Introducing Handheld Computing for Interactive Medical Education

Joseph Finkelstein, Ashish Joshi, Mohit Arora
Chronic Disease Informatics Group, University of Maryland, Baltimore MD

Abstract

The goals of this project were: (1) development of an interactive multimedia medical education tool (CO-ED) utilizing modern features of handheld computing (PDA) and major constructs of adult learning theories, and (2) pilot testing of the computer-assisted education in residents and clinicians. Comparison of the knowledge scores using paired t-test demonstrated statistically significant increase in subject knowledge ($p<0.01$) after using CO-ED. Attitudinal surveys were analyzed by total score (TS) calculation represented as a percentage of a maximal possible score. The mean TS was 74.5±7.1%. None of the subjects (N=10) had TS less than 65% and in half of the subjects (N=5) TS was higher than 75%. Analysis of the semi-structured in-depth interviews showed strong support of the study subjects in using PDA as an educational tool, and high acceptance of CO-ED user interface. We concluded that PDA have a significant potential as a tool for clinician education.

Background

Use of Personal Digital Assistants (PDA) has been increasingly widespread among clinical students and residents. Despite significant improvement in PDA functionality, current literature does not provide systematic assessment of potential use of handheld computing for interactive clinician education. In addition, existing systems for computer-assisted education do not fully utilize modern theories of adult learning[1]. To address these issues, we assessed the feasibility of a PDA-based interactive multimedia tool aimed to provide self-paced medical education utilizing major concepts of modern learning theories[2-3]. The goals of this project were: (1) development of an interactive multimedia medical education tool utilizing modern features of handheld computing and major constructs of adult learning theories, and (2) pilot testing of the computer-assisted education in residents and clinicians.

Method

System Development

The design of the PDA-based interactive multimedia education tool, called **CO**mputer-assisted **ED**ucation (CO-ED) system, conformed to following two main requirements: (1) CO-ED should be implemented as a universal authoring tool supporting rapid development of variety of interactive multimedia education programs, and (2) CO-ED should use major constructs of learning theories to deliver self-paced medical education.

To address the first requirement we implemented user interface and the educational content as two independent constructs. To address the second requirement, we utilized in the CO-ED design three major approaches promulgated by modern theories of learning: behavioral (e.g., repetition of information with positive or negative feedback on answers of students), cognitive (e.g., creating of a system of knowledge, dividing of information into pieces, problem-organized learning), and

humanistic (e.g., inspiration of students, showing them how important and significant new information is).

Protocol for the Evaluation of CO-ED

In order to test CO-ED we developed educational curriculum addressing major issues of patient safety and medical errors. The patient safety curriculum included general section and specialty sections. The general section provided an overview of the basic facts about patient safety including definition, sources and major attributes of patient safety, diagnostic errors, medication errors, laboratory and clinical procedure errors. Each specialty section contained information on commonly used medications and clinical procedures which were shown to be a source of medical errors or adversely affect patient safety.

We conducted a baseline assessment of subjects' familiarity with patient safety and medical errors issues using a knowledge questionnaire containing twenty-four questions which were drawn from the content of patient safety curriculum. After the baseline assessment, the study subjects, represented by a convenience sample of ten clinical residents and fellows, were asked to use CO-ED and to complete the patient safety course. After the patient safety course was completed, the subjects' knowledge has been evaluated again using the same knowledge questionnaire. In addition, the subjects completed an attitudinal survey and qualitative interview. Attitudinal survey included fifteen questions assessing subjects' attitudes and concerns regarding content and user interface. The qualitative analysis was based on semi-structured in-depth interviews aimed to evaluate the sufficiency of the content of the patient safety curriculum, user friendliness of the interface, individual concerns and relevancy to the subjects' personal objectives.

Results

CO-ED Implementation

As a result of this project we developed a **co**mputer-assisted **ed**ucation (CO-ED) system which can be used as a universal platform for rapid development and implementation of interactive computer-based education programs for a variety of medical topics. The implementation of self-paced interactive multimedia education is based on an algorithm presented in Figure 1. The educational curriculum is divided into consecutive sections. Each section is broken into a logical sequence of interrelated educational messages consisting of textual, audio and video components. After each educational message, the users receive a multiple-choice question aimed to assess user's understanding of the educational message. If the user answers correctly the question, next educational message is presented by the CO-ED. If the user's answer is incorrect, the current educational message is presented again. At the end of each section users receive a short quiz. Users who pass the quiz are forwarded to the next section otherwise they are asked to repeat the current section. We have programmed the educational modules to provide an encouraging prompt (e.g., applause) for a correct answer. When subjects are in error, they are given an encouraging prompt recognizing their effort to answer question and then provided with an explanation for the correct answer.

After educational curriculum for a particular topic is approved, it is entered

in Access database on a desktop using a simple data entry form. The Access database is then transferred to the pocket PC and is used by a universal CO-ED presentation module installed on the PDA. Using this approach, the educational curriculum for CO-ED can be continuously updated by downloading the most recent version of the curriculum from an institutional web site or from dedicated workstations.

Impact of CO-ED on Users' Knowledge Scores

The Figure 2 represents a comparison of patient safety knowledge measured in the subjects (N=10) before and after using CO-ED. The knowledge scores were represented as percentages of a maximal score. Comparison of the knowledge scores using paired t-test demonstrated statistically significant increase in subject knowledge ($p<0.01$) after using CO-ED.

Users' Attitudes and Acceptance of CO-ED

Attitudinal surveys were analyzed by total score (TS) calculation represented as a percentage of a maximal possible score. The mean TS was 74.5±7.1%. None of the subjects (N=10) had TS less than 65% and in half of the subjects (N=5) TS was higher than 75%.

Using qualitative analysis problems in the following areas were identified: (1) content (how understandable are messages generated by the system), (2) interface (how easy is to operate the program flow), (3) process (how relevant the component is for the user, how frequently it can be used, how efficient training is, etc). Analysis of the semi-structured in-depth interviews showed strong support of the study subjects in using PDA as an educational tool, and high acceptance of CO-ED user interface. The notion of using PDA as an interactive educational tool was supported very enthusiastically by all study subjects. The respondents felt very comfortable with the CO-ED underlying algorithm claiming that it promotes self-paced education and allows to study complex topics "on the fly", while commuting in transport or during breaks from other activities. The study subjects also indicated that they felt encouraged by the feedback provided by the computer-assisted educational modules and none reported feeling punished or insulted by the prompting. About half of the CO-ED users suggested that case scenarios should be used more extensively and that content of the patient curriculum should be more challenging. Three users were not fully satisfied with the quality of images presented as a part of educational curriculum. All users considered ability to upgrade educational content by uploading additional modules as a very important feature of the CO-ED system. None of the users had difficulties in operating the pocketPC. A short five-minute introduction was sufficient for training new users to operate CO-ED successfully.

Conclusion

We concluded that PDA have a significant potential as a tool for clinician education.

Reference list

1. Chumley-Jones HS, Dobbie A, Alford CL. Web-based learning: Sound educational method or hype? A review of the evaluation literature. Academic Medicine 2002;77:S86-S93.

2. Morgan RR, Ponticell JA, Gordon EE. Enhancing learning in training and adult education. Praeger Publishers, London, 1998.
3. Dreber MA, Caputi L. The integration of theoretical constructs into the design of computer assisted instruction. Computer in Nursing 1992;10:219-224.

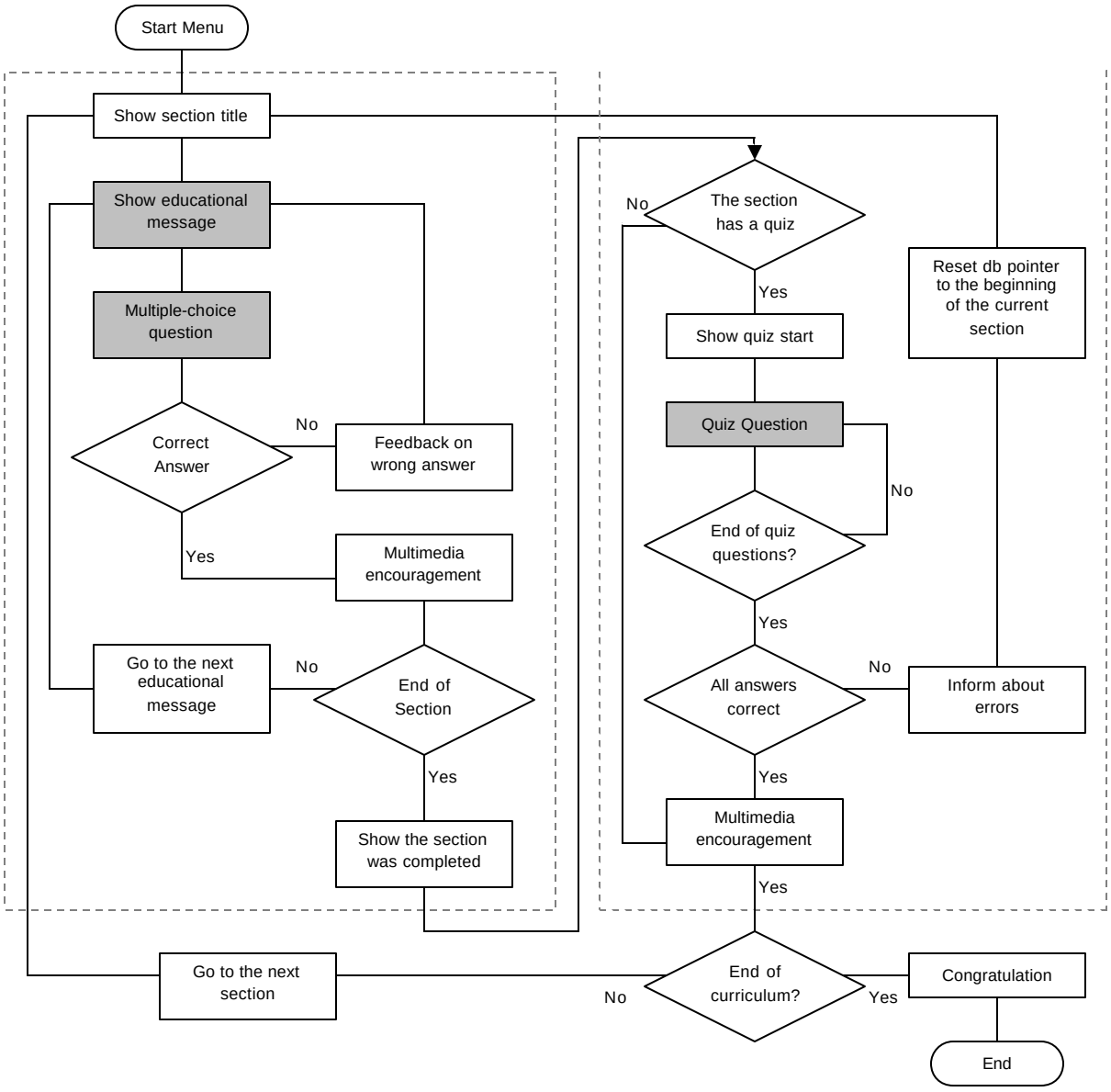

Figure 1. Algorithm for self-paced interactive multimedia education

Figure 2. Individual knowledge scores before and after using CO-ED