Students' Perceptions of Google Tools on Supporting Self-Regulated Learning in an Asynchronous Course

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***Abstract*—The study investigated students' perceptions regarding the use of an integrated set of five Google Tools (i.e., Google Classroom, Google Sites, Google Slides, Google Docs, and Google Forms) in creating a Computer-Mediated Communication (CMC) environment for self-regulated learning in an asynchronous course. Using a mixed-method convergent research design, a single online questionnaire comprising close- and open-ended questions was used to collect quantitative and qualitative data. Purposive sampling was employed, and two cohorts of undergraduate education majors were chosen. 114 participants completed the questionnaire. Quantitative data from Likert items were subjected to descriptive analysis and supplemented with students' open-ended narratives, while specific qualitative data were examined with inductive thematic analysis. The quantitative findings revealed that students positively perceived the integrated set of Google Tools in terms of its usefulness, ease of use, confirmation, satisfaction, and continuance intention for supporting their self-regulated learning. The qualitative findings highlight students' predominantly positive perception of Google Classroom as a Learning Management System (LMS) for self-regulated learning, stemming from its ease of use, efficient interface, and notification and reminder features. Minimal instances of other perceptions were also observed. The study proposes practical implications for educators to facilitate students' online self-regulated learning by leveraging and integrating these five Google Tools in forming a CMC environment. Recommendations include allocating adjustment time and practice tasks to help students familiarize with the tools for smooth online learning.**

***Keywords*—Google Tools, Google Classroom, computer-mediated communication, learning management system, perceptions, self-regulated learning, asynchronous online learning**

I. Introduction

Online learning has become more prevalent since the Coronavirus (COVID-19) pandemic. During unprecedented circumstances of physical distancing and lockdowns, many educational institutions have shifted to online learning to ensure the continuity of education. Even after the pandemic disruptions, online learning is considered a possible alternative pedagogy in higher education institutions [1].

In an online learning context, self-regulated learning is crucial in determining students' success [2–4]. Self-regulated learning involves internal processes where individuals use their thoughts, feelings, and actions to create plans and make necessary adjustments to pursue their goals [5]. By engaging in self-regulated learning, students take active ownership of their education and can manage their own learning process [6]. Despite its importance, students' low self-regulatory skills have been reported to make online learning difficult, as students are less able to monitor their learning [7]. Even for the online component of blended learning, a review has found that self-regulatory issues are one of the major difficulties students encounter [8].

Focusing on different online learning modes, asynchronous online courses have garnered increasing attention in higher education context [9]. As courses of such modality are not conducted in real time, students learn by interacting with the content of different formats uploaded by their instructors on a Learning Management System (LMS) [10]. Despite the spatial and time flexibilities offered by asynchronous courses, past studies reported challenges encountered by students in sustaining course commitment. For instance, Han *et al.*'s [11] qualitative analysis of survey questions identified time management as a primary difficulty of asynchronous online learning during COVID-19 pandemic. Melgaard *et al.*'s [12] thematic analysis of semi-structured interviews revealed low engagement as another barrier experienced in an online course utilizing pre-recorded video instructions. These findings suggest the significance of self-regulation among students, fostering them to participate and complete related course tasks in an autonomous learning environment.

Nonetheless, integrating technologies and tools can promote and foster students' self-regulated learning [13]. Digital technologies have brought forth an array of technologies that empower students to be autonomous and active while engaging in the learning process. Among the available tools, Google Tools or Google Apps such as Google Calendar, Google Docs, Google Tasks, etc., have emerged as versatile and prominent options for supporting students in following up and monitoring their learning [14]. Moreover, collaborative interaction and learning help students regulate their own learning [15]. As such, a few tools by Google can be integrated as a set to create a Computer-Mediated Communication (CMC) environment, given that the tools provide collaborative features that cover the social aspect of self-regulated learning [16]. Furthermore, the cloud-based nature of Google Tools enables asynchronous group learning experiences, which are particularly valuable for students with limited internet coverage [17], supporting them to learn when it is convenient for them. Their provision for conducting the course asynchronously in online distance learning also nurtures the development of self-regulatory skills [18], further allowing students to monitor their learning effectively.

Students' perceptions of their academic environment are vital in determining their learning outcomes [19]. Their perception is also deemed an important criterion reflecting

their acceptance of the new application of teaching and learning processes [20]. Their views and experiences towards the tools and environment can significantly impact their engagement, motivation, and overall success in self-regulated learning. While a considerable body of literature has explored the use of individual Google Tools such as Google Classroom [21–24] and Google Docs [25], in online educational environments, there is a gap persists in our understanding of students' perceptions regarding the integration of different Google Tools for facilitating self-regulated learning. Self-regulated learning, characterized by students' efforts to take control of their learning, is essential for successful asynchronous online learning [4]. Hence, this study sought to address this gap by investigating students' perceptions of using the integrated set of five Google Tools as a CMC environment to support self-regulated learning, particularly in an asynchronous online context where students navigate their learning journey more independently.

The study formulated two research questions: 1) What are the students' perceptions of using the integrated set of five Google Tools in supporting their self-regulated learning? 2) How do students perceive the role of Google Classroom as an LMS in supporting their self-regulated learning? The former went beyond examining individual tool functionalities and delved into the synergies created by their integration for self-regulated learning; the latter focused on the single Google Classroom to explore its role as a hub that houses all resources and tasks. By uncovering the tools' characteristics and features via students' perceptions, the study sought to contribute insights that can inform educators in designing and implementing more effective online learning environments. Through the use of different Google Tools paired up with suitable self-regulated learning strategies, the ultimate goal is to enhance the facilitation of self-regulation among students in asynchronous online settings.

II. Literature Review

A. Self-Regulated Learning

The literature on self-regulated learning highlights its significance in students' control over the learning process [26]. In online learning, self-regulation becomes even more crucial [2–4], as the online nature presents unique challenges, requiring students to control their learning process. For instance, before the pandemic, Rasheed *et al.*'s [27] review found that students faced procrastination and time management issues in online component of blended learning. While in the shadow of the pandemic in which learning institutions fully shifted to online learning, students faced difficulties adapting to the online environment, managing excessive workload and information, and dealing with personal health and mental issues [28]. Without the physical presence of a classroom and regular interactions with instructors and peers, students are susceptible to distractions that hinder their focus and motivation. Thus, self-regulation is essential for navigating the complexities of online learning, and it serves as a personal factor that influences students' sustainable well-being [28].

Self-regulation is an internally generated thinking, feeling, and actions that an individual plans and adjusts for achieving goals [5]. It is a self-directed process in which students transform their mental thinking into academic abilities [29]. According to Zimmerman [5], self-regulation learning consists of three phases—forethought, performance, and self-reflection—as in his cyclical phases models. Forethought is the preparation processes that occur before students take action to perform a task. Performance includes the processes of students' constant optimization and monitoring of their efforts while executing the task. As the last phase, self-reflection refers to the processes in which students assess their performance and draw implications of outcomes. These evaluations mark the end of one cycle and are useful for them to improve future learning in a new cycle.

Self-regulated learning involves active monitoring, regulation, and control of cognition, behavior, and motivation, guided by students' predetermined goals and contextual factors of the environment [30]. It highlights the importance of the areas of cognition, behavior, and motivation for students to regulate and monitor their learning. Initially, the cognition control only refers to the cognitive aspect involving students' active engagement and manipulation of academic content [31]. It then includes metacognition related to students being aware and regulating their thinking [32]. The behavioral control focuses on improvement actions to enhance the learning outcomes. The motivational control consists of sustaining the drive, interest, and attention towards achieving goals [31]. In addition to these areas, Panadero's [33] review of six models of self-regulated learning suggests that self-regulated students also monitor and regulate their emotions, involving the management of feelings to create a conducive learning environment. Moreover, Zimmerman's [5, 34] framing of self-regulated learning models based on social cognitive theory emphasizes the social area, acknowledging that learning occurs through observation and interaction.

Another important element of self-regulated learning is learning strategies, which students apply to adapt self-regulation in their learning processes [29] and to achieve better academic outcomes [3]. Zimmerman and Pons [35] identified 14 self-regulation strategies. This taxonomy of strategies includes goal setting and planning, organizing and transforming, seeking information, keeping records and monitoring, environmental structuring, rehearsing and memorizing, reviewing records, seeking social assistance, self-evaluation, and self-consequences. Students have been using these strategies to support their distance learning [36]. These strategies have also been applied in designing and developing a dashboard in an online MOOC learning environment to promote students' self-regulated learning [37]. Additionally, there are other identified strategies, such as self-judgment and self-reactions, that students use to support their self-reflection phase in a web-based environment [38]. In addition, Dabbagh and Kitsantas's [39] study confirmed that different web-based pedagogical tools (i.e., administrative, content creation and delivery, collaborative and communication, and assessment) could support different self-regulation strategies.

B. Google Tools and Self-Regulated Learning

The digital era has technologies designed specifically to support self-regulated learning, such as nStudy [40] and MetaTutor [41]; however, it is also important to consider the financial aspect and use readily available tools [13]. When a fast shift to online learning is required, Google Tools can be very useful [42]. Google Tools is a collection of Web 2.0 technologies supported by cloud computing [43] that can be used at almost no cost to facilitate students' self-regulation for online learning. The collection comprises easy-to-use tools for smooth teamwork and increased efficiency.

Google Classroom is a centralized platform for students to access and navigate organized content conveniently. Its function as an LMS aids students' self-regulated learning in ways that 1) the contents are displayed as a whole and separated units for students to plan their learning, and 2) the learning records are saved for their reflection [44]. Besides, the class commenting feature in Google Classroom [45] fits the collaborative and communication components, which students perceive as useful for help-seeking in clearing uncertainties [39]. Past studies have revealed that adopting Google Classroom as LMS supports students' online self-regulated learning [46, 47].

Google Sites offers a platform for creating and publishing wikis and webpages, providing students with necessary information throughout their learning process. Educators have applied this tool in higher education courses for students to create e-portfolios, encouraging them to take the responsibility of monitoring and recording their own learning [48–50]. It is also used as a content creation and delivery tool [39] in the form of an online course material site, housing various learning media for educators and students' references [51, 52].

Google Forms is widely used to create surveys and polls for collecting data, such as course evaluation. Additionally, it has been applied as an assessment tool to evaluate students' comprehension [53, 54]. Lailaturrahmi *et al.* [53] suggest that the assessment should be conducted at various course points to provide educators with insights into students' progress. The assessment activity also supports students' reflection on areas in which they excel or struggle, aiding their self-evaluation and self-monitoring [39]. Moreover, the tool can collect and record students' attendance [55], motivating students to be more accountable.

Google Docs is a web-based word-processing application. It supports students' individual reflective writing activity to review and analyze their learning [56–58]. Building on its cloud-based nature, the reflection activity can be conducted collaboratively in which students write the piece collectively. This works on the basis that online collaborative learning supports self-regulated learning through 1) increased autonomy learning choices, 2) social discussion and comparison, and 3) putting thoughts and reflection in writing [59]. The social discussion part can also be realized with the comment insertion function in Google Docs [54, 57, 60]. It aids students' self-monitoring process as they go through the readings and share insights with others [39]. Interacting with peers provides students with opportunities for cognitive processes such as processing and analyzing information and critically thinking about the subject matter, as well as metacognitive processes to monitor comprehension, reflect on contributions, and make necessary adjustments [60].

Google Slides is a web-based presentation tool. Educators commonly use it to create and share lecture slides and course information. These contents created are considered learning resources and reading materials, facilitating students' self-regulation via self-evaluation, task strategies, and goal setting [39]. Like Google Docs, it can also be applied to collaborative tasks to support students' self-regulated learning [59]. For instance, students working in groups used it to report their survey findings [54] and create an infographic based on previous online discussions [61].

These Google Tools offer diverse functions that support a variety of learning activities. They can be combined to form a virtual classroom [24]. As such, with Google Classroom's ability to leverage the functionalities of other Google Tools [62], educators can integrate different tools into the said LMS platform [21], enabling an efficient workflow and enhancing students' learning experience. Furthermore, when combined, the collaborative and communication features [39] of these tools support the implementation of collaborative tasks [25, 63] and aid the formation of a CMC environment that effectively supports the social aspect of self-regulated learning [16], promoting interaction and collaboration, idea exchange, and resource sharing among students.

C. Students' Perceptions of Google Tools for Self-Regulated Learning

Students' perception is one important criterion reflecting their acceptance of the new teaching and learning processes [20]. The Technology Acceptance Model (TAM) by Davis [64] includes two underlying determinants of perceived usefulness and perceived ease of use to which users accept and plan to use a particular technology that is beneficial to them. Perceived usefulness refers to the extent to which users believe using the technology would improve their job performance. Perceived ease of use is the extent to which users recognize that it is simple to use the technology. The Expectation-Confirmation Model (ECM) by Bhattacherjee [65], emphasizing the post-acceptance stage, can also be used to investigate users' perceptions and satisfaction with a technology. The model shows that the continuance intention is intricately linked with other determinants of satisfaction, confirmation, and the previously explained perceived usefulness. Continuance intention is defined as users' willingness to keep using a particular technology. Confirmation refers to the extent to which a user experiences the benefits they anticipated while using a particular technology. While, satisfaction is the emotional or psychological state that arises when a user assesses how closely the actual performance of a technology matches their anticipation.

Previous studies indicated that students perceived the application of Google Tools for self-regulated learning favorably. For instance, it was reported that students positively perceived Google Classroom [21–24], Google Docs [25], and Google Sites (paired with Google Drive) [50] in terms of usefulness and ease of use for fostering their self-regulation and autonomy. Students also expressed high satisfaction with Google Classroom [24] and positive

attitudes towards Google Docs [25] as a medium for learning. While there are limited studies on students' perceptions of Google Forms and Google Slides alone, Rejón-Guardia *et al.*'s [14] study on using different Google Tools in creating personal learning environments found that students consider these tools to be fairly useful and relatively easy to use to support their project work and learning.

Given that most of the literature explored Google Tools separately, there is speculation regarding how students perceive the integration of different Google Tools to support online self-regulated learning effectively. Also, stressing the leverage of the collaborative and communicative component of these tools, such as the class commenting in Google Classroom [45] and the comment insertion feature [54, 57, 60] in Google Docs, online collaborative learning activities are afforded in creating a CMC environment to cater the social aspect of self-regulated learning [16]. As illustrated in Lee and Abdul Rabu's [57] study, students' success in meeting the minimum task requirements for posting and replying to comments for online interaction in Google Docs is indicative of their self-regulated learning abilities. By actively engaging in peer interaction, monitoring their participation, and adapting their communication strategies as needed, these students have demonstrated their capacity to manage their learning experiences to achieve intended outcomes. As such, the study was enlightened to examine how students perceive the different Google Tools incorporated to form a CMC environment for facilitating their self-regulated learning in an asynchronous course.

III. Methods

Following the mixed-method convergent research design, the study employed a single questionnaire comprising both close- and open-ended questions to examine students' perceptions of using the five Google Tools (i.e., Google Classroom, Google Sites, Google Slides, Google Docs, and Google Forms) to support self-regulated learning. The utilization of this research design was driven by the intention to capture multiple facets of the researched topic from each participant [66]. The combination of quantitative results and qualitative findings enables a more comprehensive understanding of the topic. The close-ended questions provided numerical data for descriptive analysis, while the open-ended questions offered in-depth insights into participants' experiences.

A. Participants

Purposive sampling was used to select the participants for the study. The criterion for participant selection was students enrolling in a course named "Digital Audio and Video." The rationale for setting such a criterion stemmed from the premise that the current study was built on the previous cohorts of the same course. In previous cohorts, Google Docs was already applied as a CMC for very similar interaction and reflection activities [57, 58, 60]. Specifically, students in Lee and Abdul Rabu's [57] study showed proficiency in activity completion on Google Docs, suggesting an occurrence of self-regulated learning to achieve intended goals. However, in these previous iterations, the LMS used was Schoology. Capitalizing on 1) Google Classroom's flexibility to be integrated with other Google Tools [62] and 2) the convenience of using a single Gmail address to access all Google Tools seamlessly [67], the current study adopted Google Classroom as the LMS and integrated other four tools (i.e., Google Sites, Google Slides, Google Docs, and Google Forms) from the same Google Workspace for Education to form a CMC environment. These five tools were employed with complementary self-regulated learning strategies to support students' self-regulation. As such, selecting students from the said creative media course was deemed an opportunity to investigate their perception of self-regulated learning while using the five specific Google Tools for asynchronous online learning.

Based on the criterion, the study selected two cohorts of 147 students majoring in education and minoring in instructional multimedia, enrolled in the course mentioned above at a Malaysian Public University during the first semester of the 2021/2022 and 2022/2023 academic years. The course was conducted online as the institution encouraged online delivery even after reopening the campus. It was noted that the inclusion of students from two academic years was to yield a larger sample size, aiding the researchers to gain a more comprehensive understanding of students' perspectives. As the participants were drawn from a specific university and subject, the characteristics and nature of the academic environment and curriculum were unique to a particular context. This limits the generalizability of the results to other academic institutions or disciplines.

B. Integration of Google Tools for Self-Regulated Learning

As mentioned above, the course content was delivered and learned online asynchronously using the five Google Tools: Google Classroom, Google Sites, Google Slides, Google Docs, and Google Forms. These tools were used alongside complementary self-regulated learning strategies drawn from Dabbagh and Kitsantas [39] and Dettori and Persico [59] to enhance student autonomy. Specifically, the tools were aligned with the three categories of web-based pedagogical tools—content creation and delivery, collaborative and communication, and assessment—outlined by Dabbagh and Kitsantas [39] to support various self-regulation strategies. The emphasis on discussion and comparison for self-regulated learning in online collaborative settings, as highlighted by Dettori and Persico [59], was extended and utilized as "reflection tool" in this study. It facilitated reflective activities to fulfil the final self-reflection phase of Zimmerman's [5] cyclical phases model. Fig. 1 illustrates the roles taken on by Google Tools.

In Week 1, students gathered for a synchronous meeting with the lecturers and the facilitator for the course introduction. They were enrolled in the course class on Google Classroom, which served as the LMS (Fig. 2). It was used as the content creation and delivery tool [39] that gave students access to the posted course information, materials, and tasks. Being able to view all posted resources aided students in understanding the course overview to set clear objectives and a roadmap. The centralization of learning resources simplified students to locate and engage with materials to support their chosen task strategies. Its

"Classwork" page and "View your work" tab facilitated students to evaluate their learning, allowing them to track completed and uncompleted tasks and identify areas where they might need to enhance their approach for goal accomplishment. Google Classroom's class commenting feature also supported the communicative aspect of the CMC environment, empowering students to collaboratively engage and seek help when necessary.

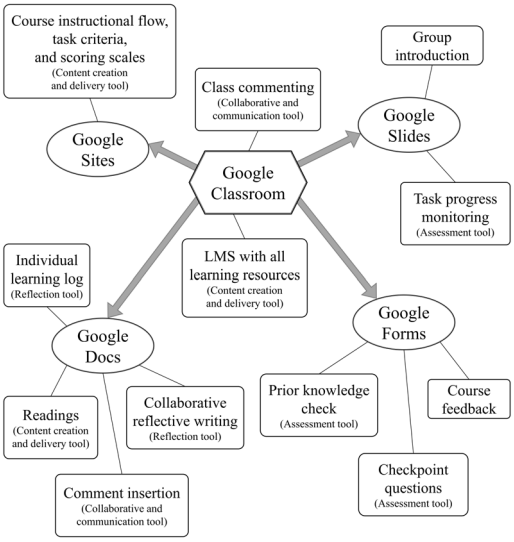


Fig. 1. Google Tools facilitating self-regulated learning.

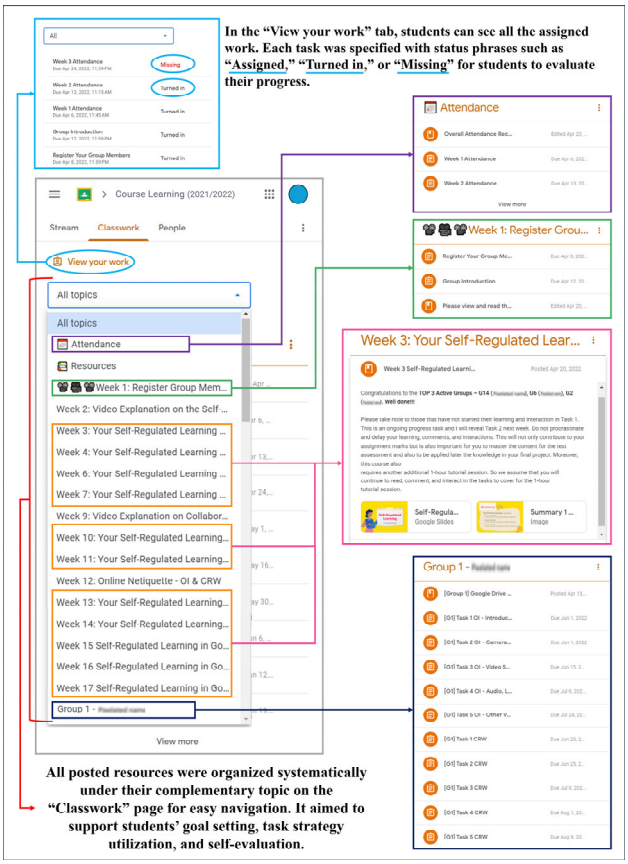


Fig. 2. Google Classroom as the course LMS.

Besides, students were directed to visit a web-based intervention guide created using Google Sites (Fig. 3), which could be accessed from the course's Google Classroom. Similar to Google Classroom, this website also works as a content creation and delivery tool [39]. It offers essential information, including the overall instructional flow of the course, netiquette guidelines, task criteria, scoring scales, and selected examples. These were guides for students to grasp a clear understanding of the activity requirements for planning a suitable approach to the assigned activities. The scoring scales provided also further allowed students to evaluate and compare their own performance with a standard [5].

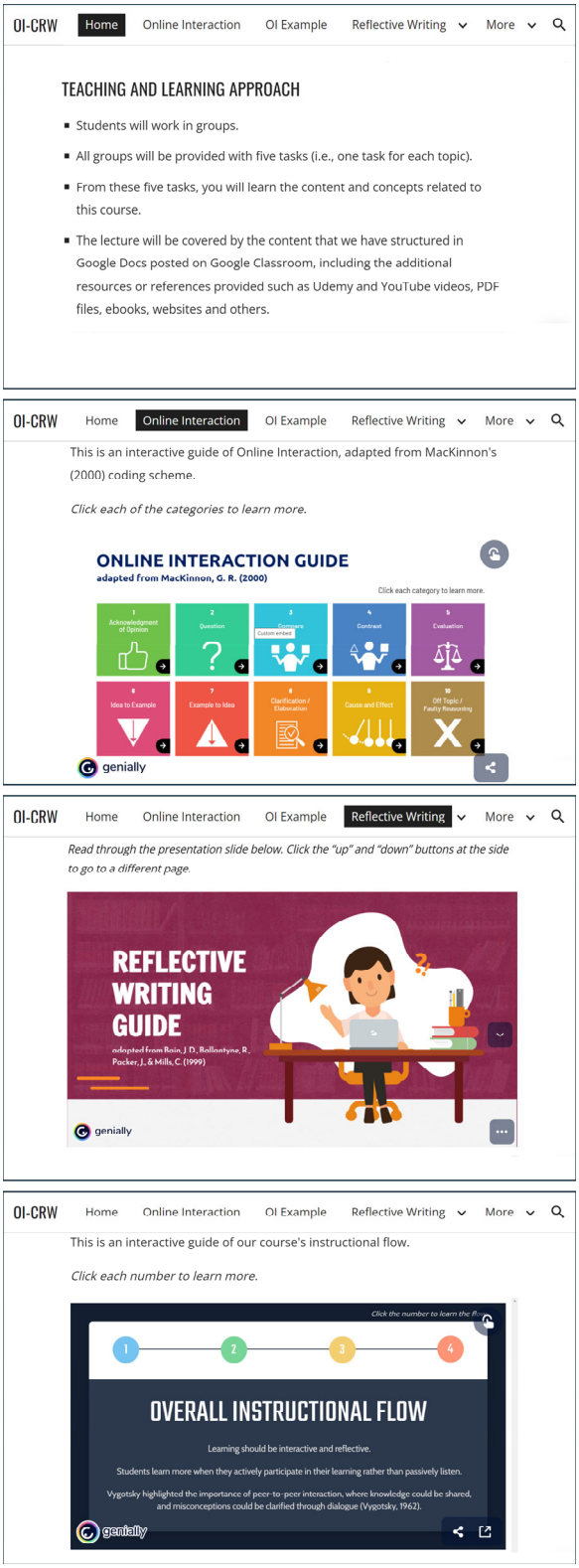


Fig. 3. Selected webpages of the web-based intervention guide created with Google Sites: (a) home, (b) online interaction guide, (c) reflective writing guide, and (d) overall instructional flow.

Additionally, students were assigned to form groups of

five members and create a group introduction using Google Slides (Fig. 4). This worked as an ice-breaking activity for students to get to know each other. This is deemed essential to prepare students for subsequent group interaction and writing activities, in which they were explicitly instructed to collaborate with the same members for all group activities throughout the semester.

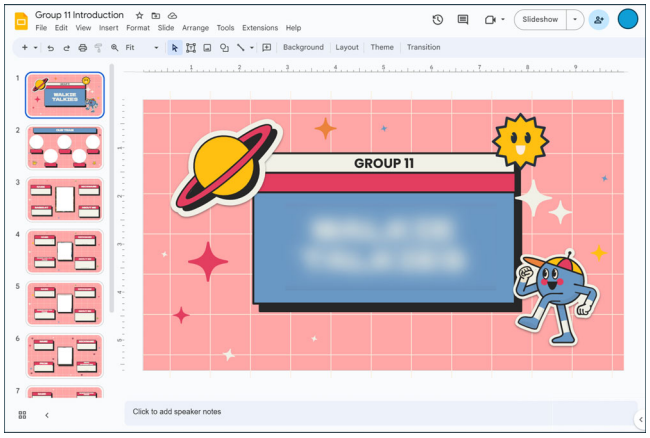


Fig. 4. Group introduction presentation on Google Slides.

The first meeting ended with students completing and submitting a prior knowledge check on Google Forms. The knowledge check consisted of two parts. The first part was a series of multiple-choice questions for prior content knowledge activation and assessment purposes before students started to learn the topics in the coming weeks. The second part comprised three subjective questions, aiming as a form of goal setting [39] at a foundational level as students answered them to clarify what they know and do not know (Fig. 5).

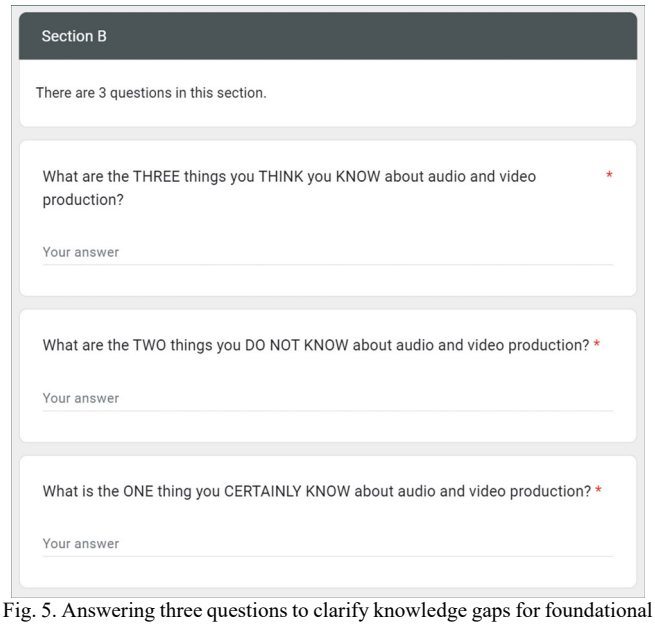


Fig. 5. Answering three questions to clarify knowledge gaps for foundational goal setting.

From Week 2 onwards, students were engaged in asynchronous classes. They learned about the relevant materials and tasks from the lecturers' posts on Google Classroom every week. Students working in groups were required to complete five tasks related to different audio and video topics using Google Docs. Each task involved 1) interacting with group members and 2) completing a collaborative writing session where groups collectively reflected on the topics learned. For online interaction component, students first had to read and engage with course notes on audio and video topics presented in Google Docs. In this sense, Google Docs worked as a content creation and delivery tool [39], providing students with reading notes that grounded the subsequent peer interaction. The interaction activity was made available through the built-in comment insertion function in Google Docs (Fig. 6). With this commenting function, Google Docs served as a collaborative and communicative tool where students could ask their members for clarification and elaboration about uncertainties [39]. They could also discuss and compare their insights to foster online collaboration [59]. Through perspective sharing, students could establish a shared understanding among peers, aiding them to refine their individual goals within a broader context. The asynchronous nature of the interaction also encouraged students to plan and manage their time effectively for engaging in multiple smaller focused sessions throughout the weeks instead of replying to all posts in one sitting.

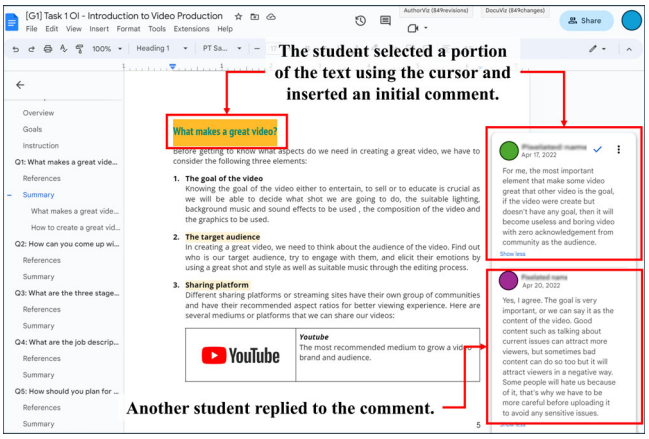


Fig. 6. Notes reading and peer interaction on Google Docs.

Meanwhile, they were encouraged to record their experiences and feelings about their learning in the individual learning log appended to the Google Docs document (Fig. 7). Although keeping the log was optional, students were encouraged to do so, as it could aid their learning evaluation and monitoring [39] and help supplement their group reflective writing later.

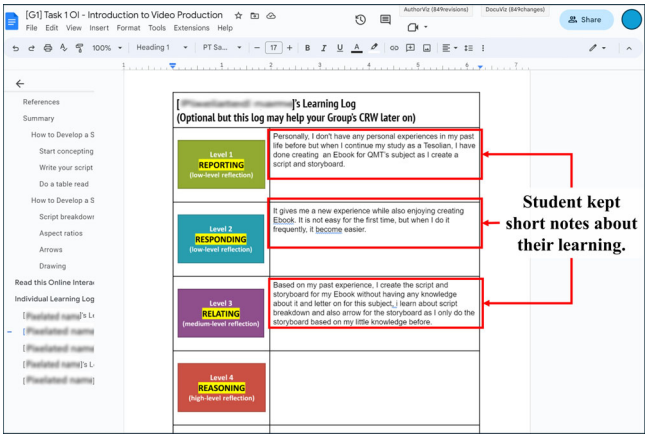


Fig. 7. Recorded short notes in individual learning log (optional).

An extended period was provided for students to engage in reading and online interactions before moving on to the second component of collaborative reflective writing, allowing sufficient time for their engagement. This reflective writing component was implemented through another new Google Docs document, with prompts to guide the group's reflection on their collective learning derived from the readings and interactions (Fig. 8). On an individual basis, reflective writing prompted students to consciously review their learning experiences and critically assess their achievements and areas for improvement [39]; on a group basis, the cloud-based nature of Google Docs provided a shared space for students to engage in viewpoint exchanges as they read their members' reflective inputs contributed to the collective piece [59].

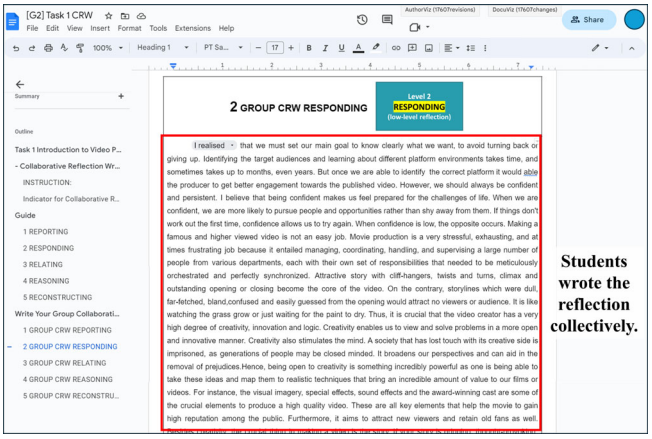
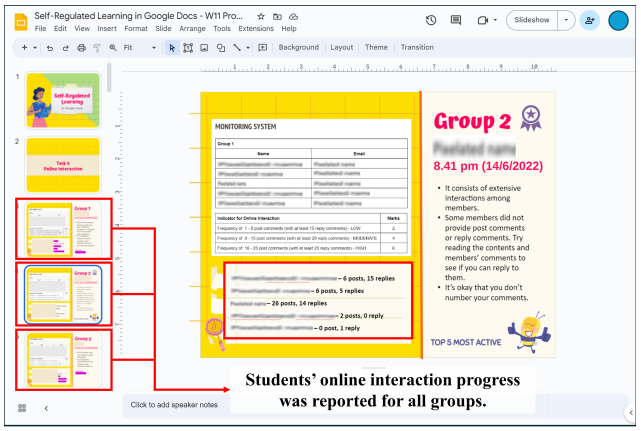


Fig. 8. Group reflective writing on Google Docs.



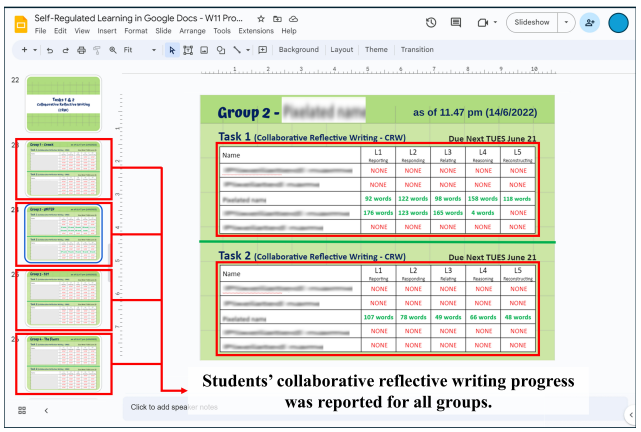


Fig. 9. Activity progress reporting on (a) online interaction and (b) collaborative reflective writing using Google Slides.

Almost every week, a summary of the number of comments posted and the status of collaborative reflection entries by each group for each ongoing task was reported to the students using Google Slides (Fig. 9). This presentation tool was used in such a way as to enable students to monitor and evaluate their task progress, affording them an opportunity to adjust strategies and course of action for task accomplishment on time [39].

Furthermore, Google Forms was employed to create topic checkpoint questions to assess students' understanding (Fig. 10). Answering these questions was deemed a form of self-assessment to gauge their own understanding and identify areas that require further clarification. The tool also collected students' course feedback. All these Google Forms submissions tracked and recorded students' weekly attendance.

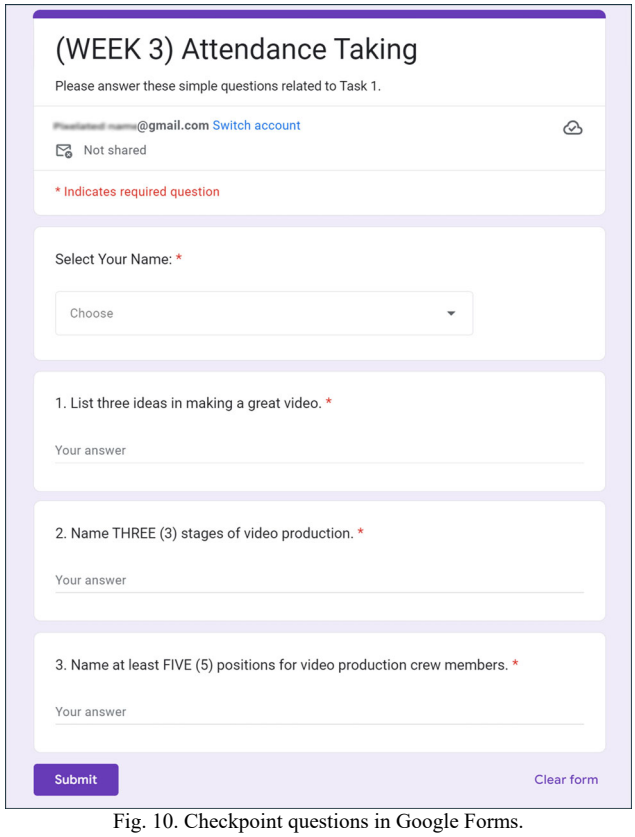


Fig. 10. Checkpoint questions in Google Forms.

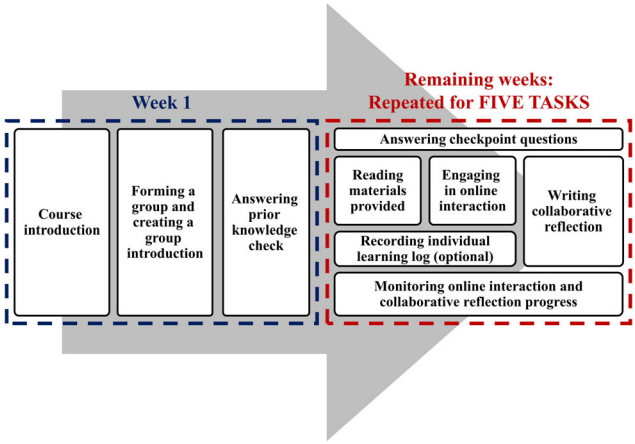


Fig. 11. Instructional flow of the learning activities.

The integration of these five Google Tools in creating a CMC environment and the specific sequence of learning activities described above formed the basis of the students'

self-regulated learning experience in the asynchronous course. Fig. 11 presents an overview of the instructional flow, while Table 1 summarizes the usage of each Google Tool throughout the course with their complement self-regulated learning strategies.

Table 1. The usage of the five google tools

Google Tool	Usage	Self-regulated learning strategy by Dabbagh and Kitsantas [39] and Dettori and Persico [59]
Google Classroom	• Work as an LMS to access posted resources, materials, and assignments	• Goal setting, task strategies, self-evaluation
	• Equip with class commenting	• Help-seeking
Google Sites	• Access information about the course instructional flow, criteria and scoring scale for tasks, and selected examples	• Goal setting, task strategies, self-evaluation
Google Slides	• Create a group introduction	• Non-applicable
	• Monitor task progress for both online interaction and collaborative reflective writing	• Self-evaluation, self-monitoring, task strategies
Google Docs	• Read materials provided	• Goal setting, task strategies, self-evaluation
	• Engage in online interaction using the comment insertion function	• Social discussion and comparison, goal setting, time planning and management, help-seeking
	• Record individual learning log (optional)	• Self-evaluation, self-monitoring
	• Write collaborative reflections	• Social discussion and comparison, self-evaluation, self-monitoring
Google Forms	• Answer prior knowledge check	• Goal setting
	• Answer checkpoint questions	• Self-evaluation, self-monitoring
	• Provide course feedback	• Non-applicable

C. Data Collection

The instrument was an online questionnaire consisting of close- and open-ended questions to collect quantitative and qualitative data, respectively. Following the completion of the learning tasks using Google Tools, the questionnaire was administered to all participants in the final week of the semester using Google Forms. The link to the Google Forms questionnaire was posted on Google Classroom with a set deadline. The questionnaire included detailed information, clear instructions, and objectives on its first page. Participants were encouraged to respond thoughtfully and honestly. Reminders were sent at predetermined intervals to increase the response rates.

The questionnaire consisted of three sections (Table 2). The first section collected demographic information. The second section focused on students' perception of the integrated five Google Tools for self-regulated learning. It comprised five constructs with 16 Likert items: perceived usefulness and perceived ease of use were adopted from TAM [68], while confirmation, satisfaction, and continuance intention were adapted from ECM [65]. These items were coded on a five-point scale from "strongly disagree" as 1 to "strongly agree" as 5, supplemented with an open-ended question for additional comments. The third section focused on students' perception of one Google Classroom tool as an LMS for self-regulated learning. The section started with a preliminary dichotomous question to confirm students' prior experience with the mentioned LMS tool. It was followed by a primary open-ended question, allowing students to provide narrative responses in their own words.

Table 2. Summary of items in the questionnaire

Section	No. of item	Type	Information collected	Source
1	1–4	Multiple choice	Demographic information	-
2	5–9	Likert scale	Perceived usefulness of the Google Tools set	Davis [68]
	10–12	Likert scale	Perceived ease of use of the Google Tools set	
	13–15	Likert scale	Confirmation of the Google Tools set	Bhattacherjee [65]
	16–17	Likert scale	Satisfaction with the Google Tools set	
	18–20	Likert scale	Continuance intention for the Google Tools set	
	21	Open-ended	Additional comments	-
3	22	Dichotomous	Prior experience in using Google Classroom	-
	23	Open-ended	Opinion about Google Classroom as an LMS	-

D. Data Analysis

The questions in the second section of the questionnaire were analyzed to address RQ1. The quantitative data from the close-ended Likert items were analyzed using the Statistical Package for the Social Sciences (SPSS) software. Descriptive analysis techniques were applied through the calculation of mean, standard deviation, and percentage distribution to describe the central tendency, variability, and distribution of students' perceptions regarding the integrated set of tools. Students' narrative comments were also used to contextualize these quantitative findings.

The items in the third section of the questionnaire were used to answer RQ2. The data collected from the preliminary dichotomous question were computed by frequency and percentage to provide an overview of students' prior experience in using Google Classroom. For qualitative data from single open-ended question that targeted students' opinions about Google Classroom, Braun and Clarke's [69] six-phase process of inductive thematic analysis was employed to generate and extract codes and themes. First, the qualitative data were imported into Microsoft Excel. After reading and re-reading the collected responses, the prominent and interesting extracts were captured to generate initial codes. These codes were then collated into broader categories. Based on shared meanings, related categories were organized into potential themes. The themes underwent a review process, cross-checking them in relation to the coded extracts and the entire dataset. Each theme was named and defined to

ensure data refinement. The analysis was presented in tabular form, with each theme grouped into corresponding perception classifications (i.e., positive, neutral, or negative) to answer the research question. It is noted that no formal inter-rater reliability was computed as the coding process was a collaborative effort involving all three researchers. Through ongoing discussions, a shared understanding and consensus were established to ensure agreement on all codes and themes that emerged from the qualitative data.

IV. Results

A. Participant Demographics

In total, 139 students submitted the questionnaire. After the submitted questionnaires were carefully screened, 25 students were excluded from the analysis as there was incomplete submission of more than 25% and monotone responses. As a result, the final dataset included 114 complete responses (N = 114). Table 3 shows the participants' demographic information.

Table 3. Demographic characteristics of the participants

Characteristic	Category	Frequency (*f*)	Percentage (%)
Gender	Female	95	83.33
	Male	19	16.67
Year of Study	Year 2	113	99.12
	Year 4	1	0.88
Age Range	18–20	14	12.28
	21–23	96	84.21
	24–26	4	3.51
Nationality	Malaysian	100	87.72
	Chinese	12	10.53
	Indonesian	2	1.75

B. Instrument Reliability

Cronbach's alpha was used to test the internal consistency reliability of the Likert items. The alpha values, ranging from 0.806 to 0.932, exceeded the acceptable threshold of 0.70 [70], indicating that these constructs had good reliability and internal consistency. Table 4 presents the results of the reliability test for each construct.

Table 4. Internal consistency reliability results

Construct	Cronbach's alpha	No. of items	Items
Perceived usefulness	0.900	5	PU1–5
Perceived ease of use	0.816	3	PEU1–3
Confirmation	0.806	3	CO1–3
Satisfaction	0.845	2	SA1–2
Continuance intention	0.932	3	CI1–3

C. Integration of Five Google Tools as a CMC Environment for Self-Regulated Learning

The 16 Likert items supplemented with one open-ended question in the second section of the questionnaire collected the students' perspectives on the integration of all five Google Tools (i.e., Google Classroom, Google Sites, Google Slides, Google Docs, and Google Forms) for their self-regulated learning of the course. Table 5 displays the mean scores of each Likert item.

Table 5. Mean ratings for Likert scale items in the questionnaire

	No.	Statement	Mean
Perceived usefulness (Mean = 4.351; Std Dev = 0.643)	PU1	Google Tools enhance my effectiveness in the self-regulated learning process.	4.404
	PU2	Google Tools improve my performance in the self-regulated learning process.	4.351
	PU3	Google Tools increase my productivity in the self-regulated learning process.	4.307
	PU4	Google Tools save me time in the self-regulated learning process.	4.307
	PU5	Google Tools are useful to me in the self-regulated learning process.	4.386
Perceived ease of use (Mean = 4.494; Std Dev = 0.570)	PEU1	Google Tools enable me to conveniently access self-regulated learning teaching and learning materials.	4.544
	PEU2	Google Tools enable me to easily navigate self-regulated learning teaching and learning materials.	4.430
	PEU3	Google Tools allow me to submit my self-regulated learning assignments.	4.509
Confirmation (Mean = 4.219; Std Dev = 0.576)	CO1	My experience with Google Tools in the self-regulated learning process was better than expected.	4.193
	CO2	The functionalities provided by Google Tools in the self-regulated learning process were better than expected.	4.254
	CO3	Overall, most of my expectations for Google Tools in the self-regulated learning process were confirmed.	4.211
Satisfaction (Mean = 4.254; Std Dev = 0.735)	SA1	I am satisfied with the performance of Google Tools in supporting the self-regulated learning process.	4.237
	SA2	I have had a positive experience with Google Tools in the self-regulated learning process.	4.272
Continuance intention (Mean = 4.243; Std Dev = 0.790)	CI1	I intend to continue using Google Tools for the self-regulated learning process.	4.193
	CI2	I intend to use Google Tools for the self-regulated learning process in the future.	4.237
	CI3	I will strongly recommend others to use Google Tools for the self-regulated learning process in the future.	4.298

In general, the results showed a high agreement level among the students, as reflected in the mean scores for all items, ranging from 4.193 to 4.544. This indicates that the set of five Google Tools is perceived positively in supporting students' self-regulation while learning the online course asynchronously. The highest item was PEU1 (4.544), under the "perceived ease of use" construct, indicating that a significant proportion of students found Google Tools as highly convenient for accessing teaching and learning materials. The lowest items were CO1 and CI1 (Mean = 4.193) under the constructs "confirmation" and "continuance intention," respectively. Although both items reflected favorable ratings, their slightly lower mean scores than the remaining suggested that the students were slightly less enthusiastic about their expected experience with and continued use of these tools for facilitating their self-regulated learning.

The mean scores for each of the five constructs are also displayed in Table 5. The mean score was high for all five constructs. The highest was "perceived ease of use"

(PEU1–3), with the mean score of 4.494 and a standard deviation of 0.570. These figures indicate that, on average, students view Google Tools as easy to use in the context of self-regulated learning. The lowest scale was "confirmation" (CO1–3), which yielded a mean score of 4.219 with a standard deviation of 0.576.

Fig. 12 illustrates the corresponding percentage distribution for each item. Unlike other items that reported neutral responses ranging from 10.53% to 14.91%, the three items of "perceived ease of use" (PEU1–3) had lower neutral responses of 3.51% to 5.26%. These items also had higher percentages of agreement and strong agreement than others, at 92.98% to 95.61%, showing that students positively perceive the tools' convenient access and easy navigation of materials and resources, as well as for allowing their assignment submission. It is highlighted that no students expressed strong disagreement or disagreement for item CO3 under the scale "confirmation." It indicates that, while some students view neutrally, the majority find that the outcomes with the set of five tools align with their anticipation.

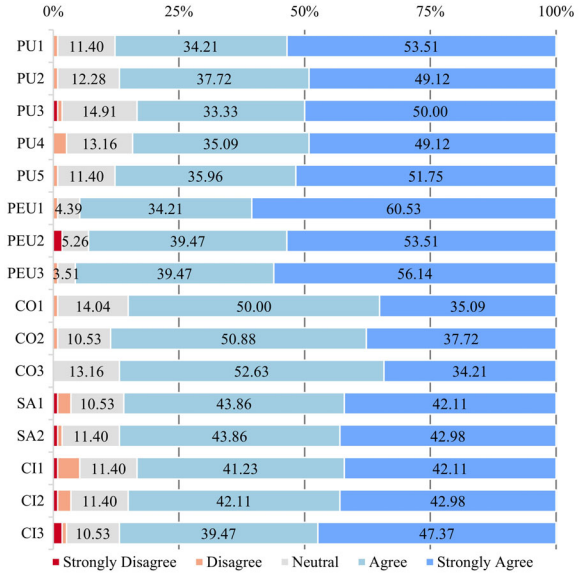


Fig. 12. Percentage distribution chart of all Likert items.

D. Google Classroom as an LMS for Self-Regulated Learning

Qualitative data from an open-ended question, supplemented with a dichotomous question, contributed to the analysis of students' perspectives on using Google Classroom as an LMS for their self-regulated learning. Table 6 shows that 75.44% of the students (f = 86) had prior experience using Google Classroom as an LMS before enrolling in the current course.

Table 6. Experience in using google classroom as an LMS

Prior experience	Frequency (*f*)	Percentage (%)
Yes	86	75.44
No	28	24.56

The open coding of responses by students expressing their thoughts about using Google Classroom as an LMS compared to other platforms, such as the university's official Moodle LMS or Schoology, yielded specific themes that were grouped into different perception classifications. Table 7 shows the codes, categories, and themes arranged according to their perception classifications.

Table 7. Summary of thematic analysis

	Theme	Category	Code
Perception: Positive	Ease of use	Familiarity	Expressing preference based on familiarity
			Convenience from familiarity with Google's ecosystem
			Able to keep pace with the lesson
		An integrated platform	Providing a single platform to access all tasks
			Allowing multiple functions to be integrated under one email account
			Smooth integration with Google Tools
		Synchronization across devices	Synchronizing progress
			Easily synchronizing works across different devices
		Accessibility across devices	Offering easy access whenever needed
			Accessible on different gadgets
			Easy access with a Google account
		No or less maintenance required	No web crashes or congestion
			Minimal web disruptions due to server overload
			Rarely requiring any maintenance interventions
			Fewer occurrences of bugs and lags
	Efficient learner interface	User-friendliness	Having a user-friendly interface
			Being more user-friendly
			Less complicated to use
			Offering a clearer layout
		Easy navigation	Navigating with ease
			Easily locating tasks
			Easily locating assignments and notes in one place
			Easily locating documents
			Easily locating materials
			Easy view of a list of tasks
		Comprehensive resource hub	Serving as a hub for all learning materials
			Providing a centralized location for accessing materials
		Systematic organization of materials and tasks	Very systematic and organized
			Providing an organized arrangement of assignments
			Providing a more systematic organization of materials
			Enabling easy and effective access to materials
			Offering a convenient way to access information
		Easy assignment submission	Enabling easy assignment submission
	Notifications and reminders	Email notifications for the latest updates	Receiving notifications about the latest information
			Notifying students about new assignments
			Receiving notifications for the learning process and tasks
			Reminding students of upcoming tasks to be turned in
		Email notifications for due dates	Connected to personal Gmail to receive due-date email notifications
			Receiving email reminders to help students keep track of their work
		Due date reminders on the interface	Displaying due tasks on the left side of the page
			Clearly displaying due dates without additional clicks
		Notifications across multiple devices	Receiving notifications directly on devices
			Receiving email notifications on all devices
		Task	Easily spotting incomplete or missing

		monitoring	assignments
			Helpful "mark as done" button for confirming submission
			Simplifying task and work-checking
			Keeping students on track
Perception Negative	Unfamiliarity	Feelings of uncertainty	Confusion
			Struggling
		Unpracticed usage	Limited experience
			Lack of exposure
Perception Neutral	Absence of preference	Recognition of similar attributes across platforms	Minimal differences across LMSs
		Recognition of diverse attributes across platforms	Equally unique as other platforms
			Different platforms have their own attributes
			Coming with pros and cons

1) Positive perception

Three themes—ease of use, efficient learner interface, and notifications and reminders—contributed to students' positive perception of Google Classroom as the LMS.

The "ease of use" theme pertains to effortlessness while operating the platform. Students emphasized the importance of familiarity with the platform, as it influenced their preference. They found the platform recognizable, reducing the need for extensive adaptation to keep up with the lesson. Additionally, Google Classroom, serving as the main platform integrated with other tools, enabled students to use one email account for various learning purposes. Using a single Gmail address in the course facilitated convenient access to all learning tasks. The platform's ability to save and synchronize students' work and progress across multiple devices was also highlighted. Students appreciated its accessibility, allowing easy usage on different gadgets using a Google account whenever needed. Furthermore, the platform's low maintenance requirement was highly valued, minimizing disruptions during usage.

- The familiarity of Google's ecosystem makes it convenient for users who are already accustomed to their services. (S128, with experience)
- … allow many things to be integrated under one email account. (S61, with experience)
- It provides seamless integration with other Google tools like Google Drive and Docs… (S128, with experience)
- … it is easily accessed on every gadget… (S16, with experience)
- I am sure everyone already has a Google account, which makes it easier to access. (S137, with experience)
- There is rarely ever any maintenance required too. (S52, with experience)

The "efficient learner interface" theme refers to the efficiency of the interface for task completion and accessing materials. Students highlighted the interface's user-friendliness, noting they could navigate it easily, including locating specific tasks or materials. The platform was a comprehensive hub, providing a centralized location to assess materials in one place. Its overall look was deemed systematic, with materials and tasks organized in a structured manner. The interface's efficiency was also evident in the seamless submission of assignments.

- … the interface of Google Classroom is very simple and easy to understand. (S127, with experience)
- I think Google Classroom is good as a resource hub to find all the learning materials... (S43, with experience)
- I think it's very systematic and organized. (S52, with experience)
- … the submission of assignments is easy to be done. (S54, with experience)

The theme of "notifications and reminders" concerns the LMS's ability to inform students about important information. Google Classroom demonstrates this feature through two aspects. Firstly, it utilizes email notifications to alert students about the latest updates, such as distributions of new announcements and tasks and reminders for deadlines. Students received these notifications across multiple devices connected to their email addresses, ensuring they were promptly informed and could take necessary actions. Secondly, the platform displayed reminders directly on the interface, notifying students about upcoming tasks that had to be submitted. The "mark as done" button also helped them confirm if they submitted a particular task. These notifying features and interface design were deemed to simplify students' monitoring and management of their task progress and completion, helping them to stay on track.

- The notification from Google Classroom was able to notify me of every single work, task, and assignment that was given to me. (S69, with experience)
- … it's connected to Gmail, so emails were sent to remind me about my assignments that were nearing their due date. (S47, with experience)
- … I prefer using Google Classroom since I often get notifications. The email I use for everyday usage is on all my gadgets. (S113, with experience)
- It's easier as the due task is displayed on the left side of the page. (S80, with experience)
- I also love the "mark as done" button since it helps me whenever I'm not sure whether I have submitted my task or not. (S106, with experience)

2) Negative perception

The theme of "unfamiliarity" emerged, exemplifying negative perceptions towards the platform due to students' uneasiness and unpracticed usage of Google Classroom. One student reported feeling slightly confused during the initial phase of using Google Classroom despite having prior experience with the tool. Additionally, one student expressed struggles with the platform, which could be attributed to their relatively short usage period.

- … I feel slightly confused in the beginning as I am not used to using this learning management… (S32, with experience)
- … I'm still struggling with it since it hasn't reached a year of use… (S38, no experience)

3) Neutral perception

The "absence of preference" theme was classified as neutral perception, indicating that students do not exhibit strong positive or negative sentiments towards the platform. Some students considered Google Classroom as unique as other LMS that they had used before, acknowledging that each platform has its specific characteristics aimed at supporting learning. There was also an instance where the

student mentioned that there was not much of a difference when comparing Google Classroom with other LMS platforms.

- ... not much of a difference (S126, with experience)
- … Google Classroom is equally as unique as other online platforms that I used before. (S56, with experience)
- ... I think it has its own pros and cons. (S113, with experience)

V. Discussion

A. Academic Discussion

The study investigated students' perceptions concerning the use of an integrated set of five Google Tools (i.e., Google Classroom, Google Sites, Google Slides, Google Docs, and Google Forms) as a CMC environment that supports self-regulated learning in an asynchronous course. Overall, the descriptive analysis of the Likert items revealed high mean scores in students' learning experiences on the various aspects of the set of tools. This finding aligns with Han *et al.*'s [71] study which demonstrates that technological tools can support students' self-regulated learning. Notably, the ease of use and usefulness of Google Tools were most highly regarded by the students. This is consistent with Rejón-Guardia *et al.*'s [14] study, in which using a personal learning environment created with different Google Tools is easy to use and useful for facilitating students' learning. As stated by Cheng and Xie [72], when technology is perceived as functional and accessible, students are less likely to feel emotional distress and are more likely to complete tasks on time, reducing procrastination—a maladaptive form of self-regulated learning. Besides, the utilization of user-friendly tools for online learning is deemed essential to promote students' persistence [73], encouraging them to stay engaged and committed to their learning.

The collaborative feature of Google Tools also deserves particular attention, as students expressed their appreciation for it. Provided that the course learning activities were mostly group work, they valued the tools' abilities to easily access their members' work and facilitate peer interactions to improve their productivity and performance. Predominantly, the cloud-based sharing feature of Google Docs was mentioned, allowing them to view and collaborate on group work: "We can easily collaborate for reports and discussion ideas while having a draft in the cloud" (S111). These findings support the idea that self-regulated learning can be enhanced within a community context [25, 63]. Collaboration with peers in a cooperative environment, such as the CMC environment formed by integrating different Google Tools in this online course, could nurture stronger self-regulation skills for student learning.

While the set of Google Tools was deemed to deliver a positive experience in meeting or exceeding students' expectations, the "confirmation" construct's relatively lower mean score could be attributed to two reasons. First, some students might have never used or have limited experience with a particular or a few tools. As such, they might have fewer expectations when they are unfamiliar with how the tools could aid them in their self-regulation process, as illustrated in students' open-ended responses: "I hardly used Google Slides" (S89), and "I don't have much experience with Google Sites" (S78). Second, students might have prior positive experiences with these tools in other contexts, provided these Google Tools were some of the most common tools used for online learning during the COVID-19, leading to elevated expectations when applying them to support their self-regulated learning process.

The study also sought to explore students' perceptions specifically on one of the tools—Google Classroom—as it was the main tool that connected with other tools for students to be involved in the various learning activities. As presented earlier in Table 7, many instances reflected students' positive perceptions of the said LMS for their self-regulating learning, along with a few instances denoting negative and neutral insights. The emerging themes of "easy to use" and "efficient learner interface" were classified as students' positive perceptions of the said LMS. These themes correspond to the multiple survey items reported with agreement in past studies [21–24]. It is inferred that these favorable regarded characteristics of tools integration, device synchronization and accessibility, resource locating, and assignment submission are enabled by the cloud-based nature of Google Classroom [62]. Particularly in courses that practice asynchrony, the cloud-based Google Classroom provides students with easy access to all posted learning materials and activities, allowing them to choose when and where to engage, set their learning schedules, and take greater control over their learning.

The "notifications and reminders" theme is in line with suggestions by the students in Araka *et al.*'s [74] study regarding additional features that an LMS should have to support self-regulated learning. This suggests the capability of Google Classroom in facilitating students to monitor their learning progress and improve time management. Also, Google Classroom enables assignment monitoring by displaying onscreen status phrases such as "Turned in" after clicking "Mark as done," or "Missing" if no submission is made before the deadlines. When students submit assignments late, the phrase "Turned in late" is displayed, causing an uneasy feeling, as the uploaded file is labeled as "late" [75]. These reminders and notifications are intensified when students receive notifications from various devices such as mobiles, laptops, and tablets. They further foster students' awareness of their time management skills and prompt them to take necessary steps to improve their planning and monitoring abilities to meet the deadlines.

Students' negative perception of Google Classroom, stemming from unfamiliarity with using the tool, was only minimal in evidence. These few negative responses are not surprising as there are studies that found Malaysian higher education students equipped with digital literacy [76, 77], suggesting that having a foundation of skills and knowledge could help students adapt to new technologies and platforms more easily for basic learning purposes. In the current case, it is highlighted that Google Classroom or its features did not pose any usage issues. It was the students' unfamiliarity with it that caused struggles. These personal subjective experiences of students being confused and unaccustomed to Google Classroom may influence their acceptance of the

tool [78]. If students persist in feeling such a way, it will hinder them from planning their learning paths and taking an autonomous role since they do not fully utilize the LMS which houses all resources and tasks.

Students' responses also show a minimal neutral perception of Google Classroom. They acknowledged the tool's merits without exhibiting strong favoritism over other alternatives. Some students were able to appreciate the distinct attributes offered by different LMS platforms, recognizing their value based on their suitability for various learning activities. This reflects the students' capability for self-regulation, as they take accountability for their learning and make deliberate choices in differentiating and selecting appropriate tools to enhance their learning experiences.

Similar overarching results are observed when comparing the quantitative and qualitative findings. First, there is a convergence in the positive perceptions of the integrated set of five Google Tools and Google Classroom. This is reflected through the alignment of the high mean scores obtained from the Likert items in terms of "perceived ease of use" and "perceived usefulness" with the two themes of "ease of use" and "efficient learner interface" yielded from the open-ended responses. The qualitative thematic analysis also provided additional insights into students' opinions about the "notifications and reminders" feature that contributed to their positive experience while using Google Classroom, which was not captured in the quantitative data.

Second, the slightly lower mean scores in "confirmation" and "continuance intention" in the quantitative data align with the qualitative findings of some students' negative and neutral perceptions of "unfamiliarity" and "absence of preference." These results might reflect that students' unpracticed usage of Google Classroom and absence of strong positive sentiments towards Google Classroom would result in a gap between their initial expectations and their actual experience with the entire set of Google Tools, as well as their intention to continue using the toolset in the future.

The comparison of the two datasets further highlights the crucial role of Google Classroom to serve as the central hub linking to other Google Tools in creating a more unified and coherent learning environment. While the findings showed that many students appreciated the ease of use and comprehensive features of Google Classroom, some reported challenges due to unfamiliarity. This disparity suggests that while the tools are generally effective, their impact can vary significantly based on individual user experience and familiarity. It points to a need for better orientation or training in using these tools to facilitate students in directing themselves to participate in assigned activities and continue using the tools for self-regulated learning.

B. Implications of Findings

The results of the study hold implications for educators. The high mean scores represent students' positive perceptions about using a set of five Google Tools as a CMC environment for supporting self-regulated learning in an asynchronous course. It can be deemed an encouragement for educators to adopt and integrate these tools in fully online learning or the online component of blended learning. Furthermore, the identification of specific Google Classroom characteristics contributing to students' positive self-regulation experiences, such as ease of use, interface, and notifications, highlights the need for educators to prioritize these features when adopting the tool. Also, the identification of tool unfamiliarity underscores the need for educators to provide students with adjustment time and practice tasks, allowing them to try out the tool's functionalities [79]. This ensures that students benefit fully from the tool for planning, monitoring, and evaluating their learning.

VI. Conclusion

The study aimed to investigate the perceptions of two cohorts of students towards using a set of five Google Tools (i.e., Google Classroom, Google Sites, Google Slides, Google Docs, and Google Forms) that formed a CMC environment for their self-regulated learning in an asynchronous course. Based on the descriptive analysis of the close-ended items, students perceived the Google Tools set positively for self-regulating their learning. The tool set was deemed easy to use and useful, and these tools aligned and confirmed students' expectations. Findings also showed students' satisfaction and future usage intention for the tool set. Based on the inductive thematic analysis of the open-ended question, most instances showed students' positive perceptions of Google Classroom for supporting self-regulating learning, stemming from its ease of use, efficient interface, and notification and reminder features. Nonetheless, students' unfamiliarity with Google Classroom and their recognition of the features across different LMS platforms also revealed negative and neutral responses. Using this Google Tools set could be useful in facilitating students to set goals and monitor learning, hence fostering them to become more proactive and responsible learners for asynchronous online learning. As such, this study would work as the initial step in probing students' perceptions, in which further research is welcomed to investigate the impact of applying these tools for self-regulated learning on students' academic and emotional aspects.

Several limitations of this study can be addressed in future research. First, while the participants involved students from two cohorts, they represented one course from one university. The generalization of the current findings is limited. Hence, it may be suggested to include students from other course disciplines and higher institutions to increase the generalizability of findings. Second, the study used a single instrument (i.e., a questionnaire) to collect students' responses. Also, the thematic analysis process of open-ended questions might still be subject to the influence of researchers' subjectivities, even if discussions among all authors were conducted to ensure consensus. As such, it may be recommended to employ a combination of quantitative and qualitative research methods, such as surveys, interviews, and learning analytics, to provide a more comprehensive understanding of students' perceptions and experiences with Google Tools. Triangulating data from multiple sources also minimizes researcher bias and further enhances the validity and reliability of the findings. Finally, the Likert items used focused on the integrated set of five Google Tools in general. Except for Google Classroom being explored via other

questions, the remaining four tools were not investigated separately. Hence, it may be suggested to add more questionnaire items specifically for each tool. This would allow for a more detailed exploration of students' perceptions of each tool and how these tools relate to the self-regulated learning strategies they use.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Sharon Jia Chian Lee conducted the literature review, analyzed the data, and wrote the manuscript. Siti Nazleen Abdul Rabu developed the questionnaire instrument and collected the data. She also supervised the whole research and writing process along with Nurullizam Jamiat. All authors reached a consensus on the qualitative thematic analysis and approved the final manuscript.

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