A Pen-Based System to Support Mathematics Problem Solving and Peer Assessment for Pupils

Solars, Y.W.CHENG, Edia, L.Y.CHEN, Rey, R.Y.RAU, Winston, M.C.WU, Tak-Wai CHAN

Graduate Institute of Network Learning Technology, National Central University, Taiwan
bDepartment of Computer Science and Information Engineering,
National Central University, Taiwan
{solars, edia, rey, winstonw, chan}@cl.ncu.edu.tw

Abstract: E-learning systems now currently existing almost using the mouse and keyboard to interact with learners. Apart from learners should waste time to learn how to manipulate the mouse and keyboard and also increase their cognitive loads on learning tasks. In the case of the teacher marking corrections on students' homework, the teacher need to correct the same questions again and again by each student, and the teacher usually can only find whether their answers were right or wrong. In particular, when the answers were wrong, it is difficult for the teacher to understand the problem solving process and to grasp the bottlenecks the students encountered. In this study, the authors develop a pen-based system to assist students in mathematics problem solving. The system can record problem solving process and in peer assessment process, students can review the record by each other. The preliminary results showed students can use the system more naturally and learn different problem solving methods from the peers.

Keywords: pen-based learning, peer assessment, mathematics problem solving

1. Introduction

Although e-learning systems have improved on our teaching and learning become more easily and effective, their interfaces have remained less the same – mouse, keyboard. In contrast, pen-based input type is related to students' school life and work, the system with pen-based input type just like the pen with book in reality.

2. Literature Review

2.1. Portfolio & Peer Assessment

Zhang & Tong [1] pointed out that the portfolio is a purpose to collect students about the learning-oriented activities or work, so that teachers, parents and students can take this understanding and assessment of student learning process and progress of the case and learning outcomes.
Topping & Ehly [5] pointed out that peer assessment among learners study aims to look forward to learners through collaboration with peers, teach, observe, counseling, monitoring, assessment, feedback and so different ways of learning.

2.2. Tablet PCs in Education & Handwriting Advantages

Teachers find that save children's handwriting online is beneficial for themselves and their students [3]. Research by Simon [4] has manifested that the tablet PCs which used as a substitute blackboard for both teachers and students is advantageous. Pen-based mathematics interfaces are also becoming popular in research topic in several years. It is believed that handwriting was faster and favored modality than typing [2].

3. System Design

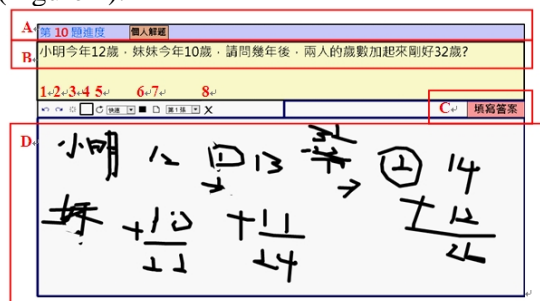A Pen-Based System was designed to support mathematics problem solving and peer assessment for pupils (Figure 1).


Figure 1: Snapshot of the system

3.1 System Overview

A. Status Bar: show the status of each question that the student have achieved.
B. Question Field: show the question text of each question.
C. Answer Field: click the button than show the answer field.
D. Handwriting Field (paper): student can write something to help them to solve problems. There are eight tools for handwriting, from 1 to 8 are undo, redo, clear, pen/eraser, replay, stop and new paper.

3.2 Each Step in Problem Solving Process

With problem solving process, there are five statuses in each question.
(a) Individual problem solving: the pen color is black and student starts to solve problem.
(b) Peer assessment and review – 1: After status (a), student will get peer problem solving record. In status (b), they will get the record three times. Student can review the peer record to observe and learn other's problem solving strategy every time. Therefore, student should use the red pen to correct peer record and evaluation.
 (c) Revise the answer and writing record: In status (c), the pen color is blue, student can revise their answer; both answer field and handwriting field. Furthermore, student receive the feedback from peer.

There is a big challenge for common e-learning system – open problem. In this pen-based system, we have supported unique solution problem (Figure 2(a)) and open problem (Figure 2(b)). We have developed a simple handwriting recognition module (Figure 2(a (H))).
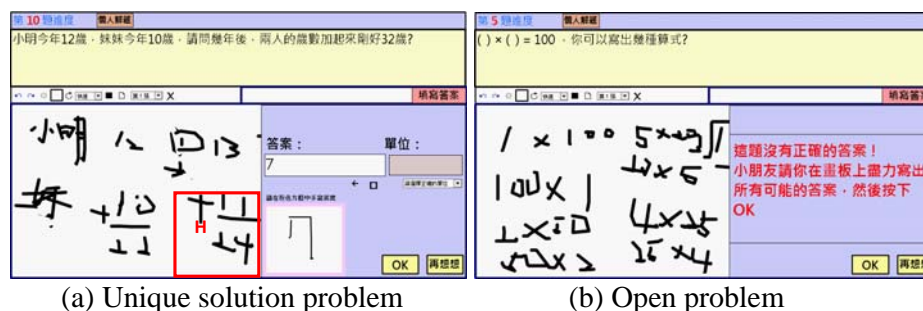
(a) Unique solution problem   (b) Open problem

Figure 2: Pen-based system have supported two type of problem

3.3 Peer Assessment Design

There are some rules in the method, we will explain as follows.
(a) Student can't get records which have written by themselves.
(b) Student can't get same record which they have gotten.
(c) Student will get three records in each question.
(d) First record delivers by the speed. The speed means student who have completed status of individual problem solving.
(e) Second record delivers by the grade which have evaluated in status of peer assessment and review – 1.
(f) Third record delivers by the same grade – 2.

4. Conclusion

It's the time to throw out the keyboard and mouse, and we all should think seriously what pen-based and handwriting will affect our life and point out the new way to change our learning and teaching. The objective of this research is to evaluate student interacted with the system which support mathematics problem solving and peer assessment. The experiment is still ongoing; we will get more and more data from digital classroom. We all hope this system can really help student to solve mathematics problem either mathematics difficult problem.

Acknowledgements

References

[1] Ji-Cheng Zhang, Hui-Yi Tong (2000) . Web-based portfolio of research evaluation and effectiveness analysis. "Distance education" ,15,16,98-111.
[2] Lisa Anthony, Jie Yang, Kenneth R. Koedinger(2007).Adapting Handwriting Recognition for Applications in Algebra Learning.
[3] Senior Honors Thesis, Daniel D.(2007) PettyIntegration and Perception of Tablet PC Software in Elementary Mathematics Education.
[4] Simon, B., Anderson, R., Hoyer, C., and Su, J. 2004. Preliminary experiences with a tablet PC based system to support active learning in computer science courses. In Proceedings of the 9th Annual SIGCSE Conference on innovation and Technology in Computer Science Education (Leeds, United Kingdom, June 28 - 30, 2004). ITiCSE '04. ACM Press, New York, NY, 213-217. DOI= http://doi.acm.org/10.1145/1007996.1008053
[5] Topping, K. J., & Ehly, S. E. (2001).Peer.-assisted learning. Journal of Educational and Psychological Consultation, 12(2), 113-132.