CS092 Article Discussion
9-April-2003

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CardioViz will incorporate the use of dynamic animations and graphs, accompanied by text-guided instruction. Our hope is to effectively supplement cardiovascular physiological courses in education. The interface design will be crucial to the ultimate success of this program. How the finished product will be used and presented to students will also be of great importance. Two articles relevant to the design of our project are: "Interactive Texts, Figures, and Tables for Learning Science: Constructivism in Text Design," published by the University of Hawaii in the *International Journal of Instructional Media*, and, "Assessment of Aerobic Endurance: a Comparison Between CD-ROM and Laboratory-based Instruction," published by the University of Strathclyde in the *British Journal of Educational Technology*.

The U. Hawaii article goes into great depth on a constructivist taxonomy consisting of knowledge application, acquisition, and creation. According to the article, constructivist textbooks should include tables and figures in such a way that maximizes the information retention and learning experience. The article uses a high-school marine biology textbook as a specific case study. One of the findings shows that in dealing with tables and figures, knowledge acquisition oftentimes outweighs the importance of knowledge application; that is, students were more apt to memorize facts and information than actually apply what they learned in a real contextual environment. The study argued that in order to effectively use tables and figures, they must be presented in an appropriate way in conjunction with the text. The issues brought up in this article are important to CardioViz because we will be dealing with displaying an animation and

graph with text explanations. The advantages and disadvantages of this choice of presentation must be seriously considered for the final design of our program.

The U. Strathclyde article presents a study on CD-ROM-based versus laboratory-based learning. The study compares two groups of students taking a course in sports medicine; particularly, the study focuses on the aerobic endurance unit. There were significant differences in the final evaluations of the two subject groups at the end of the study. While both learning from educational software and learning from traditional lectures proved to be effective methods of gaining factual knowledge, neither method seemed more effective than the other, and in addition, different skills and confidence levels developed. A CD-ROM based program is essentially a virtual simulation using educational software-based presentation methods. The difference between the U. Strathclyde study and CardioViz is the amount of information and intended use; CardioViz is to supplement a unit of a traditional course, while the U. Strathclyde program was more of a substitution for traditional laboratory instruction.

According to the U. Hawaii article, a problem that usually arises with seeing both visual and textual images concurrently is cognitive overload, or an overflow of information. In such cases "where students need to integrate information from both texts and illustrations, not where texts and illustrations are merely redundant," diagrams and figures can often interfere with the learning process. Presenting figures with text already forces students to establish implicit mental connections between the actual meanings of the text and figures; constructivist texts often require readers to "fill in" information through the use of outside media and objects. This approach is good in helping students test and shape their own ideas, and at times, makes the learned information more

memorable. However, when there is an excessive amount of information and data, students tend to concentrate on knowledge acquisition and not think about applying the knowledge elsewhere. Commonly, many traditional texts and computer-based applications face this problem. CardioViz differs in the respect that it incorporates both knowledge acquisition and application. Users will have the opportunity to learn about the cardiovascular system through supplementary explanatory text, but they will also be able to apply their understanding by changing parameters to redraw the graph and animation. Also unlike traditional educational software, CardioViz will not present a lot of background information, as it is intended to be as simple and readable as possible to someone who has already had a basic presentation of the material. CardioViz will not be the main knowledge acquisition vehicle; it will analogous to the traditional figures and diagrams that are found in ordinary texts.

The study conducted in the U. Strathclyde article was of particular interest because the user interface and design is very similar to what CardioViz will include. Their CD-ROM is certainly more complex in knowledge acquisition and includes several more menu-structures, but as mentioned before, CardioViz is aimed at being a teaching tool and not a lecture substitute. The CD-ROM has menu structures that direct the user to different topics, hypertext links, and interactive diagrams, where the user can input data that is actively plotted on the screen as the program runs. CardioViz will not have such a complex menu structure, but it will include hypertext links, an animated diagram, and actively changing plots. The results of the study are important to our decisions on CardioViz' s design, since there are several weaknesses in their approach. Although the CD-ROM subject group indicated a lot less confidence in the

material in taking the evaluation exams as opposed to the lectures, it did not perform any worse in terms of grading the final exams. However, many said they preferred traditional classroom instruction. Similar to the U. Hawaii study, the CD-ROM group suggested that there was too much information to retain, and that the CD-ROM should have reduced the information by highlighting only key points and providing accompany handouts. Students also said that the CD-ROM seemed to focus more on the exam and not the full understanding of the principles involved. Again, CardioViz should not encounter such confidence problems because course instruction is not being substituted; course instruction is only being supplemented by CardioViz, and traditional methods of interaction with peers and professors are still allowed.

CardioViz will still make heavy use of the constructivist theory as well as many advantageous aspects of software-based learning. Particular features that we feel will be important include the updating graph and animation, as that serves as a strong supporting constructivist method. As mentioned in the U. Hawaii article, "In multimedia, manipulable graphics may require that students create models and hypotheses of their own … which would exemplify the highest level of interactivity," and interactivity will help students enrich their learning experience. Currently, technology can not be a total substitute for teacher-based traditional instruction. Technology is also constantly changing, which makes it difficult to keep educational software up-to-date and effective. CardioViz aims to address all of these problems by keeping a simple interface, acting as only a teaching tool, and having an expandable foundation.

Evaluation of the success of CardioViz itself will not be tested directly. CardioViz is just one tool in a variety of teaching methods already employed in

the Bio80 curriculum. It is important to stress, once again, that the function of CardioViz is not meant to replace the traditional lecture, but rather serve as a supplement. By this our hope is to reduce the dependence on the CardioViz software for strict knowledge acquisition and instead encourage students to actively experiment with concepts learned in the classroom, or for users without the benefit of classroom instruction, the highly traditional and expository, though electronic substitute tutorial linked from the main page. By this we want to instead encourage students to make predictions and hypotheses about how already acquired notions of variables such as heart rate and stroke volume affect cardiac output. Evaluation of their predictions is by design instantaneous, but by no means explicit. This is especially important. Rather than overburden the student with fact after fact (i.e. an increase in blood volume will shift the vascular curve in the graph display to the right) the student must internalize this concept without being told that this is so. Thus, unlike the marine biology text, CardioViz allows for immediate self-assessment. Within the mathematics of the program, perceived user control is in fact dictated by previously defined variable ranges, and thus the program in itself complete, providing feedback and direct visual and graphical assessment for any of the values the user chooses to manipulate. The question of assessment, and who does the assessing, is especially important in constructivist learning as it is in traditional classrooms. That is, for example, having students classify and categorize certain objects in the marine biology text nonetheless raises the question of evaluation. How does one deal with wrong classifications to ensure that wrong notions are not perpetuated?

Perhaps it is not fair to compare CardioViz to the marine biology text as a whole, a text whose breadth of information demands a range of activities to stimulate

learning. CardioViz is more like a chapter in a much longer, and yet to be created constructivist physiology text. Its aim is to present information that would otherwise be impossible to construct physically in a laboratory setting given the level of its target audience and the time constraints given in a traditional introductory physiology course. Like the marine biology text, we do not expect knowledge creation to occur within the program itself and thus falls short of realizing the true and ultimate goal of the constructivist philosophy. Though the program is designed to provide students with a vocabulary to understand what is happening, it is our belief that CardioViz will be an effective vehicle for knowledge application.

Sources:

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