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Barbara S. Chaparro, Editor

The Role of Interactivity in Web-Based Educational Material

By Laurie Brady

Summary: The effect of interactivity within an educational website was examined regarding learning outcomes, website satisfaction, and student time-on-task. The participants consisted of 72 seventh grade students from 5 classrooms. Each participant was randomly assigned to use one of three science websites with similar content but varying levels of interactivity. Results indicate that interactivity positively influenced learning outcomes, website satisfaction, and time-on-task.

INTRODUCTION

Development of effective instructional web-resources is a growing concern for instructional designers and educators alike. Good design of these resources is critical since user interaction with a web-based learning environment is frequently a one-time event (Jones, 1994). In addition to utilizing usability guidelines, designers of instructional web-resources must also employ aspects of learning theory. A particular concern hinges on the role interactivity plays within educational web environments. While the majority of research indicates that interactivity positively influences learning (Milheim, 1995-96; Najjar, 1998; Ohl, 2001; Robertson, 1998; Shaffer & Hannafin, 1986; Sims, 1997; Stoney & Wild. 1998; Yacci, 2000) and satisfaction (Stocks & Freddolino, 2000; Teo et al., 2003; Zirkin & Sumler, 1995), relatively few studies have used websites in their experiments, and even fewer have used educational websites. Most conclusions have been made from experiments outside the realm of the World Wide Web, such as in the classroom or through other forms of multimedia (e.g., interactive video). It should not be assumed that the benefits of interactivity apply equally to all environments.

For the purposes of this study, interactivity shall refer to a form of cognitive engagement influenced by structural aspects of the medium (computer). Interactivity is influenced by the amount of control available to the user (Robertson, 1998; Borsook & Higginbotham-Wheat, 1991; Stoney & Wild, 1998) as well as the availability of features that encourage users to actively process information (Ritchie, 1996; Marzano, 1992; Thibodeau, 1997). According to the literature, increasing user-control should increase learning and user satisfaction. Similarly, increasing active processing should result in increased learning outcomes. It remains unclear, however, whether interactivity increases student time-on-task (Shaffer & Hannafin, 1986; Summers, 1990-91). Therefore, the purpose of this study is to analyze the role of interactivity within an educational website including its effect on learning outcomes, satisfaction, and time-on-task.

METHOD

Participants

Seventy-two middle school students (39 boys, 33 girls, mean age = 12.6) volunteered to participate in the study. All students were enrolled in the 7th grade and attended a public school in a small town in Kansas (population approx. 6,000). Ethnic background of the participants consisted of 93% White, 4% Hispanic, and 3% Other. On average, students visited websites a few times per month at school and a few times per month outside of school. Each classroom of volunteers was entered in a drawing for a $25 gift certificate to a local store, and an additional $15 gift certificate was given to the student from each classroom who scored the highest on the post-test.

Materials

Three websites with varying levels of interactivity were developed using content and graphics from the "Inside a Cell" website, used with permission of the Genetic Science Learning Center at the University of Utah (http://gslc.genetics.utah.edu) (see Figures 1-3).

A pre- and post-, multiple-choice comprehension test was developed utilizing content from the website. Satisfaction and background questionnaires were also developed for the study. All students used Pentium III wireless laptops, 850 MHz with 14.1" TFT display (resolution setting of 1024 x 768 pixels). All websites were viewed locally to control for any differences in download time. Performance data, including time-on-task and web pages visited, was gathered using logging software (i.e., ErgobrowserTM).

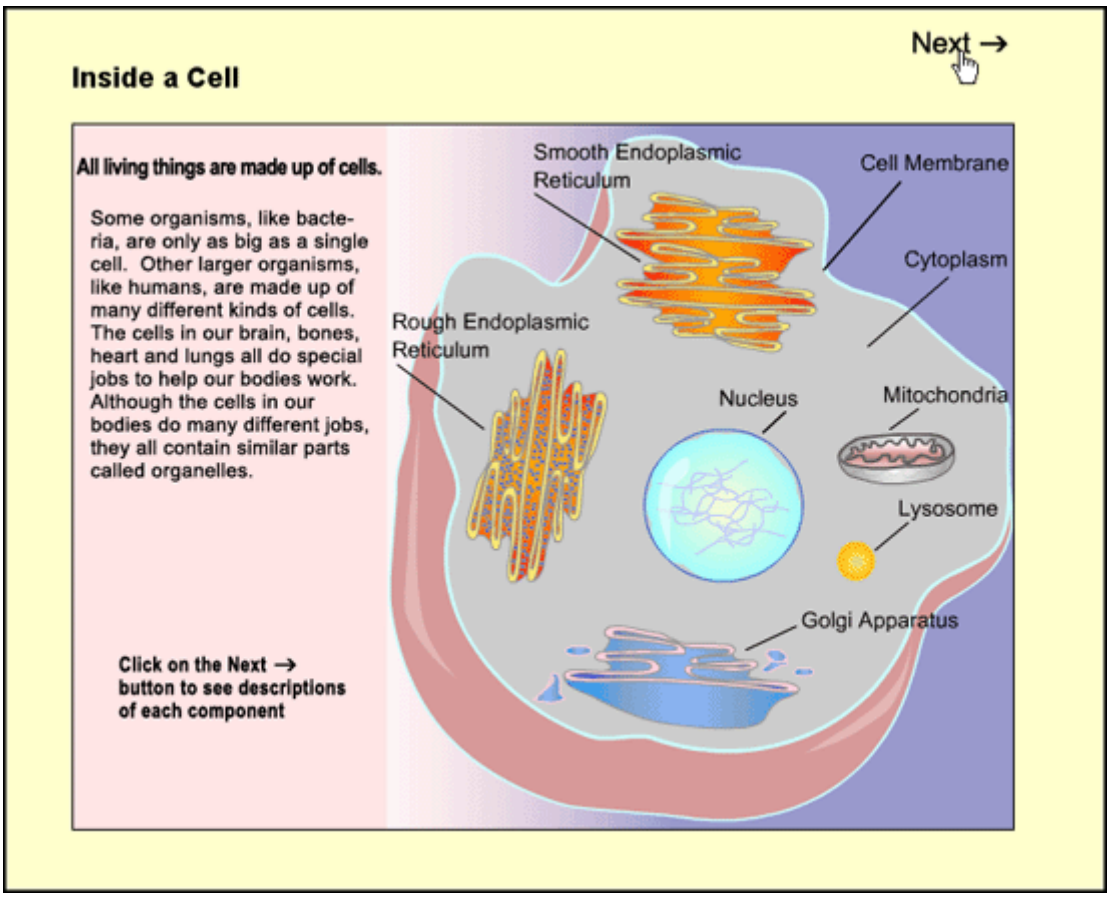

Figure 1. Reactive Website. Users were required to simply press the space bar or click on

the Next link to view each lesson page.

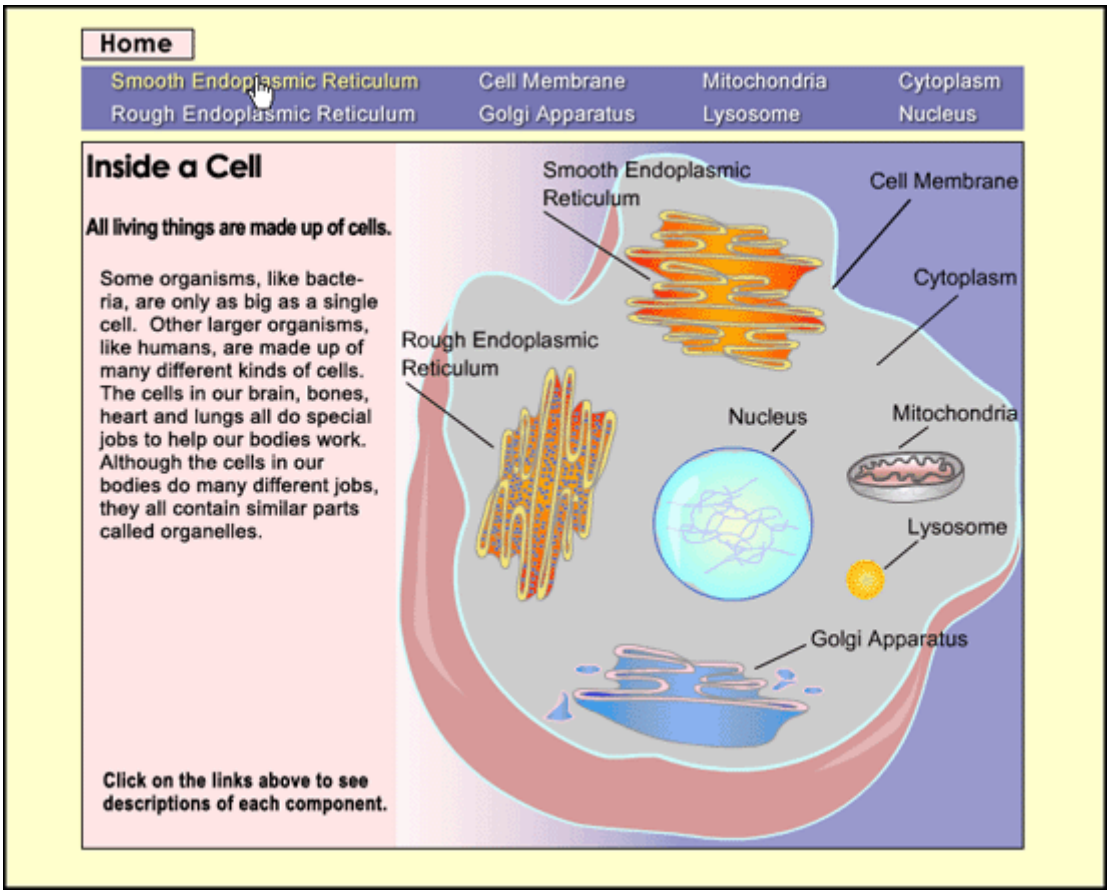

Figure 2. Coactive Website - The coactive interface allowed users to make more choices as to how to traverse the lesson. Users clicked on the links at the top of the page to view each portion of the lesson.

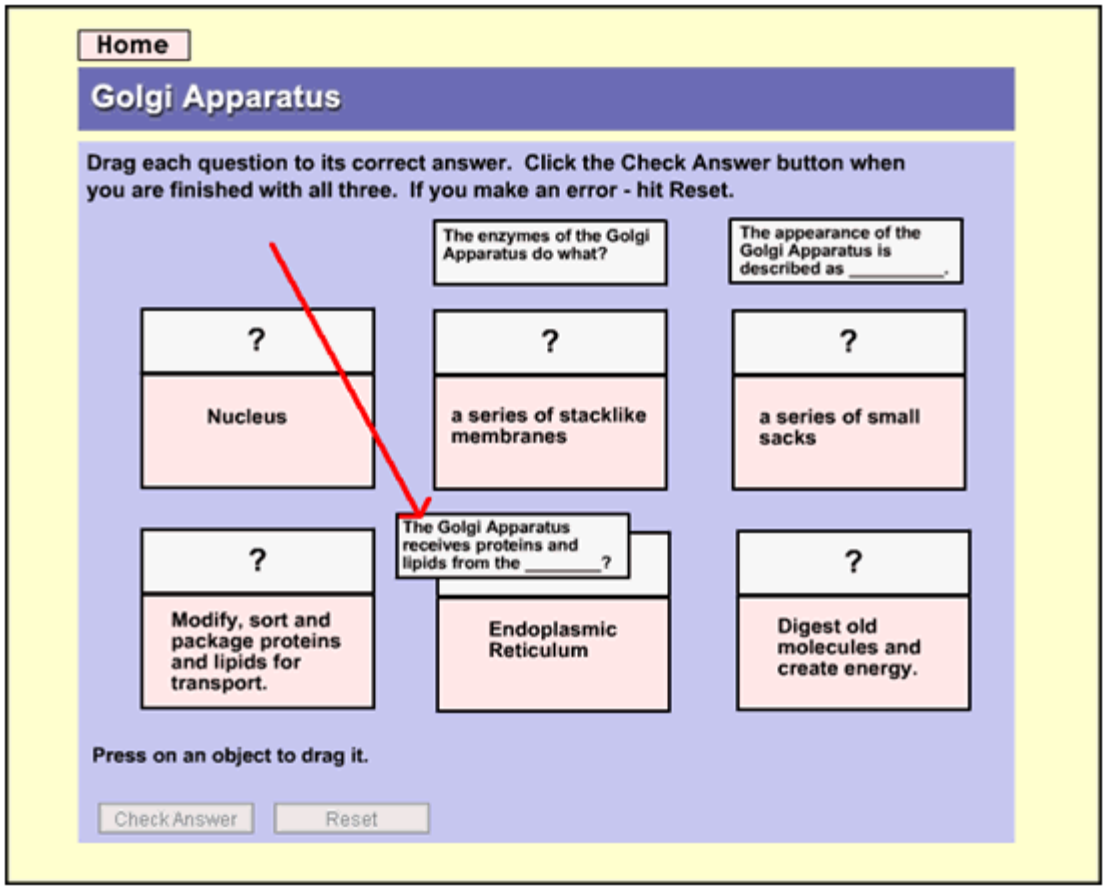

Figure 3. Proactive Website - Interactive Portion. Users were able to engage in an interactive activity for each portion of the lesson.

Procedure

All students were given a pre-test on the parts of a cell on the same day. Three matched groups were then created based on students' pre-test scores. Each group was then randomly assigned to one of the three website conditions: reactive, coactive, and proactive.

The following week the students engaged in the second part of the study. A brief tutorial on how to navigate a website was given to each class via an overhead projector as well as the experiment directions. Each student was instructed to interact with the website until he or she felt ready to take a quiz over the content. Once students were finished viewing the website, they completed a satisfaction questionnaire, post-test, and background questionnaire.

RESULTS

Learning Outcomes

Previous research on interactivity has been dismissed for failing to take into account the degree to which interactive functions were utilized (Sundar et al., 2003). Therefore, usage data was analyzed to determine which students in the most interactive group viewed more than one-half of the eight interactive exercises presented. These students were used in the final analyses (see Table 1 for all means and standard deviations.)

The difference between pre- and post-test scores on the multiple-choice quiz was calculated for

each participant. A one-way ANOVA was performed on these scores to test the effect of interactivity on learning using the matched groups. The results were significant, $F(2, 39) = 3.32$, $p<.05$. Post hoc analysis (Tukey HSD) revealed that students in the most interactive group (proactive) made significantly larger learning gains than those in the least interactive group (reactive).

Satisfaction

The satisfaction questionnaire item scores were totaled to generate an overall satisfaction rating for each participant. Results from a one-way ANOVA to test the effect of interactivity on satisfaction revealed that the most interactive website was preferred over the least interactive website.

Time-on-Task

Results of a one-way ANOVA to test the effect of interactivity on time-on-task also showed that students in the most interactive group (proactive) spent significantly more time-on-task than the students in the coactive and reactive groups. A one-way analysis of variance was also performed to test for the effect of interactivity on the number of web pages viewed. The results were not significant.

Table 1. Means and Standard Deviations for Variables by Treatment Group

	Reactive Group (Low)	Coactive Group (Medium)	Proactive Group (High)
Pre-Test (25 possible)	9.79 (3.38)	9.64 (3.00)	9.86 (3.03)
Learning Outcome (pre-post difference)	5.43 (2.10)	6.68 (3.57)	8.14 (2.48)
Satisfaction (42 possible)	27.64 (6.96)	31.79 (7.14)	36.50 (4.03)
time-on-task (minutes)	8.85 (3.97)	9.57 (4.78)	18.65 (7.58)

DISCUSSION

The purpose of this study was to examine the role interactivity plays within an educational website regarding learning outcomes, satisfaction, and student time-on-task. Students in the most interactive group (proactive) who viewed more than one-half of the interactive portions of the website were shown to make significantly larger learning gains, were more satisfied, and spent more time with the site than students in the least interactive group (reactive). Despite the differences found in time-on-task, no significant differences were found regarding the number of pages each participant viewed. Students in the most interactive group also spent longer viewing each page of the site than students in the other two groups.

One likely cause of decreased satisfaction with the least interactive website was the lack of control allowed to the user. The proactive and coactive websites both allowed users to control the order of presentation regarding the parts of an animal cell. The reactive website, on the other hand, forced the user to view the components in a pre-selected order. Research has shown that when users possess the skills necessary to handle proposed levels of learner control, outcomes tend to be positive (Stoney & Wild, 1998).

Results of this study indicate that interactivity is one factor to consider when creating or choosing

educational web resources. While a computer cannot make a student learn, providing opportunities for interaction can increase learning effectiveness. Additional research is needed to better understand interactivity, including how to foster it and when its use is most beneficial. Understanding how the components of good instructional design work together can help to ensure the World Wide Web reaches its educational potential.

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