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# Implementation of Web-Based Dynamic Assessments as Sustainable Educational Technique for Enhancing Reading Strategies in English Class during the COVID-19 Pandemic

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**Abstract:** The COVID-19 pandemic has resulted in educational disruption at a global scale. Based on the United Nation's Sustainable Development Goal 4, "achieving inclusive and quality education for all", this study designed two feasible learning models for the solution of sustainable learning during the COVID-19 pandemic, GPAM-WATA and Paper-and-Pencil test (PPT). The GPAM-WATA, a web-based dynamic assessment, offers online learning to most of the populations impacted by the COVID-19 pandemic, while PPT makes the vulnerable groups' access to learning possible with the aid of paper-based delivery. A quasi-experimental design was adopted, and both learning models were applied to a junior high school English reading course in Taiwan. A total of 122 seventh graders were randomly assigned to the GPAM-WATA group and PPT group for self-directed learning. The findings show that the GPAM-WATA is a sustainable educational technique that facilitates a better improvement in English reading performance. The PPT also has a positive effect on English reading performance, although not significantly if compared with the GPAM-WATA. This study suggests that GPAM-WATA is effective for English reading instruction in an online learning environment. The PPT can be an alternative approach for students stuck without access to online delivery during the COVID-19 pandemic.

**Keywords:** sustainable educational technique; COVID-19; web-based dynamic assessment; GPAM-WATA; English reading instruction; reading comprehension

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## 1. Introduction

The COVID-19 pandemic has had a massive impact on all aspects of life worldwide, including education. The rapid spread of COVID-19 among humans has generated the need for social distancing. Accordingly, most governments have closed educational institutions to prevent crowds. The global scale of the current educational disruption is alarming, and, if prolonged, it could threaten the right to education [1]. As scholars frequently address "learning" as a key driver for sustainable development [2] and the Sustainable Development Goal 4 aims to encompass equitable access to quality education and lifelong learning opportunities for all [3], school closures have necessitated the identification of alternative teaching methods. To continue educational activities, educational tools in the form of online learning may serve an important role since many schools provide students with online courses to mitigate the impact of school closures [4]. However, a shift to online learning presents a challenge to those areas where computers or the internet are out of reach. Before COVID-19, students in vulnerable or disadvantaged communities were particularly at risk of educational inequalities, and the pandemic has widened the existing education crisis, putting many already marginalized students at a further disadvantage [1]. Given the circumstances, relying on online learning as a solution to ensure continuity of learning may only be an option for some areas impacted by COVID-19. To promote

learning opportunities for all, it is important to highlight some actions that need to take place for supporting both educators and students out of the reach of online learning, allowing them to continue teaching and learning. In other words, school education in the COVID-19 pandemic has two possibilities: a transformation towards online learning and offline learning with the aid of paper-based delivery.

Online learning has become an important trend and may help fill the gap when conventional (face-to-face) education in the COVID-19 pandemic is not possible [4]. In addition to providing richer learning resources, online learning allows learners to learn without the limitation of time and space [5]. Given this, learners lack the supervision mechanism of traditional teaching and must be highly self-directed in an e-learning environment. Bransford et al. [6] pointed out that, in an effective learning environment, an assessment-centered learning environment, teachers incorporate assessment into teaching activities to facilitate students in performing self-directed learning. Timely feedback from the self-assessment is the major feature of the assessment-centered learning environment [7]. According to Paris and Paris [8], self-assessment is an effective strategy for helping learners to perform self-directed learning since learners can monitor their learning conditions during the learning procedure and improve their learning effectiveness through correcting their course of learning. However, it is difficult for learners to perform effective self-assessment and receive timely feedback since teachers often teach too many students in a pressured teaching schedule, and therefore an assessment-centered learning environment is difficult to construct in a conventional learning context [5].

A high degree of implementation of online learning and assessment of online learning achievement can be conducted by effective integration of technology [9]. The online learning experience becomes more effective when timely feedback is provided within a positive (human–machine) interactive environment [10]. With the help of technology, a web-based assessment system equipped with well-designed feedback information can be constructed to provide timely feedback when learners encounter learning difficulties, and therefore can motivate them to actively interact with the system to perform self-assessment [11]. Wang [12] stated that dynamic assessment was an effective assessment approach that encourages learners to perform self-assessments and that constructs an assessment-centered e-learning environment. It had two major instructional characteristics in common: "*individuals are provided with an opportunity to learn*" [7], and *"instruction and feedback are built into the testing process*" [13]. Based on the idea of an assessment-centered learning environment, Wang [12] developed the Graduated Prompting Assessment Module of the WATA (GPAM-WATA) system, a web-based dynamic assessment system to construct an assessment-centered e-learning environment. This e-learning system allows teachers to construct instructional items and prompts (IPs) and to compose e-learning materials online that allow students to engage in and perform assessment-centered e-learning [11].

The GPAM-WATA system was designed based on the concept of "*taking assessment as teaching and learning strategy*", with the expectation that the web-based dynamic assessment system can play the role of teachers or helpful peers [5,12]. The theoretical basis for the dynamic assessment is the zone of proximal development (ZPD) proposed by Vygotsky [14]. The ZPD refers to the difference between the cognitive levels that can be achieved by learners with and without assistance [11,15]. The GPAM-WATA adopts the cake format (CF) of dynamic assessment proposed by Sternberg and Grigorenko [16]. The CF dynamic assessment primarily involves a graded series of hints based on the "graduated prompt approach" proposed by Campione and Brown [17,18]. Learners must answer a series of items, wherein they can proceed to answer the next item only if they answer the previous item correctly. If they do not answer an item correctly, they are provided a graded series of hints. These preset successive hints, from "general hints" (less related to the answers and nonspecific) to "specific hints" (that provide complete guidance to the answer), help learners gradually identify the correct answer [17,18]. Through this approach, the GPAM-WATA progressively provides learners with three instructional

prompts (IPs) when they have difficulty in answering items. The three IPs provide required knowledge that learners lack in different disciplines through related pedagogical theories.

In terms of second/foreign language learning, Hulme and Snowling [19] stressed the importance of cultivating learners' reading strategy awareness by using appropriate reading materials, and they noted a direct correlation between reading strategy use and learners' academic achievements. The present study attempted to apply the GPAM-WATA for English reading instruction in a junior high school in Taiwan, investigating its effectiveness in facilitating reading performance. Fuchs et al. [20] indicated that reading fluency represented a complex process in which readers had to integrate their perceptual skills to translate letters into coherent sound representations, their lexical skills to unitize those sound components into recognizable wholes, their processing skills to identify meaningful connections within or between sentences, and finally to relate gained information with their prior knowledge for text comprehension. Kung [21] thus contended that successful reading comprehension required the application of multiple reading strategies. Yang [22] also asserted that the reading strategy could be used to help change learners' reading behavior, repair deficits in their understanding of a text, and finally enhance their reading performance.

Regarding the reading strategy, reciprocal teaching was an instructional approach designed to improve learners' reading comprehension through scaffolded teaching that comprises four reading strategies: predicting, questioning, clarifying, and summarizing [23]. This approach regards reading as a problem-solving activity whereby teachers explicitly teach and model the predicting, questioning, clarifying, and summarizing strategies in the initial phase, followed by students taking turns in leading the activity and practicing the strategies on the subsequent section of a text [24]. During the procedure, the role of students shifts from that of spectators to performers, and the role of teachers gradually fades after they model the strategies through the scaffolded instruction [25]. Reciprocal teaching is based on ZPD theory [14] and Bruner's [26] notion of scaffolding. According to Rogoff and Gardner [27], learners with low capabilities can acquire expert problem-solving skills by performing certain tasks under expert guidance. In reciprocal teaching, a teacher provides expert scaffolding to students, which equips students to solve their reading questions by using the four strategies [23]. First, students are asked to make a prediction from the clues available in the text [24]. Teachers and more capable peers provide many forms of support to learners with low capabilities when they encounter difficulties in text comprehension [25]. This support includes demonstration, discussion, asking questions, and providing feedback [28]. Finally, the summarizing strategy is applied to monitor and review learners' understanding of a text [29]. Thus, reciprocal teaching helps learners with low capabilities transform into more capable and eventually self-directed readers. Several lines of evidence have confirmed the effectiveness of reciprocal teaching in providing reading instruction to foreign/second language learners through explicit demonstration of the four strategies [29–31]. Palinscar and Brown [23] found that the performance of students who received reciprocal teaching was superior to their counterparts who received alternative teaching approaches. Based on this construct, this study adopted reciprocal teaching as a pedagogical theory in the teaching of English reading.

The global scale of the current educational disruption caused by the COVID-19 pandemic poses a serious threat to the realization of Sustainable Development Goal 4. In particular, it may further exacerbate educational inequalities for the most vulnerable, such as people who have difficulties with online learning. In addition to the online learning through the GPAM-WATA, this study offers another feasible learning model as an emergency initiative for the purpose of meeting the educational needs of the broader community during the lockdown of the COVID-19 pandemic. The GPAM-WATA system was directly used as a "test–teach–retest" self-directed online learning model to simultaneously integrate teaching and timely feedback in the assessment process. This system allows teachers to incorporate important learning materials into the design of instructional

items and their related IPs and encourages learners to engage in an assessment-centered e-learning environment (see Section 2.2.3). Considering the difficulty in implementing online learning for those vulnerable or disadvantaged communities, the Paper-and-Pencil test (PPT) with the aid of paper-based delivery was designed to perform an offline self-assessment learning corresponding to the GPAM-WATA online learning (see Section 2.3). This study tried to address the following two research questions:

(1) How effective are the GPAM-WATA and PPT in improving students' English reading strategy use?
(2) How effective are the GPAM-WATA and PPT in improving students' English reading comprehension?

## 2. Materials and Methods

### *2.1. Participants*

The participants were 122 seventh graders from 4 classes in a junior high school in Taiwan. The students from the four classes were randomly assigned to the GPAM-WATA group or PPT group. Ultimately, the GPAM-WATA group comprised 64 students (36 boys and 28 girls), and the PPT group comprised 58 students (31 boys and 27 girls).

### *2.2. Instruments*

#### 2.2.1. Learning Materials

This study applied seven types of texts for junior high school English reading, including "short essay", "letter", "poster", "advertisement", "map", "dialogue", and "timetable". Learning materials consisted of instructional items (seven types of texts) and their related IPs (four reading strategies). They were presented in different ways in the two learning models to help students use four reading strategies of reciprocal teaching to read (see Section 2.3).

#### 2.2.2. Web-Based Dynamic Assessment Items

The web-based dynamic assessment items in the GPAM-WATA were named instructional items. They were primarily used in this study to facilitate students' implementation of self-directed learning. Seven types of texts, including 28 instructional items, were designed based on the learning materials (see Section 2.2.1). Each instructional item had three IPs (see Table 1). The instructional items and their IPs were reviewed by three English instruction and assessment experts. In addition, the experts evaluated the IP content design and whether the items were properly constructed and distributed based on a two-way chart. Students in both the GPAM-WATA group and PPT group answered the same 28 instructional items. The only difference between the groups was in the administration of the assessment (see Section 2.3).

**Table 1.** Design principles of IPs of the dynamic assessment items.

| Phases | Design Principle | Reciprocal Teaching |
|---|---|---|
| $IP_1$ | Presenting key cues in the text | Predicting |
| $IP_2$ | Explaining questions and assisting students with clarification of required elements | Questioning and clarifying |
| $IP_3$ | Providing important material from the text for comprehension or direct instruction | Summarizing |

#### 2.2.3. Web-Based Dynamic Assessment System—GPAM-WATA

Each instructional item in the GPAM-WATA had three IPs that provided timely instructional messages for problem solving. These IPs were designed by teachers based on the learning goal of and answer for each item, Palinscar and Brown's [23] reciprocal teaching, and the "graduated prompt approach" [17,18]. Palinscar and Brown [23] argued that

the understanding of a text involves four steps: "predicting", "questioning", "clarifying", and "summarizing". The teaching activity in this study aimed to enhance students' reading performance by teaching them to use the four reading strategies mentioned above. In this respect, the four reading strategies were designed in the form of three IPs ($IP_1$, $IP_2$, and $IP_3$) to compensate for the knowledge of reading strategy that learners lacked and to facilitate reading comprehension. $IP_1$ was designed to provide the required knowledge on the "predicting" strategy, which included taking advantage of the clues available in the text, such as the title, charts, diagrams, and headings, for content prediction. $IP_2$ was designed to provide the required knowledge on the "questioning and clarifying" strategy, including a self-directed 6w questioning method (who, what, why, where, when, and how) for clarification of concepts. $IP_3$ was designed to provide the required knowledge on the "summarizing" strategy, which included pinpointing and retaining important material to effectively grasp the main ideas. Learners can effectively comprehend a text only when equipped with required knowledge of reading strategy in the reading process. Table 1 presents the design principles of the IPs embedded in the instructional items in this study.

Below are descriptions of how students learn in GPAM-WATA in this study. The GPAM-WATA first presents instructional items (See Figure 1), and students answer them one by one. During the assessment, the GPAM-WATA provides teaching assistance to students through the IPs (See Figure 2). If the students answer an item correctly, the system displays the message "correct" on the screen, after which they can proceed to answer the next item. When a student answers an instructional item incorrectly for the first time, the GPAM-WATA provides an IP ($IP_1$) before displaying the next item, and later, the GPAM-WATA again randomly presents the item that the student answered incorrectly. If the student is still unable to answer the item correctly, the GPAM-WATA provides a second graduated instructional prompt ($IP_2$) before proceeding to subsequent items, and it randomly returns to the same item later in the assessment. When students answer an item correctly or fail to answer correctly even after receiving three IPs, the system does not present that particular item again. This process continues until the students answer all the items. Moreover, at each repeated attempt to answer an item, the GPAM-WATA presents the multiple choices of the item in a random order. In the PPT group, the instructional items are printed on paper. After the students finish answering the questions, the correct answers and IPs for each item are provided for their reference in paper format. Therefore, through this method, the students cannot immediately know whether their answers were correct.

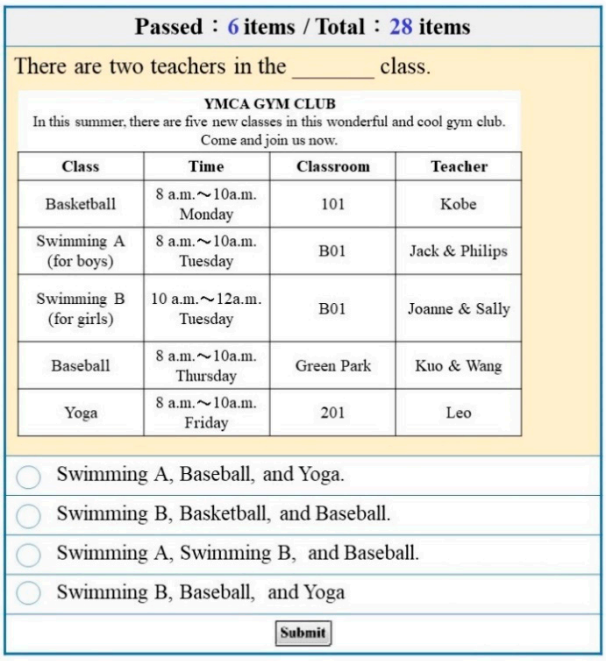


**Figure 1.** Screen of taking an instructional item in GPAM-WATA system.

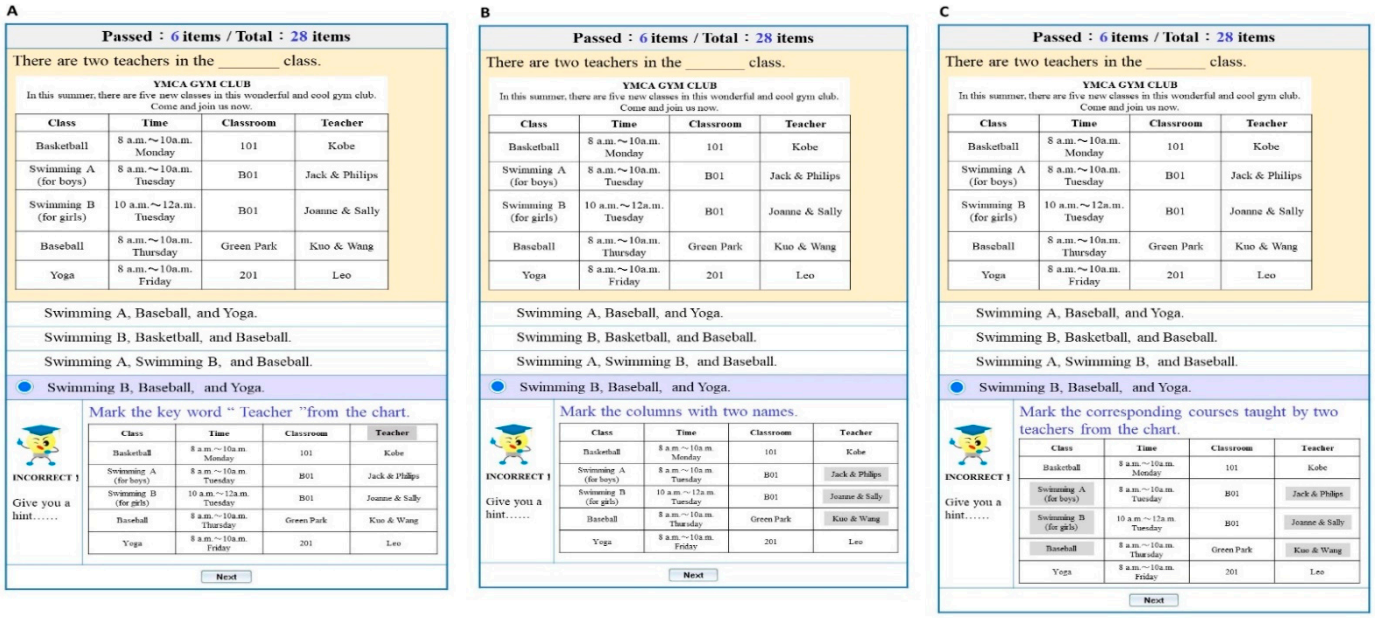


**Figure 2.** Student answers an item incorrectly and gets an instructional prompt (IP), which is the (**A**) $IP_1$, (**B**) $IP_2$, (**C**) $IP_3$ of this item, respectively.

#### 2.2.4. English Reading Strategy Scale

The English reading strategy scale was employed for both the pre-test and post-test to understand the improvement of students' English reading strategy use. The scale in this study was designed based on Palinscar and Brown's [23] four reading strategies of reciprocal teaching. The sample items were: "*I will read the title to predict the text content when reading*" (predicting strategy); "*I often comprehend the text content by asking myself questions*" (questioning strategy); "*I will mark the place where I have difficulty in understanding its content when reading*" (clarifying strategy); "*I will summarize the key points of the text when reading*" (summarizing strategy). The items were rated on a 5-point Likert scale, with

scores of 5 (strongly agree) to 1 (strongly disagree). Higher scores indicated that students were more likely to use the four strategies in the reading process (maximum of 75 points). The internal consistency reliability (Cronbach's $\alpha$) of the scale was 0.923.

#### 2.2.5. English Reading Comprehension Test

The English reading comprehension test comprised 25 multiple-choice items primarily used in the pre-test and post-test to evaluate students' understanding of reading materials. The 25 items were designed based on the seven types of texts mentioned above. Each correct answer was scored 4, and incorrect answers were scored 0 (maximum of 100 points). To assess the validity of the assessment, three English education and assessment experts evaluated whether the items were properly distributed and designed based on a two-way chart. The KR20 of the reading comprehension test was 0.933.

### *2.3. Research Design and Procedures*

This study adopted a quasi-experimental design to evaluate the effectiveness of the two learning models, GPAM-WATA and PPT. They simulated two learning possibilities that might be conducted during the COVID-19 pandemic. Students in both groups completed the same English reading strategy scale and English reading comprehension test, after which they used different learning models. Students in the GPAM-WATA group underwent web-based dynamic assessment in the GPAM-WATA system and received successive IPs online. Students in the PPT group took the same instructional items but in a paper-based version; the correct answers and the IPs for each item were also printed on a paper that was provided for their reference. A total of 28 instructional items were provided to the two groups of students.

The research procedure was as follows. First, the students were randomly divided into the GPAM-WATA group or PPT group. All students underwent the pre-test of the English reading strategy scale and English reading comprehension test to obtain students' learning conditions prior to the research. During the learning procedure, students experienced one of the two types of learning models without the teacher providing any instruction. Finally, all students retook the post-test of the English reading strategy scale and English reading comprehension test to understand their learning effectiveness in the two learning models.

### *2.4. Data Collection and Analysis*

Quantitative data, including the pre-test and post-test scores for the reading strategy scale and reading comprehension test, were analyzed using SPSS™ version 20.0. Repeated-measures analysis of variance (ANOVA) was used to evaluate the differences in reading strategy use and reading comprehension between the GPAM-WATA and PPT groups. In the process of data collection, data with incomplete pre-test or post-test due to personal reasons of students were not included in the analysis.

## 3. Results

### *3.1. Analysis of Student Improvement in the Scores of English Reading Strategy Scale*

The results of the descriptive statistical analysis of the pre-test and post-test scores of the English reading strategy scale completed by the students in both groups are presented in Table 2. Valid participants in both GPAM-WATA and PPT groups were 61 and 55, respectively. The pre-test scores significantly differed between the GPAM-WATA and PPT groups ($t = 2.785$, $p < 0.05$). Both GPAM-WATA group ($t = -7.983$, $p < 0.01$; Cohen's $d = 0.757$) and PPT ($t = -4.849$, $p < 0.01$; Cohen's $d = 0.484$) helped students in the two groups achieve significantly better post-test scores than pre-test scores.

**Table 2.** Descriptive statistical analysis of the pre-test and post-test scores of the English reading strategy scale.

| Group | Pre-Test Scores | | Post-Test Scores | | *t* Value | *p* | Cohen's *d* |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| GPAM-WATA group ($n$ = 61) | 49.930 | 11.902 | 58.300 | 10.148 | −7.983 ** | 0.000 | 0.757 |
| PPT group ($n$ = 55) | 55.640 | 9.926 | 60.270 | 9.188 | −4.849 ** | 0.000 | 0.484 |
| $t$ value | 2.785 * | | 1.096 | | | | |

* $p < 0.05$, ** $p < 0.01$.

As denoted in Table 3, the results of the repeated-measures ANOVA with the two measurement points (time_point) of English reading strategy scale as the within-subjects variable and the two learning models (group) as the between-subjects variable revealed a significant main effect for time_point ($F_{1,114} = 82.773$, $p < 0.01$, partial $\eta^2 = 0.421$). We also observed a significant main effect for the group ($F_{1,114} = 4.588$, $p < 0.05$, partial $\eta^2 = 0.039$), which indicated that the pre-test and post-test scores differed considerably between the two groups. In addition, we found a significant interaction effect ($F_{1,114} = 6.797$, $p < 0.05$, partial $\eta^2 = 0.056$), suggesting that students in the GPAM-WATA group exhibited significantly greater improvement in reading strategy use than did the students in the PPT group (see Figure 3). These findings highlight that the GPAM-WATA is more effective in facilitating reading strategy use.

**Table 3.** Summary table of repeated measures ANOVA on the scores of the English reading strategy scale.

| Source | SS | *df* | MS | *F* | Partial $\eta^2$ |
|---|---|---|---|---|---|
| Between | | | | | |
| Group | 852.864 | 1 | 852.864 | 4.588 * | 0.039 |
| Error | 21193.666 | 114 | 185.909 | | |
| Within | | | | | |
| Time_point | 2442.823 | 1 | 2442.823 | 82.773 ** | 0.421 |
| Time_point × Group | 200.582 | 1 | 200.582 | 6.797 * | 0.056 |
| Error | 3364.396 | 114 | 29.512 | | |

Note: Time_point: the pre-test and post-test scores of the English reading strategy scale; group: GPAM-WATA group and PPT group; ANOVA: analysis of variance. * $p < 0.05$, ** $p < 0.01$.

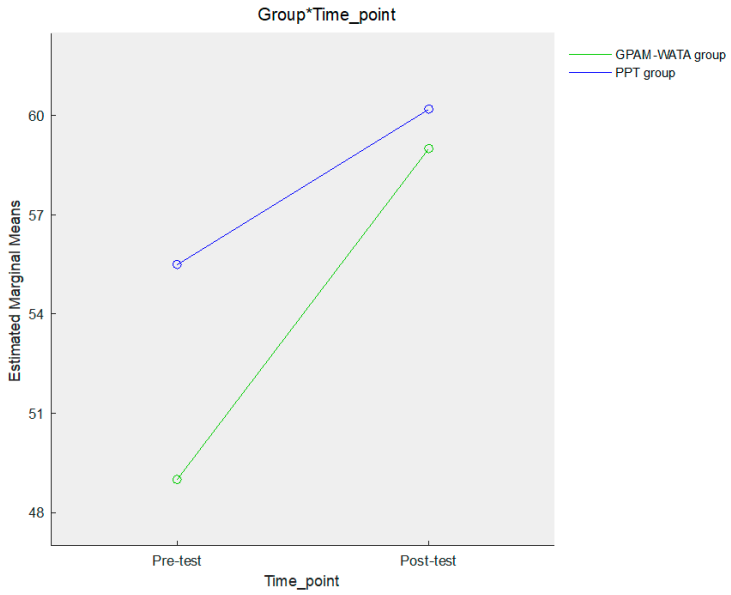


**Figure 3.** Plot of repeated measures ANOVA from the scores of the English reading strategy scale.

*3.2. Analysis of Student Improvement in the Scores of English Reading Comprehension Test*

The descriptive statistical analysis results of the pre-test and post-test scores of the English reading comprehension test in both groups are presented in Table 4. Valid participants in both GPAM-WATA and PPT groups were 64 and 58, respectively. Students in the GPAM-WATA and PPT groups had similar pre-test scores ($t = 0.892$, $p > 0.05$). Only the students in the GPAM-WAWTA group achieved significantly better post-test scores than pre-test scores ($t = -5.329$, $p < 0.01$; Cohen's $d = 0.453$).

**Table 4.** Descriptive statistical analysis of the pre-test and post-test scores of the English reading comprehension test.

| Group | Pre-Test Scores | | Post-Test Scores | | *t* Value | *p* | Cohen's *d* |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| GPAM-WATA group ($n = 64$) | 66.380 | 29.761 | 78.630 | 23.971 | −5.329 ** | 0.000 | 0.453 |
| PPT group ($n = 58$) | 71.030 | 27.726 | 73.030 | 27.840 | −1.563 | 0.124 | 0.072 |
| *t* value | 0.892 | | −1.192 | | | | |

** $p < 0.01$.

As indicated in Table 5, the results of the repeated-measures ANOVA with the two measurement points (time_point) of English reading comprehension test as the within-subjects variable and two learning models (group) as the between-subjects variable revealed a significant main effect for time_point ($F_{1,120} = 27.743$, $p < 0.01$, partial $\eta^2 = 0.188$). However, no significant main effect was evident for the group ($F_{1,120} = 0.009$, $p > 0.05$, partial $\eta^2 = 0.000$), indicating that students in the GPAM-WATA and PPT groups had similar pre-test scores but considerably different post-test scores. In addition, we found a significant interaction effect ($F_{1,120} = 14.354$, $p < 0.01$, partial $\eta^2 = 0.107$), suggesting that the gap between the students in the GPAM-WATA and PPT groups increased in the post-test (see Figure 4). These findings indicate that the students in the GPAM-WATA group exhibited significantly greater improvement in English reading comprehension than the students in the PPT group did. These findings highlight that the GPAM-WATA is more effective in improving students' English reading comprehension.

**Table 5.** Summary table of repeated measures ANOVA on the scores of the English reading comprehension test.

| Source | SS | *df* | MS | *F* | Partial $\eta^2$ |
|---|---|---|---|---|---|
| Between | | | | | |
| Group | 13.187 | 1 | 13.187 | 0.009 | 0.000 |
| Error | 166,631.862 | 120 | 1388.599 | | |
| Within | | | | | |
| Time_point | 3089.213 | 1 | 3089.213 | 27.743 ** | 0.188 |
| Time_point×Group | 1598.328 | 1 | 1598.328 | 14.354 ** | 0.107 |
| Error | 13,362.000 | 120 | 111.350 | | |

Note: Time_point: the pre-test and post-test scores of the English reading comprehension test; group: GPAM-WATA group and PPT group; ANOVA: analysis of variance. ** $p < 0.01$.

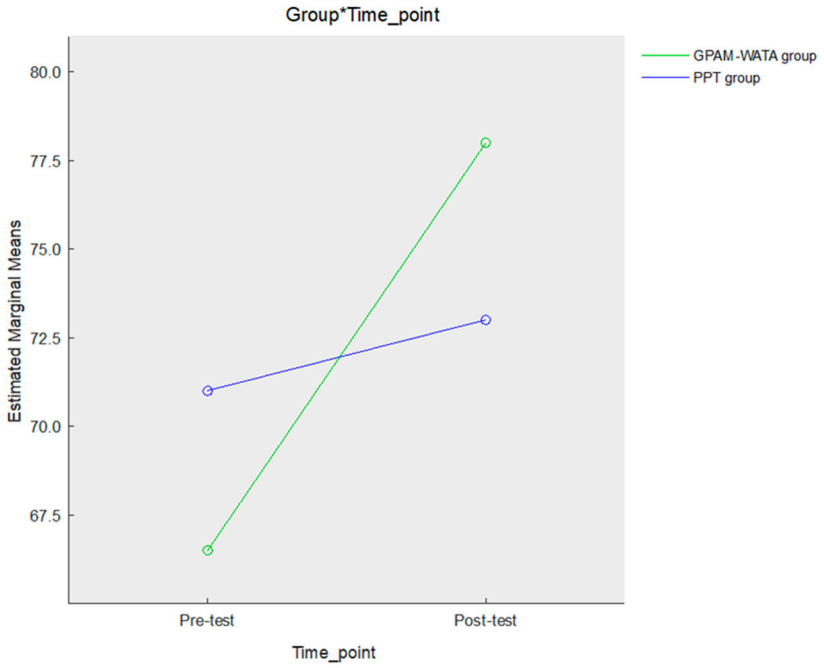


**Figure 4.** Plot of repeated measures ANOVA from the scores of the English reading comprehension test.

## 4. Discussion

The study results demonstrate that students in both GPAM-WATA and PPT groups achieved improvement in English reading strategy use and English reading comprehension. The result is in accordance with Lau and Chan's [32] viewpoints that reading strategies are an important factor affecting reading comprehension. As Lau [33] argued, the strategies used in the reading process reflect a deep commitment to text comprehension. Moreover, the GPAM-WATA exhibited significantly better improvement in English reading performance. This indicates that the GPAM-WATA is more effective in helping students transform the ability of using reading strategies into the ability of reading comprehension. Since the teacher did not provide any instruction during the procedure, it further indicates that GPAM-WATA enabled students to perform a more effective self-directed learning.

Based on the studies of Marriott [15] and Wang [11], this study attributed the finding to the fact that the GPAM-WATA is more effective in facilitating English reading instruction, compared with PPT. It has effective human–machine interaction and web-based dynamic assessment design, and the feedback strategies influence reading performance to a greater extent. The GPAM-WATA was based on the CF dynamic assessment defined by Sternberg and Grigorenko [16] and the "graduated prompt approach" proposed by Campione and Brown [17,18]. In this method, reading instruction and their related feedback (IPs) were delivered to students through the GPAM-WATA system. When students failed to answer an item correctly, the system provided them with IPs. The feedback (IPs) provided by the graduated prompt approach activates the learning potential of the students (i.e., ZPD), enabling them to understand their own learning conditions and leading them to arrive at correct answers in a self-directed way during this process [34]. That is, the IPs compensate for the knowledge of reading strategy that students lack; in turn, students can progressively obtain the intermediate knowledge required for text comprehension. In a word, the GPAM-WATA conducts an assessment-centered e-learning environment for students by incorporating dynamic assessment into teaching activities and helps to mon-

itor and correct the course of learning by providing timely feedback. The feedback received by students when they provide incorrect answers is a crucial interactive feature, and therefore GPAM-WATA is more effective in facilitating English reading instruction.

According to Martín et al. [35], during the COVID-19 pandemic, the major characteristic of a successful virtual educational environment is that teachers become guidance counsellors; moreover, students transform their learning experiences by using an active self-directed model through interaction with multimedia content with the aid of digital tools independent of space and time. In the GPAM-WATA system, learners can actively manage their self-directed learning by means of "test–teach–retest" model. Teachers first incorporate important learning materials into the design of instructional items and their related IPs, after which learners log into the system for self-assessment. The interactive model of learners and assessment in the GPAM-WATA is in line with the need for the implementation of online learning during the COVID-19 pandemic.

Research findings also reveal that students in the PPT group have a significant improvement in English reading strategy use. Such a result might be due to the fact that students in the PPT group also received IPs, as did students in the GPAM-WATA group. The difference is that the GPAM-WATA system gives the IPs in the form of online timely feedback; therefore, students can immediately know their learning conditions during the procedure, while the PPT delivers IPs in a paper-based version through which students are more likely to know their learning conditions only after they finish answering all the items. Thus, there is a certain gap in the degree of improvement between the two groups. As a matter of fact, students in the PPT group also have an improvement in their English reading comprehension, although not as significant as compared with the GPAM-WATA. This indicates that the PPT also helps to perform a self-directed learning with the paper-based instructional items and their related IPs.

Based on the findings, it can be argued that students benefit from both the GPAM-WATA and the PPT learning models. The GPAM-WATA can only really be implemented effectively when both students and educators have reliable access to the technology and resources needed for online delivery. Ahmed and Nwagwu [36] identified internet connectivity and digital devices as the key challenges to online learning. Ideally, online learning enables students to learn better. The issue at hand is not associated with the best option for educational institutions but with an inclusive and equitable education that demands emergency remote teaching to ensure that students are not excluded during this pandemic era, which is a point emphasized by Sustainable Development Goal 4 [3]. The PPT in this study avoids the issue of using an online network, and learning materials are distributed via paper-based delivery. In this respect, it can be regarded as an alternative learning model for English reading instruction that ensures a continuity in learning for the most vulnerable groups during the COVID-19 pandemic.

## 5. Conclusions and Suggestions

The two learning models in this study were designed based on the United Nation's Sustainable Development Goal 4, "achieving inclusive and quality education for all" [3]. The COVID-19 pandemic has made this goal more challenging to achieve since equity is a major constraint on access to online learning [37]. The two learning models used in this study provide feasible emergency initiatives to meet the needs of the broader community. GPAM-WATA is a sustainable educational technique and offers sustainable and effective learning solutions to the populations who can have access to the necessary hardware and software for online delivery. It allows students to perform self-directed learning in an assessment-centered e-learning environment. PPT gives the most vulnerable groups access to learning opportunities with the aid of paper-based delivery. Students can also perform their self-directed learning by means of paper-based instructional items and their related IPs. The findings show that GPAM-WATA is more effective in improving students' English reading strategy use and reading comprehension. PPT also has a positive effect in

facilitating English reading instruction, although not a significant one if compared with the contribution of the GPAM-WATA.

There are several limitations. This study adopted the GPAM-WATA system to perform online learning as an emergency initiative. Systematic training activities might not have been carried out prior to using the GPAM-WATA system. Therefore, the effectiveness of GPAM-WATA system might not be consistent across educational institutions. Similarly, an effective learning experience with the use of GPAM-WATA in this study cannot be generalized to other aspects of language learning or other age groups. It is suggested that more qualitative and quantitative research should be conducted in a broader range of subjects to comprehensively examine learners of various grades. Additionally, the English reading instruction took the class as the unit of measurement; students from the four classes were randomly divided into two groups. In this regard, students' entry behavior cannot be well controlled. The findings can be advanced if the sample size is expanded and grouped by individuals. According to Toquero [38], educational disruptions caused by other reasons may occur in the future. This uptick in demand of online learning suggests a consideration for the improvement of the short-term solution into a long-term plan that can support the regular online educational requirements of society in the future. Accordingly, effective government policies that sustain quality education even during unforeseen crises are required.

Indeed, online learning has many advantages for continuing learning in any location without interruption. However, its implementation is limited by several factors such as reliable internet connectivity, digital devices, and digital competences. According to the United Nations [3], at least 5 million students still do not have access to online learning despite its implementation in countries where schools have been closed. Under the current situation, any meaningful effort to continue learning can be a suitable alternative for those without computers or internet access during the COVID-19 pandemic. When we aim to ensure continuity of learning, it is of utmost importance to consider the current learning conditions in different areas around the world. In this study, we find that the PPT can also be a sustainable and effective learning solution for English reading instruction among the vulnerable groups stuck without access to online delivery during this pandemic era.

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