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Research on Integrating Multimedia and E-learning Platform to the Remedy Teaching of Mathematic for Learning Achievements

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Abstract - ***This study focuses on understanding students who receive remedial teaching aided by a digital teaching platform and students who receive traditional blackboard teaching to see whether the two groups of students show different learning outcomes. A total of 20 students at a junior high school in Miaoli County were selected as this study's research participants. In this study, the Moodle software was used to build a digital teaching platform to provide educational video clips, teaching materials and assignments. According to the results of this study, the learning outcomes of students who receive remedial teaching apparently outperform the learning outcomes of students who receive traditional blackboard teaching.***

Key Words: *Remedial Teaching, E-learning Platform, Learning Achievement, Technology Acceptance Model*

1. INTRODUCTION

In the process of teaching, remedial teaching is the labor-consuming part. The effective implementation of remedial teaching requires a considerate amount of time and mental input. However, regular courses have almost taken up students' time at school. Carrying out remedial teaching on students' limited time is not only a burden to students but also extra workload for teachers [1]. In an era with prevailing computer technology and the Internet, it might be possible to utilize computer multimedia's features such as 'repeatability", "individualization", and "adaptivity" to provide another way of remedial teaching to students [2].

Given abundant resources and readily available educational materials online, students can choose and view their preferred materials online, adjust their own learning speed, and repeat viewing the parts they have trouble in understanding. In addition to achieving the goal of individualized and adaptive teaching, Internet-aided remedial teaching saves the time of having remedial teaching at school, both of which are unable to be achieved by the traditional lecture-based teaching method [3].

This study focuses on understanding students who receive remedial teaching aided by a digital teaching platform and students who receive traditional blackboard teaching to see whether the two groups of students show different learning outcomes. Through building a digital teaching platform and allowing students to log in to the teaching platform through the Internet browser to start online learning, this study aims to validate that using a digital teaching platform to perform remedial teaching is better than traditional classroom teaching in terms of students' learning outcomes and having remedial teaching that requires students to log in to the digital teaching platform through the Internet browser is feasible.

A total of 20 students at a junior high school in Miaoli County were selected as this study's research participants. These 20 students were students whose performance at a mathematics quiz on the Pythagoras theorem was at the bottom one third of the entire class. Further, the study compared whether remedial teaching through a digital teaching platform and remedial teaching through the traditional lecture-based teaching method made a difference on students' learning outcomes. However, there were restrictions on this study's research methods, research samples, teaching content, and time for the experiment.

2. LITERATURE REVIEW

2.1 Remedial Teaching

Remedial teaching is an expedient form of teaching which aims to give appropriate academic guidance to students of low academic achievement and provide these students with more teaching resources and learning opportunities to make up for the insufficiency of regular teaching. Generally speaking, remedial teaching consists of three procedures: pretest, teaching, and posttest. In other words, remedial teaching comprises the cycle of assessment, teaching, and reassessment [4], which is

conducting assessments to understand students' different levels of competence to determine teaching content and teaching materials. At the end of the remedial teaching, an assessment is conducted to understand students' learning outcomes. Remedial teaching refers to providing reinforced teaching on students' weak areas to students with less satisfactory learning outcomes or students who are behind in academic performance and conducting another assessment to understand the remedial teaching's effectiveness.

2.2 Online Teaching

Apart from resulting in the circulation of a large amount of knowledge, the development and popularization of the Internet has also led to gradual change in traditional learning modes. Teaching has become not restricted to one-way teaching delivered by teachers on the platform in a fixed classroom to students in the audience. Present-day learning has evolved to learning anytime and anywhere as long as there is an internet-connected computer at hand whereas time and space are irrelevant. The same rule applies to online teaching in that students can proceed with online learning once predesigned teaching materials are put on an online teaching platform. For either online teaching or online learning, it is essential to have an ideal online learning environment which consists of the following five elements: (1) online courses; (2) online tests; (3) virtual classrooms; (4) teaching management; (5) learning tools [5].

2.3 Learning Portfolio

The so-called learning portfolio refers to the systematic and purposeful collection of students' work, assignments, or learning activities in the process of learning and using these records to demonstrate students' performance, the degree of change, or results in the process of learning. The formats of the collection could be voice, texts, images, or pictures. Therefore, it can be inferred that a learning portfolio is a collection of a learner's previous work whereas the content of the learning portfolio can be used to prove a learners' achievements and progress in learning [6]. Paris and Ayres (1994) explicated the six main objectives of a learning portfolio: (1) authentic assessment; (2) multidimensional assessment; (3) improving the quality of teaching; (4) developing metacognitive skills such as making plans and monitoring; (5) developing critical thinking and analytical skills; (6) developing the reflective thinking skill [7].

3. RESEARCH METHODOLOGY

3.1 Research Procedures

The research direction and feasibility were confirmed after assessing the research background and the research motivation. In terms of discussions on relevant literatures, the discussions started with online education, moved to the origin and modes of remedial teaching, and ended with the applications of incorporating online teaching with remedial teaching of mathematics [8]. In terms of the teaching platform, Moodle was chosen as the remedial teaching platform, which was largely because it was without cost, open to the public, and solutions to relevant applications and problems could be found online easily [9]. Further, a Pythagoras theorem learning outcomes examination was designed and a pretest of this examination was conducted and analyses were performed to make sure that the examination paper was mistake-free. The pretest was conducted to understand students' starting behavior. Later, students who were to receive the experimental remedial teaching were divided into two groups: the control group and the experimental group. Students in the control group received remedial teaching carried out in the traditional lecture-based teaching method whereas students in the experimental group received remedial teaching through using the Internet browser to login in to the digital teaching platform. After two weeks' remedial teaching, students in both groups were requested to retake the Pythagoras theorem learning outcomes examination, the data of which were analyzed with SPSS Statistics, a software package used for statistical analysis, to reach the final conclusions of this study.

3.2 Research Structure

In this study, "multimedia in combination with a digital teaching platform" and the "traditional lecture-based teaching method" were adopted to provide remedial teaching to students who were selected as the research participants. The teaching content was based on the "Pythagorean theorem" unit at the grade eight semester one mathematics curriculum. In doing so, this study attempted to investigate the two teaching approaches' effects on students' Pythagorean theorem learning outcomes. Figure 1 shows the research structure of this study.

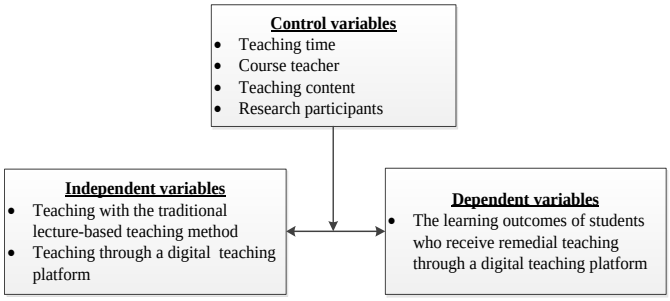

Fig -1: Research structure

3.3 Design of Teaching Platform

The teaching platform used in this study was built by suing Moodle 2.5 version as Moodle was open source software which was free of charge, easy to access, and using Moodle to build a teaching platform was easy. Each student in the experimental group was assigned an individual account name and passwords were required to log in. After students logged in to the online learning platform, students could choose from the teaching content prearranged by the teacher and started learning by watching the online teaching materials. There were also downloadable assignments for students to practice what they had learned at the end of the teaching. Meanwhile, the teacher could use this teaching platform's behind-the-scene control function to monitor how many time each student logged on to the learning platform and how much time the student spent on browsing and learning the online teaching materials on average in order to fully control students' real learning situation. On the other hand, students could also use the "leave a message" function on the teaching platform to interact and communicate with the teacher or other students.

3.4 Experimental Design

This study was to compare the difference of students' learning outcomes through using a digital teaching platform to carry out remedial teaching and using the traditional teaching method to carry out remedial teaching. This study proposed to use a quasi-experimental research method. The experimental teaching content would be based on the unit of "Pythagorean theorem" at the grade eight semester one mathematics curriculum, and research participants of this experimental teaching would be grade eight students from two classes at a junior high school in Miaoli City. Considering that the experimental teaching was remedial teaching, the research participants were set as students whose mathematics scores were at the bottom one third of their class, which resulted in 10 students from each of the two classes. Further, 10 students out of the 20 students were allocated to the experimental group in a non-random manner to receive remedial teaching aided by multimedia and a digital teaching platform whereas the other 10 students were allocated to the control group to receive remedial teaching carried out in the traditional teaching method.

Prior to the experimental remedial teaching, students in both groups were required to take a Pythagoras theorem learning outcomes pretest. After the experimental group students received the mathematics remedial teaching aided by a digital teaching platform and the control group students received the mathematics remedial teaching carried out in the traditional teaching method, students in both groups were required to take the Pythagoras theorem learning outcomes posttest upon the completion of the remedial teaching.

3.5 Research Tools

The research tool used to evaluate the research participants' learning outcomes was the "Pythagoras theorem learning outcomes examination", which was adapted after referring to other researchers' studies [8]. This study's purpose was to compare the effects of remedial teaching aided by a digital teaching platform and remedial teaching carried out in the traditional teaching method on students' learning outcomes. The same Pythagoras theorem learning outcomes examination paper was used to test students in both groups as students in the two groups received the same teaching content despite the difference in teaching tools. A total of 20 students at a junior high school in Miaoli County were selected as examinees at the Pythagoras theorem learning outcomes pretest.

(1) Analyses of question difficulty, question discrimination, and the selection of questions:
To ensure the examination questions' feasibility and appropriateness, analyses of question difficulty and question discrimination followed the pretest involving the 20 grade nine students. Based on results of the analyses, the top 33% of the examination questions belonged to the group of high scores and the bottom 33% of the examination questions belonged to the group of low scores to calculate the question difficulty and question discrimination. The resulted "Pythagoras theorem learning outcomes examination" consisted of 27 questions in total.

(2) Reliability analysis:
Following analyses of the question difficulty and question discrimination, Cronbach's alpha coefficient was used to measure the internal consistency of the examination. The resulted value of reliability was 0.960, indicating a very satisfactory level of reliability.

(3) Validity analysis:
Content validity which was established through expert reviews was used for the exam questions' validity analysis and experts in the particular field were invited to determine the exam questions' appropriateness [1]. After question reviews and modification by experts and several senior school teachers, reviews by the study's instructing supervisor, and discussions with the study's instructing supervisor, modifications on the Pythagoras theorem learning outcomes examination paper were finalized.

3.6 Data Analysis

This study began to perform the following statistical analyses on the abovementioned research hypotheses:

(1) Descriptive statistics was used to present basic statistical data such as the mean and the standard deviation.

(2) Statistics of students' scores at the pretest of the "Pythagoras theorem learning outcomes examination" were analyzed with the independent sample test to prove the homogeneous basic competence of the experimental group students and the control group students. Further, the independent sample text was utilized to analyze whether there was significant difference between the learning outcomes of the experimental group students and the learning outcomes of the control group students after the remedial teaching.

4. RESEARCH RESULTS AND DISCUSSION

Adopting a quasi-experimental research method, this study chose a total of 20 students of lower academic performance at a junior high school in Miaoli County in the 2013 academic year as the research participants. These 20 students were further asked to take the "Pythagoras theorem learning outcomes examination", which resulted in 20 valid samples and no invalid samples.

The "Pythagoras theorem learning outcomes examination" consisted of 11 multiple choice questions and 16 fill-in-the-blank questions. Each multiple choice question was three points and each fill-in-the-blank question was four points, making 97 the total points of the examination. Prior to the experimental remedial teaching, the independent sample test was used to prove the experimental group students and the control group students' homogeneous basic competence at the Pythagoras theorem unit.

(1) The verification of the homogeneity of the experimental group students and the control group students

The scores at the pretest of the "Pythagoras theorem learning outcomes examination" by students in both groups were shown in Table 1.

Running the Levene's test to assess the equality of the variance, which was the experimental group students and the control group students' scores at the pretest of the "Pythagoras theorem learning outcomes examination", led to the result that F=.532 and p=.475. The two values did not reach a level of significance, indicated no significant difference in the discrete degree of students in the two groups, and accepted the null hypothesis that students in both groups were homogenous. In addition, the t test of scores of students in the two groups at the pretest of the "Pythagoras theorem learning outcomes examination" led to the result that T=-.219, p=.829. The two values did not reach a level of significance, indicated no significant difference in the two groups of students' scores at the pretest of the "Pythagoras theorem learning outcomes examination", and proved the homogenous basic competence of students in the experimental group and students in the control group. Results of the t test are shown in Table 2.

Table -1: Statistics of pretest

Group	Quant.	Mean	SD	SEM	Mean Dif.	Mean Dif. %
experimental group	10	31.20	21.709	6.865	2.20	7.59%
control group	10	29.00	23.219	7.342		

Table -2: t test of pretest

			Assuming the equality of variances	Not assuming the equality of variances
Levene's test	F test		.532	
	Significance		.475	
t test	t		-.219	-.219
	Degree of freedom		18	17.919
	Significance (two-tailed)		.829	.829
	Mean deviation		-2.200	-2.200
	Standard error of difference between two Means		10.052	10.052
	95% confidence intervals for differences	Lower bound	-23.318	-23.325
		Upper bound	18.918	18.925

(2) The verification of the significant difference of the experimental group students' posttest score and the control group students' posttest score

Results of the independent sample test are shown in Table 3. Running the Levene's test to assess the equality of the variance, which was the experimental group students and the control group students' scores at the posttest of the "Pythagoras theorem learning outcomes examination", led to the result that F=1.083 and p=.312. The two values did not reach a level of significance and indicated no significant difference in the discrete degree of students in the two groups. Observing the t test results on the row of "assuming the equality of variances' revealed the results

that T=-2.142, p=.046, which had reached a level of significance. The difference between two mean scores was -22.700, indicating significant difference on the experimental group students and the control group students' scores at the posttest of the "Pythagoras theorem learning outcomes examination". As shown in Table 4, the mean score 56.70 of the experimental group students at the posttest was much higher than the mean score 34.00 of the control group student at the posttest.

Table -3: t test of posttest

			Assuming the equality of variances	Not assuming the equality of variances
Levene's test	F test		1.083	
	Significance		.312	
t test	t		-2.142	-2.142
	Degree of freedom		18	17.100
	Significance (two-tailed)		.046	.047
	Mean deviation		-22.700	-22.700
	Standard error of difference between two Means		10.600	10.600
	95% confidence intervals for differences	Lower bound	-44.969	-45.054
		Upper bound	-.431	-.346

Table -4: Statistics of posttest

Group	Quant.	Mean	SD	SEM	Mean Dif.	Mean Dif. %
experimental group	10	56.70	20.806	6.580	22.70	66.76%
control group	10	34.00	26.281	8.311		

According to the foregoing analyses and elucidation, this study obtained the following results:

(1) In order to proceed with the subsequent experimental teaching, relevant tests were conducted to prove that students in the experimental group and students in the control group had homogeneous understanding and level of competence in the Pythagorean theorem unit.

(2) The experimental group students' mean score at the pretest and the posttest demonstrated significant difference. As the experimental group students' mean score at the posttest was higher than their mean score at the pretest, the significant difference between the experimental group students' performance at the pretest and the posttest was verified.

(3) The control group students' mean score at the pretest and the posttest demonstrated significant difference. As the control group students' mean score at the posttest was higher than their mean score at the pretest, the significant difference between the control group students' performance at the pretest and the posttest was verified.

(4) Both the experimental group students and the control group students demonstrated significant difference in learning outcomes after the remedial teaching.

5. CONCLUSIONS

In this study, the free software Moodle was used to build a digital teaching platform to provide educational video clips, teaching materials, and assignments. It allowed student to log in to the platform through the Internet browser to achieve the goal of providing remedial education when students were not required to be at school. In doing so, this study aims to improve the current situation of mathematics remedial teaching.

The following conclusions were reached after students in both groups received the experimental remedial teaching. The way of incorporating multimedia and digital teaching platform into mathematics remedial teaching made a significant difference in students' learning outcomes. The learning outcomes of students in the experimental group apparently surpassed the learning outcomes of students in the control group.

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BIOGRAPHIES

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