing the likelihood of consistent implementation. Empirical studies have demonstrated their benefits. Schmitz and Perels (2011) found that students using diaries with self-regulation prompts exhibited improved SRL and maths scores. Yan et al. (2020) showed that students writing SA diaries had higher academic achievement, self-efficacy, and intrinsic value. Nevertheless, studies emphasise the need for clear guidelines and structured support for SA to be truly effective (Adachi et al., 2018; Wanner & Palmer, 2018).

1.5.3. The need for synergy between teacher SA instruction and students' SA diaries

The combined teacher instruction and SA diaries offer a synergised approach to developing self-assessment skills, addressing the limitations of each method individually. Students often lack the inherent ability to effectively use SA for monitoring and planning their progress, necessitating regular teacher instruction and practice opportunities (Orsmond et al., 1997; Panadero et al., 2016).

This synergistic approach aligns with self-determination theory, as teacher instruction fulfils students' competence needs by emphasising SA's importance and providing instruction on its implementation (Deci & Ryan, 2017). Concurrently, SA diaries cater to students' autonomy needs by offering freedom in their usage. The resulting two-pronged intervention creates optimal conditions for improved learning outcomes by combining structured guidance with self-directed practice. Further, teacher instruction may foster an SA culture within the classroom (Panadero et al., 2018), potentially triggering a social contagion effect for assessment behaviours (Yan & King, 2023). Students' experiences with SA during lessons, combined with observations of peer SA practices, may activate mental representations of SA, thereby encouraging their engagement with SA diaries. This multifaceted approach not only enhances individual SA skills but also creates a supportive environment for ongoing self-assessment practices.

1.6. The present study

In this study, we conducted a randomised controlled experiment with a pre- and post-test design to examine the synergistic effect of student online SA diaries and teacher instruction in prompting SA on high school students' learning outcomes and growth mindset. Participants were randomly assigned to four conditions: Diary only, Instruction only, Diary + Instruction, or control. We examined the effects of these interventions on language learning test scores and growth mindset. We have the following hypotheses:

H1: There will be significant differences in post-intervention English Language Learning (ELL) scores across the four conditions (SA Diary, Instruction, and SA Diary + Instruction, Control), after controlling for pre-intervention ELL scores. Specifically, the SA Diary + Instruction condition will yield significantly higher post-intervention ELL scores compared to the Control condition (H1a), SA Diary condition (H1b), and Instruction condition (H1c).

H2: There will be significant differences in post-intervention growth mindset scores across the four conditions, after controlling for pre-intervention growth mindset scores. Specifically, the SA Diary + Instruction condition will yield significantly higher post-intervention growth mindset scores compared to the Control condition (H2a), SA Diary condition (H2b), and Instruction condition (H2c).

2. Methods

2.1. Participants

We conducted an a priori power analysis using G*Power 3.1.2 (Faul et al., 2007) for an ANCOVA with fixed, main, and interaction effects. We anticipated a medium effect size ($f = 0.25$), specified $\alpha = .05$, power = .80, numerator $df = 3$, and one covariate (pre-test scores), which indicated a minimum total sample size of 119 to detect the main effect of the intervention. To account for potential attrition, we aimed for 35 participants per condition. A total of 135 Grade 10 secondary school students joined the study (Mean age = 15.25 years, $SD = 0.56$). The students were enrolled in a science high school in the Philippines, a specialised public high school offering advanced secondary education with a typically high-performing student population.

Randomisation was implemented at the classroom level using a computer-generated random number sequence. The four intact Grade 10 classes under the same English language teacher were randomly assigned to four conditions: control ($n = 33$), Diary only ($n = 33$), Instruction only ($n = 34$), and Diary + Instruction ($n = 35$). This approach maintained ecological validity while minimising contamination between experimental conditions. During the 10-week study, 17 students (12.6%) withdrew, resulting in a final sample of 118 participants (75 girls; mean age = 15.29). Attrition was distributed as follows: Control ($n = 5$, 15.2%), Diary only ($n = 4$, 12.1%), Instruction only ($n = 6$, 17.6%), and Diary + Instruction ($n = 2$, 5.7%). The lower attrition rate in the Diary + Instruction condition might suggest higher participation with this combined approach.

Our final sample had a notable gender imbalance (63.6% girls), which represents a limitation in terms of generalisability.

Participants in diary conditions responded to online diaries twice per week for 10 weeks. The 35 Diary + Instruction students submitted 637 diary entries ($M = 18.20$, $SD = 2.36$), while the 29 Diary only students submitted 411 entries ($M = 14.14$, $SD = 5.18$). Completion rates were 91% for Diary + Instruction and 70.7% for Diary only. In the Diary + Instruction condition, 60% completed all 20 required entries versus 41.4% in the Diary only condition, suggesting that teacher instruction enhanced engagement with the diary process.

2.2. Measures

Pre-test and post-test assessments. All students participated in a 20-item multiple-choice curriculum-specific pre-test and a 20-item multiple-choice curriculum-specific post-test. The items in the pre-test and post-test are different but aligned with the curriculum and lesson plan. Both item sets were vetted by the subject teacher in terms of the level of difficulty for English language learning. The mean score for the pre-test is 14.46 ($SD = 2.71$), and the post-test mean is 12.82 ($SD = 3.61$).

Growth mindset. The Incremental Beliefs subscale of the Implicit Theories of Intelligence Self-theory scale (De Castella & Byrne, 2015) was used to evaluate growth mindset. The subscale consists of four items (e.g. “*With enough time and effort, I think I could significantly improve my intelligence level*”), with a six-point Likert-type response scale, ranging from Strongly Disagree (1) to Strongly Agree (6). The internal consistency of the subscale in this study was $\alpha = .81$ at T1 and $\alpha = .87$ at T2.

2.3. Study procedures and conditions

The ethical approval was obtained from the authors’ university, and all participants gave written consent. A pilot test with five secondary school students was conducted prior to the implementation of the procedures. The students in the pilot were

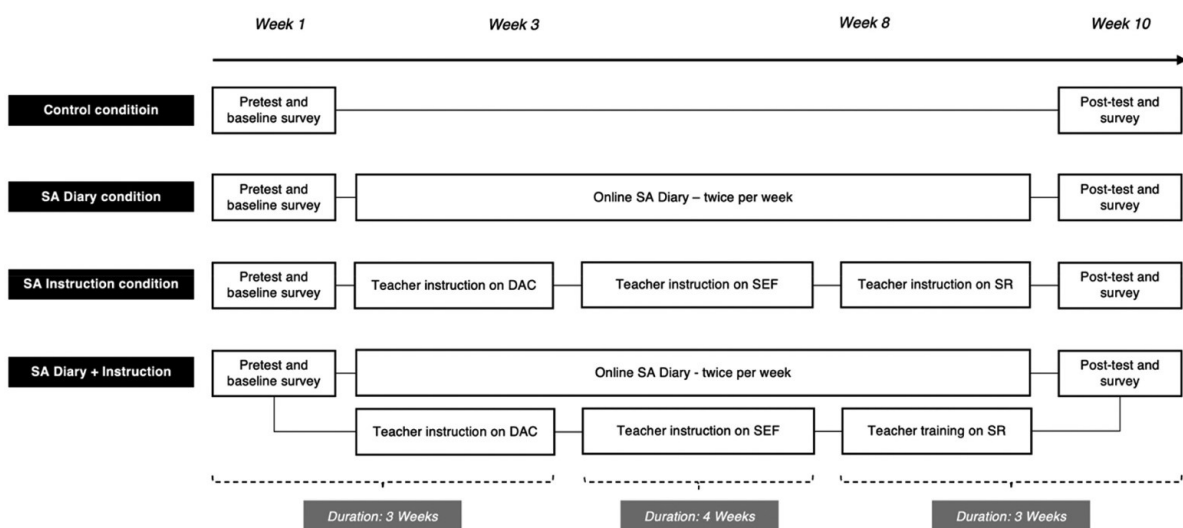


Figure 1. Details of the procedures.

briefed on all the study conditions and were consulted for comments to revise and improve the procedures of the interventions. We also asked whether they understood the details of each condition, including the contents of the SA diary. The teacher was also consulted regarding the online platform that will be used to implement the interventions. The pilot test also refined the procedures of the study (see [Figure 1](#)). Students in all four conditions were individually surveyed before and after the 10-week¹ period. At the end of the 10th week, post-test/survey data were collected.

All four experimental conditions are detailed as follows: (1) The Control condition followed the regular teaching plan with no additional experimental interventions, participating only in pre- and post-test assessments. (2) The SA Diary only condition received online SA diaries in addition to the regular teaching plan, completing diaries twice weekly (Wednesday/Thursday and Saturday/Sunday) for the entire 10-week period. (3) The SA Instruction only condition received explicit teacher instruction on SA throughout the 10-week period along with weekly reminder messages, but did not complete diaries. (4) The SA Diary + Instruction condition implemented both intervention components, receiving both the systematic diary practice and explicit instruction as described below. All students participated in the pre- and post-test. In the first week, a pre-test was administered to them, consisting of a 20-item assessment and baseline survey, to baseline or pre-intervention learning outcomes. On the tenth week, an adjusted 20-item assessment aligned with the curriculum and lesson plan and a survey was administered as a post-test to measure post-intervention outcomes.

2.3.1. Self-assessment diary implementation

The standardised SA diaries were administered electronically through Qualtrics twice per week for 10 weeks, generating 20 potential entries per student. The diary structure was guided by Yan and Brown's (2017) cyclical process model and included components designed to scaffold self-assessment practices. The diary guided students through the cyclical SA process with prompts for: (a) learning task identification (describing recent English learning activities), (b) assessment criteria determination (selecting evaluation methods such as rubrics, peer comparison, or personal criteria), (c) feedback seeking (rating usefulness and reporting use of strategies for seeking external feedback from teachers, peers, and resources), (d) self-reflection (identifying strengths, difficulties, and overall task quality), and (e) strategic planning (selecting improvement strategies for future learning). These specific practices are based on the Self-assessment Practices Scale (SaPS; Mendoza & Yan, 2021b). Additionally, each diary entry included a brief growth mindset assessment using a single-item mindset scale from the Implicit Theories scale to track mindset development over time.

Several features ensured data quality and participant engagement, including reminders about confidentiality to encourage honest responses, automatic date/week tracking to monitor completion patterns, structured prompts with clear examples to guide reflection, and an incentive structure to maintain engagement.

2.3.2. Teacher SA instruction implementation

The SA instruction was embedded within regular English lessons across three phases, implemented only for the SA Instruction and SA Diary + Instruction conditions: *Phase 1*

(Weeks 1–3): *Assessment Criteria*. Instruction emphasised understanding and using Learning Activity Sheet (LAS) rubrics, training in analysing task requirements and identifying quality indicators, with a weekly reminder message: ‘To succeed in a learning task, it is important to identify how your task will be evaluated’. *Phase 2 (Weeks 4–7): Feedback Seeking*. Instruction focused on encouragement to seek external feedback from multiple sources (teachers, peers, family, resources) and guidance on effective help-seeking strategies. *Phase 3 (Weeks 8–10): Self-Reflection*. Instruction emphasised identifying strengths and weaknesses in completed work and developing improvement strategies based on self-evaluation.

2.4. Data analysis

Statistical analyses were conducted using the R software (R Core Team, 2023).

As a preliminary analysis, we performed one-way ANOVAs on baseline measures (pre-test scores, initial SA practices, and initial growth mindset) across conditions to verify randomisation. Levene’s tests were used to check the homogeneity of variances. Descriptive statistics and bivariate correlations were calculated for the main study variables.

For the primary analyses, we used Analysis of Covariance (ANCOVA) to examine the impact of different conditions on post-intervention test scores in English language learning, SA practices, and growth mindset, while controlling for pre-test assessments of the same variables. The experimental conditions had four levels: Control, SA Diary, Instruction, and SA Diary + Instruction. Outliers were detected and removed if the standard residuals were greater than 3. Pairwise comparisons of condition levels were conducted post-hoc using estimated marginal means, with a Bonferroni adjustment to correct for multiple comparisons. The effect sizes were calculated using partial eta squared (η^2). This analytical approach allowed for an examination of the main effects of pre-test outcomes and conditions on post-test outcomes, as well as the interaction effect between pre-test outcomes and conditions.

To examine the trajectories of variables over the course of the 10-week intervention, we analysed diary entries² ($n = 1,280$) from the Diary and Diary + Instruction conditions using linear mixed effects models. These models were constructed using the lme4 package in R. The models included fixed effects for experimental conditions, diary entry (representing time progression from entry 1 to 20), and their interaction. Random intercepts for student ID were included to account for the non-independence of repeated measures within individuals. An unstructured covariance structure was assumed for the random effects. Models were estimated using restricted maximum likelihood method. Significance tests for the fixed effects were conducted using Analysis of Variance (ANOVA) with Satterthwaite’s method for approximating degrees of freedom, as implemented in the lmerTest package.

This analytical approach allowed for an examination of the main effects of pre-test outcomes and conditions on post-test outcomes, as well as the interaction effect between pre-test outcomes and conditions. It also enabled us to track changes in growth mindset over time and assess differences between the Diary and Diary + Instruction conditions throughout the intervention period.

Table 1. Descriptive statistics and bivariate correlations.

	Pre-test	Post-test	T1 Growth	T2 Growth
Pre-test	—			
Post-test	0.40***	—		
T1 Growth	0.12	0	—0.81	
T2 Growth	0.05	0.07	0.36***	—0.87
Mean	14.46	12.82	21.65	21.89
SD	2.71	3.61	2.3	2.19

3. Results

3.1. Preliminary analyses and descriptive statistics

To verify randomisation, we conducted one-way ANOVAs for pre-test English Language Learning (ELL) scores and growth mindset across conditions. While randomisation was successful for initial growth mindset scores ($F(3, 114) = 1.646, p = 0.183$), we found significant differences in pre-test ELL scores ($F(3, 114) = 4.742, p < .01$). Still, Levene's tests for homogeneity of variances were non-significant for all three variables (all $p > .05$), indicating equal variances across groups. Accounting for these baseline differences, we used ANCOVA in our main analyses, controlling for pre-test scores and initial levels of the outcome variables. This approach allows us to adjust for pre-existing differences and isolate the effects of the interventions on our outcomes of interest.

Table 1 presents descriptive statistics and bivariate correlations for the main study variables. Pre-test and post-test scores were moderately correlated ($r = 0.40, p < .001$). Growth mindset at T1 and T2 showed a moderate positive correlation ($r = 0.36, p < .001$).

3.2. Differential effect of self-assessment interventions on learning performance

To examine the direct influence of the intervention on post-test ELL scores while adjusting for pre-test ELL scores, we conducted an ANCOVA focusing on the main effects of condition and pre-test scores. This approach allowed us to assess the impact of the four interventions on improving post-test outcomes, adjusting for baseline performance levels, thereby determining the effectiveness of each intervention in enhancing ELL scores. ANCOVA results revealed a significant effect of pre-test scores on post-test outcomes, $F(1, 113) = 14.582, p < .001$, explaining approximately 11.4% of the variance in post-test scores ($\eta^2 = 0.114$). Additionally, a significant effect of condition was observed, $F(3, 113) = 3.955, p < .01$, with the effect size indicating that the condition explained about 9.5% of the variance in post-test scores ($\eta^2 = 0.095$).

Supporting H1c, pairwise comparisons using Bonferroni adjusted estimated marginal means (emmeans; see Figure 2) revealed a significant difference between the 'Diary + Instruction' and 'Instruction' groups. No significant differences were found between other pairs of conditions, not supporting H1a and H1b. Further, the means showed that the Diary + Instruction condition had the highest mean post-test ELL score ($M = 14.3, SE = 0.585$), followed by 'Diary' ($M = 13.2, SE = 0.619$), 'Control' ($M = 12.0, SE = 0.622$), and 'Instruction' ($M = 11.7, SE = 0.576$). Thus, the results indicate significant differences between the conditions in post-test ELL scores after adjusting for pre-test ELL scores. Specifically, the Diary + Instruction condition yielded significantly higher post-test ELL scores than the instruction condition.

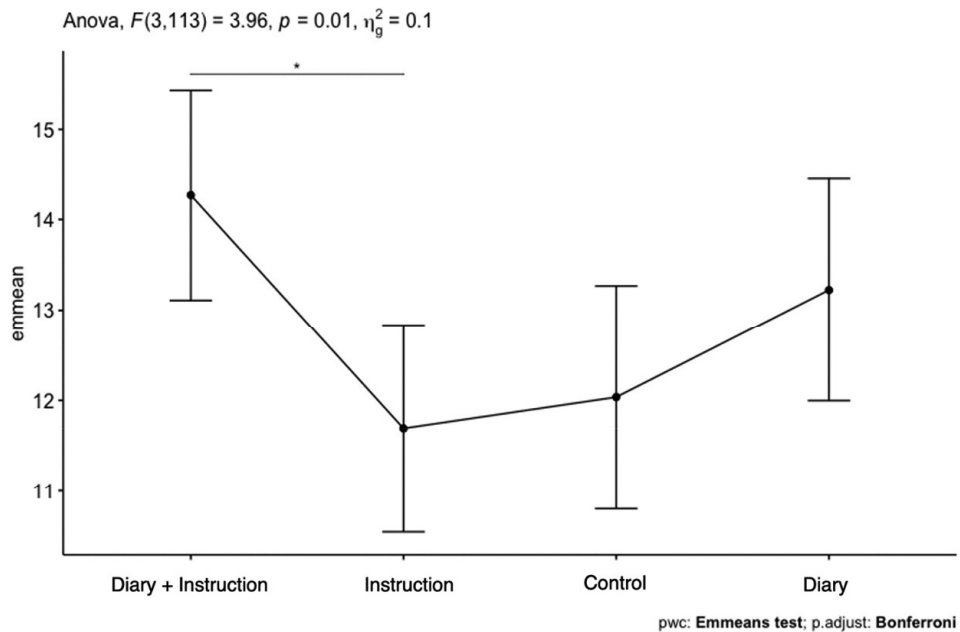


Figure 2. Estimated means difference of English language learning scores.

3.3. Differential effect of self-assessment interventions on growth mindset

Examining the effect of the intervention conditions on post-intervention growth mindset after controlling for baseline growth mindset. The ANCOVA indicated a significant influence of baseline growth mindset on post-intervention scores, $F(1, 113) = 15.042, p < .001$, which accounted for about 11.7% of the variance in post-intervention growth mindset scores ($\eta^2 = 0.117$). Furthermore, a significant effect of the intervention condition was observed, $F(3, 113) = 4.599, p < .01$, with the effect size suggesting that the intervention condition explained approximately 10.9% of the variance in post-

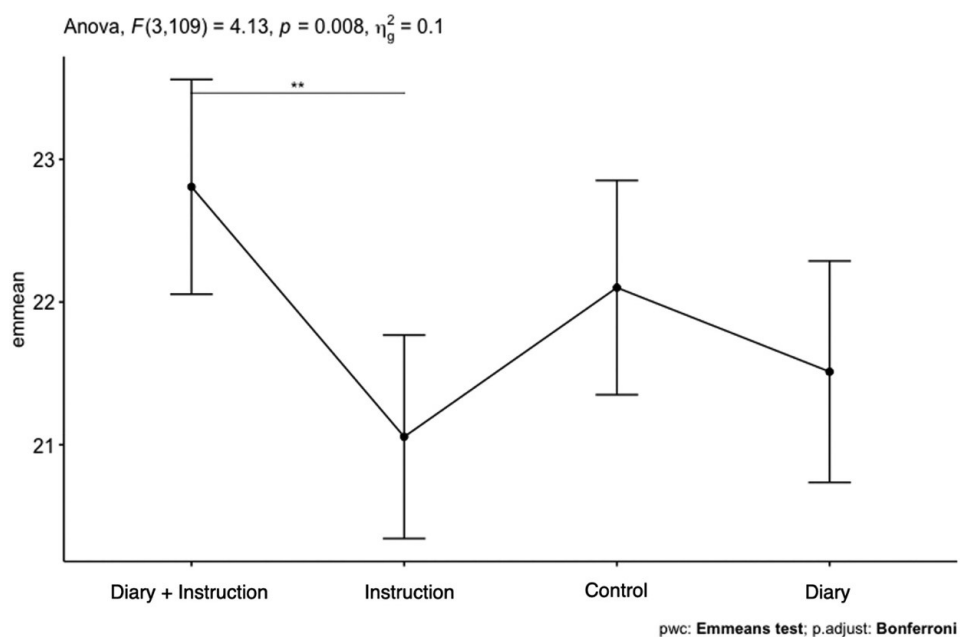


Figure 3. Estimated means difference of growth mindset, controlling for baseline growth mindset.

intervention growth mindset scores ($\eta^2 = 0.109$). Subsequent pairwise comparisons, adjusting for baseline growth mindset, showed significant differences in post-intervention growth mindset between the Diary + Instruction and Instruction only conditions (see Figure 3), supporting H2c. No significant differences were observed among the other groups, which did not support H2a and H2b. Estimated marginal means for post-intervention growth were as follows: DI = 22.8, Instruction = 21.1, Control = 22.1, Diary = 21.5. These findings suggest that the Diary + Instruction intervention was notably effective in enhancing growth mindset, even when the baseline growth mindset levels were taken into account.

3.4. Examining the trajectories of growth mindset during SA intervention

Building on our findings from section 3.3, which showed that the intervention conditions significantly affected post-intervention growth mindset scores while controlling for pre-intervention scores, we further examined the trajectories of growth mindset over the course of the 10-week intervention using diary entries ($n = 1,280$) from the Diary and Diary + Instruction conditions. Specifically, we ran linear mixed effects to test whether (1) the experimental conditions directly influenced students' growth mindset, (2) the plausible variations of growth mindset can be attributed to the interventions, and (3) whether growth mindset varied throughout the 10-week intervention.

Results of the mixed-effects ANOVA showed a significant main effect of condition, $F(1, 62.00) = 12.025, p < .001$, and a significant interaction between condition and diary entry, $F(19, 1178.00) = 1.813, p < .05$. The estimated marginal means revealed higher growth mindset scores in the Diary + Instruction condition ($M = 5.65, 95\% \text{ CI } [5.49, 5.81]$) compared to the SA Diary condition ($M = 5.23, 95\% \text{ CI } [5.10, 5.40]$) across all diary entries. Fixed effects estimates showed significant effects for diary entry 1 ($\beta = -0.18, p < .05$), entry 7 ($\beta = -0.20, p < .05$), and entry 9 ($\beta = 0.26, p < .01$), indicating fluctuations in the effect of the Diary + Instruction condition at these specific time points (see Figure 4). Figure 4 illustrates that (1) although both conditions had visibly similar starting points in growth mindset, the Diary + Instruction condition consistently showed higher scores throughout most of the intervention, (2) fluctuations in the difference between conditions occurred mainly in the first half of the study, particularly at entries 1 and 7, and (3) after week 5 (entry 9), the difference between conditions stabilised with Diary + Instruction condition maintaining higher scores.

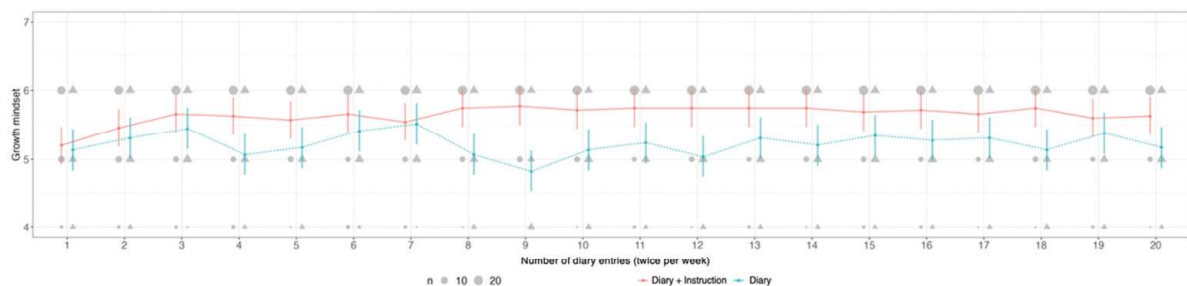


Figure 4. Trajectories of growth mindset over 20 data entries.

These extend our findings from section 3.3, demonstrating that the Diary + Instruction condition was consistently more effective in promoting growth mindset than the Diary only condition throughout the intervention period. While the overall growth mindset scores for both conditions combined remained relatively stable over time, the magnitude of the difference between conditions fluctuated, particularly in the early weeks, before stabilising in the latter half of the study, showing a stably higher growth mindset for those in the Diary + Instruction condition.

4. Discussion

This 10-week intervention examined the synergistic effect of student SA diaries and teacher instruction in prompting SA on high school students' learning outcomes and growth mindset. The results provide evidence for the effectiveness of combining SA diaries and teacher instruction, as this condition demonstrated the greatest improvements in language learning test scores and growth mindset. The findings are interpreted and discussed below.

4.1. *Intervention effects on language learning outcomes*

The SA Diary + Instruction condition demonstrated the greatest improvements in ELL outcomes, aligning with our primary hypothesis (H1c) and extending previous research on the benefits of SA interventions for academic achievement (Brown & Harris, 2013; Yan et al., 2022). The synergistic effect can be attributed to the complementary nature of the two interventions, as outlined in the study design and procedures. The teacher instruction, which focused on determining assessment criteria (weeks 1–3), seeking external feedback (weeks 4–7), and self-reflection (weeks 8–10), likely provided students with the necessary scaffolding and guidance to effectively engage in SA practices (Brown & Harris, 2014; Hattie & Timperley, 2007). This explicit instruction helped students understand the purpose and process of SA, equipping them with the knowledge and skills needed to effectively evaluate their own work (Andrade & Valtcheva, 2009; Panadero et al., 2017).

The SA diaries, which were completed twice weekly and guided students through the cyclical SA process, offered a structured platform for regular self-reflection and application of SA skills (Schmitz & Perels, 2011; Yan et al., 2020). The diaries provided students with consistent opportunities to practice and internalise the SA strategies learned through teacher instruction, promoting the development of SRL skills (Dignath & Büttner, 2008; Zimmerman & Schunk, 2011). This combination of explicit instruction and consistent practice appears to optimise the development of SA abilities and associated benefits for achievement, as it addresses both the cognitive and metacognitive aspects of SA (Yan, 2022), while fulfilling students' competence and autonomy needs (Ryan & Deci, 2017).

Notably, neither the SA Instruction only condition nor the SA Diary only condition alone resulted in significant improvement compared to the control condition. This suggests that either learning SA or engaging in SA alone does not provide substantial benefits for students. An increase in outcomes only arises in the SA Diary + Instruction condition, indicating that learning and practicing SA

simultaneously is better than either condition implemented separately. A similar phenomenon is observed and termed as the theory-practice gap in professional learning contexts (e.g. Björck & Johansson, 2019; J. E. Brown, 2019; Collin & Tynjälä, 2003). Researchers contend that the integration of theory learning and practicing mutually enhances each other. Learning SA in the classroom elucidates practical applications and delineates the parameters of given SA tasks, while practicing SA aids in the understanding of the reasoning and underlying principles behind SA task execution. Engaging in SA diaries affords students opportunities for SA skill refinement through repetition and learning from mistakes.

These findings can be explained by constructivist theory, which suggests that ‘one has to experience the world to know it’ (Peters, 2000, p. 167). Constructivist learners are tasked with synthesising experiences with new insights to construct knowledge. Scaffolded SA underscores the necessity for students to receive mentorship and guidance to construct their knowledge autonomously. Practicing SA can also be understood as experiential learning, where knowledge evolves through the transformation of experiences within existing cognitive frameworks, reshaping thought processes and behaviours (Kolb, 2014). Thus, SA is perceived as an ongoing evolution, shaped by the continual synthesis of SA experience and cognition.

From a cognitive perspective, the synergy can be understood through Anderson’s (1982) framework for skill acquisition, where skilled performance requires the transformation of declarative knowledge (‘knowing that’) into procedural knowledge (‘knowing how’) through knowledge compilation. The instruction component provided the declarative stage foundation, while the diary component offered the repeated practice contexts necessary for *proceduralization*, i.e. the process by which factual knowledge becomes directly embodied in procedures for performing the skill. Additionally, the temporal spacing of diary entries (twice weekly over 10 weeks) may have leveraged spacing effects known to enhance learning and retention (Cepeda et al., 2006), allowing for consolidation of self-assessment skills between sessions while maintaining sufficient frequency to prevent skill decay.

4.2. Intervention effects on growth mindset

The positive impact of the SA Diary + Instruction intervention on growth mindset (H2c) is particularly noteworthy, as it demonstrates the potential of SA practices to influence students’ beliefs about their abilities and the nature of learning (Dweck & Yeager, 2019). The SA diaries included brief growth mindset assessments, providing regular opportunities for students to reflect on their mindset throughout the intervention period. By emphasising the process of learning and providing opportunities for self-reflection and improvement, the combined intervention likely reinforced the idea that abilities can be developed through effort and effective strategies (Blackwell et al., 2007).

The multilevel analysis of diary entries provided further insights into the differential effects of the interventions on growth mindset over time. The SA Diary + Instruction condition consistently promoted higher growth mindset scores than the SA Diary only condition throughout the intervention period. This finding underscores the importance of combining structured self-reflection opportunities with explicit instruction to foster adaptive beliefs about learning and ability (Dweck & Yeager, 2019). The teacher

instruction, which emphasised determining assessment criteria, seeking feedback, and self-reflection, likely provided students with a framework for understanding the learning process and their role in it. By combining this explicit instruction with the regular self-reflection opportunities provided by the SA diaries, the SA Diary + Instruction condition was more effective in promoting a growth mindset than the SA diary alone.

The observed fluctuations in growth mindset differences between conditions, particularly at entries 1 (Week 1, mid-week) and 7 (Week 4, early in Phase 2), likely reflect adjustment periods as students managed the cognitive load of learning new SA concepts while beginning diary practice. According to cognitive load theory (Sweller et al., 2019), simultaneously processing intervention mechanics and developing growth mindset may have created temporary performance decrements. The stabilisation after Week 5 suggests students had integrated both components and could direct cognitive resources towards deeper mindset engagement rather than managing intervention logistics. This pattern aligns with skill acquisition research showing initial cognitive load giving way to automated processing (Kalyuga et al., 2003).

4.3. Cultural context and its implications

Our study was conducted in a secondary school in the Philippines, a cultural context influenced by collective heritage values that emphasise teacher authority and effort-based achievement (Bernardo, 2009). This cultural setting may have enhanced receptivity to our teacher instruction component, as students from collective contexts often view teacher-directed learning as complementary to student autonomy (King & McInerney, 2018). Additionally, Filipino students' tendency to endorse malleable conceptions of intelligence (Bernardo, 2020; see also Lee & Mendoza, 2025) may have provided existing cognitive frameworks that facilitated growth mindset development through self-assessment practices. The effectiveness of our combined SA Diary + Instruction approach may reflect a culturally congruent integration of autonomy and structure that resonates with educational values in this context, though the underlying psychological mechanisms likely have broader applicability.

4.4. Limitations and directions for future research

This study has several limitations that should be considered when interpreting the results. Our study was conducted within a specific educational setting (science high school in the Philippines), which may limit its applicability to broader educational contexts. The specialised nature of the school environment, with typically high-performing students, creates a unique context that may not reflect experiences in regular secondary schools. Our study focused on English language learning, and the effects of SA interventions have been shown to vary across content areas (Brown & Harris, 2013; Mendoza et al., 2022). The cognitive and metacognitive processes involved in language learning may differ from those in mathematics, sciences, or arts, potentially affecting how self-assessment influences learning and mindset in these domains. Additionally, English language learning in the Filipino context represents a second language acquisition scenario with distinct motivational and cultural dynamics.

A notable methodological limitation is our reliance on a single teacher across all conditions. While using one teacher helped control for instructor-level variables, it introduces potential experimenter effects where the teacher's knowledge of the study aims and conditions may have inadvertently influenced instruction or student-teacher interactions differently across conditions. Our final sample had more girls (63.6%), which may limit the generalisability of our findings. Previous research has identified gender differences in both self-assessment practices and mindset orientation (Lee et al., 2021), and the representation of girls in our sample may have heightened the observed effectiveness of the SA interventions. Our study relied on self-reported measures, particularly for assessing growth mindset. While the Incremental Beliefs subscale used has demonstrated strong psychometric properties ($\alpha = .81$ at T1 and $\alpha = .87$ at T2), self-reports are not free of social desirability bias and may not fully capture the complexity of mindset beliefs as they manifest in actual learning behaviour (Mendoza & Yan, 2025). It should also be noted that we did not assess the quality or depth of student engagement with the SA diaries, treating diary submission as a binary indicator rather than accounting for reflection depth variations.

Future research should address these limitations and expand our understanding of effective SA practices in educational settings. Cross-cultural studies examining similar interventions across diverse cultural settings would help identify culture-specific and universal aspects of self-assessment's impact. Studies with larger and more diverse samples could provide insights into the generalisability of the observed effects across different populations and contexts (Sisk et al., 2018). Multi-site implementations with multiple teachers randomly assigned to conditions would better isolate intervention effects from potential experimenter effects. Future research should aim for more balanced gender representation and explicitly examine gender as a moderating variable in the relationship between SA practices and growth mindset development. Future studies could strengthen measurement validity by triangulating self-reports with behavioural indicators (e.g. persistence on challenging tasks, response to failure feedback) and qualitative data from interviews or observational protocols. Incorporating qualitative coding of diary entries to assess reflection depth using frameworks such as Kember et al. (2008) four-category scheme would provide more nuanced insights into how the quality of self-assessment practice mediates the relationship between intervention and outcomes.

5. Conclusion

This study demonstrates the synergistic benefits of combining teacher instruction and SA diaries to enhance language learning outcomes and growth mindset among high school students. By providing empirical support for the added value of SA diaries alongside teacher instruction, our findings emphasise the importance of learning and practicing SA simultaneously. The study also contributes to the literature on the relationship between SA and growth mindset development, demonstrating that structured self-assessment practices can influence students' beliefs about the malleability of their abilities. As educational systems increasingly emphasise 21st-century skills such as SRL and adaptive mindsets, this research offers a practical and effective approach

to fostering academic success and lifelong learning through the integration of structured SA practices and teacher guidance.

Notes

1. Including the two-week holidays, the gap between the pre-test and post-test was approximately 12 weeks.
2. A total of 1,068 diary observations were collected from the participants assigned to the SA diary ($n = 35$; 637 diary entries) and the SA diary + instruction ($n = 29$; 411 diary entries) conditions. We used multiple imputation through chained equations (MICE), to impute the missing data which brings the total number of observations to 1,280 (64 students * 20 diary entries).

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