THE INFLUENCES OF LEARNING PORTFOLIOS AND ATTITUDES ON LEARNING EFFECTS IN BLENDED E-LEARNING FOR MATHEMATICS

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ABSTRACT

This study mainly investigates the factors affecting the learning effects in a blended e-Learning course for Mathematics. The research targets of this study are 48 junior high school students. After they had received traditional lessons in class as well as the accompanied e-Learning lessons, the influences of their learning portfolios and learning attitude on the examination scores were studied. Multiple linear regression analysis is employed to conduct data analysis. From the standardized regression model, it is discovered that the main factors affecting the examination scores of students in their learning portfolios are online test, number of hours of reading, and the learning attitude. Moreover, no significant difference is found between male and female students in the aspects of their examination scores, learning attitudes, and learning portfolios. The findings can be helpful for teachers to improve the instruction strategies in Blended e-Learning.
1. INTRODUCTION

The rapid development of the everywhere-accessible Internet has caused certain changes to instructional forms. In the early stage of computer-assisted instruction, the contents from textbooks in the past were adopted directly in the instructional materials. Although this kind of instructional materials is regarded as digital, they lack essential interacting qualities. Insufficient explanation and description to learners can easily cause laziness to learners in the learning process, or even lead to termination of learning, thus affecting the learning effects. These consequences are just caused by the inappropriate arrangement of the paths of instructional materials which creates cognitive loss and burden to learners (Dias & Sousa, 1997; Min, 1994; Yang, 1992; Yen, 1996; Yu, 2002). In order to change these shortcomings found in the past, teachers should avoid these pitfalls in editing the instructional materials of e-Learning lessons.

In today’s e-instruction platform, the learning portfolios of learners are recorded and able to be examined. The learning portfolios can present the e-Learning problems encountered by learners and the learning results. If the teachers are able to correctly trace the learning portfolios of each student, and then adjust the way of presentation of the instructional materials of the whole e-Learning Webpage based on the learning portfolios, and use better instruction strategies, then each student will be able to have adaptive learning and acquire the knowledge and skills that they should learn.

The main objectives of this study are to investigate and analyze the factors affecting the examination scores in the blended e-Learning portfolios. The blended learning model combines traditional classroom teaching and an e-Learning system (Tsou, 2003). In this model, a teacher may teach the first few sessions in a classroom. After the students have established a general idea of the course, they can then proceed to online teaching and interaction. Ideally, if we can combine the advantages of classroom teaching and e-Learning, the learning effects will be enhanced and extended in a blended model.

The instruction method adopted is a mixed use of the traditional classroom learning and e-Learning on the Internet. The evaluation of this blended e-Learning employs the information like learning portfolios, the questionnaire of learning attitude, and the examination scores provided by K12 Digital School. After the students completed the e-Learning curriculum, these data were entered to the statistical software SPSS to make stepwise analysis so as to understand how learning portfolios and learning attitude affect the examination scores of students.

The research objectives of this study are as follows:

1. To investigate the factors affecting the junior high school students’ examination scores of Mathematics in the e-Learning portfolios.
2. To investigate the learning attitude of learners in using the e-Learning materials and the learning platform.
3. To observe the learning portfolios of learners of different sexes, and investigate the difference between them over their learning.

2. LEARNING PORTFOLIOS AND ACTIVITIES

Learning portfolio purposely collects the multifaceted learning activities and works of students, so as to make students, their teachers and parents understand and evaluate the learning portfolios, progress, and learning results of students. The portfolio can be a reference for learners to re-examine their learning, and also be evidence that records the changing process of their cognition. Learning portfolio can also comprehensively present the individualization and diversification of learners (Chang, 2001).

It is known from the above that learning portfolio is a planned, systematic, and purposed record of the data related to the learning of students. Through the learning portfolio, the process of students’ learning progress can be inspected. And the learning portfolio can be referential to the instruction by teachers.

The purpose of learning portfolio is to make teachers exactly grasp the real learning processes of students, including the learning results and the solutions for the problems encountered in the learning processes. Through the interaction between teachers and students, teachers can assist students in understanding the merits and demerits during self-learning, and help students to know what learning strategies they should take when they encounter a learning bottleneck. This is a combination of instruction and learning. Therefore, the provision of an effective tracing of the learning portfolios becomes an important issue in the e-instruction environment.

Learning portfolio is a tool or method of evaluation (Chang, 2001). Through this portfolio, teachers, students themselves, or their parents are able to understand and evaluate the learning portfolios, progress, and learning results of students. The functions of learning portfolio are as follows:

1. It can establish the learning confidence of students. When students are confronted with learning problems or bottleneck, they can use their knowledgeability to overcome these problems.
2. It can stimulate the learning interests of students, enabling them to learn actively, discuss the learning portfolios with their classmates, and enhance their cooperation and participation spirits.
3. It helps students to understand the process of self-learning progress and experience the learning problems, thus further promoting the self-learning ability.
4. It can cultivate the students’ habit of recording the process of learning growth, which can be a foundation for students to make decisions of further studies and employment in the later days.
5. It can be a reference for teachers to evaluate their students and give them appropriate advice and guidance. It can also be referential for teachers’ improvement of instruction strategies in the later days.

Lin (1998) indicates that learners should conduct diversified learning activities through the Internet so as to construct a complete learning portfolio. In fact diversified learning activities include three types, namely, activities of browsing and searching, activity of the evaluation of learning, and cooperative learning activities of discussion, observation, and learning guidance. Lin also argues that an ideal e-Learning environment should possess these five elements, online course material, online evaluations, virtual classroom, instruction management, and learning tools.

Learning portfolio is an efficient method to judge the learning results (Sparapani, 1996; Yeh, Lee, & Sun, 2005). Through the learning portfolios, we are able to understand how much effort students put in their online learning. It also reveals the improvement of students from the evolution of learning portfolios at a certain period of time. Wen-Sen Chen (2003) thinks that ever since a student starts learning in the hypermedia e-Learning environment, teachers are well aware of the learning progress of the student through the Website links browsed by the student, the learning paths, and the browsing time of the student as recorded by the database. These data help teachers analyze the characteristics of the student and to diagnose the instruction information under the circumstances that the learning of the student is not interrupted at all. When the learners are browsing the instructional materials on the Website, the contents of the instructional materials on the website appear to be so rich and attractive that the students always click on too many links, creating burden to their learning. Many of the students do not perform self-browsing and self-learning according to the ideas of the designer of instructional materials, thus making students feel lost in the learning portfolios, and lose their learning motives and willingness. Therefore, the design of the links of curriculum has to avoid creating burden and loss to the students while learning. Then the learners are able to learn smoothly, and implement the instruction ideals of the designer of instructional materials.

In this way, the students’ willingness to learn can be increased, and the learning effects can be further increased. Over the evaluation of the learning effects of students, Chi-Cheng Chang (2001) applies e-Learning portfolio to instruction so as to understand its implementation on instruction and the difficulties it may encounter. The results reveal that systematic implementation and application can bring positive effects to the learning portfolios of students. The research results of Chi-Cheng Chang and I-Huei Tung (2000) show that the learners hold a highly-praising attitude toward the Internet-assisted learning curriculum other than the curriculum taken in classroom. Therefore, the investigation of how the learning portfolios of the students’ browsing of the instructional materials on the Website affects the examination scores of students is the focus of this study.
3. RESEARCH METHOD

3.1. Research Design

This study engaged 48 junior high school students (26 male students and 22 female students) as the research targets. All these 48 students received both traditional classroom instruction and e-Learning curriculum. The instructional materials were put on the K-12 digital instruction platform in the Worldwide Web network so as for students to navigate in the Internet and study the instructional materials. The instructional period lasted for three months. After the instruction, the learning portfolios of students, including the number of times of entering the Website, the number of times of being in the online class, the number of essays being posted, the number of times of joining the discussion, the number of hours of reading, the number of pages being read, the progress of reading, and the scores of online tests, were the referential evidence for evaluating the learning results of students. Most of these portfolios are self-explaining. The progress of reading is the percentage of units browsed with respect to all learning units in the e-Learning materials.

3.2. Procedures

The implementation procedures of this study are divided into three parts: preparation stage, implementation stage and collation stage.

(1) Preparation Stage

1) Establish the research theme and goal—From the past literature, the researchers looked for papers related to the improvement of learning effects, and established the research objectives so as to investigate the factors affecting the examination scores of students after their e-Learning portfolios in the instruction platform.

2) Apply for K12 instruction platform—The Website of K12 Digital School is http://ds.k12.edu.tw which provides teachers and students with e-Learning channels. It is easy and simple for teachers to open classes in the Website. Teachers are only required to make contacts by e-mails, and then the application for class opening can be soon approved. Meanwhile, teachers can have instruction platforms of their own to carry out the e-instruction work. K12 provides the functions of management of learners, management of curriculum, management of operation, management of tests, management of results, filling out of questionnaire, voting, and so on. After students have successfully applied an ID, they can enter the Digital School to select their classes. Once a class is approved by the teacher who opens the class, the student can change his/her role of an auditor to be an official student. The instruction functions provided by K12 Digital School include the browsing and learning of instructional materials, online
tests, online discussion, discussion zone of issues, viewpoints sharing zone, and other recording mechanisms of the learning portfolios.

3) Collect and read the literature—From the collected literature, the researcher got the related concepts of e-instruction and tried to understand the factors affecting the learning effects of students in their e-Learning portfolios. To improve the learning effects, the design of the links of curriculum had to avoid creating cognitive burden and loss to students during their navigation of links. By doing so, learners were able to learn smoothly, and realize the instruction ideas of the designer of instructional materials.

4) Write the instructional materials and summary—The researcher used the Webpage software (namo) to make a Webpage, and then edited the digital instructional materials, including the animated images of instruction and test bank. Besides, the chapter summary and instruction schedule were edited.

5) Construct instructional materials at K12 School—The finished Webpage and digital instructional materials were uploaded to the instruction platform of K12 Digital School. Meanwhile, these materials were also established: online test bank, issues for discussion, homework, and acceptance of official student registration for selected curriculum.

6) Edit a questionnaire of learning attitude scale—According to the learning portfolios provided by the Digital School to learners, the researcher edited a questionnaire which students could fill out after their experience of using the instructional materials on the Webpage and then operate the instruction platform. Based on the results of the questionnaire, teachers were able to revise their instruction strategies.

(2) Implementation Stage

1) Conduct blended e-Learning—The scope of the blended e-Learning covers the algebra for integers and fractions, as well as a linear equation with one unknown quantity. These materials are presented both in classroom and e-Learning platform. The traditional classroom instruction is conducted through lecturing, performing mathematical calculations, questioning, and answering. For the e-Learning part, first of all, the teacher taught students how to apply for an ID to register as an official student. The interface that students operated at K12 Digital School was classroom. Its functions included four parts: curricular contents, curricular information, curricular interaction, and individuals’ zone. After the learners were familiar with this operation interface, they could start e-Learning on the instruction platform. According to the schedule and summary of instructional materials, students could decide their learning contents, pace, and online tests. The learning items included the browsing of instructional materials on the Webpage, session exercises, animated instruction, discussion zone, sharing
and posting of students’ personal viewpoints after e-Learning, online tests, and so on.

2) Implement the 1st written tests—Its main purpose was to understand the students’ learning situation and learning results of Mathematics after they had gone through a certain adaptation period of e-Learning. Based on the test results, the teachers could adjust the extent of difficulty of the instructional materials and revise the learning schedule. Then the students were able to conduct adaptive learning.

3) Collect learning portfolios of students—K12 Digital School could provide a complete learning portfolio for each individual student, including the number of times of entering the Website, the number of pages of instructional materials being browsed, the number of times of online tests taken and their results, the total browsing time of instructional materials, the number of times of posting their viewpoints, and the number of times of expressing viewpoints on discussion zone. Among these items, the record of the students’ learning portfolios was an important reference for teachers to evaluate the learning effects of students.

4) Implement the 2nd written tests—Its main purpose was to understand whether the e-Learning was helpful to the examination scores of students after e-Learning was received, and try to determine the helpful factors. Teachers could collect these factors as useful reference in improving the e-Learning instructional materials in the future.

5) Students fill out the questionnaire of learning attitudes: Having received e-Learning, the students could fill out the questionnaire according to the learning problems encountered in the learning portfolios and their learning experience so as to reflect their personal comments and opinions of e-Learning.

(3) Collation and Analyze Stage

1) Collate the information—The information of the learning portfolios of students was collected. This information include the total number of times of entering the Website, the number of times of being in the online class, the number of essays being posted on discussion zone, the number of times of joining the discussion, the total number of hours of reading the instructional materials, the number of pages of instructional materials being read, the progress of reading, the questionnaires of students’ learning attitude, the results of the first- and second-term examinations, and the average scores of quizzes in classes.

2) Analyze the information—The information of learning portfolios provided by K12 Digital School, such as the total number of times of entering the Website, the number of times of being in the online class, the number of essays being posted on discussion zone, the numbers of times of joining the discussion, the total number of hours of reading the instructional materials, the number of pages of
instructional materials being read, the progress of reading, the questionnaires of students’ learning attitude, the results of online tests, and so on were entered into Excel. These data were then posted on SPSS for Windows 10.0 Chinese version to conduct linear multiple regression statistics, and stepwise analysis, so as to rule out the insignificant independent variables and establish a standardized regression equation.

3) **Write research papers or reports**—After the students have completed the e-Learning sessions, the teachers collected the learning portfolios of students, the results of the first- and second-term examinations, the average scores of written tests at ordinary times, and the questionnaires of students’ learning attitude. After that, through SPSS and Excel, the correlation among these data was analyzed. The factors affecting the students’ examination scores were indicated in the conclusions, which were presented in the form of suggestions for improving the e-Learning materials.

3.3. Research Tools

The research tools adopted by this study included the following items: 1) K12 Digital School; 2) written tests papers; 3) questionnaires of students’ learning attitude; and 4) software and hardware equipments.

K12 Digital School divides the e-instruction tools into two modules or operation interfaces, instruction module and learning module:

(1) **Instruction Module**

According to the instruction procedures of teachers, it was divided into five zones: management of learners; management of curriculum; management of operation; management of tests; and management of test results, as shown in Figure 1. From the above instruction functions, the learning information of students can be retrieved, enabling the teachers who open classes online to achieve better instruction efficiency. Meanwhile, the students can also acquire a sound and complete learning environment.

(2) **Learning Module**

According to the procedures used by the students, the design of learning module is divided into four zones: contents of curriculum; information of curriculum; interaction of curriculum; and individuals’ zone, as shown in Figure 2. In the selected curriculum of students, the instruction platform could automatically record the latest time in the online class, the number of times of being in the online class, the number of essays being posted, the numbers of times of joining the discussion, the number of learning hours, and the statistical form of
Figure 1. Instructional module.
Figure 2. Learning module.

Contents of Curriculum:
- Introduction of curriculum
- Arrangement of curriculum
- Tests and examinations
- Homework and reports

Information of Curriculum:
- Latest information
- Information of students
- Information of results

Interaction of Curriculum:
- Discussion of curriculum
- Online discussion

Individuals Zone:
- My curriculum
- Personal setting
- Learning portfolios

Learning Module:
learning progress. Through the information, the students could examine the learning effects themselves.

3.4. Accumulation and Analysis of Information

All the items of the students’ information collected by this study were entered to Excel and SPSS for statistical analysis, and the investigation of their characteristics. The accumulated items of the students’ information are as follows:

(1) Accumulation of Information

1) Records of learning portfolios—By using the embedded functions of the instruction platform of K12 Digital School, the learning portfolios of students could be established. It included the total number of times of entering the Website, the number of times of being in the online class, the number of essays being posted on discussion zone, the numbers of times of joining the discussion, the total number of hours of reading the instructional materials, the number of pages of instructional materials being read, the progress of reading the instructional materials, the results of online tests, and so on. The information can be employed to analyze the learning paths of the learners after e-Learning and their situation of using the K12 Digital School.

2) Written Test Papers—By using SPSS, an analysis on the average scores of the 48 students’ examination results of the two academic terms and the tests results at ordinary times was made. Besides, SPSS was also used to analyze the learning portfolios of the students recorded by K12 Digital School.

3) Questionnaire of e-Learning Attitude—Focusing on the 48 students, this questionnaire carried out a survey of their e-Learning attitude after the use of K12 Digital School. The questionnaires completed by students were studied so as to understand the situation of their use of each function of the system and their attitude, and evaluate the merits and demerits of the instructional materials of this system as well as the functions needed to be improved. Each of the factors was analyzed, enabling us to know whether the learning attitude of students would affect their examination scores after receiving e-Learning.

(2) Data Analysis

In many studies, there are more than one independent variable ($X_1$~$X_9$) affecting a certain dependent variable ($Y$). In that case, the equation established from simple regression is not sufficient to explain the relationship among variables. That is why a more complicated regression equation, called multiple regression, is needed to be established in order to include multiple predicted variables ($X_1$~$X_9$) and explain their effects on the dependent variable ($Y$). The multiple regression of the abovementioned SPSS was used to calculate the
required statistical data of each item, and then analyze and investigate the factors affecting the examination scores of students.

A standardized regression equation was established as follows:

\[ Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 \]

where \( X_1 \) denotes the number of times of entering the Website, \( X_2 \) denotes the number of times of being in the online class, \( X_3 \) denotes the number of essays being posted, \( X_4 \) denotes the numbers of times of joining the discussion, \( X_5 \) denotes the number of hours of reading, \( X_6 \) denotes the number of pages being read, \( X_7 \) denotes the progress of reading, \( X_8 \) denotes the results of online test, \( X_9 \) denotes the learning attitude of student, \( Y \) denotes the examination scores reflected on the results of written tests, and \( \beta_1 - \beta_9 \) denote the standardized regression coefficients.

4. RESEARCH RESULTS

After e-Learning was implemented in the study, different data as well as the written test results and questionnaire of students’ learning attitudes were collected from the records of the students’ learning portfolios provided by K12 Digital School. These data were statistically analyzed, and the collected research results are further explained according to the research objectives: 1) investigate the differences of learning between different sexes; 2) investigate the factors of the learning effects; 3) stepwise regression analysis; and 4) discussion and analysis.

4.1. Difference of Learning Portfolios between the Students of Different Sexes

Assisted by SPSS, the examination scores, learning attitude, and learning portfolios of male students and female students after receiving e-Learning were analyzed and compared as shown in Table 1. From the \( t \)-test of the independent sample, it is found that there is no significant difference between male and female students (both \( P \) values are greater than 0.05) over the examination scores and learning portfolios. Its possible reason is that the classes were divided at random, so the learning abilities of the male and female students are generally the same.

4.2. Factors Affecting the Examination Scores

(1) Examination Scores

After the examination scores of the students (based on the written examinations of the two terms and the written tests at ordinary times) have been examined, there are 21 students with their examination scores at above 60 scores (43.8% of
the students were passed) and 27 students at below 60 scores (56.2% of the students were failed). In the first-term examination, the average scores of all the students are 65.4; in the second-term examination, the average scores of all the students are 45.5; and in the written tests at ordinary times, the average scores of all the students are 49.3. These three results have formed the total average scores of 53.4 as the examination scores of students.

(2) e-Learning Attitude

Focusing on the 48 students from two classes involving in the research, this study carried out a questionnaire survey on the learning attitude of students.

<table>
<thead>
<tr>
<th>Process</th>
<th>Item</th>
<th>Mean</th>
<th>Standard mean</th>
<th>t Value</th>
<th>Significance</th>
</tr>
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<tbody>
<tr>
<td>Examination scores</td>
<td>Male (26)</td>
<td>49.08</td>
<td>26.54</td>
<td>-1.386</td>
<td>.172</td>
</tr>
<tr>
<td></td>
<td>Female (22)</td>
<td>58.50</td>
<td>19.19</td>
<td></td>
<td></td>
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<tr>
<td>Learning attitude</td>
<td>Male (26)</td>
<td>86.65</td>
<td>13.57</td>
<td>-1.752</td>
<td>.086</td>
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<tr>
<td></td>
<td>Female (22)</td>
<td>93.86</td>
<td>14.93</td>
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<td></td>
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<tr>
<td>No. of times in class</td>
<td>Male (26)</td>
<td>37.50</td>
<td>22.57</td>
<td>0.487</td>
<td>.628</td>
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<tr>
<td></td>
<td>Female (22)</td>
<td>33.80</td>
<td>23.40</td>
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<td></td>
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<tr>
<td>No. of essays posted</td>
<td>Male (26)</td>
<td>7.23</td>
<td>5.68</td>
<td>-0.063</td>
<td>.950</td>
</tr>
<tr>
<td></td>
<td>Female (22)</td>
<td>7.32</td>
<td>3.47</td>
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<td></td>
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<tr>
<td>No. of hours of reading</td>
<td>Male (26)</td>
<td>238.54</td>
<td>159.32</td>
<td>0.006</td>
<td>.996</td>
</tr>
<tr>
<td></td>
<td>Female (22)</td>
<td>238.32</td>
<td>100.12</td>
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<tr>
<td>No. of pages being read</td>
<td>Male (26)</td>
<td>109.77</td>
<td>67.35</td>
<td>-0.262</td>
<td>.795</td>
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<tr>
<td></td>
<td>Female (22)</td>
<td>114.86</td>
<td>66.98</td>
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<tr>
<td>Online test</td>
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<td>48.58</td>
<td>25.86</td>
<td>-0.648</td>
<td>.520</td>
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<tr>
<td></td>
<td>Female (22)</td>
<td>53.05</td>
<td>21.07</td>
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</tr>
</tbody>
</table>

(2) e-Learning Attitude

Focusing on the 48 students from two classes involving in the research, this study carried out a questionnaire survey on the learning attitude of students.
There were 48 questionnaires sent out, and 48 questionnaires actually returned. This questionnaire has 25 questions. The questionnaire investigates the students’ attitude toward the Internet-assisted learning. Taking Likert’s Scale 1-5 as the reference, the questionnaire asks the students to select one answer from the choices of “Very Agree,” “Agree,” “No Comment,” “Disagree,” and “Very Disagree” according to their opinions and comments in their e-Learning portfolios. The five scales are given 5 scores, 4 scores, 3 scores, 2 scores and 1 score respectively. The maximum total scores are 125, and the minimum total scores are 25. The Cronbach’s $\alpha$ reliability coefficient of the questionnaire is 0.8919, well over 0.8, indicating a high reliability.

(3) Records of Learning Portfolios Collected by K12 Digital School

In the records of learning portfolios, the number of times of entering the Website, the number of times of being in the online class, the number of essays being posted, the numbers of times of joining the discussion, the number of hours of reading, the number of pages being read, the progress of reading, the results of online tests, the learning attitude and the examination scores were entered by using SPSS so as to conduct multiple regression analysis.

4.3. Stepwise Analysis

After using stepwise analysis (the use of probability value $F$, and the significant value of the selected variables has to be smaller than 0.05), the insignificant independent variables (the number of times of entering the Website, the number of times of being in the online class, the number of essays being posted, the number of times of joining the discussion, the number of pages being read and the progress of reading) were deleted, and the rest of the independent variables (the online tests, the number of hours of reading and the learning attitude) were taken out to perform data analyses, including $F$-test, coefficient of determination ($R^2$), Durbin-Watson test and $t$-test, and so on, which are further described as follows:

(1) $F$-Test

$F$-test is just ANOVA, which is an overall regression model test, regarding all the independent variables as a whole, and testing whether there is significant linear relationship existed between all the independent variables and all the dependent variables. From the analysis of variables of e-Learning indicated in Table 2, the $P$ values are found to be .000, which are all smaller than the significant standard .05. Thus, the multiple regression model of this study has reached the significant standard, implying that there is linear relationship between all the independent variables and all the dependent variables.
(2) Coefficient of Determination ($R^2$) and Durbin-Watson Test

As found in the model summary shown in Table 3, the interpretability of the independent variables in relation to the dependent variables ($R^2 = .808$ after adjustment) reaches a significant level of .004, so the independent variables of the model possess high interpretability of 80.8% toward the whole. In Durbin-Watson test, if its value is close to 2, there is no autocorrelation between the mutual residual values. But in the Durbin-Watson test done in this study, the value is 2.016, which is very close to 2. Hence, no autocorrelation is occurred to the model of this study. It refers that the predictability of the multiple regression model discussed in this study is reliable.

(3) t-Test

The main purpose of $t$-test is to test whether there is significant relationship between each independent variable and dependent variable.

In the table of summarized multiple regression analysis of examination scores shown in Table 4, it is found that there exists significant linear relationship between independent variables and dependent variables. And the factors affecting the examination scores of students in their learning portfolios are the online tests ($\beta = .381$), the number of hours of reading ($\beta = .352$), and the learning attitude ($\beta = .271$).

(4) Standardized Regression Equation

The three abovementioned independent variables which would affect the examination scores of students, were added to stepwise analysis. Standardized coefficients were thus acquired as shown in Table 4. Therefore, a standardized regression equation ($Y = \beta_1X_1 + \beta_2X_2 + \beta_3X_3$) was established. $\beta_1$-$\beta_3$ (coefficients of standardization) were substituted in the regression equation. As a result, a standardized regression equation $Y = .381X_1 + .352X_2 + .271X_3$ was obtained.
In this equation: \( X_1 \) denotes the online tests, \( X_2 \) denotes the number of hours of reading, \( X_3 \) denotes the learning attitude, and \( Y \) denotes the examination scores.

### 4.4. Discussion and Analysis

After standardized regression equations were resulted from the research, the standardized regression coefficients \((\beta_1-\beta_3)\) and their significance as shown in Table 4, are further discussed and analyzed as follows:

From the standardized regression equation, it is found that the standardized regression coefficient of the learning effect of the learners’ online tests is 0.381, and the \( P \) value is 0.002 which is smaller than 0.05. Hence, significant standard is reached. This item of test result is the most important factor affecting the examination scores. The reason behind may have to trace back the design of tests. As told by the students, before answering the questions in the online tests, they had to read carefully the online instructional materials. The test results
of each student were offered as a reference for that student only, but not included in the formal learning results. These results were referential to the students in adjusting their learning ways in future days. In each test, the way of answering questions was that within a certain period of time, the student could answer the questions as many times as they like, but only the results of the first time were recorded, purposely to prevent students from memorizing the answers and not to affect the correct test results. In this way, to the hardworking students, online tests enable them to examine their learning results themselves; but to the students who did not care about their schoolwork, online test is merely a game of guessing the correct numbers, and poor learning results are not beyond our expectation. Therefore, this way can correctly test the examination scores. According to the research of Liu (1999), there is a positive correlation existed between the online tests and the learning effects of learners. Shih-Ming Chen (2004) argues that online tests have significant positive correlation with the learning effects of students. This argument is conforming to one of the findings of this study.

From the standardized regression equation, it is found that the standardized regression coefficient of the learners’ number of hours of reading and examination scores is 0.352, and the \( P \) value is 0.003 which is smaller than 0.05. Hence, significant standard is reached between them. This is the second factor affecting the examination scores. The reason behind may have to trace back to the learning portfolios. If students are suddenly distracted and cannot grasp the main points of learning in the traditional learning portfolios, they can still repeat their learning through reading the e-Learning materials, and achieve better learning results. To the students who are in lack of learning willingness and motive, they generally may not positively spend additional time on reading the e-Learning materials. Therefore, the more the number of hours of reading, the better the examination scores the students achieve. Wu (2004) thinks that the learning attitude has significant positive correlation with the learning effects of students. This argument is conforming to one of the findings of this study.

From the standardized regression equation, it is found that the standardized regression coefficient of the learners’ learning attitude and examination scores is 0.271, and the \( P \) value is 0.004 which is smaller than 0.05. Hence, significant standard is reached between them. The reason behind may be that the questionnaire of learning attitude designed for this study is referring to the “Computer Attitude Scale” formulated by I-Ting Chang (2002), Yao (2003), and Wu (2004). Thus, the reliability and validity of the questionnaire are high. Before the students filled out the questionnaires, the researcher clearly stated to them that their answers to the questions, as well as their comments and suggestions had to be actually based on their personal experience and viewpoints of e-Learning. In this way, the learning attitude of students can be correctly measured. Kuan (1997) and Wu (2004) believe that the learning attitude has significant positive correlation with the learning effects of students. This argument is conforming in this study.
5. CONCLUSIONS AND SUGGESTIONS

The e-Learning platform has the function of recording different items of the learning portfolios of students. Under the circumstances, without interrupting students’ learning, teachers can examine students’ learning portfolios at any time. When examining their learning portfolios, the teachers can understand their learning problems and the degree of hardworking, without solely relying on the traditional written tests. This way not only enables the teachers to evaluate the learning results of the students, but also helps the teachers adjust their instruction strategies at all times according to the results of evaluation.

The main purpose of this study is to investigate and analyze the factors affecting the learning effects in the blended e-Learning portfolios. The instruction adopted is a mixed implementation of both the traditional studying in classroom and the learning of online instructional materials. The evaluation of this kind of blended e-Learning relies on such information as the learning portfolios provided by K12 Digital School (the number of times of entering the Website, the number of times of being in the online class, the number of essays being posted, the numbers of times of joining the discussion, the number of hours of reading, the number of pages being read, the progress of reading, the online tests), the questionnaire of learning attitude, and the examination scores (the results of written tests). After the students had finished the e-Learning curriculum, all the abovementioned data were entered in SPSS.

By using stepwise analysis, the unobvious independent variables (the number of times of entering the Website, the number of times of being in the online class, the number of essays being posted, the number of pages being read, the progress of reading) were deleted, and the remaining independent variables (the online tests, the number of hours of reading, the learning attitude) were analyzed. As a result, the standard regression equation is acquired. From the standardized coefficients, it is known that the main factors affecting the examination scores of students include these three independent variables: the online test, the number of hours of reading, and the learning attitude. The fact that factors concerning interaction, such as number of essays being posted and numbers of times of joining the discussion, does not play a significant role in blended e-Learning seem to suggest that classroom interaction complements the need for online interaction.

After the male and female students had received e-Learning, no significant difference was found between them over the aspects of their examination scores, learning attitude, and learning portfolios. The reason was that the number of male students receiving e-Learning was different from the number of female students receiving e-Learning. On the other hand, the classes of this junior high school were divided at random, so the basic accomplishments of the male and the female students are generally the same.

Although the data resulted from this research are considered representative, if the number of learners can be increased, and the number of male students and the
number of female students can be the same, then the research data can better explain the difference of learning, and the factors affecting the examination scores can be more accurately generated. This research mainly focuses on the subject of Mathematics of junior high school. The data obtained from the study is only suitable for this single subject only. If other subjects can be added to conduct the study of e-Learning and more research samples of different subjects can be collected, then the synthetic results acquired can more precisely present the factors affecting the learning effects.

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