

Integrate Online Synchronous Teaching Strategy in a Programming Learning Course based on Code Blog Learning Platform

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Abstract.

Due to the COVID-19 pandemic, distance learning has become an important research topic in recent years. Whether synchronous or asynchronous, it elicits new challenges for teachers and students. It also shows that differing online teaching strategies significantly impact learning effectiveness. However, the statistical results indicate that APP development has become a key project in the technology industry, emphasizing that teaching programming is highly valuable. Past teaching methods have not cultivated related technical talents effectively. Therefore, the present study proposed to conduct distance learning by supporting social interaction using the Google Meet tool. We integrated the self-developed online teaching platform into the learning activities to investigate the impact on students' learning motivation through the Instructional Materials Motivational Survey (IMMS) in this mode at the end of the experiment. The IMMS measurement indicated that students' attention, relevance, and satisfaction dimensions were significantly improved, while their confidence dimension was not. For students to have good learning motivation in distance learning, it is essential to pay attention to the cognitive load of the students and avoid using information technology to make students engage in multitasking.

Keywords: distance learning, programming course, learning motivation

Introduction

Due to the COVID-19 pandemic, universities and colleges nationwide have developed online teaching experiences. Whether synchronous or asynchronous, this allows teachers and students to undergo a new classroom experience. However, online teaching has different impacts on various courses. Since programming courses emphasize students' hands-on work, and students often require assistance from peers or teachers in writing programs (debugging, syntax, and logical writing), online teaching significantly impacts

programming courses. Therefore, a common goal for college and university faculty is to ensure that students can obtain good learning effectiveness even in a distance learning mode.

According to Sensor Tower's (2021) statistical analysis, the number of downloads from the Apple Store and Google Play is estimated to reach 230 billion by 2025 (see Figure 1). This indicates that the number of apps is growing rapidly and that cultivating excellent APP developers is a future trend. Additionally, in the informatization era, since the demand for programming talents will only continue to increase, programming is an essential course. Programming courses can enrich students' professional knowledge and train people's thinking and problem-solving abilities, professional information technology, etc. Thus, programming is an essential course for cultivating logical thinking ability, and therefore, various universities and colleges have been adding programming-related courses to the required electives in their curriculums (Chen, 2011). Similarly, Papert (1980) highlighted that programming languages can help students develop the ability to think logically and critically and to learn. Therefore, it is clear from the literature that programming is a course with high learning value. However, the learning effectiveness of programming courses was often less than ideal in the past. Some research indicates that programming is a more abstract course and a type of professional knowledge that needs to be intensively practiced, understood, and internalized. However, in traditional teaching environments, the teaching environment is primarily one-way, leading to unsatisfactory learning effectiveness. This highlights that programming is more challenging to learn, as students must understand the concepts and spend more time learning. However, it is often not possible to provide the required time in the classroom, which tends to result in a lack of time for students to digest classroom content (Aleksić & Ivanović, 2016; Alammari, 2019; Lai, Jeng & Huang, 2020).

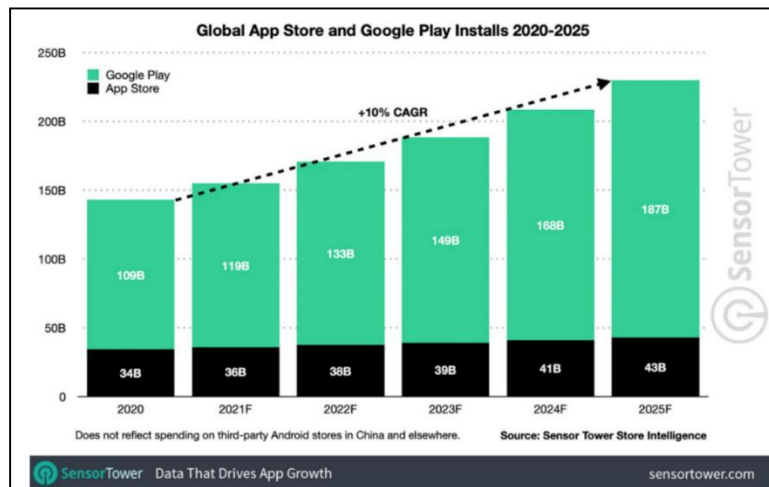


Fig. 1. Estimated APP Downloads of the World's Top 2 Channels from 2020 to 2025 (Source: Sensor Tower)

Due to the impact of COVID-19, a hybrid teaching method of synchronous and asynchronous teaching has been adopted for most distance learning models. Online services that support synchronous teaching include Google Meet, Microsoft Teams, etc., which allow teachers to interact with students synchronously through the Internet. In addition to synchronous lectures, many teachers place textbooks, assignments, questionnaires, and other course materials through digital learning platforms for students to use asynchronously. An essential issue in this distance learning mode is increasing teacher-and-student and student-and-student interactions. Today's social media platforms support many user interaction features, including article sharing, tagging friends, real-time chats, blogs, likes, tags, etc. Through these features, users' online interactions are further strengthened, and users' online creation and sharing behaviors are promoted. Hence, these features positively impact teaching and learning; sharing knowledge through the medium of social interactions and applying peer learning strategies and social interaction strategies effectively enhance learning motivation. Therefore, this study conducted distance learning for a programming course with blended online teaching using two tools, the teaching platform that supports social interaction and Google Meet, to examine the impact on the students' learning motivation.

Literature Review

Programming Teaching Research

In recent years, due to the advancements in information technology and the growing demand for professionals in the information field, programming has emerged as a discipline of utmost significance. Programming courses are pivotal in cultivating students' capacity to create information systems that enable everyday users to accomplish specific tasks. The study of this programming course includes two fundamental skill sets: logical thinking ability and programming concepts. Logical thinking ability involves the capacity to analyze, plan, and design a system, representing the crucial initial phase before the actual program development. During system analysis, individuals must follow five key procedures: goal setting, system processes, system architecture, function modules, and system effectiveness. Both system processes and architecture hold particular importance, as an effective system process can significantly impact the entire system's functionality, including user operations. Another vital skill is understanding programming concepts because individuals must possess a foundational understanding of programming language concepts before learning program development. This entails familiarity with variable usage, program flow control, conditional expression evaluation, and more. A certain level of prerequisite knowledge is essential to initiate successful program development.

Kabudi et al. (2021) also indicated that adaptive learning has an essential impact on learning; the main reason is that today's digital learning platforms cannot meet the needs of learning, which can easily lead to negative attitudes toward the system. Kabudi et al. (2021) suggested that Artificial Intelligence (AI) technology should be integrated into learning

platforms to promote students' learning so that students can obtain more relevant learning aids and teachers can maintain a better quality of teaching. Tzu-Chi Yang (2015) proposed a two-tier learning system based on testing to improve students' learning effect in a programming course and to evaluate the effectiveness of this method. Their results indicate that the two-tier learning system improved attitudes toward learning programming languages and enhanced the students' skills in writing programs. Puspitarini and Hanif (2019) and Chang et al. (2020) found that game-based teaching can improve students' learning motivation in programming courses, especially when the games contain many interactive elements and media effects. The positive impacts on learning effectiveness, satisfaction, and motivation led the authors to encourage teachers to incorporate different teaching strategies into game-based learning. Slangen et al. (2011), Kolovou et al. (2008), and Fanchamps et al. (2021) integrated programming robots into programming courses and applied them to course learning activities. The purpose was that programming robots have a high degree of flexibility, which makes learning more diversified and allows students to work according to their own understanding. Experiments have also shown that programming robots can enhance students' independent thinking ability and positively affect algorithmic thinking and mathematical ability. However, this also indicates that how to effectively train students to learn programming languages is currently a hot topic. Some studies have also suggested that digital learning allows students to learn in a more rigorous and innovative manner. Furthermore, it will enable students to be free from the limitations of the course location so that students can attend classes anytime and anywhere and interact and discuss with each other online. The common digital learning platforms today are gradually incorporating technologies such as mobile networks, cloud computing, and big data to achieve the goal of more accurate and personalized learning (Kabudi et al., 2021; Bygstad et al., 2022). In that study, a Web-based learning Java editing program environment was proposed to provide students with adaptive guidance for learning by using sentiment analysis images combined with the recommendation system e-Learning 3.0 software suite. The study suggested that this research tool is more rewarding than the traditional learning method for students and will also enhance learning effectiveness (Cabada et al., 2018).

Research Method

Digital Learning Platform Supporting Social Interaction

To enable students to communicate more frequently through the digital learning platform even when they are attending classes at a distance, the present study applied a self-developed e-learning platform. This platform is characterized by its support for common social interaction techniques and using blogs to write program notes. Thus, students can write program syntax and related notes in the form of a blog. This can improve the program's readability on the learning platform, making it more convenient for students to write program notes. Figures 2 and 3 illustrate the main functions of this platform, including the ability to tag friends, share, and like when writing program syntax, tips, and notes. The system divides the users into student and teacher groups. Students can view the teacher's programming materials on the browser and post, read, and discuss on the Code Blog.

Students use the browsing interface of the Code Blog and the social interactive features to cultivate a particular way of thinking about programs to enhance the ability of program implementation capacities. On the teacher's side, teachers can browse the students' learning history analyzed by the system during or after class, including popular Code Blogs, textual analysis of frequently asked questions, and the history of Code Blogs being viewed, discussed, and shared. This can be used as a basis for improving the strategies for teaching activities.

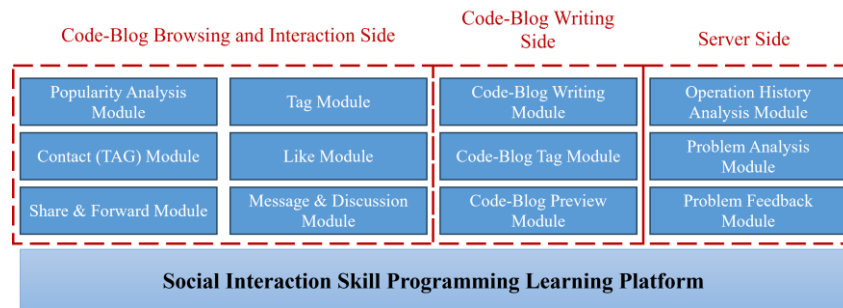


Fig. 2. Chart of Function of Social Interaction Skill Programming Learning Platform



Fig. 3. Interfaces for Reading Articles and Its Interaction Functions

Google Meet Online Synchronous Teaching Service

Google Meet is an online video communication service developed by Google and integrated with Google Hangouts and Google Chat functions. It was initially a commercial service but has been extensively used in teleconferencing and video communication since

teleconferencing has gradually been emphasized worldwide post-COVID. In the teaching field, Google Meet can be used as a tool and service for synchronous teaching.

In addition to synchronous distance teaching, Google Meet includes other services that can better meet the application of distance learning, such as including online grouping features, as shown in Figure 4. Google Meet can provide a discussion time limit for each discussion. After setting the discussion time, the teacher can ask each group to begin. When the time is up, the chat room will close and wait for the teacher to open it again.

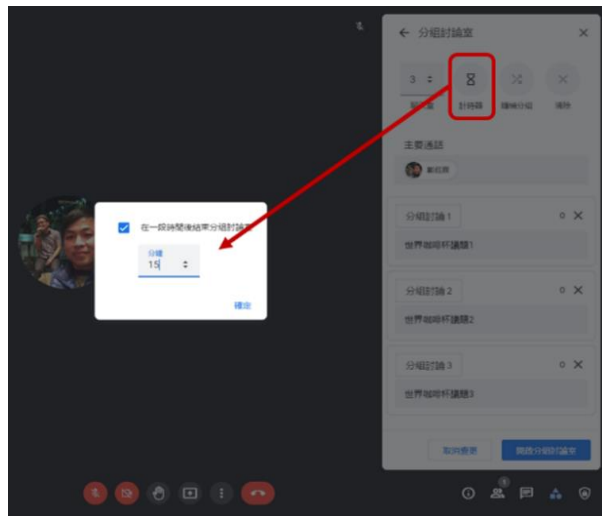


Fig. 4. Google Meet Grouping Setting

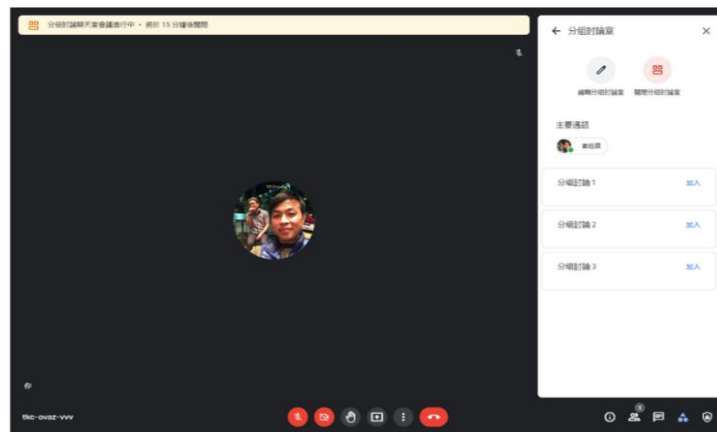


Fig. 5. Google Meet Group Discussion

Research Design

To assess students' learning motivation, this study used the Instructional Materials Motivational Survey (IMMS), which is based on the ARCS model of motivation and comprises four factors: attention, relevance, confidence, and satisfaction (Keller 1983; Huang et al., 2006). Based on the literature (Huang, Huang & Tschopp, 2010; Liao & Wang, 2008; Bolliger, Supanakorn & Boggs, 2010; Julià & Antolí, 2019), the description of the factors of the ACRS model are summarized as follows.

- (1) Attention: Attracting learners' attention increases their interest in learning and enhances their willingness to learn.
- (2) Relevance: Providing relevant learning materials or meeting the needs of learners makes them more attentive or willing to learn in the classroom.
- (3) Confidence: Teachers should help students develop positive expectations, making them feel more confident about succeeding and completing learning tasks.
- (4) Satisfaction: Making learners satisfied during the learning process will positively impact and keep them learning.

We used the IMMS scale to measure students' learning motivation, which was based on a 5-point Likert scale, where 5 points indicated "strongly agree" and 1 point indicated "strongly disagree." The reliability coefficient scores of the IMMS ranged from 35 to 180, totaling 0.96 (Keller, 2006).

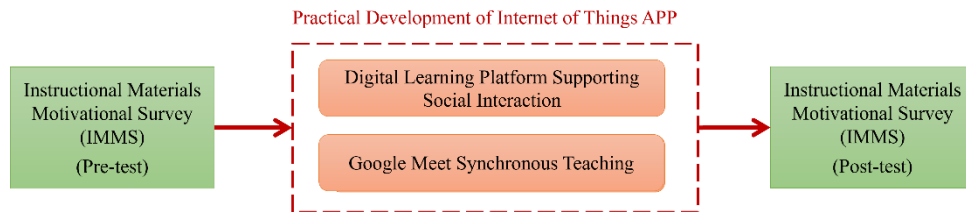


Fig. 6. Research Process

Research Results

To further explore the learners' attitudes toward the learning environment of this study, we used the IMMS to analyze their learning motivation (Table 1 illustrates the pre-test and post-test scores). The mean score on the pre-test was 3.66, with a range of 3.44-3.75. This implies that the students had some motivation to take the programming course. In the post-test, the mean score was 3.74, with a range of 3.33-3.91, slightly improving overall. However, further exploration of each dimension revealed improvement in all three

dimensions, including attention, relevance, and satisfaction. Particularly regarding satisfaction, there was a wide range of differences among the participants. Satisfaction scores ranged from 3.75 to 3.91, meaning that most participants generally believed that the instructional design proposed in this study helped the learners gain a sense of accomplishment. On the other hand, there was a significant decrease in confidence, with confidence scores ranging from 3.44 to 3.33. This implies that this instructional model was not effective in building confidence.

Table 1. IMMS Analysis Results

Participants	Dimensions	Pre-test		Post-test		<i>t</i>	<i>p</i>
		M	SD	M	SD		
(n=52)	Attention	3.71	0.52	3.85	0.51	-0.71	.04*
	Relevance	3.74	0.52	3.88	0.53	-0.45	.02*
	Confidence	3.44	0.40	3.33	0.47	2.20	.02*
	Satisfaction	3.75	0.56	3.91	0.60	-2.11	.04*

* $p < 0.05$

** $p < 0.01$

Conclusion

Table 1 illustrates that the distance learning mode designed in this study was significant in all four dimensions, as measured by the Instructional Materials Motivational Survey (IMMS). However, only attention, relevance, and satisfaction were found to be significantly higher; the confidence scores were found to be significantly lower, as per further observation. This study found that students' attention, relevance, and satisfaction were increased in this mode. This finding indicates that students' acceptance of this mode was high and partially increased the students' learning motivation. Regarding confidence, interviews were conducted to further understand the students' feelings toward this teaching mode. We found that although most students accepted the synchronous teaching mode, compared to the physical classroom, the distance teaching mode increased the sense of alienation. Furthermore, the students felt overwhelmed by the amount of information when they had to manipulate the platform and pay attention to the teacher's instruction on the other screen simultaneously.

Regarding cognitive load theory, Sweller, Van Merriënboer, and Paas (1998) and Sweller (2011) highlighted that human cognition requires a large amount of information storage when novel information is processed. However, the number of novel messages that can be processed at any given time is minimal. This makes it challenging to add messages without sufficient working storage capacity. This suggests that the design of curriculum and learning materials can place an additional learning burden on students, affecting their learning. Therefore, how to effectively reduce the cognitive load of students is an essential issue in learning. According to the report by Küçük, Yılmaz, and Göktaş (2014), students had lower cognitive load and showed more positive attitudes. On the other hand, Cheng (2017) found that if students' cognitive load was small, they may have a stronger motivation and a more positive attitude, increasing their participation in learning activities. Additionally, Cheng (2017) noted that problem-solving or providing guidance positively affected building learners' confidence. Based on these findings, teachers can use aids to guide students' learning while reducing their cognitive load and fostering their confidence in learning. According to Henry and Marrs (2015), students often learn languages irregularly due to a lack of motivation and confidence. Therefore, in a distance learning mode, when students are not overloaded with cognitive load, it can positively influence their confidence and motivation to enhance their learning experience.

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