A proper question representation mode with study content combination for Web-based formative assessment

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ABSTRACT: Web-based formative assessment is an effective way to facilitate learners' reflection and the instructors' control. It makes studying a familiar activity, thus achieving the teaching goal. A general Web-based formative assessment allows the correct answer to be hinted at when an incorrect answer has been entered, gives instant feedback and allows the test to be repeated. That is, the general Web-based formative assessment with an independent and mass question representation decreases the learning motivation and effectiveness. In this article, to address this issue, a different questions representation mode of Web-based formative assessment is proposed to provide a friendly and proper interface. The system combines study content with its corresponding assessment. Both the learners' interests and self-study opportunities are, therefore, advanced. According to the experimental results, the group taking the proposed Web-based formative assessment was superior in terms of frequency of practice and by measures of effectiveness than the group using other tools. Further, the group using Web-based formative assessment had higher learning motivations and effectiveness.

INTRODUCTION

Inherited from traditional teaching environments, modern on-line learning systems possess the traditional functionality of the teaching process with regards to assessment. For different requirements and purposes, two type of learning assessment are included, that is, summative assessment [1-3] and formative assessment [4-6]. For on-line learning, the formative assessment is appropriate because of its stage-by-stage nature, such as in the general Learning Management System (LMS). However, most LMSs perform formative assessment using an improper representation mode in which questions are presented to learners without consideration of the study content or learners' interests. Further, the benefits of formative assessment cannot be gained using this mode since the requirements of formative assessment are not fully met.

In Web-based formative assessment, three requirements must be met in developing the tool: provide hints instead of the correct answer, instant feedback and ease of repeating the test [7][8]. The details are described as follows:

- *Provide hints instead of the correct answer*; instead of directly offering the answer, related clues or hints are given to the learner to encourage rethinking and reflection on the answer. This is an effective way to develop active study habits.
- *Instant feedback*; if the learner knows that their answer is correct or not, immediately after finishing a small test stage, then learning is reinforced. Further, the answer can be rectified immediately.
- *Ease of repeating the test*; using the Internet and computer multimedia, tests can be repeated whether or not the questions are identical. This is an effective way for learners to realise their individual learning outcomes. Further, it also improves the likelihood of the learner continuing, and it enhances familiarisation.

Regardless of different viewpoints all have the same concerns, that is, to enhance motivation and increase the effectiveness of learning.

Although all of the requirements are represented in the current LMS for formative assessment, the improvement of learning effectiveness is not achieved [2][3]. One of the major reasons is the learner's unwillingness to repeatedly perform an assessment since the question representation mode decreases the learner's motivation and learning effectiveness [2][3][6][9]. It is a crucial factor and needs to be improved. Specifically, that currently questions are independent of study content [10][11], and the question representation involves large numbers of questions [12].

Therefore, it is inconvenient for learners to search the content to identify the examination they have just completed. Not only is unnecessary time wasted, but also valuable time is lost which could be used to enhance the content. In addition,

reflection and the instructor's control are infeasible unless an improved representation can be proposed to provide improved learning effectiveness.

In this article, to address these issues, an enhanced and effective Web-based formative assessment is proposed. It is designed to solve the problems with the current question representation referred to above. The question representation arranges content in line with the examinations.

The enhanced and effective Web-based formative assessment is expected to improve learning reflection and practice frequency; therefore, improving learning effectiveness. An experiment from an English learning course at a Taiwanese private technical college was performed to compare the learning effectiveness, as well as the relevant results between the current and the enhanced question representation modes.

The rest of this article is organised as follows. The first section briefly describes a related study to facilitate the understanding of this article. In the following section, the methodology, experimental design, participants and the method of data collection are outlined. Then, the experimental results are analysed in the next section. Finally, discussion and conclusions complete the article.

RELATED STUDY: WEB-BASED FORMATIVE ASSESSMENT

Web-based formative assessment is generally applied to on-line learning (e-learning or distance learning). The major advantage is to combine the traditional formative assessment with on-line learning. That not only has the benefit of remedying learners' weaknesses at once, but also assessment can be performed anytime or anywhere. Further, the system makes it easy to repeat a test [13]. Through self-evaluation, students' attention and commitment are improved [14]. The instructors can use the Web-based formative assessment to devolve to the learners' the ability to self-assess, thus improving learning effectiveness [7]. Hence, instructors should take this into account.

METHODOLOGY

An experiment to measure learning effectiveness based on the proposed framework was introduced. Its details include several major parts as follows.

Experimental Design

The design employed in this study follows the quasi-experimental design, which involved the pre-test/post-test non-equivalent experimental control group [15]. It is referred to as the compromise design because of the infeasibility of random selection in the assignment of schools, as well as classrooms [16].

As shown in Table 1, the pre-test and post-test were performed using the listening and reading examination of the General English Proficiency Test (GEPT). It is useful to understand the original English listening and reading abilities, as well as the study's effectiveness. To determine the statistical difference between the normal and experimental English listening and reading abilities, an independent sample *t*-test was used to compare English listening and reading grades.

Table 1: The experimental design.

Group	Pre-test	Independent Variable	Post-test
A	O	X1	O
B	O	X2	O

X: Experimental variables O: Pre-test or Post-test

Experimental Participants

Seventy-one students between 18 and 20 years of age were recruited from a Taiwanese private college. These students were divided into two groups (Group A and B), which is useful for removing differences of learner motivation and background. The students in Group A made use of the presentation assessment method of the general LMS, as shown in Figure 1. Then, Group B was allocated to the novel presentation assessment method, as shown in Figure 2.

Data Collection

The collected data in this study were divided into two parts. First, the examination used for the pre-test and post-test was the GEPT listening and reading examination, which is an international standard examination. In 2008, the international reliability, KR-20, for the initial level of the listening examination was between 0.75 and 0.85, with an average reliability of 0.80 [17]. For the initial reading examination, the reliability was between 0.75 and 0.85, with an average of 0.83. It implies that this examination has sufficient consistency and stability.

Next, the data were collected using the formative assessment tool with two difference presentation forms. An assessment was provided using the formative assessment platform. Learners studied the content prepared by instructors. Then, the repeat study was undertaken with the response result, instead of notification of correct answers. The control group used the general LMS formative assessment tool. The content and assessment questions are independent. The reading test was decided by learners. The learning, practices and assessments of identical subjects were independent of group.

Data Collection Procedure

Table 2 shows the learning schedule for the experiment. Self-learning and testing occur throughout weeks 2 to 4.

Table 2: The learning process schedule.

Week	Process	Group A	Group B
Week 1	Instruction Guide	○	○
Week 1	Pre-test	○	○
Week 2-4	Learners' Self-Learning and Examination	○	○
Week 3	Class Announcement (The examination completed list)	○	○
Week 4	Post-test	○	○

Figure 1: The general on-line formative assessment LMS of the control group (Group A).

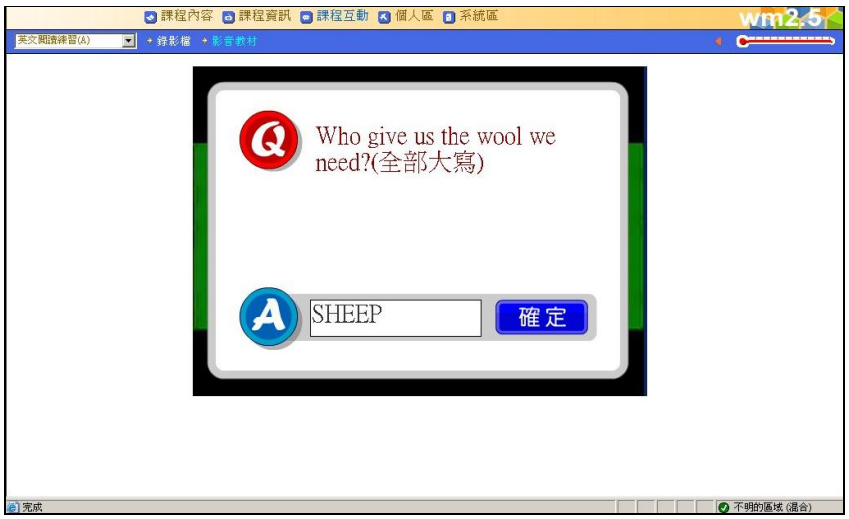

Figure 2: The specific formative assessment system of the experimental group (Group B).

Data Analysis

The results were evaluated with an independent *t*-test. There was a significant difference between the control and experimental group at all grade levels. To further express the importance of the findings, the effect size, also known as strength of association, was calculated. This set of statistics indicated the relative magnitude of the difference between

means. It described the amount of the total variance in the dependent variable that was predictable from the independent variable [18].

RESULTS

The findings were based on GEPT listening and reading assessment, which was taken by the experimental and the control groups. The pre-test aimed to test the subjects' listening and reading ability before the treatment. The results of the *t*-test confirmed there were no significant differences in the pre-test of the two groups (listening t=0.09, p=0.93, reading t=0.84, p=0.41).

Further, the correctness rates of repeat answers for Group A and Group B did show significant differences. Table 3 represents the averages and standard deviations of the pre-test and post-test taken by the students who were poor readers and good readers for the experimental group and the control group. The experimental group showed significant improvement from the pre-test (Means of listening and reading are 54.98 and 40.51, respectively) to the post-test (Means of listening and reading are 44.83 and 63.02, respectively). In contrast, the control group did not show a significant improvement from the pre-test (Means of listening and reading are 54.53 and 36.97, respectively) to the post-test (Means of listening and reading are 33.97 and 45.43, respectively).

Times for the repeat test were 1.23 for the control group (Group A) and 2.02 for the experimental (Group B) (see Table 3). The *t*-test showed no significant difference (t=4.42, p<0.01). After repeat answering, the correctness of the experimental group (Group B) was significantly better than the control group (Group A). This demonstrates that the practice frequencies of learners in Group B was better. That is, the learning effectiveness was better.

Table 3: The independent t-test of the post-test of the experimental group and the control group.

		N	M	*SD*	*SE*	*F*	*t*	*df*	*p*
Pre-test Listening	Experimental Group	41	54.98	24.52	3.83	2.02	0.09	69.00	0.93
	Control Group	30	54.53	16.26	2.97		0.09	68.43	0.93
Pre-test Reading	Experimental Group	41	40.51	21.15	3.30	16.67	0.84	69.00	0.41
	Control Group	30	36.97	11.18	2.04		0.91	63.58	0.36
Post-test Listening	Experimental Group	41	44.83	16.19	2.53	0.87	2.51*	69.00	0.01
	Control Group	30	33.97	20.33	3.71		2.42*	53.77	0.02
Post-test Reading	Experimental Group	41	63.02	15.69	2.45	5.57	3.63**	69.00	0.00
	Control Group	30	45.43	25.09	4.58		3.39**	45.29	0.00
Repeat test	Experimental Group	41	2.02	0.85	0.13	9.78	4.42**	69.00	0.00
	Control Group	30	1.23	0.57	0.10		4.69**	68.51	0.00
Correctness	Experimental Group	41	0.90	0.30	0.05	6.09	8.37**	69.00	0.00
	Control Group	30	0.20	0.41	0.07		8.00**	50.88	0.00

*p<0.05 **p<0.01

DISCUSSION AND CONCLUSIONS

As claimed in the relevant literature, e.g. [2][7][19-21], formative assessment significantly affects learning effectiveness in a Web-based learning environment. This finding is almost identical with the results of this study. Moreover, articles [19] and [21] describe learning strategies, in which rewards for passing are used to improve effectiveness.

This is similar to the instant feedback, which is used in the mode proposed here. On the other hand, Wang [2], and Costa et al [20] opine that the appropriate representation required to facilitate the enhancement of learning effectiveness is not opposed to the proposed representation mode. Therefore, the proposed method has strong support because most of the concepts are derived from the previous well-established approaches.

For Web-based formative assessment, a question representation mode, combined with the study content, was proposed. The mode is designed to remedy the drawbacks concerning content-independence and a large number of questions in the current LMS assessment tool. Further, the essential requirements of providing hints, instant feedback and ease of repeating a test are in the new mode.

According to the experimental results, it is ascertained that the practice frequencies of learners in the proposed mode are significantly better. It also showed the superiority of learning effectiveness for the group taking the new question representation mode. Hence, it can be concluded that the connection of assessment, and its corresponding content, is desirable for Web-based formative assessment. Also, the proposed mode is able to provide sufficient assistance in the current on-line learning environment.

The future work of this study would extend the question representation issue to *cognitive loading*, which has the potential to decrease learning effectiveness. Hence, how to avoid this flaw becomes important because of the rapid development of multimedia and networking. In addition, mobile devices, as well as Web-based learning, provide more

convenient learning platforms than in traditional education. Future work could consider the novel representation design for the mobile devices.

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