

An Implementation of Web-based Stepwise Learning System for the Mathematical Problems

Soon-Kak Kwon, Woo-Je Cho and Tai-Suk Kim

ABSTRACT

This study is designed to use the stepwise learning system for solving learner-oriented problem on the Web, which can help learners probe studying targets and contents of mathematics as well as search for a study-related materials. The study provides a Web-based Courseware design model based on the general multimedia systematic professor design model. It develops a program for remote lecture that can solve problems through interaction among a professor and the other learners. It also implements a remote learning system for real-time environment of mathematical problems oriented by the learner. The system designed either as a Web-based mathematical Courseware or as a text mode has the purpose of providing a Web-based stepwise learning system for solving mathematical problems oriented by the learner.

Key words: learning system, learner-oriented problem

1. INTRODUCTION

Education has an object to maximize potential energy of the individual student and exert the energy to maintain and develop our society. However our educational environment has been criticized in that it doesn't improve the potency of the individuals efficiently. The primary and middle school training courses that the Ministry of Education announced in December 1997 stated that the basic direction of the 21st century mathematical education would be to consider the learner's ability in the area of mathematics as well as studying psychology at the utmost and practicing it in the real mathematical class. In effect so, a "learner-oriented" system. In other words, separate studying-or independent studying according to the individual learning ability essentially needs differentiated education that can provide appropriate content and educational methods for each student [1-5].

In the information society, education gradually departs from the traditional passive tuition method within the classroom towards a more flexible tuition method using various advanced media techniques. Further, it is possible to realize the Just-in-time education of knowledge, information, and technology only if learners to be anywhere and anytime by using multimedia in the cyber space through the Internet. It may also create a globalization culture in which the learners can study any educational program they want anywhere in the world because the world becomes a single living space[3,6].

Therefore the study proposed and implemented a stepwise learning Courseware design model for solving mathematical problems as an integrated approach to performing the differentiated independent studying that the revised curriculum requires in the mathematical class. If considers evaluating the student's simple knowledge as well as the interest and aptitude, self-confidence, previous learning state, and participation in the class. Then, it classifies learners according to their ability and utilizes the Web for their independent and

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mathematical studying. The study will perform interactive tuition studying between learners and professors. To do so, we will examine WBI using stepwise learning and a Web-based stepwise learning pattern for solving mathematical problems at first and then suggest a stepwise learning design model to review and implement.

2. RELATED STUDIES

2.1 WBI using the stepwise learning

2.1.1 Definition of WBI

With the growing number of Internet users and the emerging request of developing an instrument to help users more easily and efficiently search Internet information, the Web is created. WBI (Web-Based Instruction) refers to a teaching method or education in a whole to perform tuition studying on the basis of the Web. Therefore implementation of WBI needs to equip a computer with networks and to actively use tools such as E-mail and search engines[7].

2.1.2 Strength and weakness of WBI

▷ Strength: away from the old class relying on text books, WBI make sure of progressing a dynamical class, ensuring creativity and independence of students at the utmost as well as encouraging studying motives and a sense of achievement.

▷ Weakness: WBI may allow students to contact unsound information. It is also lack of contents related to training courses, delays speed of information delivery, and can't expect interaction like that of the telephone or video conference.

3. WEB-BASED STEPWISE LEARNING PATTERN FOR SOLVING MATHEMATICAL PROBLEMS

Unlike the traditional learning where a group actively creating information and knowledge was

considered a professor, the Web-based mathematical problem learning oriented by learners enables both professor and students to create information and knowledge, leading to a tuition-studying process.

3.1 Characters of the stepwise learning

The characters of the Web-based learner-oriented learning for solving mathematical problems may be divided into three like below[3].

(1) It is based on realization of a lifetime learning society for the mathematical education.

(2) It makes efficient use of resources of the mathematical education.

(3) It provides high leveled learning experiences by introducing a management system on various studying.

3.2 Tuition-studying process of the stepwise learning

In the current mathematical studying, a professor person explains concepts and contents of a new chapter to learners who passively master and raises a question to make the learners understood. On the other hand, the Web-based mathematical problem learning will take opportunities to learn regardless of time and space and provide professors and learners with various interactive learning chances.

▷ Characters of the tuition-studying process of the stepwise learning

The tuition studying through the learner-oriented learning for solving mathematical problems on the Web is characterized as below:

(1) It should entail active participation of the learners

(2) It can combine and use all the studying methods utilized in class. Tab. 1 indicates how to perform the Web-based learner-oriented tuition studying in class.

Table 1. The Web-based learner-oriented tuition studying in class

A Class Tuition-studying	The Web-based learner-oriented tuition studying
Studying data explanation	Learner fare registration web or notice board
Composition direction	Registration web or notice board
Learner fare	Registration web or reference library
Reference data	Connection web or reference data registration
Question	E-mail, IRC
Reply	E-mail, IRC
Group Discussion	E-mail, IRC, Debate department
Practice lesson	Simulation utilization
Problem explaining lesson	Possibility
Studying assignment	Studying subject creation

(3) It can create better interaction between teachers and students as well as among students.

(4) It will use all the advanced software or tools to play an important role as a real tuition-studying.

4. DESIGN OF THE WEB-BASED STEPWISE LEARNING FOR SOLVING MATHEMATICAL PROBLEMS

4.1 Design factors of the Web-based stepwise learning for solving mathematical problems

Remote lectures for mathematical education need to work in the pragmatic and creative area on the ground of a lot of information knowledge and include suggestion of realistic methods. The design factors of the Web-based mathematical problem solving learning are divided into related knowledge, types of problems, and process of solving problems as fig. 1 illustrates.

4.2 Factors of learning system for the Web-based mathematical problem

The Web-based mathematical problem solving learning needs to work in the pragmatic and

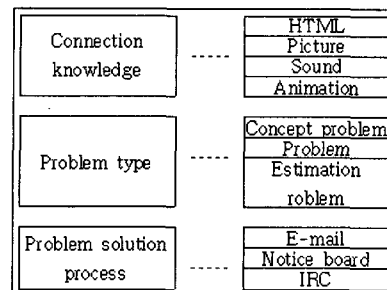


Fig. 1. Design factors of learning system for solving the mathematical problem

creative area on the ground of a lot of information knowledge and includes suggestion of realistic methods. Factors of such a remote lecture are composed of independent learners and professor persons (tuition method) and an educational activity system for the remote lecture (divided by training courses) like fig. 2.

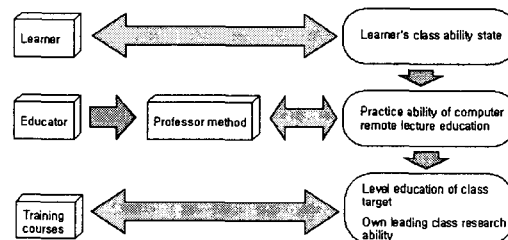


Fig. 2. Factors for learning of the mathematical problem.

4.3 Design of learning system for the Web-based mathematical problem

The learners will master related knowledge by facing problems with the mathematical problem solving learning. To expand the range of thoughts and efficiently program the Web-based mathematical problem learning needs to propose Courseware design model and map on the Web based on the systematic professor design model to develop multimedia for the mathematical problem solving learning.

4.3.1 Model of solving the learner-oriented mathematical problem

Fig. 3 illustrates a diagram of solving the

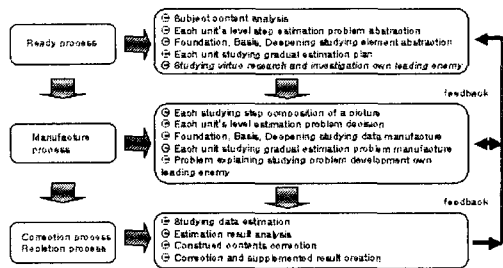


Fig. 3. Diagram of solving the learner-oriented mathematical problem

learner-oriented mathematical problem on the Web.

The model shown in fig. 3 prepares contents of training courses to learn at first, then manufactures differentiated studying materials for each learner, and finally analyzes and corrects the results of studying materials.

4.3.2 Classification of learners according to their academic performance

The learners take a test independently to evaluate their ability. Their academic performance for each chapter can classify each learner as fig 4 illustrates.

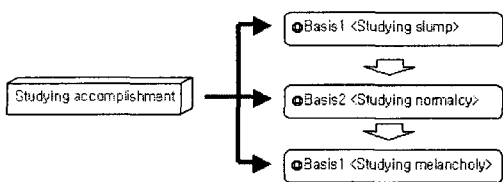


Fig. 4. Classification of learners according to their learning ability.

4.3.3 Map of learning for the mathematical problem on the Web

Fig. 5 illustrates the map of the mathematical problem solving learning on the Web. When it comes to the whole flow of fig. 5, the learners log in through the evaluation step, enter the given step for learning, and once again take a performance test to decide whether they do feedback learning about the evaluated contents or go over to the next step for another learning.

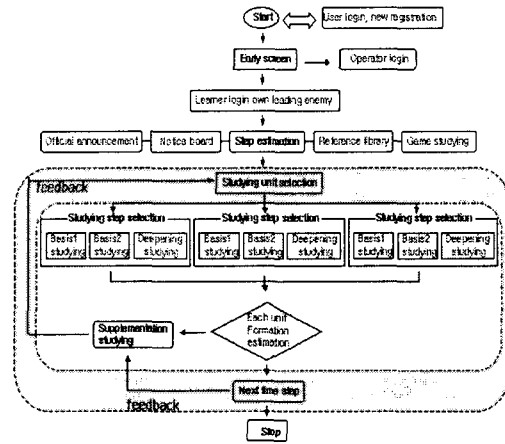


Fig. 5. Whole map of solving system for the mathematical problem.

The mathematical problem solving system on the Web, an education oriented by learners, must consider the different learning ability of the learners when deciding the training courses according to their academic performance. Also the professor persons should consider various level differences among their students and properly manage them together. In the 1:n class system like our country, it is difficult to take an appropriate action according to the different ability of the students. In this context, the Courseware design on the Web with possibility of real-time interaction can realize construction of educational environment more similar to the real life, student-centered differentiated individualized learning, and analysis of the academic achievement.

5. IMPLEMENTATION OF THE WEB-BASED STEPWISE LEARNING FOR SOLVING PROBLEMS

5.1 Web-based system oriented by learners

Fig. 6 shows a pattern of the learner-oriented learning system for solving mathematical problems on the Web. In the client/sever environment, learners will acquire various tools and programs in detail in order to implement an independent

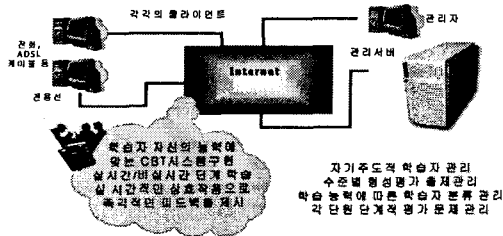


Fig. 6. Pattern of the Web-based learning system for management.

studying on their own. The sever environment will implement an evaluation system to classify learners according to their learning ability, constitute problems, and evaluate in real-time. Either educators or individual learners can do it in the client environment, removing limitation of time and space. Especially on the Web, it is possible to automatically evaluate the step evaluation problems and implement a step learners themselves want, in other words, CRT(Computer Based Training) system suitable for ability of each learner. The Web-based system creates a real-time interaction to provide immediate feedback, conveniently write and correct problems, and suggest various media and information by using links.

5.2 Solving system for mathematical problem

The independent mathematical problem solving system should take a form to thoroughly analyze contents of curriculums and to extract step evaluation problems of each chapter according to the academic performance, allowing students to independently study. To create such an educational environment needs to deliver an efficient lecture for the learner-oriented education by applying multimedia-used remote lectures and cyber classrooms. Also it needs to produce step evaluation problems carefully analyzing the curriculum contents and suitable for a number of learners. The mathematical problem solving system consists of many kinds of picture files and way files using image, moving picture, or graphic methods. In

addition, the system is completed through Flash and Authorware manufacturing tools.

5.3 Constitution of learning system for the mathematical problem

The mathematical problem solving learning system on the Web is divided into professor persons and learners. The professor person manages the existing menu, creates the necessary database and menu as well as learning manus including many kinds of software and tools, deletes users information, and produces statistic data.

The learner logs in to know whether he or she can solve the step evaluation problems of each chapter, utilizes his or her potential learning ability in the stepwise class for each chapter to study, corrects personal information, and uses the data rooms, the message boards, IRC(Internet Relay Chatting) to create better interactive studying each other. Fig. 7 shows the initial screen of "Happy World", a website, describing that a user is trying to sign up for a member and log in. After logging in, the user can select and use step evaluations, studying chapters, Q/A, data rooms, message boards, and help. The initial screen enables users to easily select each menu and the data room provides explanations of terms, software and tools related to mathematics, and so on.

The stepwise evaluation problems are composed of several questionnaires in each chapter like fig.8

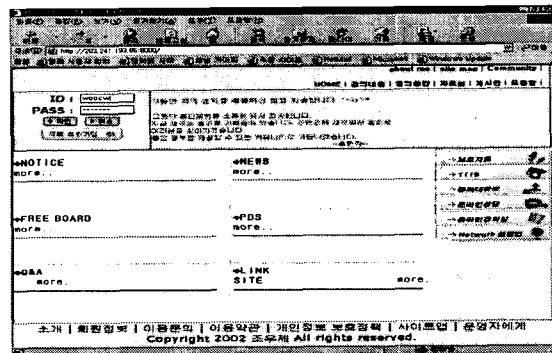


Fig. 7. The initial screen

내분점 외분점	광의보기	다운받기
대칭이동	광의보기	다운받기
두 점 사이의 거리	광의보기	다운받기
두 직선의 평행과 수직	광의보기	다운받기
부등식의 영역	광의보기	다운받기
원과 직선	광의보기	다운받기
원의 방정식	광의보기	다운받기
원과 직선사이의 거리	광의보기	다운받기
직선의 방정식	광의보기	다운받기
평행이동	광의보기	다운받기

Fig. 8. The problem category for stepwise evaluation.

With implementation the CBT system, it was designed to allow learners to click each studying step on their own according to the scores they earned in solving the step evaluation problems such as described in fig. 9 and fig. 10.

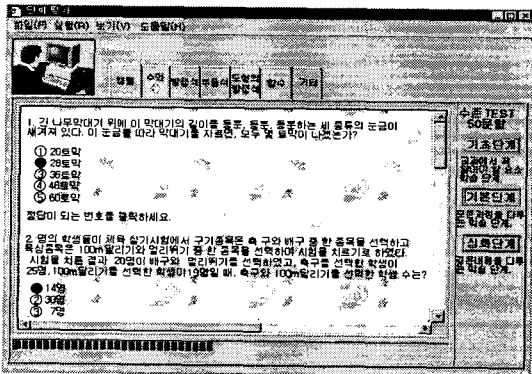


Fig. 9. An example of problems for stepwise evaluation.



Fig. 10. An example of the grade for stepwise evaluation.

The studying chapter briefly explains concepts of each chapter and consists of items each chapter. If there appears a wrong answer to the problems, a simple hint will be given for the wrong answer like fig. 11. After completely solving the problems, achievement for the studying chapter will be shown like fig. 12. And then once again a performance test will be taken for a review to decide whether giving feedback or going over to the next step according to the evaluated scores.

Fig. 13 illustrates the screen of performance evaluations in which several questionnaires for the stepwise learning of each chapter were given and solved. To know the answer is right or wrong is

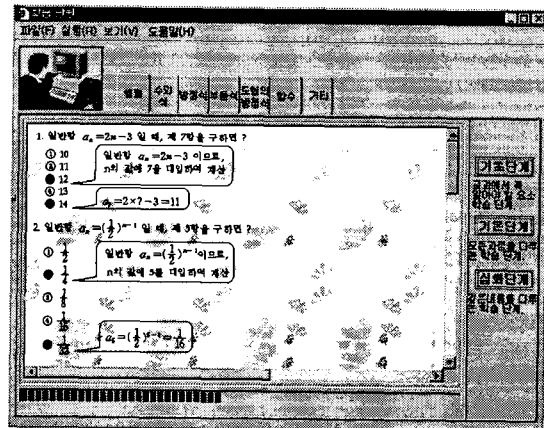


Fig. 11. An example of the studying chapter

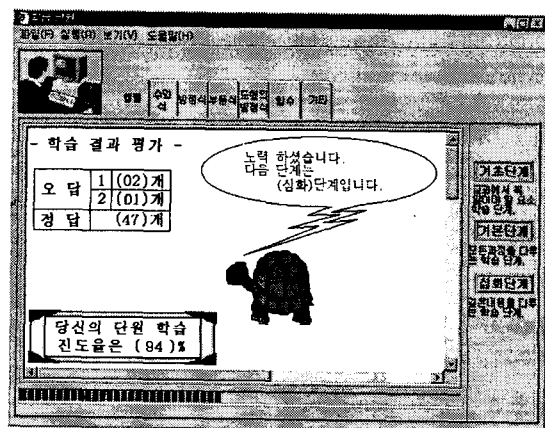


Fig. 12. An example of grade for studying chapter

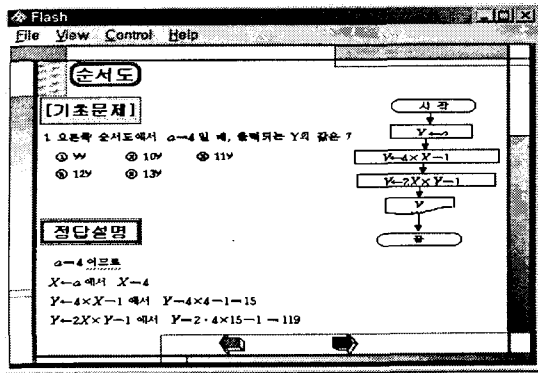


Fig. 13. The performance evaluations

to click the answer of the questionnaire. And to progress the next step is to push the arrow key below.

5.4 Evaluation of learning system for the mathematical problem

In the Web-based learner-oriented stepwise learning for solving mathematical problems, a way of improving the effect of studying is to allow learners to do independent study and to emphasize interactive learning between professors and the other learners. This study designs Courseware to achieve the purpose of studying while using the above two ways in class.

In the study, the stepwise learning basically implements the CBT system and uses push techniques to enables learners to select step-by-step studying chapters according to their ability. Also it provides basic information from that the learners need, for time-efficient learning. As a result, the learners can study regardless of time and place wherever they can use the Web. Such a learner-oriented education on the Web provides a new environment and shifts the emphasis towards learner-centered learning.

6. CONCLUSION

As the information society has rapidly developed, along with the growth of Internet, tuition

methods bring about many changes. For instance, the Web-based learning is exponentially increasing both quantitatively and qualitatively.

This paper analyzed the demands of independent learners and suggested the Web-based Courseware design model as a systematic multimedia model, in order to implement the solving learner-oriented mathematical problem. Thus, making students living in the information society recognize the learner-oriented studying is necessary. A class that uses the Internet efficiently utilizes educational opportunities that the current school courses can't give. It also provides various educational data and information for students to improve poor mathematical studying performance.

The future challenges are as follows: there should be a study on what negative effects or problems the Web-based mathematical problem solving education has: It should develop detailed items for the evaluation questionnaires: It should clarify interrelation between studying contents and system components: there should construct a better sever system; and it should design and create various Web-based Courseware in a different way. In addition, tools about many kinds of studying should be developed, researched, and implemented. In the near future, it is expected that the learner-oriented mathematical problem solving education described above will be replaced by a perfect one, expectancy to design for a more improved model evaluated by the learners for its educational effects, and to add more positive findings to the existing learning model.

7. REFERENCES

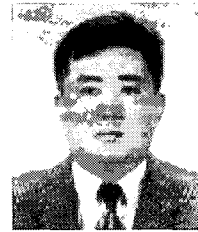
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