

Introduction: Since the introduction of educational technology in the K-12 classroom, educators have been flooded with a seemingly endless flow of educational CD-ROMs. NASA has contributed to this new trend in educational technology by developing a wide range of some of the latest, most high-tech CD-ROMs in the industry. In this rapidly changing field, every advance seems to promise new hopes and success, and the analysis of the previous educational software models seems irrelevant. As a consequence, virtually no research has been done to determine the usefulness of educational software packages in the K-12 classroom, neither within NASA nor the larger educational community [1]. Thus, developers who invest their time and money into these educational CD-ROMs are left to make educated guesses as to what features and qualities of software the educational community prefers and uses.

Literature Search: While existing research on the use of CD-ROMs in the K-12 classroom is sparse, the literature search indicated certain trends in CD-ROM use. Educators seem to be interested in CD-ROMs that can be used in a variety of contexts, that are interactive, that promote learning in their students, and that match their curriculum standards. The types of CD-ROMs most commonly found in the classroom are (1) electronic encyclopedias, (2) research/reference materials, and (3) artwork/image CD-ROMs [2,3]. Educators typically use educational CD-ROMs outside of the classroom to create instructional materials and gather information for lessons, with a small percentage using them to create multimedia presentations and access model lesson plans. The most common CD-ROM-based assignments educators were found to give to their students were practice drills, research assignments, problem solving, and data analysis [4].

The most astounding conclusion, and perhaps the reason that so little research has been done on this topic, is that a very small percentage of our nation's educators are consistently using educational CD-ROMs in their instruction. Teachers face an overwhelming number of barriers when attempting to implement this form of educational technology. Some of these barriers include (1) high costs of the CD-ROM packages, (2) preparation and utilization time, (3) curriculum standards and testing pressures, (4) perceived poor quality of the CD-ROMs, and (5) technical difficulties [5]. Due to this void in research on the utilization of educational CD-ROMs, it was understandably difficult to find anything conclusive about the use of

NASA's educational CD-ROMs. It was necessary, therefore, to conduct our own study.

Study Methodology: The study consisted of both quantitative and qualitative research. After a series of collaborations with a number of NASA's current educational CD-ROM developers, a Likert scale questionnaire was carefully constructed to elicit quantitative data. The questionnaire was put on-line, and an invitation to respond was sent by email to approximately 4000 educators. These educators were chosen on the basis of having received one of the following CD-ROMs; *Visit to an Ocean Planet (TOPEX/Poseidon Mission)*, *Winds of Change (NSCAT Mission)*, and *Ways of Seeing (Cassini Mission)*. To elicit a higher response rate, educational posters and CD-ROMs were offered to those who completed the questionnaire.

Qualitative data was gathered in a series of telephone interviews with the questionnaire respondents whom had indicated they were willing to participate. All interviews were recorded to ensure quality and accuracy. Both forms of data collection were considered in the data analysis and conclusions of this study.

Demographics: The email invitation to respond to the questionnaire successfully reached 3216 educators, due to incorrect or changed addresses. 817 of these educators responded to the questionnaire, a response rate at 27%. The highest percentage of respondents was teachers of grades 9-12 (44%), followed by 5-8 (36%), then K-4 (20%). The majority of respondents indicated they taught science (58%), with specific disciplines in general science, earth/space science, biology, environmental science, physics, physical science, and chemistry. There was a fairly even distribution among respondent's years of classroom experience, indicating that educators from all levels of experience use educational CD-ROMs. The distribution of educators from rural, urban, and suburban communities was also fairly even, and the majority of respondents (66%) were from schools with middle socio-economic levels.

Further investigation of the respondent demographics reveals discouraging findings about the state of technology in our nation's schools. First of all, the majority of respondents (58%) had only 1-3 computers in their classroom, and an additional 5% had zero computers. This finding has little variance across locations, with the exception of rural schools that have slightly lower percentages of classroom computers. As one would assume, the 10% of schools with high socio-economic levels had higher percentages of classroom computers, but there was little difference in per-

centages between those whose levels were middle or low. Another problematic finding is that a significant percentage of respondents (13%) had never received technical training during their careers, and the large majority of respondents (73%) had never received NASA training. This indicates that at least 73% of educators that received an educational CD-ROM from NASA were given *no training or instructions on how to use it*.

General Findings: When asked where educational CD-ROMs were generally found, respondents rated the Internet as the most commonly used source, above retail stores, training/workshops, and technical resource advisors. Respondents indicated that their selection of CD-ROMs is based primarily on recommendations from others, but also indicated that the alignment of the CD-ROM content with their curriculum was an important factor. Sustained use of the CD-ROM, however, depends primarily on whether or not the CD-ROM promotes learning in their students.

While educational CD-ROMs can be tailored for students to use with little or no direction from the teacher, the majority of respondents (67%) indicated they prefer CD-ROMs that are made for teacher applications. They also indicated that, given a choice, they prefer to use CD-ROMs in their instruction to the Internet. As for tutorials/usage instructions, preferences were split between placing them in a supplementary booklet (49%) or on the CD-ROM itself (46%).

Highlighted CD-ROM: For the remainder of this analysis we will focus on the *Visit to an Ocean Planet* CD-ROM (from the TOPEX/Poseidon Mission at Jet Propulsion Laboratory), due to the fact that the large majority of respondents were recipients of this particular CD-ROM. Unfortunately, 30% of these recipients never used this CD-ROM after receiving it. When asked why not, responses fell into 3 general categories: Intent to use in the future (not enough time, not to appropriate unit yet), technical difficulties (hardware problems, defective CD-ROM, no display mechanism for entire-class viewing), and dissatisfaction with the CD-ROM in general (did not align with curriculum, not grade-level appropriate, difficult and time consuming to use). One response typified the sentiments of many; "The format is too inflexible to allow incorporation into my lecture. The material is very informative...but we prefer our students to work with data on an inquiry approach, not just scroll through a presentation."

Those who used the CD-ROM, however, seemed to hold it in higher regards. The attitude assessment showed that most were very satisfied with the quality of the CD-ROM content and felt it was a valuable educational tool. Among their favorite aspects of the CD-

ROM were the interactive segments, the multimedia components, and the overall accurate, in-depth information. Many indicated that the CD-ROM "adds a dimension to learning that cannot be obtained from textbook only," and that it "immediately gets the students involved." However, this positive assessment does not translate directly into high levels of usage. While respondents indicated that they used the CD-ROM most often for classroom demonstrations, the mean score for frequency was only "sometimes." Under the range of "rarely" fell other categories of use, such as research for student projects, personal preparation/planning, individual student free time activities, and computer lab activities.

Discussion: The intent of this paper is to offer research-based recommendations for those educational CD-ROM developers who truly wish to improve the state of education. Based on this study, including the literature search, quantitative, and qualitative data collection, I would like to make the following recommendations.

Educators are faced with immense *time constraints*. Therefore, educational CD-ROMs should be designed in such a way that they require a minimal amount of preparation time to be used in the classroom. CD-ROMs should also be designed so that they can be used with a *limited number of computers*, as well as old, slow, unreliable hardware. To assist educators in preparing for *standardized tests*, the content of the CD-ROM should not only correlate with the curriculum standards teachers must adhere to, but should be appropriate to replace required curriculum. It is also vital that the CD-ROM contain appropriate, *educationally valuable content*. The CD-ROM should offer some level of *interactivity* that allows the student to participate, become engaged, be assessed, and receive feedback on their progress. These factors, combined with quality training for all CD-ROM recipients, will not ensure widespread use of a CD-ROM program, but dramatically increase its likeliness.

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BIOGRAPHY

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