A COMPARISON OF AUTHORING SOFTWARE FOR DEVELOPING MATHEMATICS SELF-LEARNING SOFTWARE PACKAGES

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Abstract

Four years ago, the authors started to develop a self-paced mathematics learning software called NPMaths by using an authoring package called Tencore. However, NPMaths had some weak points. A development team was hence formed to develop similar software called Mathematics On Line. This time the team used another development language called Scientific Notebook. In early 1998, the authors developed some question items using Maple as it includes the strong points of both Tencore and Scientific Notebook. Unfortunately, all the software mentioned above requires the downloading of the package into the local machine. All these packages (Tencore, Scientific Notebook and Maple) do not have a convenient plug-in version suitable for web browser application. The team recently developed similar software using Java. The first batch of question items using Java were used by more than 1000 students. The Java development was not too successful because the downloading time was too slow especially when many students are using the package at the same time. Currently the team is studying the possibility of using ActiveX to develop a learning package in which the downloading time is expected to be one-tenth of the Java downloading time.

I. INTRODUCTION

In the past few years, the authors have developed some mathematics self-learning software using different packages: Tencore, Scientific Notebook, Maple, Java and ActiveX. In this paper, the strengths and weaknesses of different software are discussed and compared.

II. TENCORE

Four years ago, the authors started developing a self-paced mathematics learning software called NPMaths by using an authoring package called Tencore. Tencore is a very powerful authoring tool. The authors used Tencore to develop their first software called NPMaths. Tencore enables NPMaths to have the following good features:

1. Randomly generated parameters can be incorporated into question items all have . The items also include randomly generated string variables. As a result, question items can be generated with completely different appearance. For example, the first student may have a question starting "A car..." while the other student may have the same question item starting with "A motorcycle", "A

speedboat" or " A truck" etc.

2. More than 99% of NPMaths questions are of free response type. The coder can decide the format of the answers. The answers can be expressions, fractions, decimals or even text. They can also be a series of numbers.
3. NPMaths can be run in a server so that many students can use it at the same time. Furthermore, NPMaths can record the work of the students. Each student can check which topics he/she has finished and his scores in individual topics.
4. The examples and questions of NPMaths can include pictures and animations.
5. Only the coder requires the Tencore authoring tool. The end-users can copy the binary files to run them in any personal computer. It is very convenient to the end-users. Furthermore, the user will only be provided with the binary files. They do not have the chance to view the source code files. Hence the copyright of the coder can be protected.
6. Plotting of graphs is possible and the display is clear. The speed of the animation of plotting can be controlled.

However, Tencore has the following weaknesses :

1. It was a DOS authoring tool at the time of our development. It stands by itself. There is no communication with other software or word processors. For example, the contents of NPMaths cannot be copied and pasted to MS Word documents. There are complaints that it is not easy to get a hard copy of Tencore questions. All the pictures have to be drawn using its own editor. It is impossible to import external picture files.
2. At the time of our development, Tencore could only produce a DOS environment product, which could not be converted into Web-based programs easily. Though the production company claims that its version 8 enables Tencore files to be run in the Web, they are not as convenient as other products which are web-based or web-ready. Of course the user can download the binary files from the Web and run them in the local PC. There is no interactive process between the end-user and the homepage and the response of the end-user cannot be captured.
3. The input of mathematics using Tencore is very inconvenient. Toolbar for the input is currently not possible. The users have to use special keyboard functions to input these symbols. For example, the students have to key in "ctrl-u, u" for a superscript. This method of input is time consuming and not user-friendly.
4. The coding is difficult to learn. It is time-consuming even for experienced coders.
5. Though the authoring system is not required by the end-users, many files have to be downloaded together with the question files before the question can be viewed. It is very time-consuming for the downloading.

Result : A development team was formed to develop an improved software called Mathematics-On-Line. This time the team used another developing language called Scientific Notebook.

III. SCIENTIFIC NOTEBOOK

In late 1997, we wanted to develop some courseware which can be run in the hybrid Windows-web environment. We chose Scientific Notebook version 3.00 to be our new authoring tool. Scientific Notebook is a Computer Algebra System. It contains an important part called Exam Builder which can be used as an authoring tool. Exam Builder has the following good features:

1. It has user friendly toolbars which enable the users to input many special mathematical symbols.
2. The coding is simple. People without a good knowledge of computers can learn the coding in a very short time.
3. It can import picture files easily.
4. Its graph plotting feature is convenient and user friendly.
5. It works in a Windows based environment. It can also be run in the Web environment with plug-in of Scientific Notebook. The plug-in is available in the internet.

The weak points of Exam Builder are listed below:

1. The Exam Builder in SN 3.00 can only provide multiple choice question items. Free response questions have to be marked manually. The authors have viewed the beta version of SN 3.10 which is designed to code free response question items. Unfortunately the engine will accept any correct answer in any format. As a result, the coder cannot control the expected format of the answer. In an extreme case, if a student is asked to simplify an expression, he can just copy the question and paste it into the input box to obtain a correct score.
2. The plotting of graph is not flexible. It is not easy to add any text inside the graph. Labeling of axes is not flexible also.

IV. MAPLE

In early 1998, the authors developed some question items using Maple as Maple includes a number of good features available in both Tencore and Scientific Notebook.

The strong points of Maple are:

1. It can provide free response type of question items.
2. It can import Chinese language directly. There is a high possibility that it can import other languages such as Japanese and Korean.

However, Maple has the following major weak points:

1. It is not user-friendly to the coders and the end-users.
2. Drawing diagram is inconvenient.

V. JAVA

Unfortunately, all the software mentioned above requires the downloading of the package into the local machine. All these packages (Tencore, Scientific Notebook and Maple) do not have a convenient plug-in version for the Web browser. The team developed similar mathematical self-paced learning software using Java in late 1998. A trial run was conducted to 1500 students in early 1999. Java programs have the following strong points:

1. They can be run in the browser directly without any plugin. It can also be run through the Internet. This will solve the problem of shortage of laboratories. The students can do the exercises anywhere in the campus. Students can also do the practice at home around the clock.
2. The programming is flexible. It is not dependent on the developer of the authoring tools. For any one of the authoring tools mentioned above (Tencore, Scientific Notebook or Maple), if the user finds that a particular function is not available, there is nothing the user can do about it. In Java

developments, it is more flexible for the user to add in a particular function.

Unfortunately, Java also has some major weak points:

1. The programming is difficult to learn. It is very time consuming even for an experienced programmer
2. The program cannot be run in the server. Each question has to be transferred to the local machine. The size of each question is about 200K. The questions ran very smoothly during the trial run. However, it took more than 5 minutes to download one single question when more than 1000 students were downloading at the same time.

The development team was hence studied the possibility of using ActiveX to overcome this problem. In the plan, a user-friendly editor will be developed so that any mathematics teacher can code the questions easily with the help of the editor without knowing programming language.

VI. ACTIVEX

ActiveX has the following advantages:

1. The program is written in Visual Basic. The programming is simpler than Java.
2. Using ActiveX is more convenient than Scientific Notebook and Maple.

Some ActiveX questions have already been coded and the trial run will be held in late August. After the trial run, the authors will be able to report on the performance of ActiveX.

Conclusion:

All the authoring tools mentioned in this article are good for developing self-learning mathematics packages. Each of them has its pros and cons. When we choose an authoring tool, we must take into consideration whether the product can be used easily in the working environment such as web. Among them, only Maple can accept the input of Chinese and Japanese characters. This trend is no good for the development in Asian countries as most of the languages in Asia are very similar to each other and very different from English. The developers of authoring tools should be aware of this. Otherwise they will lose this big market in the East.

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