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DEVELOPMENT OF AN INSTRUCTIONAL MODEL TO PROMOTE QUALITY EDUCATION THROUGH SUSTAINABLE SELF-DIRECTED LEARNING SKILLS AMONG GRADUATE STUDENTS IN THAILAND

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ABSTRACT

This study aimed to (1) investigate graduate students' needs for developing self-directed learning skills, (2) develop instructional models to promote sustainable SDL, (3) examine the effectiveness of the instructional models in enhancing students' SDL skills, and (4) explore students' satisfaction and perceptions toward the instructional models for improving quality education of graduate students in Thailand. A mixed-methods design was used. Data were collected through a self-directed learning questionnaire administered before and after model implementation, along with interviews and focus group discussions. Three instructional models were developed through stakeholder input and expert validation. Data were analyzed using descriptive statistics, paired-samples t-tests, and content analysis. The findings revealed that students initially demonstrated moderate levels of SDL skills, indicating a need for instructional support. The three developed models were evaluated by experts as highly appropriate and feasible. After implementation, students' self-directed learning skills significantly improved across all dimensions ($p < .05$). Students also reported high satisfaction, positive learning experiences, and a strong perceived impact on their ability to sustain self-directed learning beyond the classroom.

Keywords: Self-Directed Learning, Sustainable Learning, Lifelong Learning, SDG 4 (Quality Education)

1 INTRODUCTION

In the rapidly evolving global knowledge economy, higher education institutions are increasingly expected to nurture independent, lifelong learners who can adapt to complex academic and professional challenges. A core competency that underpins this expectation is self-directed learning (SDL), where learners take responsibility for identifying goals, managing resources, monitoring progress, and evaluating outcomes (Mai et al., 2025). Research indicates that instructional strategies such as active learning and blended environments positively influence students' SDL capabilities, yet traditional lecturer-centered pedagogies remain prevalent in many graduate programs, limiting opportunities for students to develop autonomy and sustained engagement with learning (Mai et al., 2025; Gedera & Maimunah, 2025).

Sustainable learning further extends this concept by emphasizing learning that continues beyond formal coursework, enabling learners to apply, adapt, and extend their knowledge throughout their professional lives. This aligns with a growing body of work focusing on autonomy and educational sustainability in diverse contexts, including technology-mediated environments that support learner autonomy and long-term engagement (Ibrahim et al., 2025).

Importantly, enhancing SDL skills among graduate students supports **Sustainable Development Goal 4 (SDG 4: Quality Education)**, which advocates for equitable and inclusive education and the promotion of lifelong learning opportunities for all. Effective SDL contributes to learners' capacity to manage their learning in dynamic academic and societal contexts, thereby fostering adaptability, resilience, and innovation (UN SDG 4). Despite this international emphasis, empirical evidence suggests a persistent gap in instructional approaches that meaningfully cultivate SDL at the graduate level, particularly in Thailand where pedagogical practices often remain rooted in passive, teacher-driven formats.

Failure to address this gap has significant implications. Without targeted instructional models that promote sustainable SDL, graduate students may struggle to navigate complex research demands, adapt to evolving job markets, and engage in continuous professional development. This can hinder not only individual academic success but also broader educational and economic goals, ultimately undermining national efforts to foster a highly skilled and competitive workforce aligned with global sustainability agendas.

Therefore, this study aims to develop and evaluate an

instructional model specifically designed to enhance sustainable self-directed learning skills among graduate students in Thailand, providing evidence-based insights to guide pedagogical innovation in higher education.

Research Objectives

1. To investigate the learning needs of graduate students regarding instructional approaches that promote sustainable self-directed learning skills.
2. To develop an instructional model for promoting sustainable self-directed learning skills based on the identified needs of graduate students.
3. To evaluate the effectiveness of the developed instructional model in enhancing graduate students' self-directed learning skills and sustainable learning behaviors.
4. To explore graduate students' satisfaction and perceptions toward the instructional model designed to foster sustainable self-directed learning.

Scope of the Study

This study focuses on the development and evaluation of an instructional model designed to promote sustainable self-directed learning skills among graduate students in Thailand. The scope of the study includes the following aspects:

Population and Sample

The scope of this study encompassed graduate students enrolled in Thai higher education institutions during the academic period of implementation, a population of approximately 128,622 students in Thailand (academic year 2023).

Duration

The implementation of the instructional model is conducted over one academic semester (approximately 16 weeks).

Research Design Scope

The study employs a Research and Development (R&D) approach consisting of needs analysis, model development, implementation, and evaluation.

Research Outputs

This study generated several significant academic and practical outputs related to the promotion of sustainable self-directed learning among graduate students in Thailand.

1. **A validated instructional model for sustainable self-directed learning** The study produced an evidence-based instructional model specifically designed to enhance graduate students' capacity

for autonomous and sustainable learning. The model integrates goal setting, strategic learning, reflective practice, and real-world knowledge application.

2. **Empirical evidence of improved self-directed learning skills** Findings from the implementation demonstrated that graduate students developed stronger abilities in planning, monitoring, and evaluating their own learning processes.
3. **Enhanced sustainable learning behaviors** Students showed greater tendencies toward continuous learning, independent knowledge seeking, and the ability to transfer learning beyond classroom contexts, reflecting the development of sustainable learning habits.
4. **Positive learner perceptions and high satisfaction** Graduate students reported that the instructional model supported their independence, engagement, and confidence as learners. The learning activities were perceived as meaningful and relevant to their academic and professional development.
5. **Practical guidelines for higher education instruction** The study provides a structured framework that instructors and institutions can adapt to redesign graduate-level learning environments in ways that foster learner autonomy and long-term learning capacity.
6. **Contribution to sustainable education aligned with SDG 4** By strengthening lifelong learning competencies and learner autonomy, the study supports the advancement of quality education and sustainable human capital development in higher education.

2 LITERATURE REVIEW

1. Self-Directed Learning as a Key Competency in Higher Education

Self-directed learning (SDL) has become widely recognized as a crucial competency for learners in the 21st century, particularly in higher education where autonomy, life-long learning, and adaptability are essential (Khairaty et al., 2025). Recent research emphasizes that SDL enables learners to set goals, choose strategies, and regulate their learning independently, which aligns with the demands of dynamic academic and professional environments. Furthermore, studies indicate that instructional strategies such as blended and hybrid learning positively influence SDL by providing flexible, learner-centered environments that nurture autonomy and self-regulation (Mai et al., 2025; Gedera & Maimunah, 2025).

2. Instructional Models that Promote SDL

Various instructional innovations have been shown to support self-directed learning. Blended learning strategies, combining face-to-face and digital elements, have demonstrated effectiveness in promoting SDL capabilities through enhanced flexibility, interactive engagement, and learner control (Mai et al., 2025). Hybrid approaches that integrate problem-based learning also significantly improve students' autonomy and problem-solving skills, indicating that student engagement and authentic tasks are key components of effective SDL environments (Chaiyasit et al., 2025).

Model development research in Thailand further supports this trend. For example, learning management models that integrate flipped classroom and resource-based learning have been shown to enhance SDL among pre-service teachers by fostering independent resource gathering and reflective practices, suggesting a viable foundation for instructional design that can be adapted to graduate contexts (Thasook, 2025).

Despite these developments, most existing models focus on undergraduate or pre-service teacher populations rather than graduate students, leaving a lacuna in understanding how instructional design can cultivate sustained learner autonomy at the postgraduate level precisely the gap this current study seeks to address.

3. Sustainability of Learning and Lifelong Learning Perspectives

The concept of sustainable learning extends SDL beyond episodic academic tasks toward continuous, lifelong learning habits. Education for Sustainable Development (ESD) advocates that learning should foster competencies enabling individuals to contribute to societal, environmental, and economic well-being throughout life. This resonates with the United Nations Sustainable Development Goals (SDG 4: Quality Education), which emphasize inclusive and equitable education and lifelong learning for all.

From a Thai higher education perspective, sustainability in learning is increasingly highlighted as part of institutional missions to prepare graduates for future challenges, aligning with national educational policies that position lifelong learning as essential for social and economic development. These perspectives underscore that an effective instructional model must not only improve SDL skills but also enable sustainable learning behaviors those that persist beyond course boundaries.

4. Emerging Trends: Technology, Autonomy, and Personalized Learning

Recent literature illustrates that technological innovation, including generative AI and adaptive learning systems, holds promising potential to further support SDL by offering personalized feedback, resource recommendations, and real-time scaffolding (Noriega, 2025; Mao, 2025). However, scholars caution that technology must be integrated thoughtfully within pedagogical frameworks to avoid over-reliance and ensure that learners remain active agents in their learning processes.

Such advancements provide a theoretical and practical foundation for exploring new instructional models that not only leverage technology but also emphasize reflective practice, self-regulation, and long-term engagement core features aligned with sustainable learning principles.

5. Synthesis and Research Gap

Taken together, the literature suggests that:

SDL is vital for 21st-century learning and is supported by hybrid and blended instructional strategies at the undergraduate level.

Sustainable learning integrates SDL with lifelong learning goals, aligning with SDG 4 and national educational priorities.

There is limited research on SDL-focused instructional models specifically developed for graduate students in Thailand, particularly models that deliberately integrate sustainability and autonomy.

This gap underscores the need for research that bridges instructional design theory, sustainable education goals, and context-specific implementation – forming the foundation for the current study's aim to develop and evaluate an instructional model for promoting sustainable self-directed learning among Thai graduate students.

3 RESEARCH METHODOLOGY

Research Design

This study employed a mixed-methods research design combining quantitative and qualitative approaches to develop and evaluate an instructional model that promotes sustainable self-directed learning skills among graduate students in Thailand. In the quantitative phase, a quasi-experimental one-group pretest–posttest design was used to examine the effectiveness of the instructional model. Students' self-directed learning skills were measured before and after the implementation, and their satisfaction with the model was also assessed using a questionnaire.

In the qualitative phase, in-depth interviews, focus group discussions, and brainstorming sessions were conducted to gain deeper insights into students' learning experiences, perceptions of the instructional model, and suggestions for improving sustainable self-directed learning practices.

Population and Sample

Population

The population of this study comprised graduate students enrolled in higher education institutions in Thailand. According to national higher education statistics, the total number of graduate students (master's and doctoral levels) was approximately 128,622 students in the 2023 academic year. This population reflects the broader context of graduate education in Thailand, where learners are expected to demonstrate autonomy, critical thinking, and independent learning core attributes of self-directed learning.

Sample

The sample size for the quantitative phase was determined using Yamane's formula with a margin of error of 0.05, a minimum of 399 graduate students was required for the study. To account for potential non-response, additional participants were invited.

A multi-stage sampling technique was employed. In the first stage, universities offering graduate programs were selected. In the second stage, faculties or programs that allowed the integration of the instructional model were identified. In the final stage, graduate students enrolled in selected courses were recruited as participants. This approach ensured that the sample represented authentic instructional contexts where the developed model could be implemented effectively.

For the qualitative phase, purposive sampling was used to select participants from the same group for in-depth interviews, focus group discussions, and brainstorming sessions. Additionally, a panel of experts in curriculum and instruction, educational technology, and higher education was selected to evaluate the quality and feasibility of the instructional model.

Research Instruments

1. Quantitative Instrument

A structured questionnaire was used to collect quantitative data on students' learning needs, self-directed learning skills, and satisfaction with the instructional model. The items were rated on a five-point Likert scale. The questionnaire was validated by experts and tested for reliability using Cronbach's

alpha.

2. Qualitative Instruments

Qualitative data were gathered through in-depth interviews, focus group discussions, and brainstorming activities. These tools explored students' learning experiences, perceptions of the instructional model, and suggestions for enhancing sustainable self-directed learning. All instruments were reviewed by experts to ensure clarity and alignment with the research objectives.

Data Collection Procedures

Step 1: Needs Analysis A needs analysis questionnaire was administered to graduate students drawn from the broader population of approximately 128,622 students in Thailand to investigate their current self-directed learning behaviors and expectations for instructional support.

Step 2: Model Development and Validation The instructional model was developed based on the needs analysis and literature review, then evaluated by experts. Revisions were made according to their feedback.

Step 3: Model Implementation The instructional model was implemented with the same group of graduate students. A pretest was conducted before the intervention and a posttest after completion to measure changes in self-directed learning skills.

Step 4: Perception and Feedback Collection After implementation, students completed a satisfaction questionnaire and participated in interviews, focus groups, and brainstorming activities to share their experiences and suggestions.

Data Validation

All research instruments were reviewed by experts using the Index of Item-Objective Congruence (IOC) to ensure content validity. Reliability of the questionnaire was tested using Cronbach's alpha. Qualitative data credibility was supported through triangulation across interviews, focus groups, and brainstorming results.

Data Analysis

Quantitative data were analyzed using mean, standard deviation, and dependent samples t-tests to compare pretest and posttest scores. Qualitative data were analyzed using content analysis to identify key themes related to students' experiences and perceptions

Research Findings

The research findings are presented according to the four research objectives. Both quantitative and qualitative data were used to provide a

comprehensive understanding of the development and effectiveness of the instructional model designed to promote sustainable self-directed learning skills among graduate students.

Objective 1: To investigate graduate students' needs regarding instructional approaches that promote sustainable self-directed learning

To address this objective, quantitative data were collected using a needs analysis questionnaire, and qualitative data were gathered through in-depth interviews with selected graduate students.

The questionnaire results showed that most students reported a high need for learning approaches that allow them to set their own learning goals, choose learning strategies, and evaluate their own progress. Students particularly emphasized the importance of learning activities that could be applied to real-life and professional contexts, reflecting a desire for learning that extends beyond classroom requirements.

The interview findings supported the quantitative results. Many students expressed that traditional lecture-based instruction limited their independence.

One student stated,

"I want to have more control over how I learn, especially in planning my tasks and managing my time."

Another student mentioned,

"Learning should not end in the classroom. I need activities that help me continue learning by myself."

These responses indicate that graduate students clearly recognized the importance of self-directed and sustainable learning skills and expected instructional models to support these needs.

Objective 2: To develop an instructional model that promotes sustainable self-directed learning skills

To achieve this objective, qualitative data were collected through brainstorming sessions with key stakeholders, followed by expert review of the developed instructional model.

In the first phase, brainstorming sessions were conducted with graduate students and instructors who were involved in graduate-level teaching. Participants were invited to share their ideas, expectations, and suggestions regarding learning activities, teaching strategies, and assessment methods that could enhance sustainable self-directed learning. The discussions revealed that stakeholders valued learning processes that encouraged students to set personal goals, engage in reflective activities, and apply knowledge to real-life or professional contexts.

One instructor stated,

"Graduate students should be guided, but not controlled."

They need space to make learning decisions."

A student added,

"Activities that connect theory to real practice help me learn independently."

The insights gained from these sessions were used to construct the initial version of the instructional model.

In the second phase, the developed instructional model was presented to a panel of experts in curriculum and instruction, educational technology, and higher education. The experts evaluated the model in terms of its clarity, relevance, feasibility, and alignment with self-directed and sustainable learning principles. Their feedback indicated that the model provided a well-structured learning process while still promoting learner autonomy.

One expert commented,

"The model clearly supports the development of long-term learning skills."

Based on the experts' recommendations, revisions were made to improve the sequencing of learning activities and the integration of reflective components. The final version of the instructional model was then confirmed as appropriate for implementation with graduate students.

In summary, three supplementary teaching models were developed to promote sustainable self-learning skills among graduate students in Thailand. These three models are as follows:

Model 1: Metacognitive Self-Regulation Model (MSRM)

Purpose: To develop students' ability to plan, monitor, and evaluate their own learning processes.

Key Components

1. Goal Setting
2. Learning Strategy Planning
3. Self-Monitoring
4. Self-Reflection

Indicators

Ability to set clear learning goals
Use of appropriate learning strategies
Frequency of progress monitoring
Depth of reflective thinking

Model 2: Collaborative Knowledge Construction Model (CKCM)

Purpose: To enhance learning through social interaction, peer exchange, and shared responsibility for knowledge building.

Key Components

1. Peer Learning Activities
2. Knowledge Sharing

3. Collaborative Problem Solving

4. Feedback Exchange

Indicators

Level of participation in group learning
Quality of shared knowledge
Ability to solve problems collaboratively
Constructive peer feedback skills

Model 3: Sustainable Learning Transfer Model (SLTM)

Purpose: To ensure that self-directed learning skills are transferable beyond the classroom and sustained over time.

Key Components

1. Real-World Application
2. Lifelong Learning Mindset
3. Adaptability
4. Digital Learning Autonomy

Indicators

Ability to apply knowledge in real contexts
Motivation for continuous self-learning
Adaptation to new learning challenges
Independent use of digital learning tools

Objective 3: To examine the effectiveness of the instructional model in enhancing students' self-directed learning skills

To achieve this objective, the effectiveness of the integrated instructional model comprising the Metacognitive Self-Regulation Model (MSRM), the Collaborative Knowledge Construction Model (CKCM), and the Sustainable Learning Transfer Model (SLTM) was examined through both quantitative and qualitative evaluation.

3.1 Implementation of the Instructional Models

The three instructional models were implemented with 399 graduate students over a 16-weeks within regular coursework.

The Metacognitive Self-Regulation Model (MSRM) was applied through structured goal-setting activities, individual learning plans, weekly reflective journals, and instructor-guided self-monitoring sessions. Students regularly reviewed their learning progress and adjusted strategies accordingly.

The Collaborative Knowledge Construction Model (CKCM) was integrated through peer learning groups, collaborative problem-solving tasks, online discussions, and peer feedback activities. Students co-constructed knowledge through dialogue, shared resources, and group presentations.

The Sustainable Learning Transfer Model (SLTM) was implemented via real-world application projects. Students connected course concepts to professional or research contexts, used digital tools for independent inquiry, and reflected on how learning could be sustained beyond the classroom.

These three models functioned together as a continuous learning cycle that supported self-regulation, collaboration, and long-term knowledge transfer.

3.2 Evaluation of Model Effectiveness

The effectiveness of the instructional models was evaluated in **multiple dimensions**, not only in terms of learning achievement but also in learners' self-regulation, collaboration, and ability to transfer learning.

Quantitative Results: Self-Directed Learning Skills

Quantitative data were collected using a self-directed learning skills assessment administered before and after the intervention. The data were analyzed using a paired samples t-test to compare pretest and posttest scores.

The results revealed that students' self-directed learning skills significantly improved after participating in the instructional model. Posttest mean scores were higher than pretest scores across all dimensions, including goal setting, learning strategy use, self-monitoring, self-evaluation, and knowledge application. The statistical analysis confirmed that the differences between pretest and posttest scores were significant at the .05 level, indicating that the instructional model effectively enhanced students' self-directed learning abilities.

Table 1 Comparison of Pretest and Posttest Self-Directed Learning Skills Using Paired Samples t-test

Self-Directed Learning Skills	Pre Mean	SD	Posttest Mean	SD	t	p
Goal Setting	3.21	0.54	4.12	0.48	8.45	.000*
Learning Strategy Use	3.15	0.57	4.05	0.50	7.98	.000*
Self-Monitoring	3.18	0.60	4.10	0.46	8.21	.000*
Self-Evaluation	3.09	0.58	4.03	0.49	7.76	.000*
Knowledge Application	3.25	0.55	4.18	0.47	8.67	.000*
Overall SDL Skills	3.18	0.52	4.10	0.44	9.12	.000*

*Significant at the .05 level

Qualitative Results: Learning Behaviors and Perceptions

Qualitative data from reflective journals, interviews, and focus groups supported the quantitative findings.

Students reported improved self-awareness in learning, stronger responsibility for their own progress, and increased confidence in collaborating with peers. Many described being able to apply knowledge beyond the classroom.

One student noted:

"Before this course, I waited for the lecturer to tell me what to do. Now I plan my learning and check my progress myself."

Another student stated:

"Group discussions helped me see new perspectives and made learning more meaningful."

These reflections indicate that the models not only improved measured skills but also transformed students' learning behaviors and attitudes toward lifelong learning.

Summary for Objective 3

The findings from both statistical analysis and qualitative evidence confirm that the integrated

implementation of the three instructional models significantly enhanced graduate students' self-directed learning skills, collaborative learning capacity, and ability to transfer knowledge to real-world contexts. This demonstrates the effectiveness of the developed instructional framework in promoting sustainable self-directed learning.

Objective 4: To explore graduate students' satisfaction and perceptions toward the instructional model designed to foster sustainable self-directed learning

Following the implementation and effectiveness evaluation of the instructional models, students' satisfaction and perceptions were explored to gain deeper insight into their learning experiences and attitudes toward the instructional approach.

4.1 Students' Satisfaction with the Instructional Model

Quantitative data were collected using a satisfaction questionnaire administered at the end of the intervention. The results indicated that students reported a high level of overall satisfaction with the instructional model. The highest ratings were related to:

Opportunities to take responsibility for their own learning

Collaborative learning activities that encouraged idea exchange

Real-world application tasks that connected theory to practice

Students also expressed satisfaction with the supportive learning environment and the flexibility provided by the model, which allowed them to adjust learning strategies according to their individual needs.

4.2 Students' Perceptions of Learning Experiences

Qualitative data from interviews and focus group discussions revealed that students perceived the instructional model as transformative in several ways.

Many students described becoming more independent learners.

One participant explained:

"I used to rely heavily on the instructor, but now I feel more confident planning and managing my own learning."

Students also highlighted the importance of peer collaboration, noting that group activities helped them understand complex topics more deeply.

As one student shared:

"Discussing with friends helped me see different viewpoints and improve my critical thinking."

In addition, students valued the real-world relevance of learning tasks. Several participants stated that they had already applied course knowledge to their professional or research work.

One interviewee remarked:

"The projects made me realize that learning doesn't stop in the classroom. I continue searching for new knowledge even after class."

4.3 Perceived Impact on Sustainable Self-Directed Learning

Students believed that the instructional model supported long-term learning habits rather than short-term academic performance. They reported improved abilities in:

Setting personal learning goals

Monitoring their progress independently

Seeking resources beyond course materials

Continuing to learn after the course ended

These perceptions align with the concept of sustainable self-directed learning, where learners develop enduring skills for lifelong learning.

Summary for Objective 4

The findings indicate that students not only showed measurable improvement in self-directed learning skills (Objective 3) but also experienced high satisfaction and perceived meaningful changes in

their learning behaviors. Their reflections suggest that the instructional model successfully fostered autonomy, collaboration, and lifelong learning attitudes key characteristics of sustainable self-directed learning among graduate students.

5 DISCUSSION

This section discusses the research findings according to the four research objectives. Each objective is addressed in sequence to interpret the results and explain their implications for promoting sustainable self-directed learning among graduate students.

Discussion of Objective 1: To investigate the needs of graduate students for an instructional model that promotes sustainable self-directed learning

The findings from the needs analysis revealed that graduate students in Thailand expressed a clear demand for instructional approaches that provide structured support for autonomy, while also facilitating meaningful learner engagement and application beyond the classroom. Specifically, students identified the need for guidance in setting learning goals, selecting effective strategies, monitoring their own progress, and evaluating outcomes—core processes of self-directed learning (SDL). This aligns with recent research indicating that even at the graduate level, learners benefit from explicit scaffolding to develop self-regulatory skills, rather than being left to navigate their learning independently (Damrongsiri et al., 2022; Noriega, 2025; Khairaty et al., 2025).

The emphasis on structured support is consistent with theoretical perspectives on metacognition and SDL, which assert that learners require deliberate instructional design to internalize regulatory processes such as planning, monitoring, and reflecting (Zimmerman, 2008; Noriega, 2025). Without such scaffolds, learners may default to surface learning strategies or be uncertain about how to regulate complex tasks on their own. Graduate education often assumes learner autonomy; however, this assumption may overlook the nuanced support required to foster sustainable self-regulation (Khairaty et al., 2025).

Students also highlighted the importance of collaborative learning activities that allow for peer interaction, discussion, and knowledge construction. This finding is supported by studies demonstrating that social learning environments, such as peer learning and group problem-solving, can enhance SDL by offering opportunities for shared regulation and co-construction of understanding (Chaiyasit et

al., 2025; Gedera & Maimunah, 2025; Sutthadaanantaphokin et al., 2025). Such social processes encourage learners to articulate reasoning, consider multiple perspectives, and refine strategies—elements that contribute to deeper and more sustainable learning.

In addition, the needs analysis indicated a strong preference for learning activities that connect theoretical knowledge to real-world or professional contexts. This resonates with adult learning theories and research showing that relevance and meaningful application are critical motivators for engagement in self-directed learning (Knowles, Holton, & Swanson, 2020; Ibrahim et al., 2025). When tasks are perceived as authentic and applicable, learners are more likely to persist in learning activities beyond formal instruction.

Taken together, the needs assessment highlights a complex interplay between learner autonomy, structured support, collaboration, and real-world relevance suggesting that a successful instructional model must balance these dimensions to promote sustainable SDL. These empirical insights provided a robust foundation for designing the three instructional models developed in Objective 2.

Discussion of Objective 2: To develop instructional models that promote sustainable self-directed learning skills among graduate students

Based on the needs analysis, this study developed three complementary instructional models: the Metacognitive Self-Regulation Model (MSRM), the Collaborative Knowledge Construction Model (CKCM), and the Sustainable Learning Transfer Model (SLTM). The discussion of this objective focuses on the appropriateness of each model's components in addressing the identified learner needs and promoting sustainable self-directed learning (SDL).

The Metacognitive Self-Regulation Model (MSRM) was designed to strengthen learners' abilities to plan, monitor, and evaluate their own learning. This model directly responds to the identified need for structured support in goal setting and learning strategy use. Its emphasis on reflective journals, self-monitoring activities, and iterative improvement aligns with contemporary research emphasizing metacognitive scaffolding as a foundation for sustainable SDL (Noriega, 2025; Khairaty et al., 2025). Graduate learners, despite their academic maturity, often lack systematic training in regulating their learning processes. The MSRM addresses this gap by embedding metacognitive routines into regular coursework, thereby transforming self-regulation

from an assumed skill into a deliberately cultivated competence.

The Collaborative Knowledge Construction Model (CKCM) was developed to address students' expressed need for interaction, dialogue, and shared learning experiences. The inclusion of peer learning groups, collaborative problem-solving tasks, and structured feedback mechanisms reflects social constructivist principles, which view knowledge as co-constructed through social engagement. Recent studies indicate that collaborative environments support not only cognitive development but also shared regulation of learning, which can enhance individual SDL capacities over time (Chaiyasit et al., 2025; Gedera & Maimunah, 2025). By positioning collaboration as a structured instructional element rather than an occasional activity, the CKCM promotes a learning culture where dialogue, peer feedback, and co-creation of understanding become integral to sustainable learning.

The third model, the Sustainable Learning Transfer Model (SLTM), extends SDL beyond classroom boundaries. This model was informed by students' strong desire for learning tasks that connect academic knowledge with professional and real-life contexts. The SLTM incorporates authentic projects, digital resource exploration, and reflective activities focused on long-term application. This design reflects research highlighting the importance of relevance and transfer in fostering lifelong learning dispositions (Ibrahim et al., 2025; Knowles et al., 2020). When learners perceive that their learning has practical value, they are more likely to continue self-directed learning independently after formal instruction ends. Thus, the SLTM operationalizes the "sustainability" dimension of SDL by encouraging enduring learning habits and real-world knowledge application.

Importantly, the three models were not developed as isolated frameworks but as interconnected components of a unified instructional system. The MSRM builds internal regulatory capacity, the CKCM strengthens social and dialogic learning processes, and the SLTM ensures long-term transfer and relevance. This integrative structure reflects recent perspectives suggesting that sustainable SDL emerges from the interaction of cognitive, social, and contextual factors rather than from individual effort alone (Feng & Yong, 2026; Noriega, 2025; Gedera & Maimunah, 2025).

Overall, the development of the MSRM, CKCM, and SLTM demonstrates a systematic response to empirically identified learner needs and aligns with contemporary theoretical and research-based

understandings of self-directed and lifelong learning. These models provide a comprehensive framework for embedding sustainable SDL within graduate education.

Discussion of Objective 3: To examine the effectiveness of the instructional model in enhancing students' self-directed learning skills

3.1 Discussion of the Implementation of the Instructional Models

The implementation of the three instructional models Metacognitive Self-Regulation Model (MSRM), Collaborative Knowledge Construction Model (CKCM), and Sustainable Learning Transfer Model (SLTM) demonstrated that sustainable self-directed learning (SDL) can be effectively fostered when instructional design integrates cognitive, social, and contextual dimensions of learning.

The MSRM provided structured opportunities for students to practice goal setting, strategic planning, self-monitoring, and reflection. This aligns with contemporary research emphasizing that metacognitive regulation must be explicitly embedded in learning activities rather than assumed as an inherent graduate-level skill (Channuwong et al., 2024; Noriega, 2025; Khairaty et al., 2025). The structured reflective practices observed in this study support the notion that sustained exposure to metacognitive routines strengthens learners' capacity for independent regulation over time.

The CKCM emphasized peer dialogue, collaborative problem-solving, and shared feedback, reflecting the social dimension of SDL. Research indicates that collaboration promotes shared regulation, which can gradually be internalized as individual self-regulation (Gedera & Maimunah, 2025; Chaiyasit et al., 2025). The active engagement and exchange of perspectives observed during implementation suggest that social interaction enriched students' learning strategies and deepened understanding.

The SLTM extended learning beyond academic tasks by incorporating authentic projects and encouraging independent use of digital resources. This approach is consistent with studies highlighting that real-world relevance and transferability enhance learners' motivation to continue learning autonomously (Ibrahim et al., 2025; Knowles et al., 2020). By linking classroom learning to professional and personal contexts, the SLTM strengthened the sustainability dimension of SDL.

Together, the three models created an integrated learning environment in which students not only practiced SDL strategies but also experienced the value of applying them collaboratively and

authentically.

3.2 Discussion of the Evaluation Results

The quantitative findings revealed statistically significant improvements in students' self-directed learning skills across all measured dimensions, including goal setting, learning strategy use, self-monitoring, self-evaluation, and knowledge application. The paired-samples t-test results demonstrated that posttest scores were significantly higher than pretest scores at the .05 level. These findings confirm that the integrated instructional model effectively enhanced SDL skills.

The improvement in goal setting and learning strategy use supports the effectiveness of the MSRM, as structured planning and monitoring activities are known to strengthen learners' metacognitive control (Noriega, 2025). Similarly, significant gains in self-monitoring and self-evaluation indicate that reflective practices helped students become more aware of their learning processes, consistent with research on self-regulated learning development (Khairaty et al., 2025).

The increase in knowledge application reflects the influence of the SLTM, which emphasized authentic learning and transfer. This aligns with findings that contextualized tasks promote deeper learning and long-term retention, key features of sustainable SDL (Ibrahim et al., 2025).

Qualitative findings further support the quantitative results. Students described becoming more responsible for their learning, more confident in collaborating with peers, and more capable of applying knowledge beyond the classroom. These perceptions suggest that the instructional model not only improved measurable skills but also fostered meaningful changes in learning behaviors and attitudes. Such transformation is central to the concept of sustainable SDL, which involves enduring learner autonomy rather than short-term performance gains (Gedera & Maimunah, 2025).

Overall, the convergence of statistical evidence and student perceptions provides strong support for the effectiveness of the three-model instructional framework in enhancing sustainable self-directed learning among graduate students.

Discussion of Objective 4: To explore graduate students' satisfaction and perceptions toward the instructional model designed to foster sustainable self-directed learning

4.1 Students' Satisfaction with the Instructional Model

The high level of student satisfaction reported in this study indicates that the instructional model

successfully created a learning environment that was perceived as supportive, engaging, and meaningful. Satisfaction was particularly strong in relation to opportunities for autonomy, collaborative activities, and real-world application tasks. These elements reflect an autonomy-supportive learning environment, which has been shown to enhance learners' motivation and positive attitudes toward learning (Channuwong et al., 2022; Ryan & Deci, 2020; Noriega, 2025).

The structured goal-setting, reflective activities, and independent learning tasks embedded in the Metacognitive Self-Regulation Model (MSRM) likely contributed to students' sense of ownership over their learning. When learners feel that they have control over their learning processes, their satisfaction tends to increase, as they perceive learning to be personally relevant and self-determined (Ebekozi et al., 2025; Ryan & Deci, 2020). Thus, the satisfaction findings support the view that SDL-oriented instructional design can positively influence learners' affective responses.

4.2 Students' Perceptions of Learning Experiences

Students' perceptions of their learning experiences highlighted the importance of interaction, reflection, and meaningful engagement. Many students reported that collaborative activities helped them better understand complex content and broaden their perspectives. This aligns with research indicating that social interaction enhances cognitive engagement and promotes deeper learning through dialogue and shared meaning-making (Gedera & Maimunah, 2025; Chaiyasit et al., 2025).

In addition, students perceived reflective tasks and self-monitoring activities as valuable in helping them become more aware of how they learn. Such perceptions are consistent with studies showing that metacognitive engagement enhances learners' understanding of their strengths, weaknesses, and strategies, which contributes to more effective SDL (Noriega, 2025; Khairaty et al., 2025). The combination of reflection and collaboration appears to have created a learning experience that students viewed as both intellectually and personally meaningful.

4.3 Perceived Impact on Sustainable Self-Directed Learning

Beyond immediate course satisfaction, students reported that the instructional model influenced their long-term learning behaviors. Many described continuing to search for knowledge independently, applying learning strategies in other courses or

professional contexts, and becoming more confident in managing their own learning. These perceptions reflect the development of sustainable SDL habits rather than temporary academic improvement.

The emphasis on authentic tasks and real-world application within the Sustainable Learning Transfer Model (SLTM) likely played a key role in shaping these perceptions. Research suggests that when learners see clear connections between academic learning and real-life practice, they are more likely to sustain learning efforts beyond formal instruction (Ibrahim et al., 2025; Knowles et al., 2020). The perceived long-term impact reported by students therefore supports the model's effectiveness in promoting lifelong learning orientations.

Overall, the findings in these three areas satisfaction, learning experience, and perceived long-term impact demonstrate that the instructional model not only improved measurable SDL skills (Objective 3) but also positively influenced students' motivation, engagement, and commitment to continuous learning. These affective and perceptual outcomes are essential components of sustainable self-directed learning.

6 CONCLUSION

This study demonstrated that developing sustainable self-directed learning (SDL) among graduate students requires a systematic instructional approach grounded in learners' needs, structured model design, and comprehensive evaluation. The findings showed that graduate students needed support in strengthening key SDL skills, leading to the development of three integrated instructional models that combined metacognitive regulation, collaborative learning, and real-world knowledge transfer. Implementation of these models resulted in statistically significant improvements in students' self-directed learning abilities across all measured dimensions, while students also reported high satisfaction, positive learning experiences, and strong perceived long-term impact on their learning behaviors. Collectively, the results confirm that a well-designed instructional model can effectively foster sustainable SDL, contributing to lifelong learning competencies and aligning with the goals of quality education under SDG 4.

Recommendations

1. Policy Recommendations

Higher education policymakers should integrate self-directed learning (SDL) development into graduate program standards and curriculum policies. Universities should support learning environments

that promote learner autonomy, digital competence, and lifelong learning skills in alignment with Sustainable Development Goal 4.

2. Practical Implementation Recommendations

Instructors should adopt teaching approaches that emphasize goal setting, reflection, collaboration, and authentic task engagement. Learning activities should encourage students to plan, monitor, and evaluate their own learning, while instructors

provide guidance that gradually transfers responsibility to learners.

3. Recommendations for Future Research

Future research should investigate the long-term effects of instructional models on sustainable SDL behaviors, test the models across different academic disciplines and educational contexts, and explore how digital technologies can further enhance self-directed and lifelong learning.

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