Nurturing Reflective Thinking Skills Among Prospective Teachers Through a Learner-Educator Feedback System Using Google Keep

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Article Info

Abstract

Digital feedback tools are increasingly being explored as means of fostering reflective thinking in higher education. This study investigated the use of Google Keep as a tool to cultivate reflective thinking skills in an Environmental Science course among fourth-year college students at a public tertiary institution in the Philippines using both quantitative and qualitative data sources. Students used Google Keep in completing reflective tasks during discussions, enabling real-time learner-educator feedback. Quantitative data were gathered using pre- and post-administration of the Reflective Thinking Survey Questionnaire, Kember's Reflective Thinking Rubric, and the Technology Acceptance Model (TAM) Survey. Descriptive statistics and the Wilcoxon Signed-Rank Test were employed to analyze changes in reflective thinking. Results indicated a statistically significant improvement in students' reflective thinking skills ($z = 3.659$, $p < 0.05$) based on survey data. However, Kember's rubric revealed limited depth in reflective engagement, particularly in relating personal experiences to academic concepts. Findings from the TAM survey suggested strong student acceptance of Google Keep, emphasizing its perceived ease of use and functionality. Thematic analysis of responses to the Reflection Questionnaire corroborated the tool's usability and its role in promoting reflection, while also suggesting areas for interface enhancement. Overall, the findings affirm the potential of Google Keep as a practical, accessible platform for delivering feedback and cultivating reflective thinking in higher education science courses.

Introduction

In educational contexts, feedback between learners and educators serves as a fundamental pillar for enhancing student learning and development. It plays a critical role in monitoring progress, guiding improvement, and fostering metacognitive engagement (Li et al., 2025; Pollard & Armatas, 2025). Beyond shaping academic outcomes, feedback also strengthens teacher–student relationships, supports self-efficacy, enhances motivation, and promotes deep learning (Tampal et al., 2019). Contemporary scholarship increasingly frames feedback as a dialogic and learner-centered process rather than a unidirectional transmission of information, emphasizing students' active participation in giving, receiving, and using feedback to regulate their learning (Nicol & Macfarlane-Dick, 2007; Black & Wiliam, 1998; Sadler, 1998). However, despite its recognized value, large-scale studies conducted in the United Kingdom and Australia continue to report persistent challenges in feedback practices, particularly in terms of timeliness, personalization, and student engagement (Winstone & Boud, 2019). These challenges are especially pronounced in science education, where learners are expected to engage in reflective thinking, integrate conceptual understanding, and apply knowledge to complex, real-world problems.

When effectively designed and implemented, feedback mechanisms can scaffold learners' cognitive processes, promote higher-order thinking, and support the development of essential competencies such as critical thinking, problem-solving, and self-regulation. Empirical evidence suggests that learner-centered feedback models, particularly those that encourage students to initiate and act on feedback, lead to higher engagement and improved feedback quality (Raymond et al., 2019). These shifts reflect broader conceptual changes in feedback theory, which increasingly view feedback as a collaborative, socially situated process embedded within complex learning environments (Weller & Gotian, 2023). Central to these outcomes is metacognition, defined as individuals' awareness and control of their own cognitive processes (Flavell, 1979). Metacognitive skills enable learners to plan, monitor, and evaluate their learning, thereby fostering meaningful and sustained engagement with academic content.

The role of metacognition is particularly salient in Environmental Science education, where students must grapple with environmental crises such as pollution, climate change, biodiversity loss, and resource depletion. Environmental and crisis education aims not only to develop scientific understanding but also to cultivate responsible citizenship and environmental stewardship through inquiry-based and reflective learning experiences (North American Association for Environmental Education [NAAEE], 2016). However, environmental education also faces significant challenges arising from technology-driven production and consumption patterns and the increasing complexity of planetary crises, necessitating pedagogical approaches that move beyond traditional sustainable development frameworks toward more critical and transformative learning paradigms (Menezes, 2018; Layrargues, 2020). Teaching about ecological crises while simultaneously experiencing them creates unique pedagogical tensions, highlighting the need for learning environments that support reflection, sense-making, and critical engagement (Suarez et al., 2023).

Consistent with these demands, a meta-analysis by Antonio and Prudente (2022) confirmed that metacognitive instruction has a significant positive effect on students' academic achievement, particularly in science disciplines.

These findings reinforce the importance of instructional approaches that deliberately integrate feedback and reflection to support learners' metacognitive development. In response to the limitations of traditional feedback systems, there is a growing call for innovative strategies and technologies that can better facilitate timely, constructive, and learner-centered feedback. As Sterman et al. (2018) emphasized, educational reform requires innovation to effectively navigate increasingly complex learning environments.

The integration of digital tools, including mobile and web-based applications, offers promising pathways for addressing these challenges. Technology-supported feedback systems can provide timely, personalized, and flexible feedback, particularly in contexts where human instructional resources are constrained (Deeva et al., 2021). Such tools expand opportunities for synchronous and asynchronous interaction and enable reflective learning beyond the boundaries of time and space (Nicol, 2012). One such tool is Google Keep, a widely accessible note-taking and task management application. Owing to its flexibility, cross-device compatibility, and collaborative features, Google Keep can be repurposed as a learner–educator feedback platform aligned with social constructivist and connectivist learning theories, which emphasize knowledge co-construction through interaction within social and digital networks.

Within Environmental Science education, where reflective engagement and feedback are essential for grappling with complex environmental issues, Google Keep offers a practical and accessible means of supporting learner–educator dialogue and metacognitive reflection. By enabling students to document ideas, respond to reflective prompts, and receive timely feedback, the platform has the potential to strengthen reflective thinking while fostering active participation in learning. This study explores the use of Google Keep as a digital feedback tool to nurture reflective thinking skills in Environmental Science among fourth-year prospective teachers in a public college in Malolos, Bulacan, Philippines. Specifically, it sought to answer the following research questions:

1. How may students' reflective thinking skills be described before and after exposure to Google Keep using Kember's Reflective Thinking Survey Questionnaire?

2. Is there a significant difference in students' reflective thinking skills before and after the implementation of Google Keep?

3. How may students' reflective thinking skills be described during the intervention based on Kember's Reflective Thinking Rubric?

4. How may students' acceptance of Google Keep as a learner–educator feedback tool be described in terms of technology acceptance and system usability?

5. How may the learner–educator feedback system in Environmental Science using Google Keep be described based on students' reflections?

6. What improvements to the learner–educator feedback system using Google Keep may be suggested based on students' feedback?

Literature Review

Evolution of Learner–Educator Feedback Systems

Historically, feedback in education positioned learners as passive recipients of information, with teachers

assuming authoritative roles in evaluating performance and directing learning. Over time, this traditional paradigm has shifted toward more dialogic and learner-centered approaches, wherein students actively engage in giving, receiving, and using feedback to improve their learning outcomes. Nicol and Macfarlane-Dick (2007) argue that high-quality learning is closely associated with students' active participation in feedback exchanges, transforming feedback into a two-way process that supports learner autonomy and self-regulated learning. This reconceptualization of feedback is reinforced in formative assessment literature, where feedback is viewed as a critical mechanism linking evaluation to subsequent learning actions (Black & Wiliam, 1998; Sadler, 1998). Particularly in science education, well-designed feedback systems play a vital role in supporting conceptual understanding and the development of higher-order thinking skills, underscoring the need for their thoughtful and purposeful integration into instruction (Kaldaras et al., 2024; Swanson et al., 2021).

Empirical studies further substantiate this shift toward learner-centered feedback models. Raymond et al. (2019) demonstrated that transitioning from educator-driven to learner-initiated feedback significantly increased both the frequency of feedback requests and completion rates, while also improving the quality of feedback related to students' strengths. These findings align with broader conceptual changes described by Weller and Gotian (2023), who traced the evolution of feedback from a transactional exchange of information to a collaborative, learner-centered process embedded within complex socio-cultural learning environments. As learning contexts become increasingly dynamic, technology has emerged as a key enabler of these pedagogical shifts. Deeva et al. (2021) highlighted how automated and technology-supported feedback systems can provide personalized and real-time support, particularly in contexts where instructional resources are limited. However, despite their growing use across educational domains, the literature remains fragmented, indicating the need for more data-driven and student-centered feedback solutions.

Importantly, Nicol (2012) emphasized that while learning technologies do not fundamentally alter the nature or purpose of feedback, they significantly expand the ways in which feedback can be implemented. Through synchronous and asynchronous modalities, digital tools offer new opportunities for timely, flexible, and dialogic feedback interactions, while simultaneously introducing new pedagogical and design challenges for educators. Collectively, these studies underscore an ongoing evolution toward feedback systems that prioritize learner agency, interaction, and reflection—principles that are increasingly supported and amplified through educational technologies.

As feedback practices continue to evolve toward more dialogic and learner-centered approaches, their role becomes especially critical in disciplines such as Environmental Science, where learners are expected to reflect on complex real-world issues and develop informed, responsible responses.

Environmental Science and Crisis Education

Engaging students in environmental science and crisis education is essential for cultivating both scientific understanding and responsible citizenship. As emphasized by the North American Association for Environmental Education (2016), inquiry-based engagement with ecological issues enhances critical thinking and fosters

environmental stewardship. Environmental crises—such as pollution, climate change, biodiversity loss, and resource depletion—demand pedagogical approaches that foreground real-world problem-solving, reflective thinking, and informed decision-making. These challenges position environmental education not merely as content transmission but as a transformative learning space where learners critically examine human–environment interactions.

At the same time, research highlights substantial pedagogical and structural challenges in environmental science and crisis education. The current planetary crisis is deeply rooted in unsustainable production and consumption patterns shaped by technology-driven urban lifestyles, necessitating forms of environmental education that move beyond conventional sustainable development frameworks (Menezes, 2018). In the United States, Morrone (2001) identified a persistent science education crisis marked by low scientific literacy, noting that environmental themes can serve as integrative frameworks to enhance student learning. More recently, scholars have emphasized that environmental education is confronted by intersecting crises—including climate collapse, antiecologism, and global pandemics—which call for paradigm shifts away from market-oriented and technocratic approaches toward more critical and reflexive pedagogies (Layrargues, 2020). Teaching about ecological crises while simultaneously experiencing them further complicates instruction, presenting both challenges and opportunities for transformative scholarship as educators reassess the content, methods, and purposes of environmental education in crisis contexts (Suarez et al., 2023).

Within this complex landscape, effective environmental science education requires not only disciplinary knowledge but also opportunities for reflection, self-monitoring, and meaning-making—processes closely associated with metacognition. Digital tools can play a pivotal role in addressing these needs by supporting reflective and dialogic learning practices. Tools such as Google Keep enable students to document observations, track project progress, and receive timely feedback, thereby supporting deeper engagement with environmental content while encouraging creativity and collaboration. When used purposefully, such technologies can enhance cognitive engagement, promote metacognitive awareness, and support contextualized understanding of environmental issues, aligning instructional practices with the reflective demands of crisis-oriented environmental education.

Feedback as a Driver of Metacognition

Metacognition, originally conceptualized by Flavell (1979), refers to individuals' awareness and regulation of their cognitive processes. It encompasses both metacognitive knowledge—understanding how one learns—and metacognitive regulation—planning, monitoring, and evaluating learning strategies (Lai, 2011; Swanson, 1990; Akturk & Sahin, 2011). Research consistently demonstrates that metacognitive instruction enhances self-efficacy, promotes student ownership of learning, and improves academic performance (Sadeghi & Mohtashami, 2011; National Council for Special Education, n.d.).

Educators play a crucial role in cultivating metacognition through explicit instruction, reflective prompting, and structured feedback. Strategies such as metacognitive checklists (Schraw, 1998), reflective questioning during

tasks (Mevarech & Kramarski, 2003), and post-assessment self-reflection (Tanner, 2012) have proven effective in fostering metacognitive skills. These practices are further reinforced through collaborative learning structures grounded in social constructivist theories, wherein peer interaction and dialogue promote higher-order thinking. A meta-analysis by Antonio and Prudente (2022) affirmed the positive effects of metacognitive strategies in science education, particularly when integrated with information and communication technologies (ICTs). Digital platforms equipped with reflection prompts and feedback mechanisms can scaffold self-regulated learning and deepen students' metacognitive engagement. Given the central role of feedback in supporting metacognitive processes, there is increasing interest in digital tools that can facilitate timely, structured, and reflective feedback within learning environments.

Google Keep as an Educational Tool

Google Keep, a cloud-based note-taking and organizational tool, offers substantial potential in educational settings through its user-friendly features such as color-coded notes, checklists, voice memos, and image annotation (Brown, 2024). These functionalities support learner organization, promote collaboration, and encourage creative expression. When integrated into instruction, Google Keep enables teachers and students to co-manage tasks, share timely feedback, and curate multimodal learning artifacts that enhance engagement and understanding. Its educational utility aligns with the principles of social constructivism and connectivism, which emphasize active participation, collaboration, and networked knowledge construction.

Furthermore, Google Keep supports the International Society for Technology in Education (ISTE) Standards by fostering student agency, digital collaboration, and creative communication. According to Trust (2022), the application aligns well with the SAMR model, functioning as a substitution for traditional note-taking, augmenting learning through collaborative lists, modifying instruction via multimodal note creation, and redefining learning by enabling students to share outputs beyond the classroom. Supporting this, Pilomonu et al. (2023) demonstrated the effectiveness of Google Keep in project-based learning, particularly in improving students' writing skills, thus affirming its applicability as a tool for enriching instructional practices and learner engagement. Situating Google Keep within broader e-learning environments further highlights its role as part of technology-supported feedback systems that enhance accessibility, interaction, and learner engagement.

E-Learning and Technology-Supported Feedback

E-learning, defined as instruction delivered through electronic devices and digital networks, expands access to education while enhancing flexibility and learner autonomy (Kenan, 2015). The asynchronous nature of digital learning platforms supports just-in-time access to resources, continuous interaction, and individualized pacing. Applications such as Google Keep, when embedded within e-learning ecosystems, offer valuable affordances for real-time collaboration, feedback exchange, and documentation of learning processes.

Technology-enhanced feedback systems strengthen instructional practices by improving feedback timeliness, clarity, and learner engagement. Studies by Black et al. (2011) and Stuart et al. (2011) indicate that digital

feedback enables learners to revisit instructor comments, reflect more deeply on feedback, and respond constructively. Typed and digitally mediated feedback also improves legibility and reduces ambiguity compared to traditional verbal or handwritten feedback. Recent research by Zou et al. (2023) further highlights that technology-enhanced teacher, peer, and self-feedback significantly improve students' critical thinking, writing quality, and engagement, with teacher feedback delivered through digital platforms demonstrating the strongest effects.

Synthesis

Taken together, the reviewed literature underscores the interconnected roles of learner-centered feedback, metacognition, and digital technologies in fostering reflective learning, particularly within science education contexts. As environmental challenges demand critical engagement and informed action, the integration of metacognitive strategies and technology-supported feedback systems becomes increasingly imperative. Google Keep emerges as a promising, accessible digital tool that aligns with pedagogical and technological frameworks supporting reflective thinking. Grounded in social constructivist principles and supported by empirical evidence, its use as a learner–educator feedback system warrants further exploration in nurturing reflective thinking skills among prospective teachers.

Methods

Research Design

The research utilized both qualitative and quantitative research designs. Quantitative data complemented qualitative findings to provide a comprehensive view of Google Keep's effects on the learner–educator feedback system and students' reflective thinking skills in Environmental Science. The research design was used by all participants who benefited from improving the learner-educator feedback system in Environmental Crises after the intervention of G-Keep.

Research Locale and Participants

This study involved thirty-one (31) 4th-year students enrolled in a public college in Malolos, Bulacan, Philippines, during the academic year 2023-2024. Participants were selected through purposive sampling based on specific attributes, knowledge, skills, and relevance to the study's objectives. The research was conducted face-to-face with the permission of the school administration and the selected students. Most participants were female (n = 27, 87%), followed by males (n = 2, 6%) and LGBTQIA+ students (n = 2, 7%). Considering their age, the majority are 20 years old (65%), followed by 21 years old (23%), 23 years old (6%), and 24 and 25 years old (1%).

Research Instruments

To evaluate the learner-educator feedback system using G-Keep and address the research questions posed in this study, researchers used questionnaires and a rubric focusing on skills like reflective thinking. These instruments

were designed to measure the system's effectiveness and nuances of the feedback system in the context of G-Keep.

Pre and Post-Reflective Thinking Survey Questionnaire (Pre-RTSQ and Post-RTSQ)

The study employed a Reflective Thinking Survey Questionnaire (RTSQ) for pre-and post-test, a quantitative research tool utilizing a Likert scale adapted from Kember et al. to assess students' reflective thinking skills before and after exposure to G-Keep. As Creswell (2002) defined it, quantitative research involves testing objective theories through variable analysis. The unidimensional Likert scale was used to gauge participant perspectives across 16 questions categorized into four sections: habitual action, understanding, reflection, and critical reflection. The Likert scale offers four response options without a neutral choice: strongly disagree, disagree, agree, and strongly agree, enabling researchers to assess the extent of agreement or disagreement regarding reflective thinking ability. The scale assumes a linear relationship between experience intensity and strength. The quantitative data from these instruments were analyzed by descriptive statistics – mean and standard deviation, and using the Wilcoxon Signed Ranks Test. Table 1 shows the number of items in each level and the sample statements of the pre-and post-RTSQ.

Table 1. Distribution of Items and Sample Statements in the Reflective Thinking Survey Questionnaire (RTSQ)

Level	Number of Items	Sample Statements
Habitual Action	4	I can perform activities on Environmental Science without having to think too much of what I am doing.
Understanding	4	The lesson on Environmental Science requires us to understand concepts taught by the instructor
Reflection	4	I question the way others approach learning, taking quizzes/exams, and performing in Environmental Science, aiming to think of a better way
Critical Reflection	4	The way I look at myself changed as a result of Environmental Science

Kember's Reflective Thinking Rubric (KRTR)

Participants' reflections in Google Keep were evaluated using Kember's Reflective Thinking Rubric, a quantitative research tool. This rubric assigns scores based on predefined criteria to guide researchers in evaluating. Like Kember's, analytical rubrics enhance student learning by providing constructive feedback and highlighting strengths and weaknesses. They effectively assess oral and written work, allowing teachers to provide targeted feedback and students to understand evaluation criteria, resulting in higher-quality outputs. The adaptation of Kember's Reflective Thinking rubric aims to provide a comprehensive and tailored assessment tool for evaluating and describing reflective thinking in the context of Environmental Crises using Google Keep during the intervention. The quantitative data gathered was analyzed by descriptive statistics – mean and standard deviation. Table 2 shows Kember's Reflective Thinking Rubric.

Table 2. Kember's Reflective Thinking Rubric and Descriptive Performance Levels

Criteria	Critical Reflection	Reflection	Understanding	Habitual Action
	4 (3.18 - 4.00 |80-100%)	3 (2.78 - 3.17 | 70-79%)	2 (2.40 - 2.77 | 60-69%)	1 (1.00 - 2.39 |D/F: >60%)
Reflection on Existing Knowledge (Learning Experience and Personal Insight)	Engages in a thorough examination of current knowledge, challenges assumptions, and expresses novel viewpoints based on experience.	Actively and thoughtfully reflects on established knowledge, presenting fresh insights gained through experiential learning.	Utilizes existing knowledge without endeavoring to assess or appraise it; displays comprehension but does not connect it to other experiences or personal reactions.	Provides automatic or superficial responses with minimal conscious or deliberate thought, lacking reference to existing knowledge; responses are given without an attempt to comprehend them.
Connection to Academic Concepts (Personal Experience, Class Content. Literature)	Shows an exceptional link between personal experience and class material (concepts/theories) and literature; provides proof of applying theory and reshaping perspectives.	Clearly establishes connections between personal experience and class content (concepts/theories); offers evidence of applying theoretical concepts.	Associates personal experience with class content (concepts/theories) but at a surface or abstract level.	Fails to establish connections between personal experience and class content (concepts/theories) or relevant literature.
Evidence of Development (Shift in self, or knowledge about what is learned)	Expresses a shift in their viewpoint regarding themselves or a specific issue/concept/problem arising from the encountered experience.	Expresses fresh comprehension and insights concerning oneself or a particular issue/concept/problem stemming from the acquired experience.	Displays restricted or superficial insight into oneself or a particular issue/concept/problem due to the encountered experience.	Presents no proof of gaining insights into oneself or a particular issue/concept/problem as a result of the experienced situation.

Technology Acceptance Model Survey Questionnaire (TAMSQ)

The study utilized the Technology Acceptance Model Survey Questionnaire (TAMSQ) to gauge students'

acceptability of Google Keep as a learner-educator feedback app in environmental crises. The Technology Acceptance Model (TAM), developed by Fred Davis, focuses on perceived usefulness and perceived ease of use as crucial factors influencing technology adoption. Derived from TAM, TAMSQ has two categories: technology acceptance and system usability. Technological acceptability explores user perceptions regarding the usefulness and ease of use of G-Keep. On the other hand, system usability has two subcategories: attitude toward using it and behavioral intention of use. The former explores the users' trust, personal initiative, characteristics, and context. The latter explores the behavioral intention of use of the user of the proposed technology. This structured questionnaire provides insights into technology acceptance dynamics and offers a systematic approach to assessing user perspectives. The quantitative data from these instruments were analyzed using descriptive statistics, such as mean and standard deviation. Table 3 shows the indicators, number of items in each level, and sample statements.

Table 3. Indicators, Number of Items, and Sample Statements of the Technology Acceptance Model Survey Questionnaire (TAMSQ)

Indicator	Number of Items	Sample Statements
Perceived Usefulness (PU)	5	The advantages of Google Keep, which is used as a feedback app, outweigh the disadvantages.
Perceived Ease of Use (PEOU)	5	the user interface of the system was clear and intuitive
Trust	5	It ensures the privacy of its users.
Personal Initiatives and Characteristics (PIC)	5	I found using Google Keep to be an efficient tool for the learner-educator feedback system.
Context	5	Google Keep proved to be meaningless and irrelevant to my studies.
Intention to Use (IU)	5	Google Keep can be adapted into a feedback app, I am inclined to integrate it into my future engagements and teaching.

Reflective Questionnaire (RQ)

A reflective questionnaire with four (4) open-ended questions is utilized, emphasizing the importance of reflection in education. Scholars like Kolb (1984) and Helyer (2015) highlight how reflection aids in transforming experiences into concepts and recognizing ongoing learning. The questionnaire serves to gauge the impact of the teaching and learning environment on reflective thinking, crucial for student improvement and skill development. A systematic procedure guided the study's aims, comprising pre-implementation, during-implementation, and post-implementation phases. Numerical data collection was employed throughout the implementation to evaluate causality and outcomes, determining if there was a significant change in the learner-educator feedback system post-intervention.

Teaching Intervention

To nurture prospective teachers' reflective thinking skills, the researchers implemented a Google Keep–supported learner–educator feedback intervention using the 7E instructional model. The class is grouped with 5-6 members. G-Keep was used in the exploration phase, where peer and instructor feedback were quickly given. Individual exploration was done on day one, and collaborative sharing and synthesizing group responses were done on Day 2. The extension phase also used G-Keep, where the participants reflected on their learning. After a day, the researchers assess their reflection and provide feedback on the participants' responses.
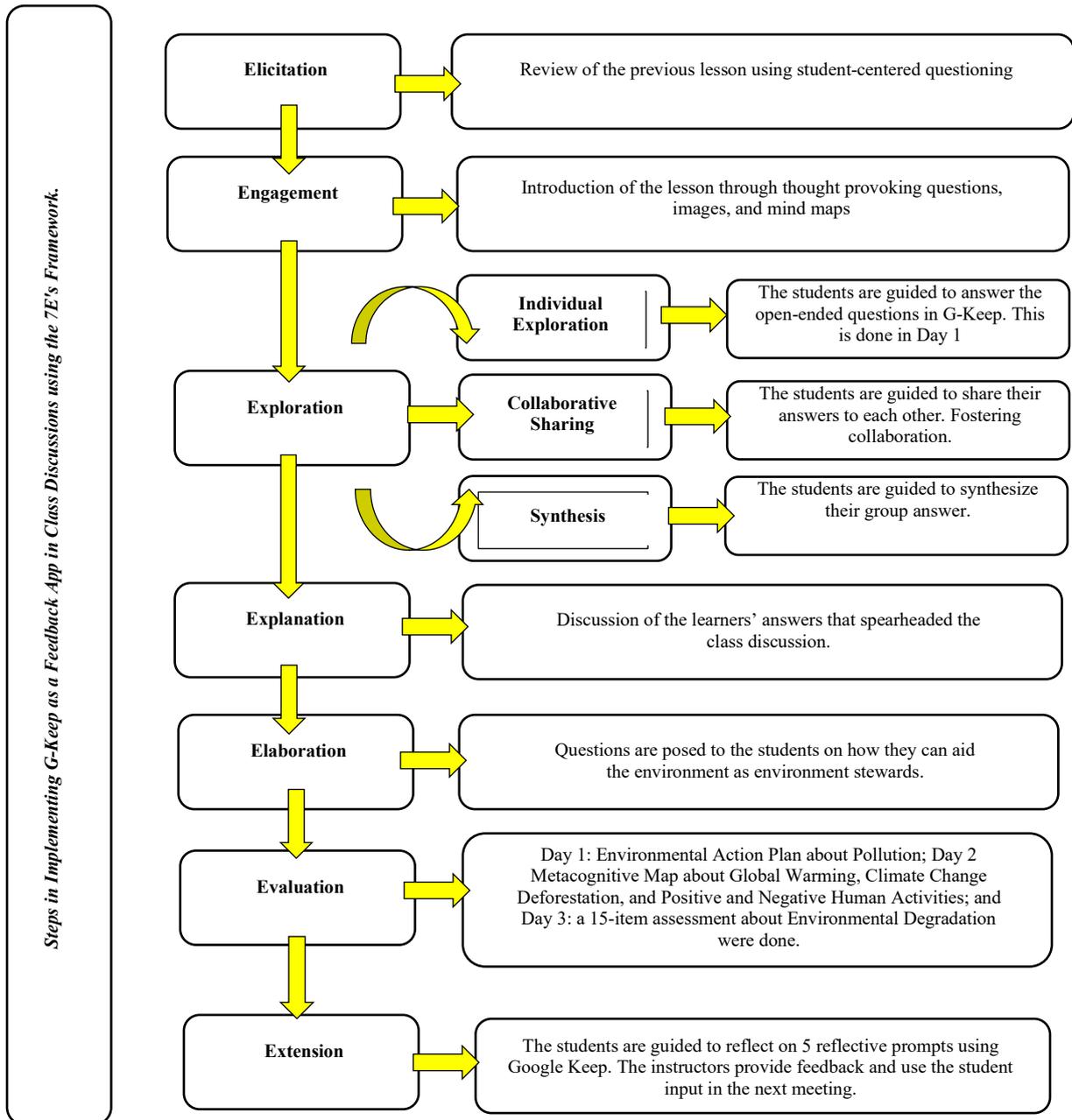

Figure 1. Implementation Framework of Google Keep as a Learner–Educator Feedback Tool

The study aimed to nurture reflective thinking skills in prospective teachers through a learner-educator feedback

system using Google Keep. The researchers implemented a teaching intervention based on the 7E instructional model with groups of 5-6 members. G-Keep was utilized during the exploration phase for quick peer and instructor feedback. Individual exploration occurred on Day 1, followed by collaborative sharing and group synthesis on Day 2. The extension phase involved reflection on what was learned, with researchers providing feedback the following day. Figure 1 shows the summarized steps in implementing G-Keep as a feedback app.

G-Keep Interface

Google Keep, the application that was used in the study, is a multimodal note-taking, organizing, and list-making tool that works with Google Drive, Google Classroom, Google Forms, and Google Hangouts. Educators may utilize the app to assist students in managing group projects, tracking their learning progress through collaborative to-do lists, and encouraging their students to show off their creative skills by writing notes. (Trust, T., 2022) Instructors create labels based on their needs, whether categorizing notes by activities, evaluation, or reflective inquiry prompts, allowing the participants to organize their perspective labels easily. Additionally, G-Keep is collaborative; it can make changes by editing notes and instantly reflecting on all participants on each label. Moreover, instructors can leave feedback within the context of the notes. Figure 2 shows the main screen of G-Keep, which presents notes in a visual card format.

a   b   c

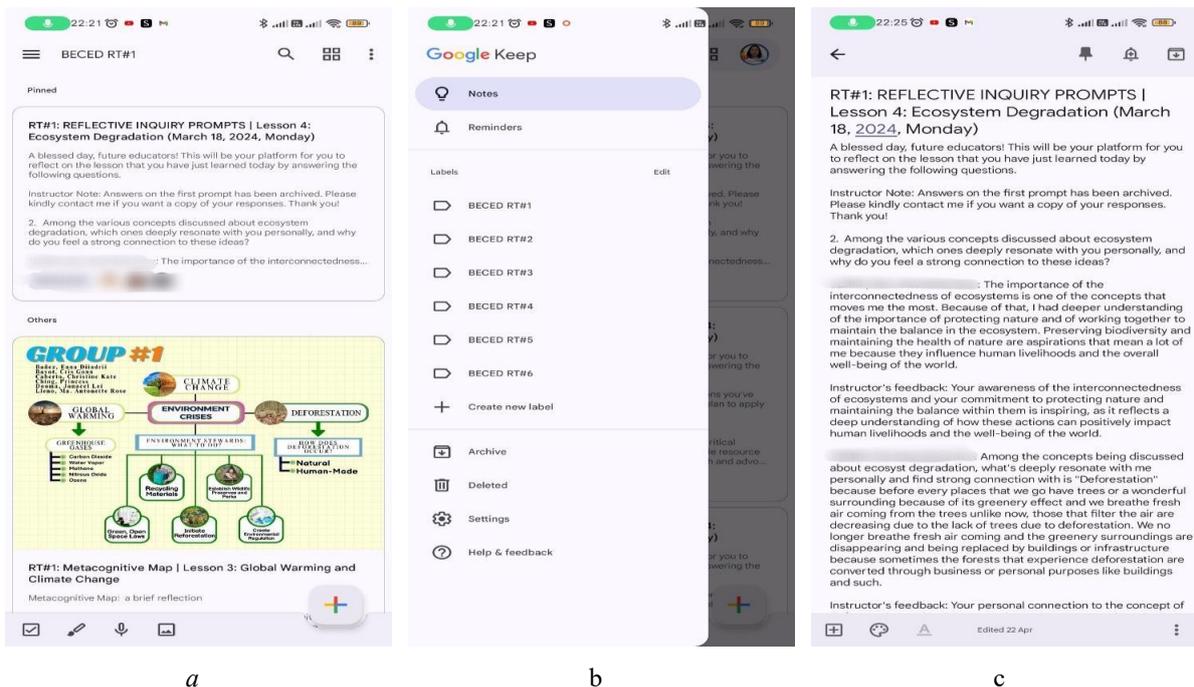Figure 2. G-Keep Interface. (a) G-Keep Main Interface, (b)G-Keep Side Bar (c) G-Keep Notes

Research Procedure

This section discusses the steps that the researchers followed in conducting their study. The researchers created A systematic procedure that guided them in targeting the study's aims. The method comprises three phases: pre-implementation, during implementation, and post-implementation.

Pre-implementation

In Figure 3, the pre-implementation process is outlined. The researchers followed the four steps before proceeding with the discussion. The researchers contacted the dean of the target college, the college secretary, and the teacher of the target class. They had a verbal inquiry to ask permission to conduct a study in their college. After that, a consent letter was given to the personnel mentioned before the researchers started the study. After asking for permission from the mentioned personnel, a meeting was conducted to plan for the target group of participants participating in the study. When a group of participants was established, a letter of approval was given to ensure that they were willing to participate in the study. The collected data and information were confidential and used in the study only. First, the participants were oriented on the research and were introduced to G-Keep and how to use it as a learner-educator feedback app in environmental crises. The pre-RTSQ was given to the participants to describe their reflective thinking skills prior to exposure to G-Keep; this was analyzed with the post-RTSQ to determine the significant change in students' reflective thinking prior to and after exposure to G-Keep, which is discussed later in the paper.
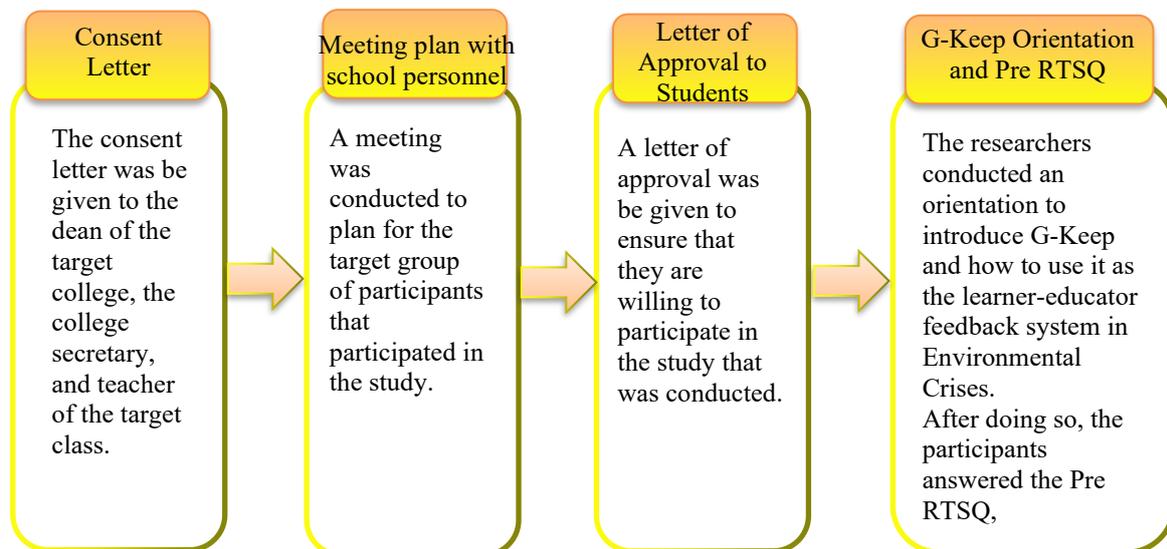
Consent Letter	Meeting plan with school personnel	Letter of Approval to Students	G-Keep Orientation and Pre RTSQ
The consent letter was be given to the dean of the target college, the college secretary, and teacher of the target class.	A meeting was conducted to plan for the target group of participants that participated in the study.	A letter of approval was be given to ensure that they are willing to participate in the study that was conducted.	The researchers conducted an orientation to introduce G-Keep and how to use it as the learner-educator feedback system in Environmental Crises. After doing so, the participants answered the Pre RTSQ,

Figure 3. Pre-implementation Flowchart

Implementation

In Figure 4, the implementation process was outlined. The researchers discussed each topic of environmental crises for two weeks. During the first week, the researchers introduced the topic by implementing elicit and engaging activities for the class. After doing so, the discussion of the first topic, anthropogenic impact and different types of pollution, was initiated. After the discussion, the students completed their reflection, which allowed them to reflect and ask for feedback using G-Keep. After the class, the researchers supplemented the input needed by the learners. After doing so, the researchers assessed the students' reflections using Kember's reflective thinking rubric. This routine was the same in the second week. The only difference is that the class further addressed the learners' concerns about the previous topic using the contents from G-Keep, and the topics discussed were global warming, climate change, deforestation, positive and negative human activities, and

ecosystem degradation, respectively. In week 3, the researchers further examined the concerns raised during the previous topic and implemented the post-implementation of this research.
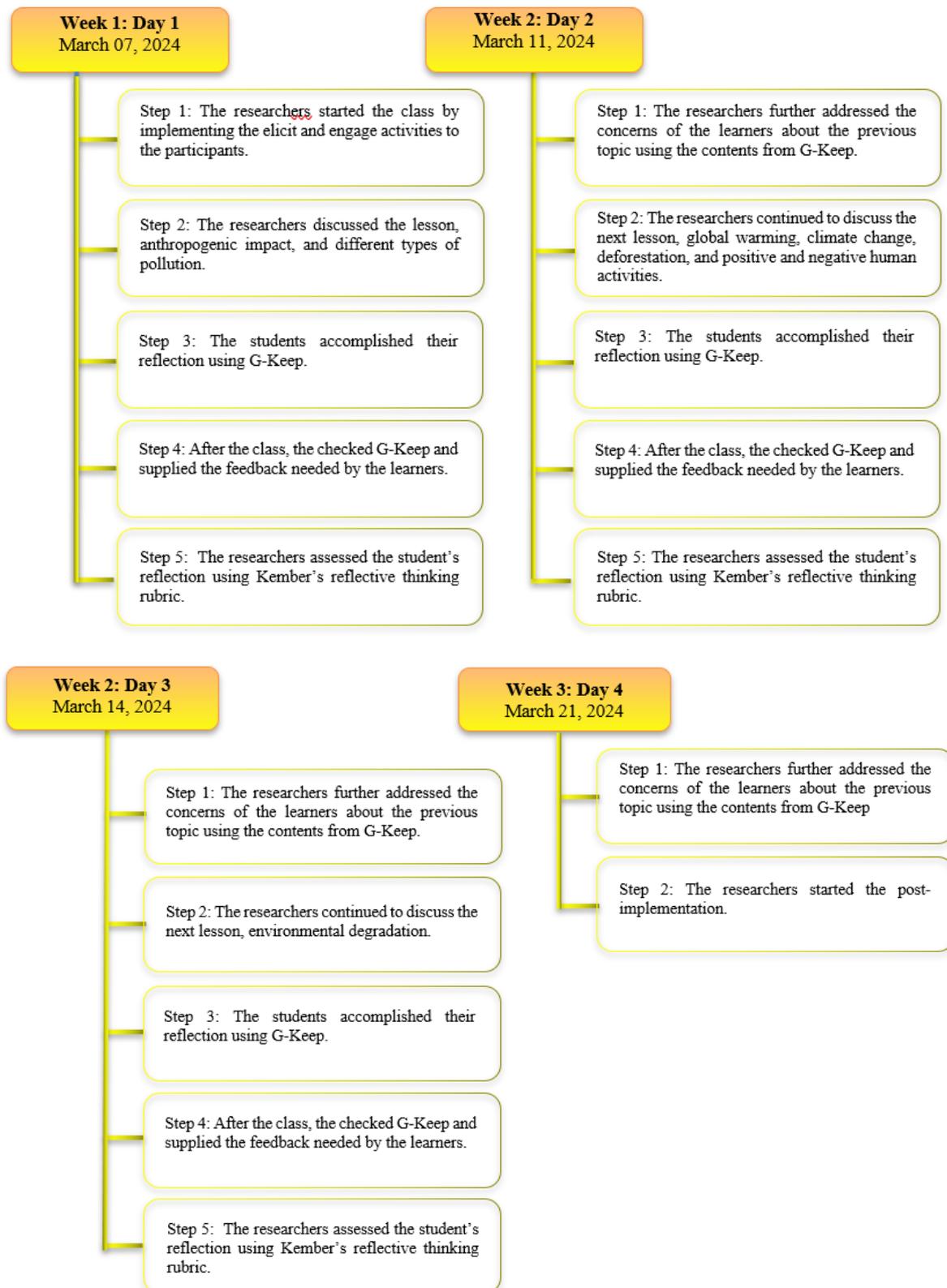
Week 1: Day 1
March 07, 2024

Step 1: The researchers started the class by implementing the elicit and engage activities to the participants.

Step 2: The researchers discussed the lesson, anthropogenic impact, and different types of pollution.

Step 3: The students accomplished their reflection using G-Keep.

Step 4: After the class, the checked G-Keep and supplied the feedback needed by the learners.

Step 5: The researchers assessed the student's reflection using Kember's reflective thinking rubric.

Week 2: Day 2
March 11, 2024

Step 1: The researchers further addressed the concerns of the learners about the previous topic using the contents from G-Keep.

Step 2: The researchers continued to discuss the next lesson, global warming, climate change, deforestation, and positive and negative human activities.

Step 3: The students accomplished their reflection using G-Keep.

Step 4: After the class, the checked G-Keep and supplied the feedback needed by the learners.

Step 5: The researchers assessed the student's reflection using Kember's reflective thinking rubric.

Week 2: Day 3
March 14, 2024

Step 1: The researchers further addressed the concerns of the learners about the previous topic using the contents from G-Keep.

Step 2: The researchers continued to discuss the next lesson, environmental degradation.

Step 3: The students accomplished their reflection using G-Keep.

Step 4: After the class, the checked G-Keep and supplied the feedback needed by the learners.

Step 5: The researchers assessed the student's reflection using Kember's reflective thinking rubric.

Week 3: Day 4
March 21, 2024

Step 1: The researchers further addressed the concerns of the learners about the previous topic using the contents from G-Keep

Step 2: The researchers started the post-implementation.

Figure 4. Implementation Flowchart

Post-Implementation

Figure 5 presents an overview of the post-implementation process. Data based on the participants' answers was collected. The post-RTSQ was given to the participants to determine whether there was a significant difference in the learner-educator feedback system after the implementation of G-Keep. After doing so, the TAMSQ was answered by the participants. The participants also answered the Reflection Questionnaire (RQ) to share their experiences and feedback about the learner-educator feedback system in environmental crises using G-Keep.
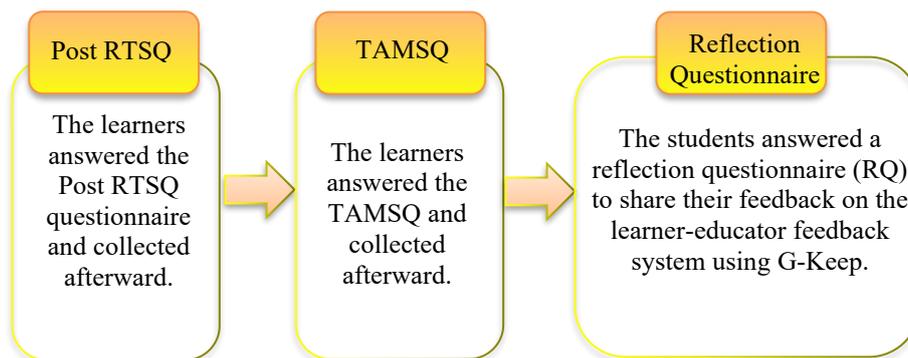
Figure 5. Post-Implementation Flowchart

Results

This section presents the quantitative and qualitative results on the effectiveness of G-Keep as a learner-educator feedback system in fostering students' reflective thinking skills.

Quantitative Findings

Pre - Reflective Thinking Survey Questionnaire

Table 4 presents the changes in students' reflective thinking skills before and after the exposure to G-Keep.

Table 4. Wilcoxon Signed-Rank Test for the Difference between Pre-RTSQ and Post-RTSQ of Students with regards to Levels of Reflection

Levels of Reflection	Pre-RTSQ	SD	Post-RTSQ	SD	MD	z	Asymp. sig	r	p-value	Verbal Interpretation of r
Habitual Action	2.82	.48	3.59	.39	0.77	-4.57	.00	-0.81	0.0001	Large effect
Understanding	3.65	.35	3.73	.44	0.08	-1.21	.23	-0.21	0.23	Small effect
Reflection	3.35	.36	3.60	.50	0.25	-2.70	.007	-0.48	0.0070	Small effect
Critical Reflection	3.34	.43	3.60	.54	0.26	-2.49	.01	-0.44	0.013	Small effect
Overall	**3.29**	**.32**	**3.63**	**.43**	**0.11**	**-3.66**	**0.00**	**0.65**	**0.0003**	**Large effect**

*Note: No. of items = 16; at N = 31 *significant at α = 0.05; effect size (Cohen's d) is (r=z/√2N), 0.10>r>0.30 (small effect), 0.50<r<0.30 (medium effect), and r>0.50 (large effect).*

The table shows that the pre-RTSQ mean score was recorded at 3.29 (SD=.32) while the post-RTSQ mean score was at 3.63 (.43). The results revealed that there was a significant difference between the overall mean scores in the Pre-RTSQ and Post-RTSQ of the students in relation to the different levels of reflection before and after being exposed to G-Keep as a learner-educator feedback system in learning Environmental Crises. The data given in the table above rejects the null hypothesis of this study. This data indicates that the students exhibited significant improvement in their overall reflective thinking in different levels of reflection after using G-Keep as a learner-educator feedback system, as evidently shown by the scores acquired during the Pre-RTSQ and Post-RTSQ ($z = -3.66$, p-value = 0.0003). This result provides strong evidence that Google Keep enhances the learner–educator feedback system in Environmental Science. Using G-Keep as a learner-educator feedback app resulted in effect sizes r = 0.65, which indicates a large and positive effect size in students' reflective thinking. The p-value of 0.0003 indicates that the results obtained were statistically significant compared to the alpha level of 0.05. Hence, this implies that using G-Keep as a learner-educator feedback system greatly impacts the students' reflective thinking skills. The results indicate that using G-Keep as a learner-educator feedback system prosperously amplified the students' reflective thinking about the different levels of reflection: Habitual Action, Understanding, Reflection, and Critical Reflection, where Understanding was highly manifested.

The quantitative findings indicate that exposure to Google Keep led to a significant improvement in students' reflective thinking across all levels of reflection. This result confirms earlier findings that technology-supported feedback and metacognitive scaffolds can enhance reflective thinking and self-regulated learning in science education (Hattie & Timperley, 2007; Antonio & Prudente, 2022). Similar to Zou et al. (2023), the immediacy and clarity of digitally mediated teacher feedback appear to play a critical role in supporting learners' reflective engagement. Allowing the participants to reflect on using their mobile phones showcases the integration of mobile learning in education, which has a positive impact on the student's academic achievement (Daher & Salhab, 2023). This notable increase is caused by the reflective inquiry prompts located on the app and the feedback that the educator provides to the participants. Structured reflection prompts combined with immediate feedback enabled learners to monitor and evaluate their learning effectively.

Moreover, reflection prompts were also implemented during the exploration phase of the class, which contributed to nurturing their reflective thinking skills. Reflection goes beyond assessment and focuses on self-improvement. It involves a deeper level of thinking processes to enhance one's performance and learning. (Watanabe-Crockett, 2018.)

Describing Students Reflecting Thinking Skills using KRTR

Table 5 presents the students who demonstrated a level of understanding in reflecting on existing knowledge (REK), with a grand mean score of 2.76 (SD = 0.05). However, they primarily utilized existing knowledge without critically assessing or connecting it to other experiences or personal reactions (Kember et al., 2008.) Regarding the Connection to Academic Concepts (CAC), the grand mean score was 2.30 (SD = 0.21), suggesting that students showed habitual action in their reflection. They failed to connect personal experiences and class content or relevant literature (Kember et al., 2008.) For Evidence of Development (ED), the grand mean score was 2.52

(SD = 0.17), indicating an understanding level of reflection similar to REK. The students display restricted or superficial insight into themselves or a particular issue/concept/problem due to the encountered experience (Kember et al., 2008.)

Table 5. Grand Mean Score and Standard Deviation of Students' Scores on the three criteria: Reflection on Existing Knowledge (REK), Connection to Academic Concepts (CAC), and Evidence of Development (ED), based on Kember's Reflective Thinking Rubric, across all lessons on Environmental Crises.

Criterion	M	SD	Levels of Reflection
Reflection on Existing Knowledge	2.76	.05	Understanding
Connection to Academic Concepts	2.30	.21	Habitual Action
Evidence of Development	2.52	.17	Understanding

As for describing their reflective thinking skills during the intervention, utilizing the three (3) criteria from KRTR, the results describe the reflective thinking skills of the learners to be utilizing their newfound knowledge. However, despite the observed gains, students demonstrated limited depth in reflective engagement, particularly in connecting personal experiences to academic concepts. This contrasts with studies that report deeper levels of critical reflection when reflective activities are implemented over longer durations or with sustained individual reflection phases (Kember et al., 2008; Chen et al., 2020). The relatively short intervention period and the collaborative nature of reflections in this study may have constrained opportunities for deeper critical reflection. Moreover, it was also observed that due to how the reflection process using G-Keep was organized - the students were grouped. They can see each other's reflections; this may be a factor for them to be influenced by their peers' reflections and not rely on their own.

Technology Acceptance Model Survey Questionnaire (TAMSQ)

The data from Figure 6 highlights that perceived ease of use registered the highest score, with a mean of 4.57 and a standard deviation of 0.51, indicating a solid perception of "to a great extent." This finding corroborates Wilson's (2019) study, suggesting that perceived ease of use holds a more significant influence on intention than perceived usefulness, supported by the higher t-value associated with perceived ease of use.
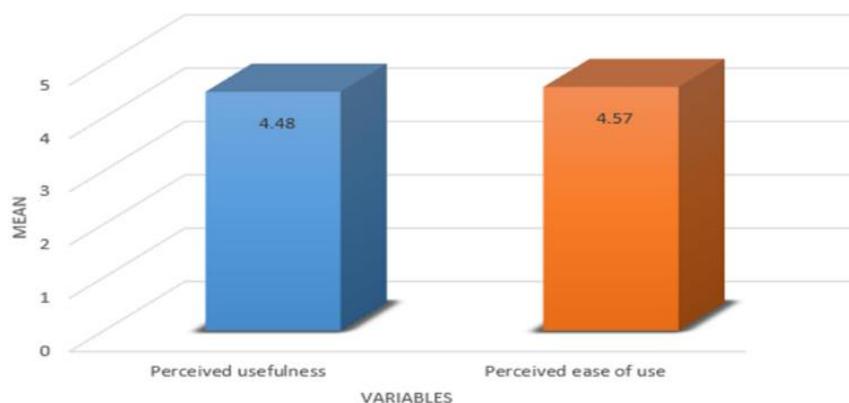

Figure 6. Students' Technology Acceptance of Google Keep Based on the TAMSQ

Conversely, perceived usefulness obtained the lowest score, with a mean of 4.48 and a standard deviation of 0.64, also interpreted as "to a great extent." The data revealed that students find G-Keep easy to use and valuable when reflecting and obtaining feedback about their reflections on environmental crises. Since an application was utilized, it is imperative to measure the students' acceptability of it. The quantitative data from TAMSQ suggests that in terms of technology acceptance, G-Keep was easy to use and navigate. Using Google Keep is as simple as putting a sticky note on a wall—simple and gets the job done (Kingcott, 2018).
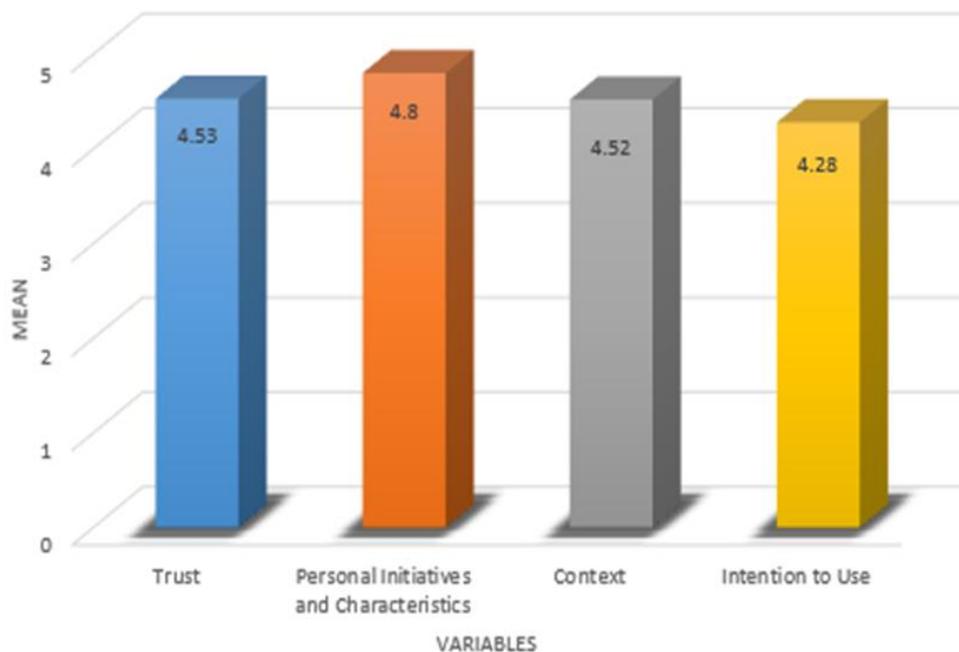

Figure 7. Students' Perceived System Usability of Google Keep Based on the TAMSQ

According to Figure 7, Personal Initiatives and Characteristics obtained the highest mean score of 4.8 with a standard deviation of 0.54, indicating a perception of "to a great extent." The results suggest that learners possess personal initiatives and characteristics conducive to using G-Keep as a feedback system. Conversely, the intention of use garnered the lowest mean score of 4.28 with a standard deviation of 0.91, also interpreted as "to a great extent." However, students express their intention to utilize G-Keep for future educational purposes. In summary, the overall average mean of 4.53 with a standard deviation of 0.21 defines the perception as "to a great extent," indicating that students highly accept G-Keep as a feedback app for nurturing reflective thinking skills for Environmental Crises. Considering the behavioral intention of use, the data reveals that students had a positive attitude towards using G-Keep. The result is observable among the participants - their openness to new experiences led them to use G-Keep during the intervention.

Qualitative Findings

Thematic Analysis

The qualitative data from the reflection questionnaire were classified under the following themes: (1) significant experiences, (2) difficulties, (3) most effective features/s, and (4) suggestions.

Table 6. Thematic Analysis of Students' Significant Experiences in Using Google Keep

Theme	Sub-themes	Codes	Sample Responses
	Reflection and Organization	Enable me to reflect	Participant 1: "Using Google Keep enable me to reflect deeply on the lesson and also collaborate with my classmates, and get feedback from our teachers - Sir Cyfer and groupmates."
		Organize my thoughts	Participant 22: "Google keep helped me a lot to organize my thoughts or answer and it also help me to be aware to my groupmates answer."
		Helps in understanding	Participant 11: "For me, my significant experience is using Google keep as a learned-educator it really does help me a lot understanding the knowledge that instructor shared."
Significant Experiences	Collaboration and Communication	Collaborate with my Classmate	Participant 7: "Using google keep it was easily to reflect and collaborate with others."
		See Each Other's Ideas	Participant 18: "We can see each other idea about the topic."
		Feedback made me feel validated	Participant 31: It's rewarding to see and receive feedbacks from th instructors, makes me feel validated."
	Feedback	Made Learner Educator Feedback Easier	Participant 26: "I think Google keep makes the feedback system in learner-educator easier."
		Get feedback	Participant 17: "The significant experiences I've experienced while using Google Keep is I can easily get immediate feedback on my reflection."
	Usability and Efficiency	Easy to use	Participant 12: "It is easy to put our reflection about the topic"
		Effective and Efficient	Participant 16: " Effective to use in making reflections and less time in writing the answering questions."
		Good to use	Participant 8: "My significant experiences while using Gkeep. The gkeep is good to use for students because gkeep is many benefits for the student specially educators"
		Convenient	Participant 20: "I think using G keep as a feedback system is really convenient"
	Enjoyment and Engagement	Fun and enjoy	Participant 9: "It's fun and all the learning that I've learned i put them easily in the google keep. I had a great time using Google keep."
	Environmental	Environmentally	Participant 27: "This is very helpful to me and also

Theme	Sub-themes	Codes	Sample Responses
	Awareness Knowledge Expansion	Friendly Expand my knowledge	environmental friendly because its paperless" Participant 28: "I've been using G-Keep since I was a 1st year college. And this experience expand my knowledge of using G-Keep."
	Challenged Faced	Answer Erased	Participant 21: "At first, my experience was mixed with confusion and excitement, because I was confused when my answer were erased but then, I enjoyed using Google Keep."

The data from Table 6 indicates that the phrases "get feedback" and "easy to use" received the highest frequency, with a frequency of 8. The data reveals that students' significant experiences include obtaining feedback from their instructor and the ease of use of G-Keep. Meanwhile, the phrases "Helps in understanding," "Made Learner Educator Feedback Easier," "Environmentally Friendly," "Expand my Knowledge," and "Hard time" each received the lowest frequency, specifically with a frequency of 1.

From the themes that emerged from the qualitative data, Google Keep serves as a platform for reflection and providing feedback due to its collaborative features and ease of use, as participants 7 and 12 stated in Table 6. Implementing Google Keep in a classroom setting, teachers may assist students in managing group projects, tracking their learning progress through collaborative to-do lists, and encouraging their students to show off their creative skills by writing, and these notes may be in the form of reflection. (Trust, 2022).

Table 7. Thematic Analysis of Students' Reported Difficulties in Using Google Keep

Theme	Sub-themes	Codes	Sample Responses
Difficulties	Technical Issues	Getting erased	Participant 16: "The challenges i face when i utilizing the google keep the other answer erased while we are typing."
		Disappearing	Participant 3 Our reflections were sometimes unintentionally disappeared and sometimes the prompts need to be accomplished were not reflected to the account
		Technical errors	Participant 4 The difficulties I experienced is there are some technical errors like the answers are getting deleted unintentionally.
		Slow	"Participant 12 This challenges that I face in using Google keep when we put an answer in the Google keep sometime is slow you always make sure to have copy of your answer in your phone."
		Internet connection	Participant 10: "My difficulties is we need internet connection in answering the questions in Google keep. I make sure that we have a good connection."
		Phone unit	Participant 22: "The difficulties/challenges that I faced is my

Theme	Sub-themes	Codes	Sample Responses
			cellphone unit is Huawei so I don't have a playstore so I can't download the app and sometimes my answer suddenly become clear."
	Copying Tendencies	Tendency to copy	"Participant 5 The answers are open with other members. There are tendencies to copy the answers or accidentally remove it."
	No Technical Issues	None	Participant 18: "I don't have any difficulties/challenges on learning about environmental crises."

The data from Table 7 demonstrate that the phrase 'getting erased' obtained the highest frequency. The research shows that students experience difficulties, such as responses being suddenly erased while using G-Keep. Furthermore, the phrases 'slow' and 'phone unit' have the lowest frequency. Limitations of the app also emerged, such as their responses being erased, as participants 4 and 16 mentioned stated in Table 7. The student researchers observed that when multiple participants edited the same Google Keep note simultaneously, some responses were unintentionally overwritten or erased. To address this issue, future implementations may assign individual notes for initial reflection or require students to draft responses offline before posting them to shared notes. Moreover, some of the participants need access to an internet connection or have a weak one, rendering them unable to use G-Keep properly during or after the discussion. This occurrence is included in the limitation of the application.

Table 8. Thematic Analysis of Students' Perceived Most Effective Features of Google Keep

Theme	Sub-themes	Codes	Sample Responses
Most Effective Feature	Enhanced Creativity and Expression	Very helpful	Participant 1: "I think the most effective feature is where we can collaborate with each other in one place is very helpful for us to get immediate feedback that we can't really have or get all the time in the classroom setting."
		Promote creativity	Participant 3.: "Feedbacks can be express in a creative way and it promotes creativity among learners and educators while being immersed in the technology."
		Can type and insert picture	Participant 7" The most effect is we can insert picture's and text collaboratively."
	Facilitated Collaboration	Shared and collaborate	Participant 17: "The specific feature lf Google Keep as learner- educator feedback system that i find most effective is we can collaborate easily and we can know the feedback immediately."
	Improved Effectiveness	More effective	Participant 12: "Its very effective and very useful it can help me to write answers unlike in the pen and paper we need to use correction."
	Reflective Thinking and	Can reflect and give	Participant 16: " i easily see their comments and reactions on our answers through that comments i can

Theme	Sub-themes	Codes	Sample Responses
	Feedback	feedback	improve what i need to improve more."
	Notable Information Management	Can note important thing	Participant 8. :The most effective is lesson on Environmental Crises is us have advantage so keep notes and important thing."
	No Specific Response	No answer	

Table 8 shows that the phrases "reflect and give feedback" attain the highest frequency. The data showed that the learners get feedback quickly from the instructor using G-Keep while "promote creativity," "more effective," and "can note important things" got the lowest frequency. Following the implementation of G-Keep, the following are the verbatim responses from our participants regarding the unique features that the students find most compelling. The following statements stated in Table 8 were evident to the participants since they were engaged in the reflecting process. Moreover, they appreciated the feedback from their instructor. They are expressive when they receive feedback from their work, which makes the features of Google Keep. This multimodal note-taking app promotes collaboration among their peers (Trust, T. 2022) which is beneficial to them in nurturing their reflective thinking skills in Environmental Crises lessons.

Table 9. Thematic Analysis of Students' Suggestions for Improving the Use of Google Keep

Theme	Sub-themes	Codes	Sample Responses
	User Satisfaction	Satisfied	Participant 7: "For me, I am satisfied on what google keep has. So that, for me, I have no suggestion be added to enhance."
		Features are Good	Participant 9: "For me all the features are good and was a good feedback experience for both learners and educators."
Suggestions		Easy to Use	Participant 32: "None, because i find it easy to use and I am satisfied with the app."
	Ease of Use and Functionality	Process of Inserting the Answer	Participant 12: "None, only the process of insert our answers in the reflection in the Google keep."
		Color, Fonts, and Design	Participant 29: "For me its so plain and not interesting to open. More features like color, icon and pocket, should be added."
	Desired Additional Features	Add Chat box	Participant 6: "Maybe the could add a comment box feature where collaborator/facilitators can give comments/feedback in a more systematic way.
		Monitoring history	Participant 1: "The feature/s that needs to be enhanced in Google Keep is the sudden disappearance of the text we're typing and I think it would be better if there are options for text fonts, colors, and themes, for us to make creative and

Theme	Sub-themes	Codes	Sample Responses
			more visually pleasing notes about Environmental Crises. Lastly, I think it would be great if the edit history can be monitored so that the teacher can know if students were able to really participate and if their answers are really from them."
		Privacy	Participant 4: "Maybe to add more privacy in one's answer."
	Accessibility and Compatibility	Availability to all cell phones	Participant 22: "I don't have any suggestion features but I hope it will be available even in Huawei or any cellphone unit that don't have playstore"
	Innovation and Uniqueness	Innovative	Participant 24: "None the app is very innovative"
	No Specific Response	None No answer	

Table 9 shows that the phrase 'color fonts and design' obtained the highest frequency, indicating that learners suggest adding features like color, icons, and pockets to enhance the feedback system between learners and educators when utilizing G-Keep. Meanwhile, the words 'availability to all' acquired the lowest frequency, indicating that most learners can access G-Keep. Following the implementation of G-Keep, the following are the verbatim responses from our participants regarding additional features they suggested. Participant 29 suggested integrating options to modify the visual aesthetics of Google Keep, which was a theme that also emerged from the qualitative data. Although the teacher-researchers oriented the participants that Google Keep has options to change the visual appearance of their Google Keep notes, no one changed it and focused on the reflective prompts. Moreover, G-Keep offers ample themes and backgrounds (Romero, 2022); however, they are limited.

Despite the positive findings, several limitations should be acknowledged. The study involved a relatively small, purposively selected sample from a single institution, which may limit the generalizability of the results. Additionally, the short duration of the intervention and the use of collaborative reflection tasks may have constrained the development of deeper critical reflection, while technical issues such as erased responses and internet connectivity challenges may have influenced students' reflective outputs.

Conclusion

This study explored the use of Google Keep as a digital feedback tool to foster reflective thinking skills among prospective teachers in an Environmental Science course. Drawing from a mixed-methods approach, the findings provide compelling evidence that integrating Google Keep into classroom instruction can enhance learner-educator feedback systems and support the development of students' reflective thinking. Quantitative results showed a statistically significant improvement in students' reflective thinking, particularly in habitual action, reflection, and critical reflection. The large effect size observed suggests that the platform contributed meaningfully to students' metacognitive engagement and self-assessment. While Kember's Reflective Thinking

Rubric indicated some limitations in students' depth of reflection, particularly in connecting personal experiences to academic concepts, the data also highlight that reflective growth was evident, albeit emerging.

Students expressed strong acceptance of Google Keep, as evidenced by high scores in perceived ease of use, personal initiative, and system usability. Thematic analysis of qualitative feedback further emphasized the platform's intuitive interface, collaborative features, and its ability to facilitate immediate and meaningful feedback exchanges. However, several technical and contextual challenges, such as erased entries, device compatibility issues, and tendencies for peer influence during group reflections, underscore the need for thoughtful implementation and platform support.

Overall, this study affirms the potential of Google Keep as a practical, accessible, and pedagogically sound tool for promoting reflective thinking in science education. The integration of structured reflection prompts with immediate feedback helped create an interactive, student-centered learning environment. As learners engaged in metacognitive activities, they became more aware of their thought processes, learned to evaluate their performance, and demonstrated increased agency in their learning journeys.

Future research should consider longitudinal studies and comparative designs to examine the sustained effects of digital feedback tools on reflective thinking. Moreover, refining implementation protocols—such as individual reflection phases and technological safeguards—can further enhance the depth and authenticity of students' reflections. As educators navigate the integration of educational technologies, tools like Google Keep offer promising pathways to support metacognition, feedback, and meaningful learning in the digital age.

Recommendations

Based on the findings and insights of this study, several key recommendations are proposed to guide future implementation, instructional practice, and research. First, it is essential to provide comprehensive orientation and technical training to both students and instructors before integrating Google Keep into the classroom. This includes familiarization with the app's functionalities, collaborative features, privacy settings, and visual customization tools to ensure effective and confident usage. Educators are also encouraged to design reflective activities that initially emphasize individual reflection before collaborative sharing. This strategy may mitigate tendencies toward peer influence and foster deeper, more authentic connections between learners' personal experiences and academic content.

To address the technical limitations identified—such as disappearing responses and device incompatibility— teachers should implement backup mechanisms, such as maintaining offline records or using alternative apps for documentation. Additionally, exploring comparable educational platforms (e.g., Microsoft OneNote, Notion, or Padlet) may offer similar pedagogical benefits while enhancing accessibility and flexibility across devices. Embedding metacognitive scaffolds—such as reflective prompts, rubrics, and feedback checkpoints—within Google Keep is recommended to enhance reflection quality. Establishing feedback loops, where students' reflective inputs are explicitly acknowledged and used to inform subsequent instruction, can reinforce the value

of reflection as a dialogic learning process.

Moreover, the study recommends leveraging Google Keep's integration with other Google Workspace tools—such as exporting notes to Google Docs for extended reflection or incorporating Google Classroom for centralized feedback collection. These synergies can help educators create more connected and interactive digital learning ecosystems. Finally, future research should consider longitudinal and comparative studies to examine the sustained impact of using digital feedback tools on students' reflective thinking and academic performance. Employing quasi-experimental designs or including control groups could provide more robust evidence of causality. By implementing these recommendations, educators and researchers can advance the pedagogical potential of digital technologies in fostering metacognition, feedback engagement, and reflective learning in diverse educational contexts.

References

Akturk, A. O., & Sahin, I. (2011). Literature review on metacognition and its measurement. *Procedia – Social and Behavioral Sciences, 15*, 3731–3736. https://doi.org/10.1016/j.sbspro.2011.04.364

Antonio, R. P., & Prudente, M. S. (2022). Effectiveness of metacognitive instruction on students' science learning achievement: A meta-analysis. *International Journal on Studies in Education (IJonSE), 4*(1), 43–54. https://doi.org/10.46328/ijonse.50

Brown, A. (2024). The progression of technology integration in the music classroom to support student engagement: Part I—Using Google Keep. *Journal of General Music Education, 38*(1), 22–27.

Centre for Pedagogical Innovation, Brock University. (n.d.). *Critical reflection rubric*. https://brocku.ca/pedagogical-innovation/wp-content/uploads/sites/53/Critical-Reflection-Rubric.pdf

Chen, M.-R., Hwang, G.-J., & Chang, Y. (2020). A reflective thinking-promoting approach to enhancing graduate students' flipped learning engagement, participation behaviors, reflective thinking, and project learning outcomes. *British Journal of Educational Technology, 51*(6), 2288–2307. https://doi.org/10.1111/bjet.12823

Deeva, G., Bogdanova, D., Serral, E., Snoeck, M., & De Weerdt, J. (2021). A review of automated feedback systems for learners: Classification framework, challenges and opportunities. *Computers & Education, 162*, 104094. https://doi.org/10.1016/j.compedu.2020.104094

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive developmental inquiry. *American Psychologist, 34*(10), 906–911.

Hargreaves, A. (2000). Mixed emotions: Teachers' perceptions of their interactions with students. *Teaching and Teacher Education, 16*(8), 811–826. https://doi.org/10.1016/S0742-051X(00)00028-7

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81–112. https://doi.org/10.3102/003465430298487

Hepplestone, S., Holden, G., Irwin, B., Parkin, H. J., & Thorpe, L. (2011). Using technology to encourage student engagement with feedback: A literature review. *Research in Learning Technology, 19*(2), 117–127. https://journal.alt.ac.uk/index.php/rlt/article/view/836

Kaldaras, L., Wang, K. D., Nardo, J. E., Price, A., Perkins, K., Wieman, C., & Salehi, S. (2024). Employing

technology-enhanced feedback and scaffolding to support the development of deep science understanding using computer simulations. *International Journal of STEM Education, 11*(1), Article 30. https://doi.org/10.1186/s40594-024-00490-7

Kalina, C., & Powell, K. C. (2009). Cognitive and social constructivism: Developing tools for an effective classroom. *Education, 130*(2), 241–250.

Kember, D., McKay, J., Sinclair, K., & Wong, F. (2008). A four-category scheme for coding and assessing the level of reflection in written work. *Assessment & Evaluation in Higher Education, 33*(4), 369–379. https://doi.org/10.1080/02602930701293355

Kenan, T. (2015). *Improving the effectiveness of e-learning implementation in the School of Engineering at Tripoli University* (Doctoral thesis, University of Huddersfield). https://eprints.hud.ac.uk/id/eprint/28702/

Kingcott, C. (2018, August 21). Google Keep: A smashing example of great product design. *Medium*. https://medium.com/@caleb.kingcott/google-keep-a-smashing-example-of-great-product-design-69c42c12ff61

Lai, E. R. (2011, April). *Metacognition: A literature review*. Pearson.

Layrargues, P. P. (2020). Pandemias, colapso climático, antiecologismo: Educação ambiental entre as emergências de um ecocídio apocalíptico. *Revista Brasileira de Educação Ambiental (RevBEA), 15*(4), 1–30. https://doi.org/10.34024/revbea.2020.v15.10861

Li, S., Ou, L., & Lee, I. (2025). The timing of corrective feedback in second language learning. *Language Teaching*. Advance online publication.

Marikyan, D., & Papagiannidis, S. (2023). Technology acceptance model: A review. In S. Papagiannidis (Ed.), *TheoryHub Book*. https://open.ncl.ac.uk/theories/1/technology-acceptance-model/

Menezes, D. V. C. (2018). A educação ambiental diante da crise planetária. *REMEA – Revista Eletrônica do Mestrado em Educação Ambiental*, 139–151.

Mevarech, Z. R., & Kramarski, B. (2003). The effects of metacognitive training versus worked-out examples on students' mathematical reasoning. *British Journal of Educational Psychology, 73*(4), 449–471. https://doi.org/10.1348/000709903322591181

Morrone, M. (2001). Primary- and secondary-school environmental health science education and the education crisis: A survey of science teachers in Ohio. *Journal of Environmental Health, 63*(9), 26–30.

National Council for Special Education. (n.d.). *The metacognitive teacher and learner: Teaching to think, learning to learn*.

Nicol, D. (2012). Resituating feedback from the reactive to the proactive. In *Feedback in higher and professional education* (pp. 34–49). Routledge.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199–218. https://doi.org/10.1080/03075070600572090

North American Association for Environmental Education. (2016). *Education we need for the world we want*. https://naaee.org/about/ee

Pollard, V., & Armatas, C. (2025). Feedback is integral: Using a revised ICAP framework to achieve active learning in an asynchronous online course. *Online Learning, 29*(3), 236–254.

Raymond, B. L., Fowler, L. C., & Robertson, A. C. (2019). The impact of converting from an educator-driven to

a learner-initiated feedback model. *Journal of Education in Perioperative Medicine, 21*(3), E627.

Romero. (2022, March 18). Upgrade the look of your Google Keep notes with colors and backgrounds. *9to5Google*. https://9to5google.com/2022/03/18/upgrade-the-look-of-your-google-keep-notes-with-colors-and-backgrounds-heres-how/

Rooney-Varga, J. N., Sterman, J. D., Fracassi, E., Franck, T., Kapmeier, F., Kurker, V., Johnston, E., Jones, A. P., & Rath, K. (2018). Combining role-play with interactive simulation to motivate informed climate action: Evidence from the World Climate simulation. *PLOS ONE, 13*(8), e0202877. https://doi.org/10.1371/journal.pone.0202877

Sadeghi, Z., & Mohtashami, R. (2011). Role of metacognition in learning process. *Iranian Quarterly of Education Strategies, 3*(4), 143–148.

Sadler, D. R. (1998). Formative assessment: Revisiting the territory. *Assessment in Education: Principles, Policy & Practice, 5*(1), 77–84. https://doi.org/10.1080/0969595980050104

Salhab, R., & Daher, W. (2023). The impact of mobile learning on students' attitudes towards learning in an educational technology course. *Multimodal Technologies and Interaction, 7*(7), Article 74. https://doi.org/10.3390/mti7070074

Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science, 26*(1–2), 113–125. https://doi.org/10.1023/A:1003044231033

Suarez, D. C., Kircher, C., & Santi, T. (2024). A clear and present pedagogy: Teaching about planetary crisis (when you're in a planetary crisis). *Antipode, 56*(1), 276–298. https://doi.org/10.1111/anti.12977

Swanson, H., & Clarke-Midura, J. (2021). Integrating formative assessment and feedback into scientific theory-building practices and instruction. *Assessment in Education: Principles, Policy & Practice, 28*(2), 118–134.

Swanson, H. L. (1990). Influence of metacognitive knowledge and aptitude on problem solving. *Journal of Educational Psychology, 82*(2), 306–314. https://doi.org/10.1037/0022-0663.82.2.306

Tanner, K. D. (2012). Promoting student metacognition. *CBE—Life Sciences Education, 11*(2), 113–120. https://doi.org/10.1187/cbe.12-03-0033

Thomson, G., & Hoffman, J. (2003). *Measuring the success of environmental education programs*. Canadian Parks and Wilderness Society.

Trust, T. (2022). *Online tools for teaching and learning*. EdTech Books. https://edtechbooks.org/onlinetools

ViewSonic. (2021). *Create effective feedback with education technology*. https://www.viewsonic.com/library/education/create-effective-feedback-with-education-technology/

Weller, J., & Gotian, R. (2023). Evolution of the feedback conversation in anaesthesia education: A narrative review. *British Journal of Anaesthesia, 131*(3), 503–509. https://doi.org/10.1016/j.bja.2023.05.021

Winstone, N., & Boud, D. (2019). Exploring cultures of feedback practice: The adoption of learning-focused feedback practices in the UK and Australia. *Higher Education Research & Development, 38*(2), 411–425. https://doi.org/10.1080/07294360.2018.1532985

Zou, D., Xie, H., & Wang, F. (2023). Effects of technology-enhanced peer, teacher and self-feedback on students' collaborative writing, critical thinking tendency and engagement in learning. *Journal of Computing in Higher Education, 35*, 166–185. https://doi.org/10.1007/s12528-022-09337-y