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THE EFFECTS OF AN ONLINE FORMATIVE ASSESSMENT PRACTICE ON STUDENTS' SELF-REGULATED LEARNING: AN EXPERIMENTAL STUDY AT A SECONDARY SCHOOL IN HANOI

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Abstract. Students are expected to take greater responsibility for their learning in today's educational world. To help students develop their self-regulated learning and investigate the effects of an online formative assessment practice on self-regulated learning, an experimental study was conducted at a secondary school with 54 student participants. The treatment included three key components: explaining learning objectives, providing formative feedback, and using gamified online quizzes. The data were collected over sixteen weeks using a 48-item version of the Motivational Strategies for Learning Questionnaire (MSLQ) before and after the treatment. The results indicate that the online formative assessment had a modest but measurable effect on the students' self-regulated learning.

Keywords: online formative assessment, self-regulated learning, secondary education.

1. Introduction

Self-regulated learning (SRL) is crucial for academic success because it fosters student autonomy, motivation, and academic success (Zimmerman, 2002) [1]. However, at the secondary school under study, summative assessment dominates, and the students tend to prioritize memorization over deeper learning. This situation raises an important question: How can educators effectively support students in developing stronger self-regulated learning skills? One promising approach is formative assessment, which provides students with continuous feedback, helping them reflect on their learning and make necessary adjustments (Black and Wiliam, 1998) [2]. This kind of feedback can be automated, interactive, and have progress-tracking features via online platforms. Online formative assessment allows students to foster metacognitive awareness, motivation, and self-monitoring skills, which are key components of SRL (Nicol and Macfarlane-Dick, 2006) [3].

However, despite its theoretical benefits, there remains a need for empirical evidence on the actual impact of online formative assessment on students' SRL strategies in real English classroom settings. This study sought to provide insights into whether online formative assessment can serve as a practical tool for fostering self-regulated learning in real English classroom settings by comparing an experimental group that receives online formative assessment strategies with a control group following traditional assessment methods.

To achieve the above-mentioned objectives, the research seeks an answer to the following question: What are the effects of online formative assessment on students' self-regulated learning?

2. Content

2.1. Literature review

2.1.1. Formative assessment

Assessment is the process of collecting, analyzing, and interpreting information about students' learning to improve instruction and measure academic progress (Bachman and Damböck, 2017) [4]. Assessment falls into two main types: summative and formative. Summative assessment evaluates learning at the end of an instructional period, while formative assessment provides continuous feedback to improve learning (Bell and Cowie, 2001) [5].

Formative assessment, as defined by Bell and Cowie (2001), is a method in which teachers identify and respond to student learning to improve it during the learning process. Therefore, formative assessment serves as a tool for assessment for learning rather than assessment of learning. According to Black and Wiliam (1998), effective formative assessment consists of five key strategies, namely (1) clarifying, sharing, and understanding learning intentions and success criteria, (2) engineering effective classroom discussions, (3) providing feedback, (4) activating learners as instructional resources for each other, and (5) activating learners as owners of their learning.

2.1.2. Online formative assessment

Online formative assessment (OFA) utilizes digital tools to facilitate continuous assessment, feedback, and progress monitoring. It includes quizzes, interactive assignments, discussion forums, and gamified assessments, offering immediate and personalized feedback (Gikandi *et al*., 2011) [6]. Immediate feedback allows students to gauge their understanding, identify areas of weakness, and adjust their learning strategies in real time, promoting self-regulation. Online formative assessments can be designed to align with specific learning objectives. Students, when aware of these objectives, can use online formative assessments as benchmarks for their progress. Meeting these goals enhances their self-efficacy and motivation, which are the essential components of SRL.

The benefits of OFA have been highlighted in several studies, including enhanced feedback quality (Gikandi *et al.,* 2011; Shute, 2008), increased engagement (Dabbagh and Kitsantas, 2012) [7], self-paced learning (Alamri et al., 2020) [8], and data-driven insights (Qazi and Pachler, 2024) [9].

2.1.3. Self-regulated learning

Research on self-regulated learning explores how students actively manage their learning processes through metacognition, motivation, and behavioral regulation (Zimmerman, 1990; Zimmerman, 2002) [10].

Metacognition, or the ability to plan, monitor, and regulate one's cognitive processes, is central to self-regulated learning (Zimmerman, 2002). Flavell (1979) [11] divides metacognition into two major components: metacognitive knowledge and metacognitive regulation.

Motivation is a critical driver of self-regulated learning, influencing students' willingness to set goals, persist through challenges, and actively engage in their studies (Zimmerman, 2002). There are two types of motivation: intrinsic and extrinsic (Deci and Ryan, 1985) [12].

Behavioral engagement, referring to students' effort regulation – the ability to stay focused and maintain motivation even when faced with difficulties (Pintrich, 1999) [13], seek help when needed - recognize when they need support and take proactive steps to obtain it (Karabenick and Dembo, 2011) [14], environmental structuring - creating a learning environment that supports focus and productivity (Greene and Azevedo, 2007) [15], task management - the ability to plan, prioritize, and break down learning tasks into manageable steps (Boekaerts, 1992) [16].

The above-mentioned components of SRL can happen as a cyclical process: (1) Forethought, where students set goals and plan strategies; (2) Performance, involving self-monitoring and adjustments during learning; and (3) Self-reflection, where students evaluate outcomes and refine strategies (Zimmerman, 2008) [17].

Figure 1. Zimmerman's (2008) model of self-regulated learning

Motivational Strategies for Learning Questionnaire (MSLQ), developed by Pintrich *et al*. (1991) [18], is one of the most widely used instruments for measuring self-regulated learning. It assesses both motivational and learning strategy components, aligning closely with Zimmerman's (2008) three-phase model of SRL, which describes how students actively regulate their metacognition, motivation, and behavior in learning.

2.2. Previous studies

Research on formative assessment and self-regulated learning has expanded significantly over the past few years, with numerous studies highlighting their interconnectedness.

Black and Wiliam (1998) reviewed over 250 studies, concluding that formative assessment enhances self-regulated learning by promoting self-assessment, goal-setting, and strategic learning adjustments. Zimmerman (2002) reinforced this, emphasizing that SRL skills - goal setting, self-monitoring, and self-reflection - are strengthened through structured feedback.

Empirical studies on online formative assessment further explore its potential. Shute (2008) [19] found that real-time feedback from digital tools improved self-regulation, while Deterding *et al*. (2011) [20] demonstrated that gamification elements such as leaderboards, quizzes, etc. increased motivation and engagement. However, Simon (2019) [21] found no significant impact of formative assessment on motivation, suggesting that additional factors influenced its effectiveness.

Despite strong support for FA in fostering SRL, challenges remain. Williams-McBean (2021) [22] argued that vague feedback limited its impact, while Panadero and Jonsson (2013) [23] stressed the need for structured self-assessment training. Additionally, Clark (2012) [24] found that FA is more effective in student-centered environments than in rigid, teacher-directed settings.

In short, while research supports OFA's role in SRL, gaps remain, particularly in understanding its effects in secondary education, especially in Vietnamese classrooms. This study addresses this gap by examining how OFA influences SRL in this context.

2.3. Methodology

2.3.1. Research design

This study employs an experimental design developed by Campbell and Stanley (2011) [25] to examine the effects of online formative assessment on self-regulated learning. This design allows for comparison between an experimental group that receives online formative assessment treatments and a control group that follows traditional summative assessment methods.

To enhance internal validity, stratified sampling prevented selection bias, the same teacher and materials ensured consistency, and identical pre-test/post-test instruments maintained

reliability. External validity was strengthened by conducting the study in a natural classroom setting and ensuring diverse student representation.

2.3.2. Research setting

The study was carried out in an English language classroom at a public secondary school in Hanoi, Vietnam, over 16 weeks (one semester). The school follows the Vietnamese National Education Program and uses the government-approved *Global Success* textbook, aligning with the 2018 General Education Curriculum. The students covered from Unit 7 to Unit 12 of the Global Success English book Grade 7, namely Traffic, Films, Festivals around the world, Energy sources, Travelling in the future, and English-speaking countries. Fifty-four seventh-grade students whose English proficiency levels range from A1 to A2+ were chosen as the participants of the study. Randomly, 27 students were assigned to the control group and 27 students were assigned to the experimental group.

2.3.3. Research procedure

2.3.3.1. Sampling

Before the treatment, a stratified random sampling method was used to ensure a diverse representation of English proficiency levels, enhancing the study's reliability and validity. The sample included 54 Grade-7 students from a public school in Hanoi, categorized into three levels based on prior academic performance: 22 very good, 10 good, and 22 not good. To maintain balance, three academic performance groups were divided randomly into experimental and control groups using the "Spin the Wheel" online tool.

2.3.3.2. Pedagogical treatment

The treatment in this study consisted of three components, namely (1) explaining learning objectives before each unit, (2) improving feedback quality throughout each unit, and (3) using gamified online assessment quizzes for the students to learn and self-evaluate after the unit.

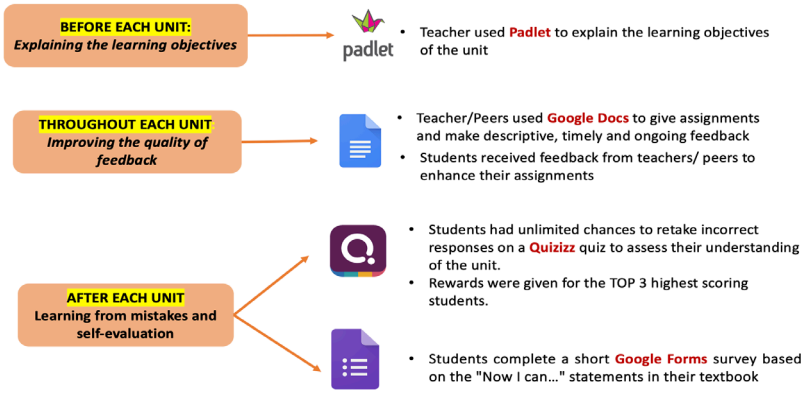

Figure 2. The online formative assessment practice

(1) Explaining learning objectives (before each unit)

(2) Improving feedback quality (ongoing)

(3) Gamified online assessment (after each unit)

2.3.4. Data collection

This study used a quantitative approach, gathering data through the Motivational Strategies for Learning Questionnaire (MSLQ). The MSLQ, a widely used tool for measuring self-regulated learning, assesses motivational, metacognitive, and behavioral components, aligning with Zimmerman's (2000, 2002) self-regulated learning framework. Originally comprising 81 questions across 15 subscales on a 7-point Likert scale, the framework was adapted to a 5-point scale for clarity and shortened to 48 questions through modifying or eliminating items while maintaining all

subscales. The MSLQ was administered twice (pre- and post-test), with responses analyzed using SPSS Statistics.

2.3.5. Data analytical framework

To evaluate the effects of formative assessment on students' self-regulated learning, this study employed a structured quantitative data analytical framework (Campbell and Stanley, 2011). The primary data sources of the study included pre-test and post-test assessments (MSLQ), which were administered to measure changes in the students' self-regulated learning behaviors before and after the treatment.

The data from the pre-test and post-test were analyzed using SPSS Statistics. A series of statistical tests were conducted on SPSS Statistics to systematically analyze the data: Cronbach's Alpha reliability analysis, descriptive satistics, independent samples t-test, paired samples t-test, and Cohen's d effect size measurement.

2.4. Findings and discussion

2.4.1. Quantitative data analysis

2.4.1.1. Reliability analysis

Reliability is a crucial factor in ensuring the consistency and accuracy of measurement tools. One of the most widely used measures for assessing reliability is Cronbach's Alpha, which determines the internal consistency of a set of items within a subscale.

Table 1. Reliability statistics for items 1-17 (Motivation)

Cronbach's Alpha	N of items
.701	17

Table 2. Reliability statistics for items 18-33 (Metacognition)

Cronbach's Alpha	N of items
.753	16

Table 3. Reliability statistics for items 34-48 (Behavior)

Cronbach's Alpha	N of items
.648	15

Cronbach's Alpha assessed the internal consistency of the MSLQ's three subscales:

- Motivation ($\alpha = 0.701$): Acceptable reliability for research, though with room for improvement.
- Metacognition ($\alpha = 0.753$): Good reliability, indicating strong interrelation among items.
- Behavior ($\alpha = 0.648$): Moderate reliability, suggesting the need for refinement, likely due to fewer items.

The MSLQ demonstrates acceptable to good reliability (0.70–0.75), providing a reasonably consistent measure of student motivation, metacognition, and behavior in learning.

2.4.1.2. Descriptive statistics

These values provide an overview of how students performed before and after the treatment, allowing for an initial evaluation of potential changes in self-regulated learning.

Table 4. Descriptive statistics of the pre-test and post-test

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	54	2.17	4.19	3.4234	.36158
Posttest	54	2.65	4.23	3.5579	.33815
Valid N (listwise)	54				

The mean increased from 3.4234 (pre-test) to 3.5579 (post-test), suggesting slight improvement. Standard deviation decreased from 0.36158 to 0.33815. A lower standard deviation

in the post-test suggests that the scores became more concentrated around the mean, implying that the participants' performance became more consistent after the treatment.

2.4.1.3. Hypothesis testing

An independent samples t-test compared mean scores between the experimental and control groups in the pre-test and post-test conditions to assess treatment effects.

Table 5. Independent samples test

	Group_Level	N	Mean	Std. deviation	Std. error mean
Pre-test	Experimental	27	3.3506	.36970	.07115
	Control	27	3.4961	.34471	.06634
Post-test	Experimental	27	3.6165	.33728	.06491
	Control	27	3.4992	.33496	.06446

		Lene's test		t-test for equality of means						95% Confidence interval of the difference	
		F	*Sig.*	*t*	*df*	*One-sided p*	*Two-sided p*	*Mean difference*	*Std. Error Difference*	*Lower*	*Upper*
Pre-test	Equal variances assumed	.147	.703	-1.496	52	.070	-.14557	.09728	-.34077	-.34077	.04963
	Equal variances not assumed			-1.496	51.747	.070	-.14557	.09728	-.34080	-.34080	.04966
Post-test	Equal variances assumed	.153	.697	1.282	52	.206	.11728	.09148	-.06628	-.06628	.30085
	Equal variances not assumed			1.282	51.998	.206	.11728	.09148	-.06628	-.06628	.30085

Descriptive statistics show the experimental group started lower (M = 3.3506) than the control group (M = 3.4961) in the pre-test but improved in the post-test (M = 3.6165) while the control group remained stable (M = 3.4992).

For the pre-test, the t-value (-1.496, p = .141) indicates no significant difference between groups. In the post-test, the t-value (1.282, p = .206) suggests that the experimental group's improvement was not statistically significant. While the treatment showed a slight numerical increase, further analysis is needed to confirm their impact.

Table 6. Paired samples test

		Paired Differences					t	df	Significance	
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference*					
					Lower	*Upper*			*One-Sided p*	*Two-Sided p*
Pair 1	Pretest_Control – Posttest_Control	-.00309	.08165	.01571	-.03539	.02922	-.196	26	.423	.946
Pair 2	Pre-test_Experimental – Post-test_Experimental	-.26594	.22052	.04244	-.35317	-.17871	-6.267	26	<.001	<.001

A paired sample t-test assessed pretest-posttest differences in both groups. The control group showed no significant change (M = -0.0031, t = -0.196, p = .846). In contrast, the experimental group showed a significant improvement (M = -0.2659, t = -6.267, p < .001). These results indicate that the treatment was effective only for the experimental group, while the control group's performance remained unchanged.

The post-test results show no significant difference between the groups after the treatments. The p-value of 0.206 suggests that the changes in scores were not statistically different between the control and experimental groups.

Table 7. One-way ANOVA test

		Sum of Squares	df	Mean Square	F	Sig.
Pretest	Between Groups	.286	1	.286	2.239	.141
	Within Groups	6.643	52	.128		
	Total	6.929	53			
Posttest	Between Groups	.186	1	.186	1.644	.206
	Within Groups	5.875	52	.113		
	Total	6.060	53			

The post-test results show no significant difference between the two groups after the treatment. The p-value of 0.206 suggests that the changes in scores were not statistically different between the control and experimental groups.

Table 8. Descriptive statistics for pre-test and post-test scores by group

	Group_Level	N	Mean	Std. deviation	Std error mean
Pre-test	Experimental	27	3.3506	.36970	.07115
	Control	27	3.4961	.34471	.06634
Post-test	Experimental	27	3.6165	.33728	.06491
	Control	27	3.4992	.33496	.06446

Effect size measures the practical significance of differences. Cohen's d for the pre-test (-0.407) indicates a small to moderate negative effect, meaning the control group scored slightly higher. For the post-test (0.349), it suggests the experimental group performed slightly better after the treatment, but the effect remains small to moderate. While the treatment had a measurable impact, the effect size is below the medium threshold (0.5), indicating a limited practical difference.

2.4.1.4. Mean scores of the questions in the MSLQ subscales

The experimental group showed greater improvement across all aspects, while the control group's scores remained stable or slightly declined. Below are the pre-test and post-test mean scores for questions (Q) with significant improvement:

(1) Motivation subscale

Q3: *Knowing the learning objectives helps me stay engaged in lessons* (+0.55, Mpre = 3.78 → Mpost = 4.33).

Q5: *I feel motivated to learn because I want to show my abilities to others* (+0.40, Mpre = 3.41 → Mpost = 3.81).

Q6: *I enjoy engaging in activities that allow me to test my knowledge, such as quizzes or test* (+0.67, Mpre = 2.89 → Mpost = 3.56).

Q9: *If I study in appropriate ways, then I will be able to learn the materials in this course.* (+0.45, Mpre = 3.81 → Mpost = 4.26).

Q13: *I am confident I can understand the most complex material presented by the teacher in this course.* (+0.56, Mpre = 2.44 → Mpost = 3.00).

Q17: *Knowing that I can redo incorrect answers makes me feel less anxious.* (+0.55, Mpre = 3.41 → Mpost = 3.96).

(2) Metacognition subscale

Q22: *I try to apply ideas from course readings in other class activities, such as discussion.* (+0.44, Mpre = 2.93 → Mpost = 3.37)

Q24: *I make simple charts, diagrams, or tables to help me organize course material.* (+0.56, Mpre = 2.37 → Mpost = 2.93).

Q32: *I set specific goals for what I want to learn in each lesson.* (+0.41, Mpre = 2.96 → Mpost = 3.37).

(3) Behavioral subscale: Improvements were observed, but none were substantial.

2.4.2. Discussion of the three components of SRL

The most notable improvements were observed in the students' motivation, particularly in areas related to engagement, confidence, and reduced anxiety. Several key questions demonstrate significant increases in mean scores, suggesting that the online formative assessment practice in the study played a crucial role in enhancing students' motivation. The students found that knowing learning objectives helped them stay engaged and that interactive activities such as quizzes made learning more enjoyable (Q3: *Knowing the learning objectives helps me stay engaged in lessons*, Q5: *I enjoy engaging in activities that allow me to test my knowledge, such as quizzes or test)*. Students felt more motivated when they had opportunities to demonstrate their abilities and believed that effective study strategies would lead to success (Q5: *I feel motivated to learn because I want to show my abilities to others.).* The ability to redo incorrect answers in the treatment helped the students feel more at ease, reducing test-related stress (Q17: *Knowing that I can redo incorrect answers makes me feel less anxious.)* There was also a notable increase in the students' confidence in understanding complex material, indicating that the formative assessment practice might have helped them develop stronger self-belief in their learning abilities (Q9: *If I study in appropriate ways, then I will be able to learn the materials in this course.)*

Metacognition, or students' ability to plan, monitor, and regulate their learning, also showed significant improvements in the experimental group. Key indicators of metacognitive development include: the students became more likely to transfer knowledge to different learning activities, demonstrating a deeper understanding of course materials (Q22: *I try to apply ideas from course readings in other class activities such as discussion.).* The increased use of charts, diagrams, and tables to structure learning suggests that the online formative assessment in the study encouraged the students to develop more effective learning techniques (Q24: *I make simple charts, diagrams, or tables to help me organize course material.).* The students became more deliberate in setting specific learning goals for each lesson, which is a key aspect of self-regulated learning (Q32: *I set specific goals for what I want to learn in each lesson).*

While motivation and metacognition showed strong improvements, the changes in the students' behavioral engagement were not as substantial. This result could indicate that behavioral change takes longer to develop, and a longer treatment period may be required to observe significant improvements. While students may have improved their internal learning strategies (motivation and metacognition), their external learning behaviors (such as study habits and participation in class activities) did not change drastically.

2.4.3. Discussion of the effects of online formative assessment on students' SRL

This study provides strong evidence that online formative assessment (OFA) enhances self-regulated learning (SRL), particularly in motivation and metacognition. The students who participated in OFA became more motivated, strategic, and aware of their progress. However, its limited impact on behavioral engagement suggests that formative assessment alone may not fully develop SRL. OFA supports SRL by:

Real-time feedback → Encouraging reflection and immediate adjustments;

Gamification and engagement features → Boosting motivation and persistence;

Self-assessment and reflection → Enhancing metacognitive skills;

Goal-setting and progress tracking → Promoting a structured learning approach.

Despite these benefits, the moderate effect size (Cohen's d) suggests that longer treatment periods and additional support may be needed to maximize OFA's impact.

3. Conclusion

This study examined the effects of online formative assessment on students' self-regulated learning using pre-test and post-test data from the experimental and control groups. While formative assessment did not significantly improve SRL, it played a crucial role in shaping students' motivation and metacognition over time.

Despite its insights, this study has limitations. The small sample size (54 students) restricts generalizability, and the short study duration makes it unclear whether SRL improvements would persist in long-term. The sole reliance on self-reported data from the Motivated Strategies for Learning Questionnaire (MSLQ) poses potential biases, as students' responses may be influenced by social desirability or subjective perceptions rather than actual learning behaviors. Furthermore, external factors like students' prior experiences and attitudes may have influenced results. Some students might also have skipped content or sought external help, inflating scores and misrepresenting actual learning gains.

Future research should expand sample size and diversity, investigating the long-term effects of formative assessment on SRL. Studies should also examine different formative assessment types and how individual differences impact effectiveness. Cultural and educational contexts should be explored to determine whether findings apply across various learning environments. Additionally, incorporating proctoring tools and tracking engagement patterns could improve the accuracy of SRL assessments. Addressing these areas will help refine formative assessment strategies and support students in developing independent learning skills.

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