Will Multimedia Visual Learning Aids Benefit Target Students in a Project-Based Learning Environment?

A Research Analysis

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Abstract

Educational hypermedia has been heralded as providing instruction that accommodates learners' individual differences, allowing them to learn in accordance with their unique needs, desires, and preferences. There is evidence for educational hyper-media's efficacy that point to learner control, multimedia capability, and parallels to theories of human memory. Hyper-media might be intuitively appealing but, empirical research has not confirmed (or rejected) this assumption. Nor is there compelling evidence to suggest that learners who possess different cognitive styles benefit equally from educational hypermedia environments (Daniels & Moore, 2000).

A major claim of hyper-media advocates is that it can adapt to the individual differences of learners and provide instruction to accommodate these differences. Indeed, educators have enthusiastically embraced commercial hypermedia programs, and thanks to the plethora of user-friendly authoring programs, have begun to design their own hypermedia lessons. However, the excitement over hypermedia technology is tempered by the research (or lack thereof) on hypermedia in education (Daniels & Moore, 2000).

From various research journals, highlights will be shown of difficulties and advantages with using multimedia, television’s overall impact, and which target audience can benefit mostly from this type of learning medium in a project-based learning environment.

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Difficulties and Advantages

One problem regularly reported in hypermedia research is that learners often get "lost in hyperspace". This disorientation appears to be a common problem in the non-linear hypermedia environment and may result from cognitive "overload" of information or the structural features of the hypermedia program (Jonassen, 1991). Cognitive overload has been cited as a major problem for hypermedia users contributing to disorientation, missed information, and other problems. Providing different structures and navigational aids, while helpful, may not address all of the issues that lead to poor performance in hypermedia programs (Weller, Repman & Rooze, 1994). Many researchers have lamented the fact that hypermedia research has not kept pace with the development of educational hypermedia systems. Based on the research of multiple-channel communication it is clear that multimedia presentations with a high degree of relevant cross-channel cues improve comprehension and recall (Dwyer, 1987). It is also evident that the capacity to process multi-channel messages varies among individuals and those mildly dissonant cues can negatively affect the learning process (Lange, 1995). Although many studies can be found that support learner controlled instruction, the majority of learner control research reports no significant benefit for learners with a high degree of control over their instruction. According to Merrill (1984) & Clark (1983) many learners do not possess the meta-cognitive skills necessary to monitor and adjust their learning when given control over instruction. In his review of Aptitude-Treatment-Interaction studies, Clark (1982) contends that learners often select instructional options they prefer but which are not the most appropriate.

Moreno, Mayer, & Spires (2001) wanted to test if an animated pedagogical agent would have effect on learning. College students (in Experiment 1) and 7th-grade students (in Experiment 2) learned how to design the roots, stem, and leaves of plants to survive in 8 different environments through a computer based multimedia lesson. The students learned by interacting with an animated pedagogical agent who spoke to them (Group PA) or received identical graphics and explanations as on-screen text without a pedagogical agent (Group No PA). Group PA outperformed Group No PA on transfer tests and interest rating but not on retention tests. To investigate further the basis for this personal agent effect, Moreno, Mayer, & Spires (2001) varied the interactivity of the agent-based lesson (Experiment 3) and found an interactivity effect. Students who participate in the design of plant parts remember more and transfer what they have learned to solve new problems better than students who learn the same material without participation. Next, Moreno, Mayer & Spires (2001) varied whether the agent's words were presented as speech or on-screen text, and whether the agent's image appeared on screen. Both with a fictional agent (Experiment 4) and a video of a human face (Experiment 5), students performed better on tests of retention and problem-solving transfer when words were presented as speech rather than on-screen text (producing a modality effect) but visual presence of the agent did not affect test performance (producing no image effect). Results support the introduction of interactive pedagogical agents who communicate with students via speech to promote meaningful learning in multimedia lessons (Moreno, Mayer & Spires, 2001).

According to cognitive load theory (Sweller, 1999), when learners split their visual attention between visually presented text and graphics, it can overload working memory capacity.

Television’s Impact

The average television weekly viewing time is approximately 27 hours per week, while the average reading time is 8.1; a 3 to 1 ratio (Angle, 1981). Achievement is dependent on what kind of television is watched by children. High informational viewing generally correlates positively with achievement, while low informational viewing correlates negatively (Thompson & Austin, 2003).

Whether television's information enriches, impoverishes, or has no effect on student achievement is partially dependent on the content and quality of the programming instead of intrinsic qualities of the medium itself (Razel, 2001). If students are exposed to programs with high informational content (i.e., news programs or documentaries) students have a better opportunity to increase their knowledge and skills (Memory, 1992). If most of the viewing is of the low informational content variety (i.e., shorter fast-action shows, cartoons, music videos, soap operas) the opportunity for a detrimental academic impact is increased (Geist, 2000). The role television should or should play as an official part of the school's curriculum is a debate that is decades old. Kohr (1979) performed an analysis of data collected from 90,000 fifth, eighth, and eleventh graders from 750 schools and found no significant individual student level differences, but discovered a strong negative relationship at the school level. One longitudinal study (Anderson, Huston, Schmitt, Linebarger & Wright, 2001) found that adolescents who watched educational programs as preschoolers had a positive effect on their grades, behavior, creativity, and social behavior during later years. Another study (Wright, Austin, Aletha, Murphy, St. Peters, Pinon & Kotler, 2001) found that viewing of child-audience informative programs between ages 2 and 3 predicted higher academic performances of low-income children. Others are not as optimistic about the long-range benefits of children's educational TV shows such as Sesame Street. Some contend that the learning involved has the potential to reinforce trivial cognitive skills and produce distractible learners with short attention spans (Levine & Levine, 1996).

Schools would do better by embracing the medium and promoting homework via television. Classroom teachers might encourage students to (a) supplement their learning with viewing documentaries that corroborate subject matter found in textbooks, (b) provide updated statistics through current events reporting, (c) write reports on television programs about history, (d) contrast how a single event is reported by two different news stations, (e) critique informational shows for accuracy and objectivity, (f) report on television interviewing strategies and techniques, and (g) encourage greater reading comprehension and ability through the viewing of TV performing arts presentations (Memory, 1992).

In addition, Levine & Levine (1996) suggest the following suggestions for classroom teachers and administrators to consider: 1. Utilize a "window of opportunity" component that considers age appropriateness and child development theory. 2. Utilize policies and practices that draw on literature about risk factors and validated strategies that change high-risk behaviors. 3. Attack the academic problems within a holistic environmental and "family systems" approach. 4. Encourage activities and lesson plans that teach very young children how to differentiate between fact and fiction.

Since children find ways to watch TV regardless of adult supervision, it is best to teach and train them in the proper usage of a medium that could help them prepare for better school and career advancement (Thompson & Austin, 2003).

Audience and Effective Tools

Tangible Interfaces for Collaborative Learning Environments embodies a different notion of support for collaborative learning. It supplements physical learning activities with computer tutors that ask relevant questions when the students get stuck (Scarlatos, 2002) This system encourages the group as they make progress, and offers to give them "hints" when they don't. The hints take a scaffolding approach, asking the children to consider smaller related problems. The major advantages of the Tangible Interfaces for Collaborative Learning Environments prototype are: 1) makes the computer take on the role of "guide on the side" without dominating the educational activity, 2) allows the students to work in groups on physical learning activities, without having to learn a computer interface, and 3) prescribes a method for uniquely representing the state of a puzzle or model, enabling the system to rapidly check for solutions or partial solutions (Scarlatos, 2002)

Testing took place at the Goudreau Museum of Mathematics in Art and Science, located on Long Island, NY. The control groups used nothing to make their tangrams, while the variable groups were able to use the Tangible Interfaces for Collaborative Learning Environments computer prototype (Scarlatos, 2002). Most groups using the prototype were able to solve the first problem, (constructing the square) while most of the groups not using the computer prototype were not (Scarlatos, 2002). The results also found that, in general, children using the computer prototype spent less time fooling around, and more time discussing approaches to the problem (with discussions frequently triggered by the hints).

Eidson & Simmons (1998) set out to gain information about how different modes of simulation data presentation (a graphics mode and an alphanumeric mode) influence students' performances on process skills and genetics conceptual understanding assessments. The general research question, which guided their study, was: What is the relationship of simulation graphics and alphanumeric modes of data presentation to students' process skills and conceptual understanding? Eidson & Simmons (1998) also had specific questions such as: How do the graphics mode of data presentation and the alphanumeric mode of data presentation in CATLAB (a genetics simulation) relate to students' performance on specific process skills applications? What influence does the graphics mode of data presentation and the alphanumeric mode of data presentation in CATLAB have on conceptual understanding in genetics?

The findings determined that the use of CATLAB resulted in enhanced conceptual understanding of genetics for students. Use of either the graphics or the alphanumeric modes of data presentation in CATLAB appeared to significantly enhance students' performance on the process skill subtest of identifying variables. The CATLAB learning activity gave students the opportunity to practice and improve this skill (Eidson & Simmons, 1998).

Designing investigations and operationally defining variables appeared to be influenced significantly by the graphics mode of data presentation. In the process of designing an investigation, graphic representations may have aided some students. Winn (1987) has suggested that graphics could be helpful to those students who possess weak verbal skills. Winn further suggested that graphics appeared to play a more significant role where students had to recognize and apply concepts. The ability to form relationships between various task elements may have been enhanced more by the graphic representation of cats than by the alphanumeric description of the cats.

By contrast, use of the graphics and alphanumeric modes of data presentation did not appear to significantly enhance students' performance on the process skill subtests of identifying and stating hypotheses and interpreting data. Students had difficulty identifying and stating hypotheses during the CATLAB activity. This basic process may have produced problems with other parts of the problem-solving process. The failure of students to interpret their data appropriately (to support or reject their hypotheses) could stem from a difficulty in understanding how to design investigations and how to collect the critical data for problem-solving (Eidson & Simmons, 1998) In general, the graphics and alphanumeric modes of data presentation in CATLAB appeared to enhance students' performance on conceptual understanding of dominance, co-dominance, and dominance with lethality. The CATLAB activity was designed to engage students in developing and enhancing specific genetics concepts through their analysis of various patterns of inheritance (Eidson & Simmons, 1998).

Individual ability differences in the development of the skills necessary to solve genetics problems may have contributed to the inability of some students to focus on the task at hand. For example, lower-achieving students may not have any greater success processing information presented in a graphic format than in an alphanumerical format (Lowe, 1989). This appeared to be true in this study due to the wide range of skills needed to solve genetics problems using either data presentation format (Eidson & Simmons, 1998).

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