Using Mathematical Subjects to Study Self-Test for Enhancement the Detection of Learning Effectiveness

Ting-Sheng Weng, Meng-Hui Hsu, Jen-Yen Lin, and Der- Ching Yang

***Abstract*—As the development of information technology, Internet applications in the field of education management have become increasingly widespread, especially from the aspect of student learning assistance. Learning environments that combine network communications and computer science technology can allow students to learn more effectively through network diversification, as well as internal and external links to resources. This study combined individual teacher's websites with an item bank, using mathematics subjects as an example, to develop a digital teaching material management and item bank assisted learning platform. The Moodle platform constructed by this study could satisfy the interactive learning purposes through each module's links and assist the learners to use their individual abilities to proceed with self-learning and testing procedures. The platform's automatic feedback mechanism could provide score calculations, correct answers, warnings when marks were being deducted due to wrong answers. In addition, this study also investigated the mathematic learning achievement results and the users' overall evaluations of the self-management teaching assistance. This teaching platform could effectively enhance the learner's willingness to study mathematics and promote positive attitude toward mathematics learning.**

***Index Terms*—Application of information technology, mathematics network, moodle exam feedback mechanism, warning mechanism.**

I. Introduction

Traditionally, mathematics has been used for scientific analyses of various issues, and computer science is an applied science that is based on mathematics. With the development of computer technology; however, some sciences that received little attention in the past have been showing their importance.

At present, the major research areas of theoretical computer science include computational geometry, programming language theory, computability theory, algorithm design and complexity analysis, cryptography and information security, distributed computing theory, parallel computing theory, network theory, and biological information calculation. These areas overlap with each other and continue to derive new research topics, and in this way, mathematics and computer science continue to evolve and progress.

The computer science applications developed from applied mathematics, such as the graphic displays used in CAD (computer aided design) software have been used by numerous industries. The applied sciences used in computer graphics are mainly based on calculus and matrix mathematics.

II. Motivation and Purpose

In fact, a number of mathematical concepts, such as images, logic, programming, and ratio, have already entered into daily life. All manner of industries are being mathematized and are using more and more mathematical knowledge. Therefore, the evolution and progress of mathematics education is related to the long-term development of national economics and technology, as well as long-term social development [1]. Whether it is mathematical curriculum reform and construction or related to software development and trials, all are important research topics.

In the past, there was too much of a focus on mathematics skills training [2]. Math classes were boring, and many learners felt that mathematics was monotonous, disgusting, and even frightening. Now, computers have become a learning partner and tool for students, and math is no longer boring and fearful for students; their fear is being replaced by a passionate and expectant learning attitude [1]. From another aspect, the R&D of mathematic teaching software must emphasize user-friendly flexible applications and diversity, which can reduce the differences in the student's classroom teaching efficiency. For example, a learning platform built by the teaching software could allow the students to adjust their own learning pace and reduce the burden on the teachers at the same time. A good teaching platform design could be an excellent remedial teaching tool.

This study combined personal teaching websites to create a modular teaching platform (Moodle). The established teaching sites had interactive learning features, and through each module's links, they helped the learners use their individual abilities to proceed with learning and self-testing of their process, etc. In addition, the platform automatically made determinations, contained a test feedback mechanism, could provide the correct answers and calculate the total scores, and had a warning system to alert when marks were being deducted for wrong answers, all of which could train the learners to think carefully and

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Ting-Sheng Weng is with the Department of Business Administration, National Chiayi University, Chiayi, Taiwan, R.O.C. (e-mail: politeweng@mail.ncyu.edu.tw).

Meng-Hui Hsu is with the Department of Mechanical Engineering, Kun-Shan University, Tainan, Taiwan, R.O.C.(e -mail: mhhsu@mail.ksu.edu.tw).

Jen-Yen Lin is with the Department of Applied Mathematics, National Chiayi University, Chiayi, Taiwan, R.O.C.(e -mail: jylin@mail.ncyu.edu.tw).

Der-Ching Yang is with the Graduate Institute of Mathematics and Science Education, National Chiayi University, Chiayi, Taiwan, R.O.C.(e -mail: dcyang@mail.ncyu.edu.tw).

have effective problem-solving skills.

III. Literature Review

There are internal and external applications of mathematical problem solving skills. Externally speaking, they include everyday life problems. Internally, they refer to mathematics problem solving itself. A complete understanding of mathematical applications requires having both the internal and external parts.

In computer applications that use mathematical sciences, Singapore and British scholars have pointed out that learning and guidance should include two items: students must have the ability to find the correct answer from the computer, and they must be able to use their own abilities to verify the reasonableness of the answers. Therefore, students should have the ability to judge, rather than simply press a button [2].

Mathematics has always been considered a language of science and is the key to learning science and technology thus is rarely used in people's daily lives [3]. However, in today's technology and information society, mathematics has become a prerequisite for many jobs, as well as a stepping-stone for employment opportunities. The lack of mathematics ability will restrict a person's potential for development. Mathematics can be effective in training an individual to have clear thinking and the habit of independent thinking. Mathematics is no longer just a requirement for further studies, but is increasingly required for people to make a living. Thus, mathematical curricula must put more emphasis on wide applications to suit changing needs. To do this, the related computer software, hardware, and updates are indispensable. Useful computer teaching and learning tools can greatly improve mathematical teaching and learning quality and efficiency.

IV. Modular Object-Oriented Dynamic Learning Environment (Moodle)

Moodle (Modular Object-Oriented Dynamic Learning Environment) is an open source software, also known as a CMS course management system, learning management system, or virtual learning environment. The program code is completely written in PHP and can be installed and run on any webpage server that supports PHP. It also supports many of the major databases, such as MySQL.

All of the required software and the operating system required to build the environment, such as Windows Server IIS and Linux Apache can run it. The web setup tool can use the free setup resource Appserv, which integrates Apache, MySQL, PHP, and MysqlAdmin into one set of free software. Of these tools, Apache is the server software, MySQL is the database software, PHP is the web page program design software, and MysqlAdmin is the database management software. When using Moodle, student participants only need to apply for an account and can then start the class. The manager only needs to upload the class materials to the teaching platform to satisfy the site's education purposes.

V. Research and Analysis

Network applications bring the convenience of information transfer and flow, but not all teachers have the skills to use such networks. Based on this consideration, this research integrated application information technology to set up mathematics teaching material on the Moodle platform. The teacher's personal teaching website was connected to the Moodle platform, so that the teacher's groups could have the flexibility of use different teaching platforms and achieve the goal of website teaching.

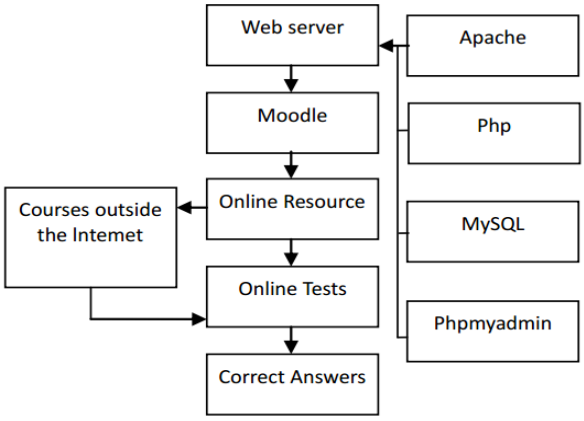

Fig.1. Teaching platform structure flowchart.

This research used the Apache server software, the Php web design programming language, a MySQL database, and the Phpmyadmin database management interface to complete the setup of the web server. Moodle was used to provide online resources and links to the teaching materials provided by other reading sites, as well as online tests. A mathematical network was used as an example, and the network was structured to be able to continue providing the user functions when there was a sudden failure of the network link. Fig. 2 shows the connection of the web server to other sites.

This study also provided an online testing mechanism on the Moodle platform. Managers could use the Moodle webpage management interface to maintain the curricula and teaching materials provided by the teachers, which could be uploaded to the MySQL database. In addition, the participants used terminal equipment to proceed with the class and to implement online tests. The teachers were only required to upload the completed test questions to the platform interface to implement online testing. The platform feedback mechanism provided testers with the standard answers and indicated the problem-solving steps. This mechanism allowed both the teachers and students to

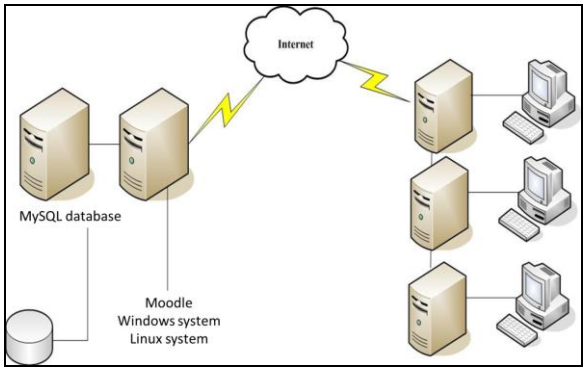

Fig. 2. Webpage server links to other sites.

discuss why certain answers were wrong, thus achieving the purpose of teaching and learning interaction. At the same time, students could immediately see their test scores and complete the function of self-assessment.

VI. Test Paper Flow Chart

Tests and examinations are used to detect the students' learning effectiveness. The Moodle platform provides online real-time test functions that can form the question contents using both written words and images. The question flow is shown in Fig.3.

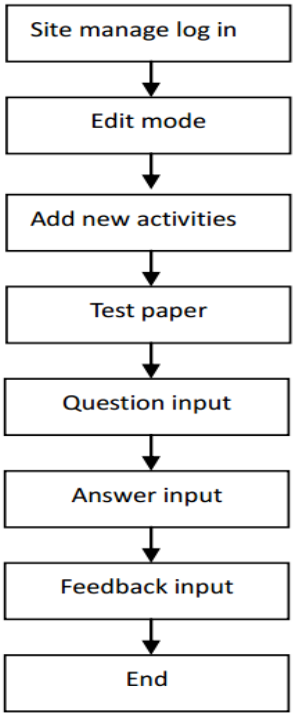

Fig. 3. Test question flow chart.

Fig. 3. shows the test paper question process, in which the teacher logs in as an administrator, opens the edit mode, selects "test paper" under "add new activities", enters the prepared test paper topics, either in text or image form, selects the correct answer, and then enters the correct answer into the feedback information.

This paper used a test titled "parameter equations and polar coordinates" as an example to explain the output process. Fig. 4. to Fig. 6. show how three sections, the test paper name, the subject content, and the answer content, were created.

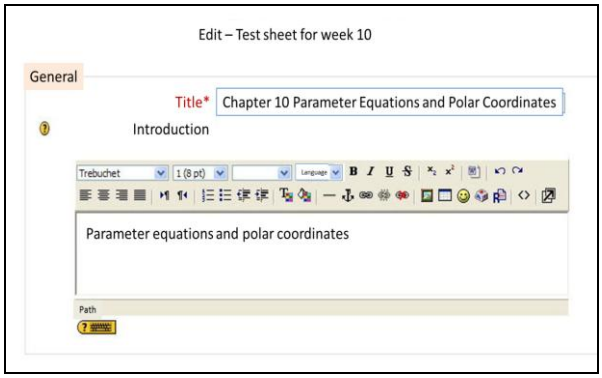

Fig. 4. The steps for entering the name of the test paper.

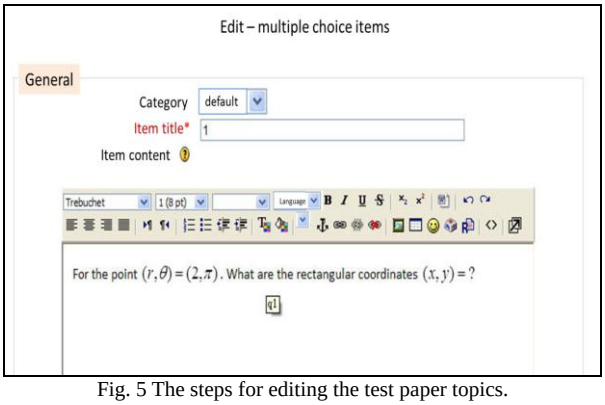

Fig. 5 The steps for editing the test paper topics.

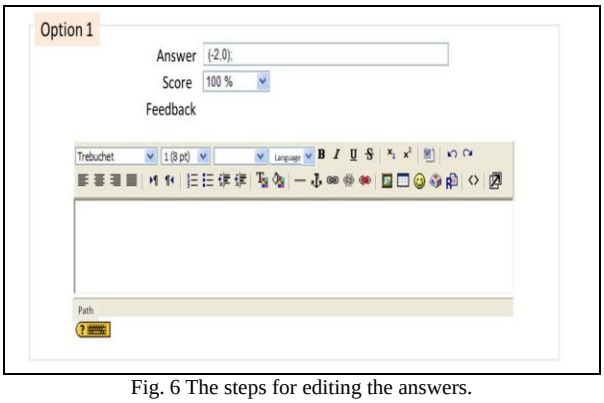

Fig. 6 The steps for editing the answers.

Regarding the answers selected by the students and the feedback given, the platform screen provided two functions. Fig. 7 shows the system screen with a green highlight, indicating the student's correct answer. Fig. 8 shows the system screen displaying a red x, indicating the student's wrong answer, and showing the correct answer at the same time. As a result, the students would immediately know their right and wrong answers. The teachers could interact with the students either in class or after class, to increase the benefits of interaction between teaching and learning.

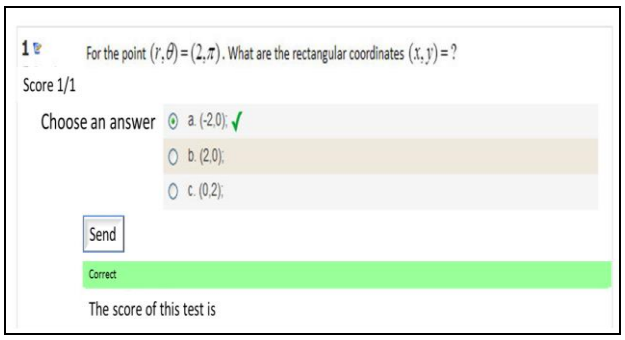

Fig. 7. Platform judging the student's answers after the exam.

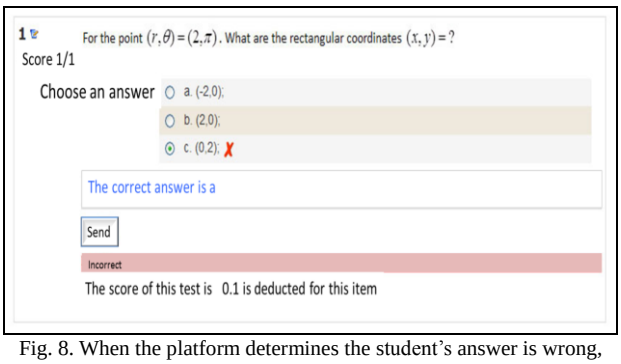

Fig. 8. When the platform determines the student's answer is wrong, it provides the correct answer and shows the point deduction.

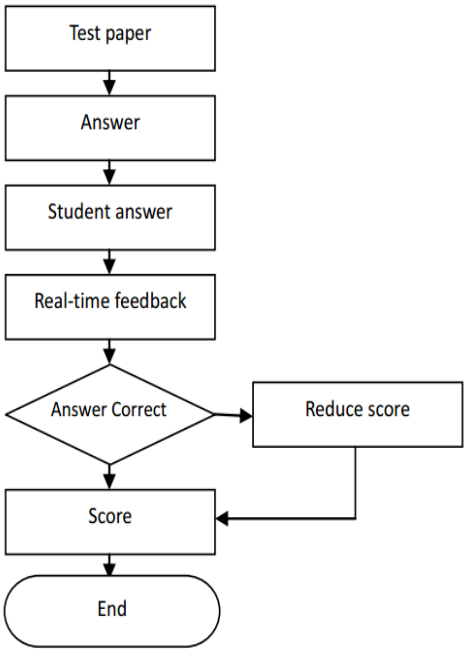

Fig. 9. Score deduction flowchart.

Fig. 9. shows the score deduction process. The teachers would present the test questions by placing them into that week's testing data bank, and the students could then self-test their learning effectiveness on the platform. After sending out the test, the testing system would instantly provide feedback on the answers and the score. The teaching platform had a score deduction setting, and the score deduction could make the students become more cautious about their answers. In order not to have a poor score, the learner would be very careful about their selection instead of just selecting the answers. This allowed the teachers to better understand the learners' level of understanding of the course. The teachers were not required to use extra time to correct homework, thus giving them more efficient use of their time to complete their tasks.

This study developed a digital teaching materials management and exam question assisted learning platform for mathematics. Through the platform, the learners could practice and use the testing bank to raise their mathematical problem solving abilities, as well as help them reflect on their learning. In addition, a questionnaire was used to ask the students about their learning efficiency. The study results showed that the practice test data bank support mechanisms could help students improve their problem-solving confidence, especially for students with low self-confidence, who showed improved confidence in learning math. This also showed that the establishment of an assisted learning platform could stimulate the students' learning motivation. Information stimulation is a must for proper learning. In addition, through the score deduction mechanism, the learners could find the information about their successes and failures.

VII. Conclusion

This study combined individual teachers' websites with an item bank, using mathematics as an example, to develop a digital teaching material management and item bank assisted learning platform. The Moodle platform set up by this study reached the interactive learning purposes through each module's links and assisted the learners to use their individual abilities to proceed with self-learning and testing procedures. The platform's automatic feedback mechanism provided score calculations and correct answers, and had the ability to warn when marks were being deducted due to wrong answers. The results of this study showed that learners who used this digital mathematics learning platform could effectively raise their desire to learn about fractions, and there was a positive effect in improving mathematics learning attitudes and effectiveness. This result support the previous studies that technology integrate into mathematics teaching and learning has positive effect on attitudes toward mathematics learning and performance on mathematics [6], [7], [8] In addition, the research results also verified that through network links and sharing, teaching and learning could have endless possibilities, forming a new trend of multi-element interactive learning in today's society, which could accelerate the spread of knowledge.

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T. Weng is an Assistant Professor of the department of Business Administration at National Chiayi University, Taiwan. He received his Ph. D. in Division of management and information science, Graduate School of Advanced Technology from Kinki University, Japan in 2000. He had served as visiting Professor at Meiji University in Japan from 2006 through 2007. His major research interests include science technology and management, e-learning, Information Education, Technology Education, MIS, and image processing. E-mail: politeweng@mail.ncyu.edu.tw.

J. Lin is an Assistant Professor of Department of Applied Mathematics, National Chiayi University, Taiwan. He received his Ph. D. in Institute of Applied Mathematics, National Cheng Kung University, Taiwan in 2005. His major research interests include Mathematical Programming, Operations Research, Production Planning, Transportation Science, Quadratic Programming. E-mail: jylin@mail.ncyu.edu.tw.

M. Hsu. Dr. Hsu was born on 12 29, 1963. He took M. S. and Ph. D. from the Department of Mechanical Engineering, National Cheng-Kung University, TAIWAN, 1990 and 1996, respectively. Now Dr. Hsu is an associate professor of Mechanical Engineering Department at Kun-Shan University in TAIWAN. His research interests include Mechanism and Machine Design, Theory of Creative Design, and Servo Control Systems. E-mail: mhhsu@mail.ksu.edu.tw.

D. Yang is a professor of the Graduate Institute of .Mathematics and Science Education at National Chiayi University. Dr. Yang received his PhD in mathematics Education from University of Missouri-Columbia in 1995. His research focuses on number sense, mathematics teaching & learning, technology & mathematics teaching and learning, curriculum study.