Improving Seventh-Grader Online Learning Engagement Using Assessment Feedback and Self-Regulated Learning Strategies

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Article info

Abstract

The global spread of COVID-19 necessitated a shift from classroom-based to online learning, resulting in decreased student engagement at an inner-city school in Bangkok. This article explores the use of assessment feedback and self-regulated learning strategies to enhance student engagement. The researchers employed a two-cycle action research model, consisting of four stages: planning, action, observation, and reflection. The study was conducted over four weeks with 35 seventh-grade students, using observations, semi-structured interviews, and content analysis during each cycle. The findings revealed an increase in student participation, with more students consistently logging into class and remaining engaged throughout. Additionally, students demonstrated the confidence to turn on their cameras to greet peers and showed a greater commitment to learning. Peer support emerged as an important factor in their studies. Teachers provided feedback through Google Classroom and e-Portfolios, promoting student autonomy, which led to increased engagement and fostered desirable learning behaviors that may be applicable in other educational contexts.

Introduction

In the early 2020s, the COVID-19 pandemic marked a significant shift in educational history, as schools worldwide transitioned from traditional face-to-face classrooms to online learning. In Thailand, this transition was fully adopted, with schools relying heavily on online platforms. According to a survey by the Organization for Economic Co-operation and Development (OECD), Thai teachers were generally better equipped with online tools compared to their counterparts in other OECD countries. However, the survey revealed that many Thai students lacked access to quiet learning spaces, digital devices, and stable internet connections (Reimers, 2020), indicating that they were not fully prepared for online learning. Moreover, the Bangkok Metropolitan Administration's mandate to control the spread of COVID-19 led to an abrupt shift to online learning. This situation transformed the learning environment from traditional square classrooms to global online platforms. In the first semester of the 2021 academic year, 35 secondary school students enrolled in their first online science course. Despite having access

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to quiet spaces, digital devices, and stable internet, these students were still distracted by activities outside the lesson. This aligns with interviews of public-school teachers in Bangkok, who reported that students were not paying attention in class, showed minimal interaction, kept their cameras off, or disengaged from the learning process altogether (Fakcharoenphol, 2020). Teachers observed a decline in communication, participation, persistence, and overall efficiency, suggesting that students were not engaged in their learning. Academics argue that engagement is a crucial factor in reducing dropout rates (Farrell & Brunton, 2020). Therefore, teachers must adopt strategies that foster student engagement, helping them stay focused and harmoniously integrated into the learning process.

Today's assessment trends emphasize integrating assessment activities with learning to foster positive student-teacher and student-student interactions in a supportive classroom environment. Assessment for Learning and Assessment as Learning aim to transform the teacher's role from judge to facilitator, continuously supporting students' learning (Earl, 2013; McMillan, 2018). Teachers provide feedback tailored to students' knowledge and skills, guiding them on how to improve. Students also evaluate themselves and their peers using these assessment methods, which help monitor learning progress throughout the semester. Assessment for Learning shapes learning, primarily driven by the teacher, while Assessment as Learning focuses on the learner's active participation in self-assessment and skill development driven by the learner's habits and abilities(Chappuis & Stiggins, 2017).

One key strategy in Assessment for Learning is using teacher feedback to stimulate student enthusiasm and promote self-development (DeLuca & Klinger, 2010). Additionally, incorporating technology in the assessment process supports self-regulated learning, which can enhance individual and in learning community engagement and lead to better academic outcomes (Finn & Zimmer, 2022). Self-regulated learning, involving self-control and motivation, aligns with the goals of Assessment as Learning, aiming to develop students' cognitive, affective, and psychomotor skills.

While feedback and self-regulated learning strategies are typically used independently in traditional classrooms, this study seeks to integrate Assessment for Learning and Assessment as Learning techniques into online classroom activities to address student engagement issues. The researchers will use feedback and self-regulated learning as key strategies to enhance student engagement in online learning environments.

Objective

This study aims to enhance student engagement in online learning through the use of feedback and self-regulated learning strategies.

Conceptual framework

The researchers integrated Assessment for Learning and Assessment as Learning techniques into classroom activities using feedback and self-regulated learning as strategies to address student engagement problems in online learning. An action research methodology was employed (see Figure 1).
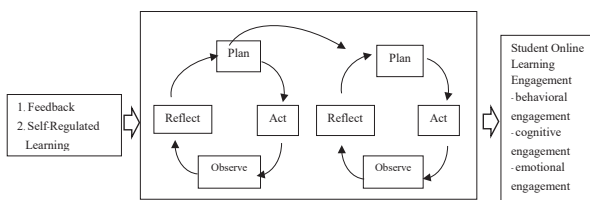

Figure 1 A framework for developing student engagement in online learning

Literature review
Student Engagement in Online Learning

Engagement is a critical factor in online learning, playing a key role in reducing dropout rates, improving academic achievement, and helping learners develop the skills needed for future employment. Despite its importance, student participation in online learning is generally lower than in face-to-face settings (Farrell & Brunton, 2020). Engagement, in this context, refers to a learner's commitment to acquiring knowledge from various sources. It often reflects positive motivation, where learners enjoy the process of learning and demonstrate a desire to continue acquiring knowledge and applying it to their lives (Finn & Zimmer, 2022). Learning engagement is visible through learners' performance in academic activities and behaviors that demonstrate their connection to and involvement in learning, ultimately contributing to their success (Guo, 2018).

Several factors influence student engagement, including class size, student support, peer evaluation, case study learning, and the use of interactive lessons (Hodgson et al., 2013). Interactivity, particularly among

peers, teachers, and course content, fosters enthusiasm and a collective learning experience that leads to higher-quality instruction and improved outcomes (Martin & Bolliger, 2018). As online learning becomes more prevalent, researchers like Ding et al. (2018), Deng et al. (2020), and Wang et al. (2022) have identified three components of student engagement in online learning:

Behavioral engagement involves students' active participation, such as attendance, asking questions, completing assignments, and engaging in online discussions. Studies have shown a strong link between these behaviors and positive learning outcomes, making them key predictors of grades and assessment scores (Darling-Aduana, 2019; Nguyen, Cannata, & Miller, 2018; Wang et al., 2022).

Emotional engagement refers to learners' emotional responses to learning activities, including interest, boredom, happiness, sadness, and anxiety. In an online setting, emotional engagement reflects learners' attitudes towards their peers, teachers, and the learning environment. Positive emotional engagement enhances active learning (Molinillo et al., 2018; Wang et al., 2022).

Cognitive engagement refers to learners' perceptions of themselves and learning includes motivation, effort, and strategy use. It also means mastering difficult skills using self-regulating metacognitive strategies, such as planning, monitoring, and assessing a person's understanding of a topic or a task. Therefore, in the online learning context, cognitive engagement refers to the learning efforts to acquire complex content or skills in the online learning process (Shernoff, 2013; Wang et al., 2022).

Overall, student engagement in online learning is driven by behavioral, emotional, and cognitive factors. These dimensions of engagement are evidenced by students' participation in class, attention during lessons, and persistence (Ding et al., 2018; Deng et al., 2020; Henrie et al., 2015; Wang et al., 2022). This study examines behavioral engagement (e.g., persistence, attendance, and on-task behavior), cognitive engagement (e.g., perceived relevance, strategy use and beliefs), and emotional engagement (e.g., enjoyment, enthusiasm, and satisfaction).

Assessment for Learning and Feedback

Assessment for Learning (AfL) is a method of shaping learning that is used to indicate students' understanding. AfL aims to develop student meta-cognition, where students are aware of their cognition and also can control and evaluate themselves as well as

their group or class. To that end, the teacher's role is to support students by helping them develop skills and awareness so that they can plan, follow up, evaluate, and improve themselves. AfL enables teachers to seek additional feedback from students for improved teaching and student learning (Bartlett, 2015; McMillan, 2018; Stanley & Alig, 2014). Engagement is an integral part of lesson plans that highlight learning methods as a "key element" in classrooms. Teachers who recognize the benefits of learner motivation must have essential skills that reflect their professionalism. As a result, teachers primarily plan, assess, and use assessment information as feedback for remedial action or to develop individuals or groups of learners to improve throughout the academic year (Wisniewski et al., 2020). The teacher is the one who is responsible for providing feedback to students as a method to empower them.

Feedback is an important and crucial part of Assessment for Learning because it provides information from representatives, such as teachers and peers, about student performance (Hattie & Timperley, 2007). Formative feedback offers information about students' progress throughout the learning unit, promoting learning through instant or timely constructive feedback from online teachers. This feedback can support assessment and teaching, close gaps in understanding, and motivate learners. A lack of feedback is one of the most frequently cited reasons for students withdrawing from online courses or becoming "black-screen" students. Teachers often view feedback as a gift rather than an interaction between instructors and learners. In various instructional settings, feedback has been a powerful influence on learning (Hattie & Timperley, 2007).

With the growing popularity of online learning, digital feedback is now more readily available than ever, enabling learners and teachers to better understand how to offer feedback and identify opportunities for improvement. Online feedback includes information from teachers or classmates received as written statements, audio files, videos, pre-programmed auto-responses, live web conferencing, which learners can use to reflect on the effectiveness of the curriculum and improve their performance. Hattie & Timperley (2007) Feedback Model is organized around three steps-feed-up, feedback, and feedforward-highlights the effectiveness of feedback. Additionally, the researchers expanded the concepts of online feedback at various levels: task-level emphasizes diagnosis and reasoning; process-level emphasizes development, reinforcement, connection,

and promotion; self-level emphasizes motivation, time management, communication, and seeking assistance; and emotional-level emphasizes mood (Wang et al., 2021). Feedback strategy can be divided into two components: feedback content and feedback methods for sharing information and opinions with students.

According to Hattie & Timperley's (2007) Feedback Model, researchers applied feedback in an online learning context by greeting students in real-time, using chat boxes and symbols. They assessed prior knowledge with quizzes, tests, or online surveys, and then reported test results and provided feedback on study plans (feed-up). Teachers and students collaboratively developed learning objectives, tasks, and assessment criteria. However, students did not participate in monitoring each other's tasks. During the teaching stage, teachers employed media and technology suitable for online learning, encouraging students to explore (feedback). Despite this, students continued to fail to submit their assignments on time, leading the teacher to provide incomplete feedback. Additionally, if students did not understand their tasks, teachers could offer further advice on group work, assignments, and homework (feedforward).

Assessment as Learning and Self-regulated Learning,

Earl (2013) defined Assessment as Learning as a subset of Assessment for Learning. Assessment as Learning (AaL) emphasizes the learner's active role in the assessment process. Unlike AfL, which is primarily teacher-driven, AaL encourages students to take ownership of their learning by engaging in self-assessment and reflection. This approach fosters metacognitive skills, helping students plan, monitor, and evaluate their learning, both individually and in group settings (Keeley, 2016; Hawe & Dixon, 2017).

AaL is personal, ongoing, reflective, and self-initiated (Keeley, 2016; Hawe & Dixon, 2017). As a result, AaL aids the management of one's learning (self-regulated learning), improves student confidence, and increases responsibility and autonomy.

Self-regulated learning

Self-regulated learning is a set of strategies that students use in their studies, involving a metacognitive process that requires active participation before, during, and after academic work (Pintrich, 2004; Zimmerman, 2015). According to Zimmerman's concept, self-regulated learning refers to a student's self-control and motivational processes for goal-oriented learning. Pintrich's conceptual framework builds on Zimmerman's idea, emphasizing that self-regulated learning involves managing thoughts and motivation within the learning context. In light of the COVID-19 pandemic, researchers have proposed ways to empower students by adapting self-regulated learning strategies to online learning practices. Hong et al. (2021) identified six components of self-regulated online learning: task strategy, mood adjustment, self-evaluation, environmental structuring, time management, and help-seeking. They found that participants with high levels of academic procrastination exhibited low levels of self-regulated online learning, resulting in a perception of online learning as ineffective.

Moreover, many scholars have provided guidelines and recommendations for fostering self-regulated online learning. For instance, in Assessment as Learning, teachers can encourage students to keep a record of their learning, conduct self-assessments individually or in groups based on specific criteria, and reflect on ways to improve. They can also create concept maps summarizing what they have learned from various sources (Gayton & McEwen, 2007; Martin & Bolliger, 2018; Mega et al., 2014) to guide future learning and enhance performance.

The self-regulated online learning framework helps researchers set class objectives, prioritize learning schedules and timelines, discuss expected outcomes of class activities, and define evaluation methods, while also motivating students to collaborate. Students monitor and regulate their own learning as well as their peers', seek knowledge, experiment, solve context-related problems, assess their abilities, and strive to improve. When they encounter difficulties, students can seek help from classmates or the teacher, then work on a learning log. Thus, learning engagement is fostered through feedback and self-regulated learning.

Research Methodology

Context of the Study

This research was conducted in a school in Bangkok, which offers classes from early childhood through secondary education. During the first semester of the 2021 academic year, in accordance with the Bangkok Metropolitan Administration's order to control the spread of COVID-19 and reduce the risk of infection among students, in-person classes were suspended as students were being vaccinated. Regarding online learning in Thailand, teachers used various online conferencing platforms such as Zoom, Microsoft Teams,

Facebook Live, Line, or Google Meet, depending on what the schools provided and the learners' preferences.

The study group consisted of Seventh Grade students from a school in Bangkok studying diffusion and osmosis content during the first semester of the 2021 academic year. The group included one classroom with 35 students—14 males and 21 females. The researcher had already been teaching this class alongside another fellow researcher, making the research team co-developers. The research focused on two subunits: diffusion and osmosis. All students' parents supported online learning by providing communication devices and a stable internet connection.

Participants and Design

The action research team consisted of three secondary science teachers (one female and two male) with experience ranging from 10 to 23 years, as well as a university researcher. The teachers and researchers met once a week. The 35 students, aged 12-13, were enrolled in their first online science course in secondary school. Among the students were five who were ethnic or political refugees from Burma and Laos. Only students with access to online learning tools such as smartphones, netbooks, or laptops, and who could connect to Google Meet, were selected. Students without internet access or online learning devices were excluded from the study.

Online learning allows teachers to teach at any time and place convenient for them. Most learning processes required enrollment in the classroom system. When developing self-regulated online learning engagement, most academics referenced teacher feedback principles such as Feeding Up, Feeding Back, and Feeding Forward (Wang et al., 2021), as well as self-regulated online learning practices, including task strategy, mood adjustment, self-evaluation, environmental structuring, time management, and help-seeking (Hong et al., 2021).

The researchers studied different types of assessment and found that Assessment for Learning and Assessment as Learning helped students stay more focused on the lesson. They believed these two assessment techniques could be integrated, which inspired them to conduct this study. The research was designed to focus on feedback (teacher-led role) and self-regulated learning (student-led role) to develop self-regulated online learning engagement. The researchers integrated Assessment for Learning and Assessment as Learning techniques into a teaching-based approach using three steps: warm-up, presentation and practice, and wrap-up (Table 1).

Table 1 Process in developing learning engagement using feedback and self-regulated learning strategies

Steps	Strategies	
	Feedback (AfL: teacher-led role)	**Self-regulated learning** (AaL: student-led role)
Warm-up	- Greeting and doing an ice-breaking activity: chat-box or real-time conversation (synchronous) - Testing students' prior knowledge by asking questions in the chat box (asynchronous) - Using the answers as a guideline in determining learning outcomes, content, learning activities, and assessments	- Collaborating to determine the learning direction, prioritize the content to be studied, and establish the methods and assessment criteria (synchronous and asynchronous) - Using the peer buddy method to motivate each other to study (synchronous and asynchronous)
Presentation and practice	- Using PowerPoint to explain content, showed YouTube clips, and demonstrated diffusion and osmosis experiments (synchronous and asynchronous) - Ask students frequently and assign tasks via Google Classroom (synchronous and asynchronous) - Assigning tasks using e-Portfolio (asynchronous) - Followed up and provided feedback on each student's practice (asynchronous) - Giving feedback (asynchronous)	- Collaborating to gather information, perform tasks (demonstration and experiment), and critique each other's tasks (synchronous and asynchronous) - Using the peer buddy method to observe and control each other to study. (synchronous and asynchronous)
Wrap-up	- Using questions to summarize lessons (synchronous and asynchronous) - Assessing the assignment (asynchronous) - Providing feedback on tasks and processes using text and symbols (synchronous and asynchronous)	- Seeking help from peers or teachers when they could not find an answer - Keeping learning logs during and after class. (asynchronous) - Reflecting on their learning from their portfolio (asynchronous) - Creating learning notes to summarize the lesson; mapping, diagrams, and summaries (asynchronous)

Method

The objective of this study was to develop online learning engagement using Assessment for Learning and Assessment as Learning. To achieve this, we employed an action research methodology. Action research is defined as a problem-solving approach in which teachers take on the role of researchers to address and improve classroom issues (Mills, 2018). In this research, we followed the action research spiral proposed by Kemmis et al. (2016) and utilized two cycles of action research (Figure 2).

Implementing action research

Group discussions among the three teachers and interviews regarding the challenges of online learning revealed the following insights from both teachers and students: (1) Teachers found it difficult to engage students online as effectively as in face-to-face classes. When students did not understand or were unable to interact and receive feedback during class, they disengaged. (2) Students struggled to concentrate, lacked motivation and self-regulation, felt uncomfortable turning on their videos, and were unsure of what they needed to improve.
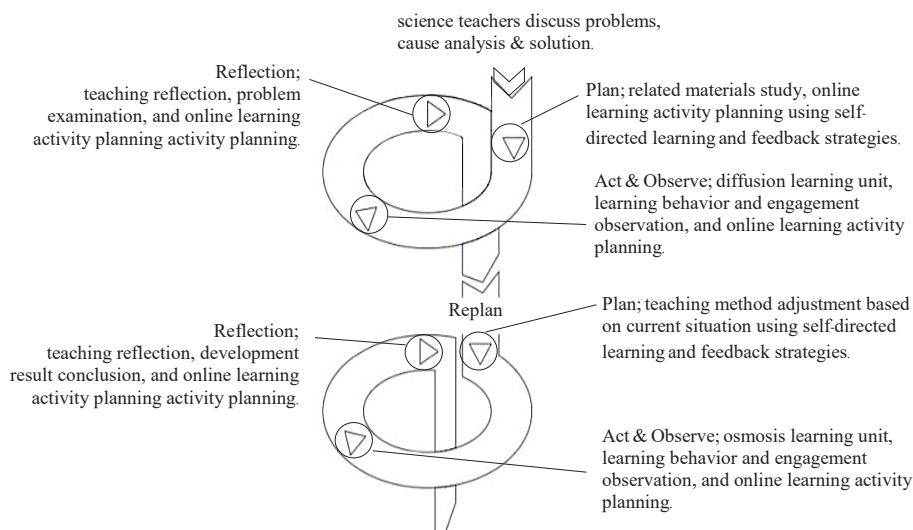

Figure 2 The Action Research Spiral based on Kemmis et al. (2016)

The researchers discussed the issue of student online learning engagement with the science teachers at the school to propose a plan that integrated teacher feedback and self-regulated learning strategies into classroom activities. They then implemented the plan over two lessons: diffusion and osmosis. The researchers observed student online learning engagement in three areas: behavioral engagement, cognitive engagement, and emotional engagement. Group discussions were held to identify difficulties and limitations in order to improve the procedure for the next cycle. The researchers observed self-regulated online learning engagement in each cycle using the triangulation method to reduce bias. They also counted the number of students enrolled online. Next, semi-structured follow-up interviews were conducted, and the data were analyzed using content analysis, with descriptive findings presented.

(3) Unstable internet connections, insufficient phone capacity, and inadequate equipment hindered students' ability to participate in online learning. (4) Many students lived in congested areas that were unsuitable for online learning.

The researchers focused on the difficulties faced by both teachers and students, with the primary challenge being maintaining learning engagement. The research team agreed to embed assessment within the lessons to prevent students from being overly aware of being assessed. This method had been used in face-to-face learning, but the team adapted it for online learning. The researchers concluded that assessment can be effectively integrated into the online teaching and learning process.

This research was conducted in two cycles to develop online learning engagement by incorporating

assessment techniques throughout the teaching process. The learning unit consisted of two sub-units: diffusion and osmosis. Each cycle included the stages of planning, action, observation, and reflection.

Trustworthiness

The researchers used two methods to ensure trustworthiness: triangulation involving multiple data sources and member checking (Creswell & Poth, 2018). The details are as follows: (1) Triangulation was achieved by collecting data from various sources, including observations, post-teaching notes, student reflection diaries, and interviews. These multiple data sources helped to confirm any behavioral changes observed in the students. (2) Member checking involved taking the summarized data back to the students to confirm its accuracy. This method ensured that the researchers' interpretations aligned with the students' realities, providing a clearer confirmation of the findings

Results

1. Cycle One: Diffusion lessons (two weeks)
   Planning

During the planning stage, the researchers developed the instruments used in the research and outlined the course of action as follows. The research instruments included:

(1) A learning plan that integrated Assessment for Learning and Assessment as Learning techniques into a three-step teaching approach: warm-up, presentation and practice, and wrap-up. Experts evaluated the appropriateness of these learning activities.

(2) A self-regulated online learning engagement observation tool developed based on academic concepts and adapted for online learning (Ding et al., 2018; Deng et al., 2020). This tool assessed three components: behavioral engagement (attendance, persistence, on-task behavior), cognitive engagement (perceived relevance, beliefs, strategy), and emotional engagement (enjoyment, enthusiasm, satisfaction). Experts confirmed its face validity with a Rater Agreement Index of 0.72.

(3) Structured interviews for teachers, using open-ended questions to explore issues encountered while organizing activities and students' learning behaviors during the study. Experts reviewed the language and appropriateness of the questions.

This stage took two weeks (three hours per week). The learning unit on diffusion consisted of four hours, divided into three subunits: basic concepts of diffusion (1 hour), diffusion in plant cells (2 hours), and

plant stomata (1 hour).

Action: The researchers shared online class links with the students via LINE Groups, instructing them to join the meetings on Google Meet. Once students joined, the teacher greeted them and sent stickers to create a welcoming atmosphere. The teacher then introduced themselves, shared learning expectations, rated the students' overall online learning engagement, and recommended appropriate learning strategies. The researchers observed the online classes once a week to monitor the teachers' feedback and students' self-regulation. The lessons on diffusion were divided into three sections: one hour for the first section, two hours for the second, and one hour for the third. An observation form was used to record student characteristics during each session. The researchers worked with two groups of stakeholders: students and teachers.

Observation

The Student Engagement in Online Learning observation focused on three areas:

- Behavioral Engagement:

1. Persistence: 23 students connected to the online classes, 10 of whom turned on their cameras, while the rest left theirs off. Ten students consistently attended, and eight were punctual. Most used smartphones to attend class.

2. Attendance: Students did not initially express opinions during class, with some using unrelated programs or browsing websites. However, they gradually participated in discussions, commented, took notes, and began setting learning goals.

3. On-task Behavior: Students hesitated to ask questions out of fear of judgment, slowing down the submission of complex assignments (such as mind mapping, demonstrations, and experiments). However, they managed to submit takeaways from Google and YouTube lessons on time. Eventually, students became more comfortable asking questions in real time and via chat.

- Cognitive Engagement:

1. Perceived Relevance: Students were aware of the COVID-19 situation, prepared necessary tools, and chose quiet settings when available, often turning off their cameras when in noisy environments.

2. Strategies: Initially, students failed to plan for online classes or prioritize tasks. Later, some began organizing their studies by taking notes, creating mind maps, and seeking additional resources online.

3. Beliefs: Students viewed online learning

as comparable to face-to-face learning, appreciating the freedom to study from anywhere without school uniforms. They valued the autonomy to seek resources, such as peers, teachers, and the Internet. They used simple software like Microsoft Word and PowerPoint but lacked peer feedback on assignments submitted via Google Classroom.

 - Emotional Engagement:

 1. Enjoyment: Some students enjoyed searching for online resources and working on group projects, but others engaged in non-school-related activities. Some avoided turning on their videos during follow-up sessions.

 2. Enthusiasm: Students showed limited interest in online classes, leading to longer explanations and lower participation. They often missed deadlines and engaged in non-class activities like gaming and browsing.

 3. Satisfaction: Students were uncomfortable being on camera and disliked feeling constantly watched. Some faced issues with internet connectivity, and others shared devices with siblings, leading to poor communication and missed work.

 During this first cycle, students expressed discomfort about sharing personal information, such as their home environment, and turned off their videos. Few attended classes on time, and many lacked confidences in approaching teachers or managing online learning.

Reflection:

 In this cycle, students were hesitant to ask questions, struggled to plan and prioritize assignments, and were often disengaged, using devices for non-class activities. The research team revised their plans into two categories: feedback (for teachers) and self-regulated learning (for students).

 - Feedback Adjustments:

 1. Synchronous Feedback: Real-time discussions, presentations, demonstrations, and feedback focused on tasks and self-assessments rather than mistakes.

 2. Asynchronous Feedback: Written or symbolic feedback on tasks and processes was provided through Google Classroom and an e-portfolio.

 - Self-Regulated Learning Adjustments:

 1. Environmental Structure: Students could choose whether to turn on their videos but were required to keep learning records.

 2. Mood Adjustment: Teachers encouraged self-introductions using quotes or mottos to foster comfort.

 3. Task Strategy: Students were paired with a "buddy" for communication and progress tracking.

 4. Self-evaluation: Students and buddies collaborated to assess each other's learning and supervision.

 5. Time Management: Constant in-class communication helped ensure student presence.

 6. Seeking Assistance: Students could ask for help through chat during the lesson.

 2. Cycle Two: Osmosis lessons (two weeks): The research team optimized the action plan from Cycle 1 by adjusting the lesson plan. The emphasis focused on positive feedback to boost learning motivation, self-esteem, and perceived self-efficacy. Peer support was also emphasized for monitoring, follow-ups, and collaboration.

 Planning:

 The teaching steps included:

 (1) Warm-up: The teacher greeted students and introduced learning guidelines. Students could choose to turn their videos on or off, and they introduced themselves through chat or speech. Teachers provided feedback on learning strategies. Students sought, made choices, and set goals for studying with their classmates.

 (2) Presentation and Practice: Teachers used PowerPoint, YouTube videos, and demonstrations to present lessons. Assignments were given through Google Classroom and e-portfolios Peers communicated shared information and tracked each other's assignment progress. In online classrooms, there was constant communication to ensure that everyone was engaged. Channels on which students could request assistance were created, and teachers provided feedback on each student's practice via the channels.

 (3) Wrap-up: Students sought help when needed, and teachers provided feedback both asynchronously (written or symbolic) and synchronously (spoken or gestural). Students wrote learning notes to summarize the lesson. Assignments were managed using Google Classroom and the e-portfolio program.

 In this cycle, the lesson on osmosis was taught for four hours over two weeks. The first hour was spent on the basic concept of osmosis, the next two hours were spent on osmosis experiments, and the last hour was used to summarize. Learning tools such as LINE Group, Google Meet, PowerPoint, Google Classroom, and E-portfolio were added. After the lesson, researchers conducted interviews with students about their behavior and what happened during the online classes.

Action: The procedure followed that of Cycle 1 but with adjustments in feedback and self-regulated learning based on the student group's context. Researchers observed and recorded student behavior during online classes once a week.

Observation, the Student Online Learning Engagement observation yielded the following results. Behavioral engagement, (1) Persistence: 35 students registered for online classes. 18 students in the online class turned on their videos, while the rest turned them off. 24 students were consistent with their online class attendance, and 21 students attended online classes on time. Most students use smartphones to attend class. (2) Attendance: students looked forward to giving self-introductions in their unique way (with quotes and mottos,). They turned their videos and microphones on during the lesson or sent messages during learning activities to respond to the teacher's questions. They also participated in discussions to define assignments and assessment criteria, adjusting them to their learning goals. (3) On-task behavior: students could summarize the content of the lesson and complete time-sensitive tasks. They got along well with their classmates and talked about their work both in and out of the classroom. They also created a Line group as a way to send and receive documents (instead of emails).

Cognitive engagement, (1) Students recognized the severity of the COVID-19 outbreak and behaved appropriately in online learning. They gathered their class materials, tried to be in an appropriate setting for study, and paid attention to the teacher on the screen even though some had complained about experiencing eye fatigue (2) Strategies: students planned to study with their buddies, spending most of their time in online classes taking notes and researching` additional resources on the Internet. (3) Belief: students believed in their ability to study online using programs or tools, and they believed that online learning is comparable to traditional learning. They also believed that teachers and others could access and provide feedback on any assignment submitted via Google Classroom or the e-portfolio.

Emotional engagement, (1) Enjoyment: greetings from friends (mottos, quotes) created a positive atmosphere in the classroom. Students enjoyed working with their classmates to review concepts. They also liked texting or video-calling their classmates and teachers when working on assignments or reviewing homework. (2) Enthusiasm: students were interested in attending classes and had logged into the online classroom to verify and introduce themselves (quotes, mottos). Students and buddies collaborated on activities and were motivated to work on assignments and deliver them on time, improve them based on feedback from teachers, create works with graphics programs, and seek new knowledge beyond the content of the lesson. Furthermore, some students assisted their friends in completing a learning activity. (3) Satisfaction: students appreciated when teachers were approachable and offered tips on learning, workflow, and results. They also expressed concern towards their classmates by asking questions about each other's learning circumstances. Furthermore, classmates provided follow-up work on time and participated in activities together throughout the lesson. Students also used tools to build knowledge and set learning goals, workload, and assessment criteria to suit their ability levels. Students were also able to relax during the learning activities.

Reflection, according to the findings of the observations, students showed positive improvements in online learning engagement such as increased attendance and persistence, self-confidence in their ability to set and achieve educational goals, interactions with classmates in and out of the classroom (synchronous and asynchronous), learning with friends (buddies) and increased enjoyment in the classroom through the use of quotes or slogans during self-introductions (Table 3).

In addition, the interviews with the students were consistent with the research observations. For example, the students saw the importance of peer support in their studies, such as following up on time and helping each other in their studies. At times, students who were concerned about their appearance or home conditions turned off the videos, the students were engaged even though they did not appear in the class. In addition, students did extra research from other learning sources.

The research team agreed that the second research cycle was more comprehensive, with the guidelines tailored to the context of instruction. Teachers used tools such as Google Classroom, e-portfolios, and LINE groups to provide immediate feedback. They also used collaborative learning (buddies) to help monitor students' behavior in class.

Table 3 Student Engagement in Online Learning observations between cycle one and cycle two

Student Engagement in Online Learning	Observations of Cycle One	Observations of Cycle Two
Behavioral	(1) 23 students logged into the class, 10 of whom were constantly present but were disengaged and disinterested in the activity or content throughout the lesson. (2) Comments were not provided in the online classroom, but the content was recorded for lesson review. (3) Some students were hesitant to ask questions because they were afraid of being judged—some delayed submission of complex assignments.	(1) 35 students logged into the class, with 24 staying the entire time. Students had self-control in studying, did not turn off their phone screens during class, and occasionally interacted with and asked questions to the teacher. (2) Students turned on their videos or used their microphones to greet friends, join the class, and set their own learning goals. (3) Students summarized the lesson content, completed time-sensitive tasks, and created a Line group chat to accept tasks from friends.
Cognitive	(1) Students were aware of the severity of COVID-19, learned, prepared equipment, and located the appropriate location. (2) Most students failed to plan and prioritize, but some had planned their studies. (3) Students believed that online learning could replace traditional methods, but the feedback did not persuade them.	(1) Students were aware of the severity of COVID-19, took appropriate online learning practices despite experiencing eye fatigue. (2) Students planned to study with their buddies and were committed to learning. (3) Students believed anyone can access and provide feedback through Google Classroom and the e-portfolio.
Emotional	(1) Some students enjoyed looking up online resources, but many were engaged in non-school-related activities. (2) Students were disinterested in online classes, participation, and assignments. (3) Students were uncomfortable when they saw their pictures on the screen.	(1) The online classroom was filled with laughter during classroom greetings, and when students worked with buddies. (2) Students were interested in attending classes; logged in, collaborated, and provided recommendations to their friends (3) Students were appreciative when teachers were approachable and offered learning tips.

Discussion

This study demonstrates that the Student Engagement in Online Learning development approach, using feedback and self-regulated learning strategies, is effective in teaching lessons on diffusion and osmosis. While the lesson content differed, the scope was similar, as both topics fall under the broader category of substance transport processes. The research team did not separate research from teaching activities, which led to these processes running in parallel throughout the action research. The focus of this study is solely on the development of student engagement, as the team did not assess science achievement due to the limitations of online environments, such as the inability to conduct lab experiments, which affected students' science learning experiences.

Initially, the research team implemented strict guidelines and techniques that proved inappropriate for the context. Adjustments were made later to ensure the strategy was feasible, and the students reciprocated, showing continuity in the action research cycle (planning, action, observation, and reflection). Ultimately, the team identified best practice guidelines for Student Engagement in Online Learning. Feedback and self-regulated learning, integrated as assessment techniques throughout the process, played a key role in positively impacting student engagement. Assessment, as part of instructional management, is crucial for monitoring student progress and facilitating their connection to the teaching and learning process (Keeley, 2016).

The study was conducted in a school located in Bangkok, Thailand, which benefits from reliable communication equipment and a stable internet connection. While the guidelines are specific to this context, they can be adapted to other environments, especially those with similar access to communication tools and technology. These strategies can be applied to both offline and hybrid formats, including managing workloads outside of classroom activities, such as homework. Google Classroom and e-portfolios, used for assignment management in this study, promote interaction and create an online learning community. Students appreciated these platforms as tools for feedback and self-regulated learning. The use of forums, chats, group assignments, and peer assessments allowed students to feel autonomous in their learning, fostering self-directed review of learning activities during their free time. These platforms also enhanced social interaction, creating a sense of connectedness within the classroom community (Martin & Bolliger, 2018; Mega et al., 2014). Teachers used questions to review and provide feedback on students' tasks, learning processes, and self-regulation during both presentation and practice stages. This approach aligns with research that highlights how assessments can stimulate enthusiasm for learning, resulting in the development of self-study skills, rapport, and cooperative learning (DeLuca & Klinger, 2010).

The research involved two cycles of action research. Results from the first cycle were unclear, possibly due to students' unfamiliarity with the

communication tools and the online learning environment. Students were also navigating the sudden shift to online learning during the COVID-19 pandemic, which disrupted traditional classroom dynamics. By the second cycle, engagement improved as students became more comfortable with the platform and learning style. The teachers incorporated questions into all stages of learning activities, using both real-time conversations and chat boxes to engage students. This approach helped students feel included in the classroom and allowed teachers to monitor changes in student behavior. Feedback was delivered both synchronously and asynchronously, with positive feedback given publicly and negative feedback provided privately. This approach encouraged students to review and improve their thinking and follow up on their own or their peers' learning progress (Chappuis & Stiggins, 2017). As a result, students were more motivated to learn, became curious, and effectively applied their knowledge (Wisniewski et al., 2020).

Additionally, starting lessons with an introduction or greeting, such as a quote or slogan, unexpectedly motivated students to stay engaged. This activity fostered humor and a relaxed classroom atmosphere, encouraging peer interaction. Peer support, as observed in this study, was effective in promoting engagement through goal setting, learning design, and role switching, consistent with previous findings on the benefits of peer support in learning engagement (Hodgson et al., 2013; Bartlett, 2015).

Conclusion

The research team opted for action research to find the right solution to address the lack of learning engagement in online classrooms. Our Student Engagement in Online Learning research methodology simultaneously considers techniques, methods, tools, feedback, and self-regulated learning, multiplying the chances of success when compared to a methodology that relies on a single factor.

The research team discovered two factors that positively impact Student Engagement in Online Learning. Firstly, teachers were enthusiastic in the action research process because the research process included a brainstorming session to exchange ideas, find ways to collaborate on the development of the students' desired characteristics, and plan teaching operations. Additionally, the reflection stage allowed all stakeholders to be aware of existing issues in the classroom and they came together to aid in new and better methods or approaches,

also known as "back to track". Secondly, both assessment techniques impacted student learning by diagnosing student learning problems, improving learning strategies or student performance skills both individually and collectively (AfL), and assessing students' roles and self-directed learning habits, the level of responsibility, monitoring, and self-regulated learning (AaL).

Changes in this study were made possible by teachers adjusting their beliefs—learning to collaborate effectively with colleagues—and their behaviors, such as staying attentive, focusing on classroom activities, and consistently following established processes.

However, the teacher's role in providing feedback is similar to that of a "learning stimulus." Feedback has to be provided at the right time without disrupting the student's learning rhythm to motivate learning. This gives students the freedom to learn, a relaxed and positive classroom atmosphere, a sense of responsibility for learning, and a service mindset towards classmates to share knowledge and compassion. On the other hand, when used at the wrong time or regardless of context, these techniques can be detrimental or undermine students' potential. Wrong timing and context could cause the students to lose confidence, negatively perceive their ability, lack learning engagement, lack cooperation on the assigned tasks, and eventually leave the online classroom.

Suggestions

1. This study provides an overview of the combined use of Assessment for Learning and Assessment as Learning techniques. It is not possible to determine which assessment technique has more of a positive effect on the development of Student Learning Engagement. This study focuses solely on the Student Online Learning Engagement development process, and therefore it does not consider academic achievement or any other competency that follows; however, this may be an opportunity for further study.

2. Even though the current situation of the COVID-19 outbreak has softened and people are living their normal lives, promoting Student Online Learning Engagement among students is always important. This approach method or platform may be used in the context of combined learning, such as assigning workloads as homework and creating a platform to assign workloads outside of class hours for various subjects, particularly in Bangkok schools with similar contexts.

3. Feedback and self-regulated learning strategies

are still the mainstays in developing and promoting Student Online Learning Engagement. They can be used in the context or situation of organizing learning activities both online, on-site, and hybrid.

Acknowledgment

Reference

Bartlett, J. (2015). *Outstanding assessment for learning in the classroom.* New York: Routledge.

Chappuis, J. & Stiggins, R.J. (2017). *Student-involved assessment for learning.* (7th ed.). Upper Saddle River, New Jersey: Prentice-Hall.

Creswell, J.W, & Poth, C.N. (2018). *Qualitative inquiry and research design: choosing among five approaches.* (4th ed.). Singapore: SAGE.

Darling-Aduana, J. (2019). Behavioral engagement shifts among at-risk high school students enrolled in online courses. *AERA Open, 5*(4).

DeLuca, C., & Klinger, D. A. (2010). Assessment literacy development: identifying gaps in teacher candidates' learning. *Assessment in Education: Principles, Policy & Practice, 17*(4).

Deng, R., Benckendorff, P., & Gannaway, D. (2020). Linking learner factors, teaching context, and engagement patterns with MOOC learning outcomes. *Journal of Computer Assisted Learning, 36*(5), 688–708.

Ding, L., Er, E., & Orey, M. (2018). An exploratory study of student engagement in gamified online discussions. *Computers and Education, 120,* 213-226.

Earl, L. M. (2013). *Assessment as learning: using classroom assessment to maximize student learning* (2nd ed.). California: Corwin Press.

Fakcharoenphol, W. (2020). Readiness to implement online learning management under the Covid-19 pandemics. *Journal of Education and Human Development Sciences, 4*(1), 44-61.

Farrell, O., & Brunton, J. (2020). A balancing act: a window into online student engagement experiences. *International Journal of Educational Technology in Higher Education, 17*(1), 25.

Finn, J. D., & Zimmer, K. S. (2022). Student engagement: What is it? Why does it matter? In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (2nd ed.)(pp. 97–131). Boston: Springer.

Gayton, J., & McEwen, B. C. (2007). Effective online instructional and assessment strategies. *American Journal of Distance Education, 21*(3), 117–132.

Guo, J. D. (2018). Building bridges to student learning: Perceptions of the learning environment, engagement, and learning outcomes among Chinese undergraduates. *Studies in Educational Evaluation, 59,* 195-208.

Hattie, J., and Timperley, H. (2007). The power of feedback. *Review of educational research, 77,* 81–112.

Hawe, E., & Dixon, H. (2017). Assessment for learning: a catalyst for student self-regulation. *Assessment & Evaluation in Higher Education, 42*(8), 1181-1192.

Henrie, C. R., Halverson, L. R., & Graham, C. R. (2015). Measuring student engagement in Technology-mediated learning: A review. *Computers & Education, 90,* 36–53.

Hodgson, Y., Benson, R. & Brack, C. (2013). Using action research to improve student engagement in a peer-assisted learning program. *Educational Action Research, 21*(3), 359-375.

Hong, J. C., Lee, Y. F., & Ye, J. H. (2021). Procrastination predicts online self-regulated learning and online learning ineffectiveness during the coronavirus lockdown. *Personality and individual differences, 174,* 110673.

Keeley, P. (2016). *Science formative assessment: 75 practical strategies for linking assessment, instruction, and learning.* USA: SAGE Publications.

Kemmis, S., McTaggart, R., and. Nixon, R. (2016). *The action research planner: doing critical participatory action research.* New York: Springer.

Nguyen,T.D., Cannata,M., & Miller,J (2018). Understanding student behavioral engagement: importance of student interaction with peers and teachers. *Journal of Educational Research, 111*(2), 163-174.

Martin, F. & Bolliger, D.U. (2018). Engagement matters: student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning, 22*(1), 205- 222.

McMillan, J. H. (2018). *Classroom assessment: principles and practice for effective standards-based instruction* (7th ed.). Boston: Pearson Education.

Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of Educational Psychology, 106*(1), 121–131.

Mills, G. E. (2018). *Action research: A guide for the teacher researcher* (6th ed.). Boston: Pearson.

Molinillo, S., Aguilar-Illescas, R., Anaya-Sanchez, R., & Vallespin-Aran, M. (2018). Exploring the impacts of interactions, social presence and emotional engagement on active collaborative learning in a social web-based environment. *Computers & Education, 123,* 41–52.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16,* 385-407.

Reimers, F. M., & Schleicher, A., (2020) *A framework to guide an education response to the COVID-19 Pandemic of 2020.* Retrieved September 1, 2023, from https://read.oecd-ilibrary.org/view/?ref=126_126988-t63lxosohs&title=A-framework-to-guide-an-education-response-to-the-Covid-19-Pandemic-of-2020

Shernoff, D. J. (2013). *Optimal learning environments to promote student engagement.* New York: Springer.

Stanley, T., & Alig, J. (2014). *The school leader's guide to formative assessment: using data to improve student and teacher achievement.* New York: Routledge.

Wang, H., Tlili, A., Lehman, J.D., Lu, H., and Huang,R. (2021). Investigating feedback implemented by instructors to support online competency-based learning (CBL): a multiple case study. *International Journal of Educational Technology in Higher Education, 18,* 5.

Wang, C., Mirzaei, T., Xu, T. et al. (2022). How learner engagement impacts non-formal online learning outcomes through value co-creation: an empirical analysis. *International Journal of Educational Technology in Higher Education, 19*(32).

Wisniewski, B, Zierer K and Hattie J. (2020). The power of feedback revisited: a meta-analysis of educational feedback research. *Frontiers in Psychology, 10,* 3087.

Zimmerman, B. J. (2015). Self-regulated learning: Theories, measures, and outcomes. In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences* (2nd ed.)(pp. 541–546). Pergamon: Elsevier.