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Developing and Evaluating a "Virtual Go Mode" Feature on an Augmented Reality App to Enhance Primary Students' Vocabulary Learning Engagement

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Abstract: This article reported on a study of development and evaluation of the Virtual Go Mode feature embedded in a VocabGo app to enhance primary students' vocabulary learning engagement. A total of 15 primary students in Hong Kong participated in this evaluation study for one week. Both quantitative and qualitative data were collected and analysed. The results showed that students' vocabulary learning engagement was high when using the Virtual Go Mode. It is suggested that future research focus on empirical studies in designing and implementing virtual location-based tasks supported by AR technologies in class to provide opportunities for students to practice and consolidate newly learned words and enhance their learning engagement in the post-COVID-19 pandemic.

Keywords: Augmented Reality (AR) app, Virtual Go Mode, VocabGO, vocabulary learning, engagement

1. Introduction

Due to the COVID-19 pandemic, school education is being affected by closures and transition from face-to-face to online teaching and learning (UNESCO, 2020). The sudden shift has caused students' social-emotional problems due to social isolation, lack of support, and poor learning effectiveness (Dhawan, 2020). In addition, many school teachers, such as language teachers in Hong Kong, have limited online teaching experiences and received inadequate professional development on how to conduct lessons effectively online (Chiu, 2021). How to support language teachers to teach and engage students to learn is a major concern in current situations. A number of studies have been found positive correlation between vocabulary learning performance and motivation in technology-enhanced learning context (e.g., Law et al., 2019).

This study aims at developing and evaluating a "Virtual Go mode" feature on an augmented reality (AR) app – VocabGo to enhance lower primary students' vocabulary learning engagement when classes were conducted entirely online. The next section presents the literature, followed by the design of the virtual Go Mode, and evaluation of it. Finally, a discussion is made and future work is explored.

2. Literature Review

2.1 English as a Second Language vocabulary learning during COVID-19

Vocabulary plays a role of a fundamental building block of text comprehension and communication for English as a second language (ESL) learners (Nation, 2006). However, it is a difficult task to acquire vocabulary because it is concerned with multi-dimensional knowledge (Schmitt, 2007). According to Nation (2001), knowing a word involves not only receptive and productive knowledge, but also its form, meaning and use. Therefore, vocabulary acquisition process is complex and demanding. During COVID-19, the transition to online learning for formal education has worsened the situation (Baber, 2020; Klapproth et al., 2020).

2.2 Augmented reality enhanced engagement in ESL vocabulary learning

Context-based vocabulary learning in authentic contexts have been adopted in English language teaching practices (Tai et al., 2020; Özkan, & Nurlu, 2019). Various types of technologies have been adopted to enhance students' learning motivation and outcomes, among them, AR has been gaining popularity. AR helps bridge ESL students' lack of background knowledge by creating meaningful associations between the content and authentic environments (Santos et al., 2016). Many studies show that AR has made vocabulary learning more effective and enjoyable than the traditional way (e.g., Eang & Na-Songkhla, 2020; Yaacob et al., 2020), and helped invoke flow experiences (e.g., Ji & Shin, 2019). Flow state is deemed to be a robust indicator for learner engagement and immersion (Hamari et al., 2016). Learners in a flow state are intrinsically motivated (Ji & Shin, 2019).

Thus, this study aims at designing and evaluating a "Virtual Go Mode" feature on an AR app – VocabGo developed by our research team to enhance lower primary students' vocabulary learning engagement when all classes were conducted online. The newly designed "Virtual Go Mode" feature enables primary students to explore virtual objects on their own.

3. "Virtual Go mode" Feature on the AR app - VocabGo

3.1 Features of VocabGo

The "Virtual Go Mode" feature embedded in the AR app – VocabGo was designed to support students' practice and use of the newly learned words in class through game-based learning. The design was based on dual-coding theory (Paivio, 2014), and second language acquisition (Nation, 2006). Before introducing the feature of "Virtual Go Mode", the features of VocabGo which was developed by our team are presented first. VocabGo consists of four modes [(see figure 1 (a)]: (1) "Find mode" where students can scan the real objects with identified newly learned English words included in the current curriculum unit; (2) "Go mode" which includes a physical Go mode for students to conduct location-based vocabulary learning tasks; (3) "Explore mode" where students can do free scanning of objects with words beyond the curriculum unit; and (4) "Challenge mode" where students can do game-based, computer-generated quizzes about the words learned in the first three modes. In addition, VocabGo also includes "My Collection" for collecting the word cards and "Learning Community" for sharing the collected word cards and make comments.

3.2 "Virtual Go Mode" Feature on VocabGo

In this study, we focused on the design of the new feature "Virtual Go mode" in response to the sudden transition from face-to-face to online classes. As shown in Figure 1 (a) and (b), "Virtual Go Mode" is in "Go Mode". It was designed for students to practice and consolidate the newly learned words via virtual location-based tasks with 360° Google Street View. To perform the learning task, students needed to enter "Go Mode" first, then press the "Virtual Go" button in the lower right corner.

4. An evaluation Study on "Fruit and Colour" in a "Virtual Fruit Market"

4.1 Design of "Virtual Fruit Market"

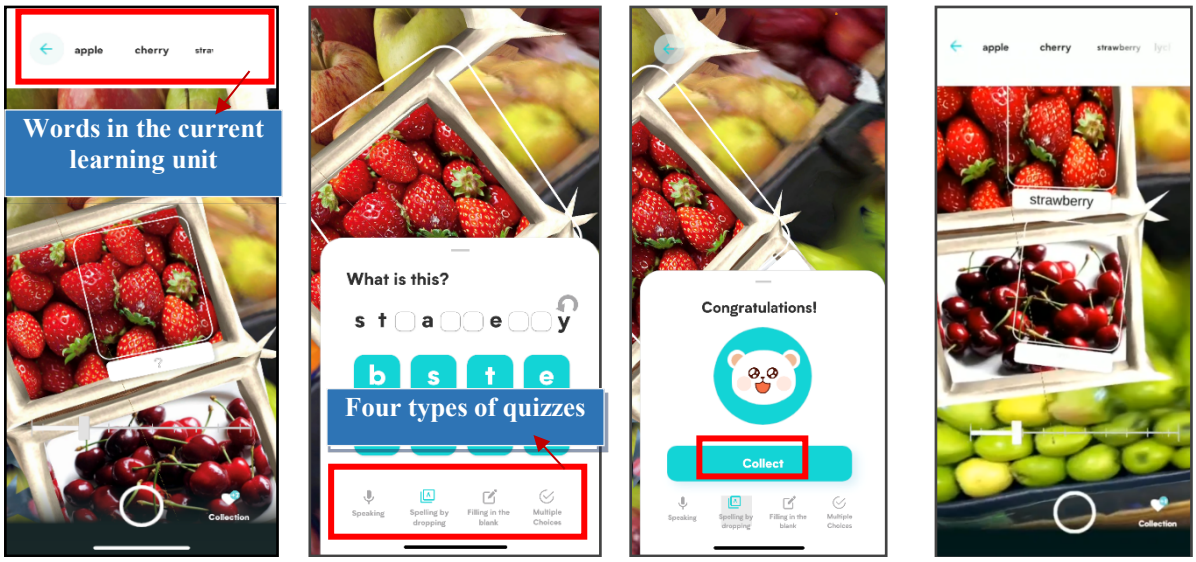
This study took the design of "Virtual Fruit Market" for enhancing students' engagement to practice and consolidate the newly learned words in formal online class teaching via Zoom during COVID-19 as an example. The topic of the vocabulary learning was "Fruit and Colours". In view of this topic, we designed a "Virtual Fruit Market" – PARKnSHOP where seven areas were designed with different colours [refer to Figure 1 (c)]. In each zone, the fruit (singular form) with the corresponding colour were allocated [refer to Figure 1 (d)]. For example, the "Orange Area" includes "orange, "Red Area" includes "apple, strawberry", "Purple Area" includes "grape", "Blue Area" includes "blueberry", "Yellow Area" includes "lemon, mango", "Green Area" includes "apple, grape, pear", and "White Area" includes "coconut".

While conducting the task, students could press the "Go" button to enter the virtual supermarket, then select a colour area to find and identify the fruit with the corresponding colour [refer to figure 1 (d)].

(a) four learning modes (b) Virtual Go mode in Go mode (c) a virtual supermarket (d) a location-based virtual task

Figure 1. Introduction to the Virtual Go mode in VocabGO app.

Figure 2 shows an example of a student's learning logs in the "Red Area". The top list shows the words in the current learning unit that students needed to review and consolidate [refer to Figure 2 (a)]. Students could adjust the size of the recognition frame to scan the object. Once the object was identified, a quiz [see Figure 2 (b)] would randomly be generated by the system to evaluate whether the student grasped the colour and name of the fruit. After it, the student could collect the word card to his/her own learning logs in "My Collection" [see Figure 2 (c)]. Students could continue to scan and collect objects [refer to Figure 2 (d)].



(a) scan the object (b) system-generated quizzes (c) collect the word card (d) identified objects

Figure 2. An example of a student's learning logs in the "Red Area" in the "Virtual Fruit Market".

4.2 Research Question and Research Context

The research question for the pilot study was: *What was the impact of the Virtual Go Mode on students' vocabulary learning engagement*?

Participants were 15 Grade One students in a primary school in Hong Kong. The study lasted for one week. Before performing the task, the teacher briefed the students how to use the feature on the app and explored the task after finishing learning the new words via Zoom. Students could also practice and consolidate the words after online class time.

4.3 Data Collection and Analysis

In this study, both quantitative and qualitative data were collected for analysis. Data sources included the questionnaire on learning engagement and interviews. The questionnaire was adapted from Ji and Shin's study (2019) with 12 items in four dimensions: concentration, control, curiosity and internal interest. Responses were given on a five-point Likert scale, ranging from 1 for "strongly disagree" to 5 for "strongly agree". The interview questions were constructed based on the questionnaires, aiming at understanding students' learning engagement when using the Virtual Go Mode embedded in the VocabGO app. Six participants in two focus groups were invited to conduct the interviews on voluntary basis. Each of the interviews lasted about 20 minutes.

Descriptive statistics were adopted to describe the means, standard deviations of students' learning engagement supported by the Virtual Go Mode. Content analysis was used to analyse focus group interviews to understand primary students' learning engagement using the Virtual Go Mode in the VocabGO app.

4.4 Procedure of the Study

The procedure of the study was shown in Figure 3. During the orientation part, the teacher demonstrated the features of the Virtual Go Mode on the VocabGO app. In addition, hands-on practice of the app was provided. Then, students practised and consolidated the words after online class time during COVID-19. After one week, an online survey was conducted to investigate their learning engagement. Finally, two focus group discussions were conducted to further understand detailed feedback and suggestions.

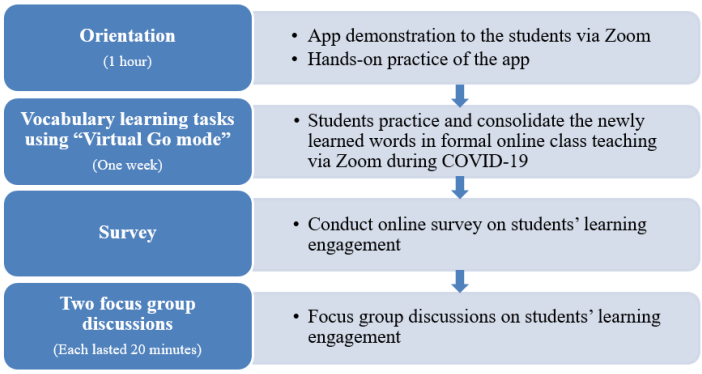


Figure 3. Procedure of the study.

5. Results

5.1 Survey Results

The survey results are presented in Table 1. In this study, the Cronbach's alpha was 0.714, suggesting that the items have relatively high internal consistency (Cronbach, 1951). The survey results indicated that students' learning engagement of using the Virtual Go Mode was high regarding curiosity (M=3.67, SD=.97), internal interest (M=3.47, SD=.39), concentration (M=3.22, SD=.77), However, students' control was in the relatively low level (M=2.96, SD=.58).

Table 1. *Descriptive Statistics of Students' learning Engagement of Using the Virtual Go Mode*

Items	N	Min	Max	Mean	SD
Curiosity	15	2.00	5.00	3.67	.97
Internal interest	15	2.67	4.00	3.47	.39
Concentration	15	2.33	5.00	3.22	.77
Control	15	2.00	4.00	2.96	.58
Valid N (listwise)	15				

5.2 Interview Results

The focus group interviews indicate that Virtual Go Mode in the VocabGO app improved students' learning engagement regarding curiosity, internal interest, concentration, and control. The focus group interviews show that the majority of interviewees agreed that Virtual Go Mode in the VocabGO app made vocabulary learning interesting, thereby enhancing their learning engagement. Regarding "curiosity" in their flow experience, all of the students felt that the Virtual Go Mode aroused their curiosity because they were able to complete a variety of quizzes by scanning fruits in the Virtual Fruit Market" – PARKnSHOP. Two interviewees (pseudonyms were used) further explained:

- *"The Virtual Go Mode is very interactive. Learning vocabulary is like going on an adventure. I am curious as to what fruits I may discover in various colour zones." (Tom)*
- *"It was a totally different learning experience. It stimulated my imagination, as if I were at a virtual market and discovered a variety of fruits." (Cindy)*

In terms of "internal interest", all students reported that the Virtual Go Mode was fun and interesting, making the English vocabulary learning experience enjoyable.

Regarding "concentration", students mentioned that in most cases, they were absorbed in the activity, but if the recognition failed, they would be aware of other things, such as Internet speed and objects around them in the real life.

Finally, in relation to "Control", reported that they were clear about how to use the Virtual Go Mode to complete the learning task.

The interviewees also commented and provided suggestions on the app design: (1) the object recognition accuracy should be improved when an object is scanned using the app; (2) the size of the recognition frame should be adjusted; and (3) audio recording function did not work well.

To sum up, the interview results indicated that the Virtual Go Mode could enhance students' engagement regarding "curiosity, internal interest and concentration". However, in terms of "control", technical issues (e.g., recognition accuracy, recognition frame) need to be solved in order to improve students' sense of control in the future.

6. Discussion and Conclusion

The results of the evaluation study showed that students' learning engagement was in good levels in terms of curiosity, internal interest and concentration, except for control. Therefore, this study concluded that the Virtual Go mode had the potential to enhance English vocabulary learning engagement among lower grade primary school children. The interview results were consistent with findings in previous studies, suggesting that AR-enhanced language learning is beneficial for increasing learning engagement and making learning enjoyable (Ji & Shin, 2019; Hamari et al., 2016; Wen, 2021). It is suggested that future research focus on empirical studies in designing and implementing virtual location-based tasks supported by the AR app in class to provide opportunities for students to practice and consolidation newly learned words and enhance their learning engagement in the post-COVID-19 pandemic.

The limitations of the study lie in mainly four aspects. Firstly, the findings could not be generalised due to the short duration of the study and the small number of participants involved. Thus, future studies could be carried out longitudinally and involve a larger sample size. Secondly, this study did not examine the effects of gender on students' English vocabulary learning outcomes. Thus, studies of gender differences will be conducted in the future. Thirdly, the technical issues might influence students' learning experience. Therefore, hands-on workshops on using the app will be implemented in the future studies. Finally, based on the students' feedback, the app needs further improvement to maximise its benefits for students' vocabulary learning.

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