

Automated Analysis and Feedback for Mass Utilization of a Multimedia Tutorial

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Abstract

Of major concern in administration of a multimedia tutorial system is proper recording and analysis of a user's activities and success. Recording of the student's actions during the tutorial session gives the designer the capability to "recreate" the tutorial session and refine the system to meet the student's needs. The system can then be adjusted to provide appropriate interactions and feedback to the student.

SIMPLE, an NSF-sponsored software package written by Dr. W. M. Marcy and Dr. M. O. Hagler of Texas Tech University, can be used to create a tutorial session and record all details of each action a student takes within the tutorial session. A portion of the software, called Analyze, searches the records and is used to sift out the information of interest to the designer based on special criteria.

In the Spring of 1996, Amarillo College in Amarillo, Texas, used the SIMPLE software to create an NSF-funded math tutorial. The results of preliminary testing of the Analyze portion of the SIMPLE software to track student's progress are presented in this paper.

Introduction

Amarillo College has an enrollment of approximately one thousand students each semester in developmental mathematics. In an effort to supplement the developmental math curriculum, an NSF funded curriculum development grant provided the funds to design an interactive, multimedia tutorial system (Mathematical Interactive Network Design or MIND). An NSF ILI grant provided the funds to purchase 18 Pentium multimedia PCs. At this level in the mathematics department, students take standardized tests administered in the Math Lab. Each test may be repeated one time (a different version covering the same material) but the student is not required to do so. For many of the students, no improvement in grade is obtained. In an effort to provide some instructional support outside of the classroom, SIMPLE software was used to create and interactive developmental mathematics tutorial. Students could use the tutorial at any time but were required to use

the tutorial if a test was to be repeated when the first score was below 70. Proof was required to demonstrate proper completion of the tutorial prior to repeating the test.

One of the major concerns was the proper recording and analysis of each user's activities and success. SIMPLE automatically recorded each of the student's actions, correctness of answers, and times of each event into an Event In Context (EIC) log. See Figure 1. Figure 1 demonstrates the actions of a user over a time period of one minute and 40 seconds. Personally reviewing all entries for each of one thousand students over multiple sessions was not practical.

```
Login_User[I. MStudenten]12345|13:52:49|05-23-1996|
Open_Database[C:\SIMPLE\DATABASE\ANSWER.MDB]GlobCode.Ba
s|13:52:54|05-23-1996|
@LABEL[8 + 1.0)]Answer01|13:53:00|05-23-1996|
ANSWER[1.0) 15 - OK]Answer01|13:53:05|05-23-1996|
LABEL[1 + 2.0)]Answer01|13:53:07|05-23-1996|
ANSWER[2.0) 23 - OK]Answer01|13:53:13|05-23-1996|
@LABEL[2 + 3.0)]Answer01|13:53:17|05-23-1996|
ANSWER[3.0) Ans7 - ~OK]Answer01|13:53:24|05-23-1996|
@MEMO[15 + 4.0)]Answer01|13:53:30|05-23-1996|
ANSWER[4.0) Ans3 - OK]Answer01|13:53:32|05-23-1996|
@LABEL[3 + 5.0)]Answer01|13:53:38|05-23-1996|
ANSWER[5.0) ans3 - OK]Answer01|13:53:43|05-23-1996|
@LABEL[4 + 6.0)]Answer01|13:53:45|05-23-1996|
ANSWER[6.0) Qwerty - OK]Answer01|13:53:53|05-23-1996|
@LABEL[5 + 7.0)]Answer01|13:53:54|05-23-1996|
ANSWER[7.0) Qwerty - OK]Answer01|13:54:00|05-23-1996|
@BUTTON[11 + 8.0)]Answer01|13:54:01|05-23-1996|
ANSWER[8.0) - OK]Answer01|13:54:02|05-23-1996|
@PICTURE[9 + 9.0) Bridge]Answer01|13:54:02|05-23-1996|
ANSWER[9.0) Bridge - OK]Answer01|13:54:03|05-23-1996|
@LABEL[6 + Section 1]Answer01|13:54:08|05-23-1996|
% OK[Section 1 88.9 %, 50.0% to pass, 9 tries (9), 8 OK, 1 ~OK.]
Answer01|13:54:12|05-23-1996|
@PICTURE[8 + 1.0) Race Car]Answer02|13:54:20|05-23-1996|
ANSWER[1.0) Race Car - ~OK]Answer02|13:54:21|05-23-1996|
@PICTURE[7 + 3.0) F15]Answer02|13:54:22|05-23-1996|
ANSWER[3.0) F15 - OK]Answer02|13:54:24|05-23-1996|
```

```
@LABEL[4 + Section 2]Answer02|13:54:28|05-23-1996|
% OK[Section 2 50.0 %, 100.0% to pass, 2 tries (1), 1 OK, 1 ~OK.]
Answer02|13:54:29|05-23-1996|
@BUTTON[17 + Description 39]Answer01|13:54:34|05-23-1996|
Logout_User[I. MStudenten|12345|13:54:34|05-23-1996|
```

Figure 1. Sample EIC Log.

A utility named Analyze was provided by Dr. Marcy for detailed analysis of the EIC logs on an individual or class basis.

A pilot program involving 90 students at Amarillo College allowed testing of the feasibility of the Analyze utility to provide an efficient mechanism to review student's actions within the tutorial. The 90 students were members of three different teachers' developmental math classes.

Analyze

Analyze contains criteria template files that allow for searching of the EIC logs. The template criteria are of the form:

```
NULL[parm]tag|00:00:00|01-01-1996|*OR
```

- The first field NULL applies to the Command.
- The second field par applies to the parameter.
- The third field tag applies to the screen tag.
- The fourth field 00:00:00 applies to the time.
- The fifth field 01-01-96 applies to the date.
- The sixth field *OR determines the logic used.

For example, if the criteria file selected was @BUTTON[parm]|tag|00:00:00|01-01-96|, this will match any record in the EIC logs with the command BUTTON (@BUTTON is recorded when the student clicks on one of the controls such as a navigational control or an answer checking control.) All the records that matched the criteria, the time the action was taken, the time elapsed between events, the parameters captured, the date, and the average number of recorded events per minute can be viewed. The analysis may be reviewed on screen or printed. At the beginning of the listing, are the summary statistics and a comment line. See Figure 2 for an example.

```
>>>----- Begin Analysis -----<<<<
Class Average :75.00
>>>-----<<<<
>>>----- Begin Session -----<<<<
User Name      : I. M. Studenten
User ID       : 459588674
Session Date  : 03-15-1996  10:55:34
ReportDate   : 03-15-1996  10:59:10
LogFile      : C:\SIMPLE\MAIL\45958867.LOG
Notes        :
Criteria     : NULL[parm]tag|00:00:00|01-01-1996| Logical: OR
Matches      : 11
Duration     : 67.00 secs  1.12 mins
Average/Min  : 9.85 /min
>>>-----<<<<
Correct : 3  Incorrect : 1
Individual Average :75.00
>>>-----<<<<
00001 Login User
      I. M. Studenten
      459588674 03-15-1996  10:55:34
00002 Open Database
```

Figure 2. Sample EIC Data Analysis

With the analyze program, the logs can be reviewed by student, action, session, date, etc. The logs can also be reviewed by class in order to find any similar actions taken. For example, the Analyze program may be used to determine what percentage of students are answering a particular question incorrectly. This would then allow the instructor to address this issue in class or correct the tutorial if the error was in the tutorial problem statement.

Pilot Program

At Amarillo College, 90 students were selected to pilot test the developmental math tutorial MIND. As previously stated, a student at this level was not satisfied with a test grade, could take another version of the test in an attempt to demonstrate improved performance. For these 90 students, if the first grade was below a 70, the portion of the tutorial corresponding to the material had to be properly completed prior to the retesting. If retesting was attempted without proper completion of the tutorial, the second grade was not accepted.

For this pilot program, each teacher reviewed the logs of the student in his/her class. The teachers had various levels of expertise using a PC but were all comfortable using the Analyze portion of the SIMPLE software. An initial demonstration regarding the capabilities was first required but then the teachers all functioned independently.

The recording of the EIC logs and the Analyze program default to the C drive. Due to some complications with the hardware configuration of the computers in the Math Lab, it was necessary to record the student logs on individual floppy disks. Each student was required to purchase a floppy disk which was left in the Math Lab to allow the teachers access at all times. When a student retested, the teacher would determine if the previous grade had been below 70, and if so, would

obtain that student's disk and using Analyze, check for proper completion of that portion of the tutorial.

Results were excellent. The teachers had no difficulty searching the records using various parameters. The most prevalent search pattern involved a listing of all records of the student's activities as opposed to a smaller subset of activities. Teachers commented that this was the most popular search as they liked to "see everything." The summary at the beginning of each session indicated the number of problems correct and incorrect but teachers would search the listing in an attempt to determine "what the student was thinking." While this may seem unrealistic, the minute detail of the logs did give the teachers insight into the students thoughts at the time. Individual teachers would often respond in a manner confirming the recording of the actions, such as , "Yes, that's just like her."

Conclusions

Observations of the logs influenced some of the design decisions regarding the tutorial as a whole. Students frequented certain sections of the tutorial more than others. In particular, when students moved through the tutorial at their own discretion, some of the students reviewed the subject material first, followed by exercises and then the self test while other students performed the self test first and then reviewed the subject material. The tutorial is being redesigned to allow more flexibility in the students access to various areas of the tutorial.

Implementing Analyze to search the EIC logs for incorrectly answered questions, indicated patterns of errors (on the students' part and the designer's part). Changes to particular sections and questions that the students exhibited difficulty in answering correctly were also a direct result of using the Analyze portion of SIMPLE.

The teachers using the Analyze utility in conjunction with the tutorial, indicated confidence in their ability to interpret the search results and confirm the depth and quality of the students' progress. Tracking of a student's progress through as many as 50 sections of the tutorial would have been impossible without the Analyze utility.

Analyze is an excellent software utility that allows for monitoring of large numbers of user actions. Based on the ease with which the 90 students in the Amarillo College were monitored, it is anticipated that all students in the Developmental Math series will be required to use the MIND tutorial by Spring 1997. This close monitoring is only possible due to the combination of the SIMPLE based tutorial and the Analyze utility.

SIMPLE Software

An inexperienced multimedia developer, who has some small experience using a PC with Microsoft Windows 3.11, Windows '95 or Windows NT can produce a SIMPLE learning environment in a few days. The developer can structure and modify the SIMPLE learning environment and the corresponding user interface without writing any code or control scripts. For those developers who cannot forgo the pleasure of programming, SIMPLE provides a straight forward way to seamlessly integrate custom written screens and procedures directly into the SIMPLE environment. Custom programming requires the use of Microsoft Visual Basic 3.0 Professional. SIMPLE will run on an I386, I486, or Pentium PC that runs, Microsoft Windows 3.11, Windows '95, or Windows NT with a VGA or Super VGA video card and monitor. The system must have a minimum of 4 megabytes of RAM and about 10 MB of free disk space for installation. For multimedia work, you will need the multimedia extensions for Windows 3.11 and associated hardware such as a Sound Card and a CD-ROM drive. The software can be downloaded from the WEB server ALN.COE.TTU.EDU or via anonymous FTP from WMM.COE.TTU.EDU.

Biographies

Kathryn C. Wetzel

Dr. Wetzel is an Associate Professor in the Sciences and Engineering Division of Amarillo College. As a direct result of her doctoral research, she has begun the development of an interactive Developmental Mathematics tutorial (MIND). The MIND tutorial is funded in part by an NSF curriculum developmental grant and an NSF ILI grant.

William M. Marcy

Dr. Marcy is Professor of Computer Science and Associate Dean of Engineering for Research and Administration at Texas Tech University. He has extensive experience in developing commercial software and hardware. Recently, Dr. Marcy has been exploiting the powerful linking and embedding capabilities offered by the new visual software development environments to build complex interactive learning environments. One of these software packages is SIMPLE, which was developed under an NSF grant. SIMPLE is currently being used as part of an NSF grant by Dr. Kathryn Wetzel to develop an interactive learning environment at Amarillo College. As Associate Dean of Engineering, Dr. Marcy acts as Director of Continuing Engineering Education for the College of Engineering.