A RESPONSE TO INSTRUCTIONAL AND ASSESSMENT DEMANDS OF MIDDLE SCHOOL SCIENCE EDUCATION: THE JASON MULTIMEDIA SCIENCE PROJECT[1],[2]

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ABSTRACT

Teachers are expected to create challenging science learning environments for all students with new media while attending to standards measured by standardized tests. A response to this is the use of interdisciplinary, multimedia science curricula such as the JASON Project. An evaluation study was conducted by EDC's Center for Children and Technology on the JASON Multimedia Science Curriculum using a mixed-methods design, including surveys and focus group interviews, to answer the questions: Who are the teachers who use JASON curriculum? With which students do they use JASON? How do teachers assess this interdisciplinary multimedia science curriculum? The findings showed that the curriculum served a variety of student populations, including, in addition to mainstream middle school students, students labeled gifted and talented, at-risk, and special needs, and that respondents frequently used the curriculum and the variety multimedia components available in their classrooms.

KEY WORDS: *science curriculum, multimedia, middle school, interdisciplinary, inquiry-based science*

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[1] **Caroline Joyce (caroline@jason.org), Director of the JASON Project, will be presenting with the authors at NECC 2003.**

[2] This paper is based on two evaluation reports about the JASON Multimedia Science Curriculum (Ba, Admon, & Anderson, 2002; Ba, Goldenberg, & Anderson, 2002), available at www.edc.org/cct. This material is based on work supported by the JASON Foundation for Education and the U.S. Department of Education Star Schools Program. Any opinions, findings and conclusions expressed in this material are those of the authors and do not necessarily reflect the positions or policies of the JASON Foundation or the U.S. Department of Education.

INTRODUCTION

Ensuring that all students, including those from culturally and linguistically diverse backgrounds as well as those with disabilities, reach high academic standards in science may demand that educators examine their assumptions about teaching and learning (Kahn, 2003; Lee, 2001). Moreover, teachers today face two challenging instructional and assessment requirements when teaching science: they are expected to both engage students in real multimedia science explorations and also comply with a variety of accountability measures, most notably state mandated assessments. In other words, teachers are held accountable for preparing all students to do well on the standardized achievement tests, and many feel they have little choice but spend a great deal of time on test preparation. At the same time, teachers are expected to teach their diverse students to explore science content deeply, think critically, and use technology to create project work (Yeh, 2001).

How teachers accomplish this, given the barriers they face, such as inadequate preparation to teach inquiry-based science (National Science Foundation, 1996), requires a constructive response. One approach is to engage students and teachers in multimedia projects embedded in authentic scientific inquiries and explorations. In this model, teachers can learn alongside their students how to apply inquiry-based pedagogical methods and how to manage and guide projects that employ multiple media. Such projects provide intellectual and material scaffolding for teaching with new media in an educational climate that stresses traditional accountability measures while also demanding technology-integration.

One such project, the JASON Project's multimedia science curriculum (JASON Foundation for Education, 2003), offers teachers and students a unique opportunity to learn about how the

earth and space systems support life and about the technologies used to study the earth-space system. The project focuses on scientists and scientific study in the context of a research expedition, relates science to other subject domains, and provides for interactive learning; it serves approximately 25,000 teachers and 1 million students around the country each year. The JASON Multimedia Science Curriculum brings teachers and students together to construct their own knowledge by putting science concepts and skills to work, anchored by a media-based environment. It aspires to help teachers engage students in complex, difficult tasks that lead to the development of scientific thinking and problem-solving skills. It provides teachers with instructional tools that bring together academic standards, the rich environment of a new curriculum topic each year, and student performance measures that support state standards and assessment initiatives. The main components include a print curriculum and prologue video, live exposition broadcasts and update video, and Team JASON Online:

- The **print curriculum** mirrors researchers' work in the field or lab, offers standards-based instructional exercises and assessment tools, and includes a video, which introduces and reinforces key curriculum topics and themes, as well as models fieldwork.
- The **live expedition tele-presence**, central to the JASON Multimedia Science Curriculum, helps students become a part of the research team, experience the expedition firsthand, and relate their work to that of the researchers. It is held annually at a specific location for a two-week period, and involves research and Argonaut teams (scientists, teachers, and students), technical and broadcast staffs, JASON partner sites, and the local community.

- **Team JASON Online (TJO)** is a set of integrated online interactions (teacher-directed exercises, discussion groups, chat sessions, additional curriculum exercises, assessment tools, online journals, etc.) used by teachers, students, and scientists to articulate and share their understanding of science concepts, skills, vocabulary, and projects.

The Center for Children and Technology (CCT) is in the midst of a multi-year evaluation study of the impact of the JASON Multimedia Science Curriculum on students and teachers. This paper focuses on how responsive the JASON Multimedia Science Curriculum is in helping teachers deal with the dilemma of rich instruction and mandated assessment. It presents and discusses some of CCT's Year Two evaluation findings relevant to the above dilemma, and addresses specifically the following questions:

- Who are the teachers who use JASON curriculum?
- With which students do they use JASON?
- How do they assess this interdisciplinary multimedia science curriculum?

RESEARCH DESIGN AND METHODS

To answer the above questions, we used a mixed-method evaluation design: surveys and focus groups.

Surveys

The goals of conducting the surveys were to better understand from a descriptive perspective how the teachers use the various JASON curriculum components (e.g., print curriculum, videos, live expedition broadcast). The surveys focused on teachers' backgrounds, including their

teaching and JASON experience and experiences with and thoughts about the different components of the JASON Multimedia Science Curriculum.

First, we sent an initial large-scale survey to the 25,000 teachers who participated in the JASON Project in 2002, and received a total of 1,896 surveys[3], an estimated response rate of 8%.[4] We then sent out a follow-up large-scale survey to the 1,896 teachers who responded to the first survey, and received back a total of 1,133 follow-up surveys, an estimated response rate of 60%.

We conducted a series of analyses on the data collected from both surveys: frequencies, cross-tabulations, and correlations. We first used the frequency and cross-tabulation analyses to develop teachers' profiles based on their personal backgrounds (e.g., gender, education), teaching and technology experiences, and experience with the JASON Project and curriculum. Second, we developed profiles of the teachers based on how effective they were in using the JASON curriculum. As mentioned above, the JASON Multimedia Science Curriculum consists of four well-integrated components: print curriculum, Team JASON Online, videos, and live expedition broadcast. Thus, we define as advanced users teachers who use all four components in the classroom. We made the assumption that the more components a teacher uses, the more likely he or she is to implement the entire curriculum in the classroom. To identify any statistically significant relationships in teachers' use of the JASON Multimedia Science Curriculum, we correlated the number of components teachers used (one to four) with a variety

[3] The survey was distributed to approximately 10,000 teachers via e-mail and approximately 17,000 teachers on paper. Because of overlaps between the databases, we estimate that the survey reached approximately 25,000 teachers. We received a total of 1,896 teachers' surveys: 849 online surveys (45%) and 1,047 paper surveys (55%).

[4] An 8% response rate is a conservative figure because of the overlapping numbers inherent in the databases used. One caution is that this eight percent sample may not be a truly representative sample of people who have been trained on or use less often the JASON multimedia components, representing perhaps those JASON teachers who sent for materials, attended workshops, or are somehow on the JASON Foundation's mailing lists. As a result, our sample may be skewed in some way and that the more frequent users were more likely to answer our survey and that we do not have information about other users.

of independent variables drawn from the teacher's personal background and school characteristics, using cross-tabulation and correlation analyses.

Focus groups

The goal of the focus group interviews was to explore survey findings in more depth along two dimensions: (1) teachers' use and modifications of the JASON Multimedia Science Curriculum, and (2) the benefits and challenges of being a practitioner in the JASON multimedia environment. A semi-structured focus group interview guide was developed addressing the following two topics: the curriculum, in terms of content and format and the teachers, in terms of training, experience with the JASON multimedia curriculum, the impact of the curriculum on their students, and suggestions for improving the curriculum.

Teachers were selected based on how their student populations are labeled academically (e.g., honors, at-risk), their students' race and ethnicity, school geographic location, and teacher characteristics (e.g., teachers' gender and ethnicity). Using these criteria, we chose teachers from the pool of respondents to the follow-up survey, and set up five focus groups with a total of 23 teachers. Each group contained four to five teachers who taught similar types of students. There were five teachers serving students labeled gifted or honors, five teachers serving students labeled general education, five teachers serving students labeled at-risk, and four teachers serving special populations of students, defined as students receiving special education or English as a Second Language services.[5]

We analyzed the data for emergent themes to serve as the basis of a detailed report of teachers' experiences, views, feelings, and expectations of the JASON Multimedia Science

[5] A focus group of parents who homeschooled their children also took part in this study; their results are not included in this paper.

Curriculum, and of its function in their everyday teaching lives. We then refined the findings based on our field notes and the transcripts, as well as our own perspectives about the JASON Project.[6]

FINDINGS

This section presents our main findings[7] about the ways the JASON Project helps teachers from different teaching backgrounds serving diverse populations of students provide their students with rich multimedia science explorations. It also presents the teachers' opinions about these experiences. Our findings are presented under two areas: teachers' assessment of the curriculum and its impact on their students, and the identification and profile of the typical JASON teacher.

Teachers' Opinions about the JASON Multimedia Science Curriculum and Its Impact on Their Students

Teachers clearly indicated that the JASON project has had a powerful impact on their teaching practices in the following ways: introducing them to technology integration; providing the benefits of a well-integrated multimedia curriculum; and making classroom management easier. The JASON teachers praised the curriculum as a rich resource for teaching because of its flexible format, interdisciplinary approach, and alignment to national and state standards. Teachers rated the print curriculum format favorably because it met most of their teaching and

[6] As in any qualitative study, because of the small numbers of involved, participants cannot be expected to be representative of their target population in a statistical sense, and the findings might not be generalizable from one specific focus group (e.g., special education teachers) to the entire special education population of students and their teachers. Nonetheless, we feel the insights that can be derived from this method are sufficiently worthwhile to outweigh its limitations.

[7] For more detailed results, see the JASON Multimedia Science Curriculum Year 2 Evaluation Reports (Ba, Admon, & Anderson, 2002; Ba, Goldenberg, & Anderson, 2002), available at www.edc.org/cct.

assessment objectives. In their survey responses, teachers who used the online component, TJO, indicated that TJO helps them enhance their ability to teach science in an exciting way (95%), connect with current research and researchers (94%), introduce technology into the classroom (93%), learn how scientists work in teams (91%), encourage students to develop their own questions (86%), learn how to use the Internet (86%), network outside of the classroom (81%), assist students in exploring careers (81%), and learn how to design science experiments (78%). Teachers who used the live broadcast reported that it helps them enhance their ability to teach science content (81%), introduce technology into the classroom (74%), connect with current research and researchers (86%) and network outside of the classroom (67%).

In addition, teachers discussed the various ways in which their teaching of the JASON curriculum benefited their students. They reported that the JASON project (a) improved their students' learning and performance; (b) excited students, promoting teamwork among them which helped them with reading, writing, and answering questions; (c) reduced their fear of confronting challenges or ambiguity in classroom activities, and helped them focus on their work; (d) provided a vehicle for increased parental participation; and (e) increased students' awareness of the world around them and of everyday science in that world. Overall, they rate their students' experience with the JASON curriculum positively and the TJO as good to excellent. In their survey responses, teachers agreed that it met their students' learning objectives in the following areas: collaboration (81%), problem-solving (81%), research (69%), assessment (68%), and technology (62%).

In their survey responses, teachers agreed that the print curriculum helped their students learn more about how scientists work in teams (81%), how to solve problems (81%), how to design

science experiments (69%), how to present what they know (68%), how to work with multimedia (62%) and how to use the Internet (59%). Many teachers talked about how the JASON curriculum made their students more aware of the world around them. They talked about it showing their students that "learning is happening in the real world, not just under their textbooks." Some teachers talked about the JASON curriculum deconstructing the stereotype of scientists as old white men in lab jackets and glasses, therefore making science a more appealing career option for their students. Students "can actually see [on the live expedition broadcast, and videos], **'**Oh, maybe this is something I'd like to do.' Here's these people in their twenties sloshing around and doing these things. They will role model for these students the careers that are available."

In terms of the multimedia components of the curriculum, teachers noted in their survey responses that TJO encourages students to develop their own questions (86%) and assists students in exploring careers (81%), among many other things. Teachers who watched the broadcast live find the question-and-answer format an effective way to share information with students about the curriculum topic (93%).

We talked in some detail with the teachers about how they use the JASON curriculum with different groups of students (e.g., special education, at-risk, general education, honors/gifted and talented). Each group of teachers discussed the ways they use the JASON Multimedia Science Curriculum, along with the modifications they made for their particular student population.

- The teachers of students labeled **gifted or honors** have a lot of flexibility to tinker with the curriculum. They allowed their students to do a lot of independent exploration.
- Teachers of students who perform **at or above average** for their grade levels in regular

classrooms adapt the JASON curriculum around their regular curriculum and standards. In addition, they say that they particularly appreciate the multimedia nature of the JASON curriculum.

- The teachers of **at-risk or low-achieving** students adapt the curriculum to meet the reading comprehension and writing levels of their students.
- The teachers of **special student populations** find the curriculum to be flexible as well as challenging for students with specific learning difficulties or limited English proficiency.

Despite all the variations in their use of the JASON curriculum and the challenges teachers faced when using it in their respective classrooms, we found that those teachers who team-teach, teach at the lower grade levels, participate in local training workshops, or have a lot of experience with technology[8] use JASON more comprehensively.

One major theme that emerged from the focus groups was the impact of state and local standards and testing on the teachers use of JASON materials. According to many teachers, the flexibility of the JASON curriculum is beneficial because teachers can easily adapt it to the demands of different local contexts. Moreover, the flexibility gave them freedom to be creative within their local standards.

> Its flexibility is great. [I used to teach] in a different building every day. Five elementary schools and I taught the fifth and sixth grade…. [JASON] was simple: pick and choose, do what I want, move it around. Two years ago I went to a middle school, so the fifth graders were still in the elementary and the sixth graders were in the middle school and the middle school was departmentalized to their own 43-minute class schedule. So your whole sense of structure changes but the JASON project was manipulate-able into that structure. (1)

The teachers also appreciated the format of the print curriculum, which allowed them to seek

[8] This finding about technology is unsurprising, given the nature of JASON and its close relationship to technology.

out and integrate additional resources into their teaching practices. Some teachers reported that JASON's flexible format made it easy to integrate outside resources, such as reading material, films, and television shows, into the lessons. Others spoke about the importance of using local resources, such as guest speakers, field trips, and local science explorations, and how the JASON format promoted their use. One teacher invited as a guest speaker to his class a high school colleague who had been involved in a project that sent her to the North and South Poles, an activity that complemented the theme of "Frozen Worlds" of the 2001-2002 JASON curriculum.

The teachers interviewed as part of the focus groups agreed that for the most part JASON "aligned nicely" with their local science standards and assessments. A few teachers said that they have to stop teaching the JASON curriculum at the peak of the JASON Project, January and February, to prepare students to take standardized assessments; one teacher said, "Our testing is always the end of January and February…all my [JASON] teaching stops."

To maximize the effectiveness of the JASON multimedia science curriculum, teachers think the JASON Foundation for Education and their respective schools and districts should be aware of the implementation challenges that teachers face in adapting the curriculum for their students. The adaptation issues discussed included: accessibility of the print curriculum, curriculum and academic-level issues, quality of hands-on activities, issues related to standards and testing, and technology access and multimedia issues. The teachers faced the following training and support obstacles: distant training locations and training time; technology compatibility and TJO access levels; not enough demonstrations of hands-on activities; cost and marketing issues; and lack of support in school and the JASON community. The teachers also felt a strong need for ongoing training and support.

Portrait of JASON Teachers

Based on survey responses and the focus group interviews, the following is a "portrait" of JASON teachers.

The JASON-using survey respondents were mostly White (90%) females (86.2%). More than half (54.5%) have graduate degrees, while more than a third (39%) have college undergraduate degrees only. In addition, most (78%) have some type of science academic training: 22% are certified science teachers, and 56% have taken science courses. They have been teaching on average for 14.5 years (SD=9.5). The majority of the teachers taught in middle and elementary schools: a little more than half (53%) served elementary schools, while about a third (37%) worked in middle schools. They report that they have used computers for an average of eight years (SD=5.2) and the Internet for an average of 4.6 years (SD=2.6) as professional or instructional tools. Fifty four percent of the teachers engage in computer and Internet activities a few times a week with their classes. They serve a generally White student population (according to teacher reports in these surveys, 71% of JASON students are White) with a range of academic placement levels and socioeconomic backgrounds. They have been in the JASON Project for either one year (36.6%) or between two and four years (44.5%).

According to the teachers interviewed, the JASON curriculum has motivated teachers to develop new ways of learning about science and other disciplines, to change the way they think about learning, and to expand their academic and professional interests through up-to-date scientific knowledge and access to a new topic every year. The teachers talked about how teaching the JASON curriculum has kept them fresh and motivated as teachers. Said one teacher, "It's motivating, because I'm having just as much fun as they are…Because it does change every

year, it makes it more exciting for me because I'm learning just as much as they are." Another commented, "I am a better learner now." Other teachers described how they had had an aversion to science before using JASON, and how it altered their attitude toward learning and teaching science. "I hated science. The evidence is my report card. I would fight it all across high school and in college. And as a teacher, I didn't enjoy teaching [science] until JASON. And the reason being that JASON gives it a context. It is a big full picture. It's not isolated."

Furthermore, JASON introduced them to technology and helped them integrate technology into their teaching. Those teachers with adequate technology resources found the curriculum easy to integrate into their teaching. One teacher commented, "I'm one of those older teachers, you know; like you, I didn't learn computers in college…JASON got me into computers, got me excited about it." Another remarked, "We have computer labs and we have desktops for all our eighth graders. So we're very technology oriented. To me it's so much easier to incorporate technology into the [JASON] curriculum… You don't have to fake it; it's there. It's very easy to incorporate that."

The nature of the curriculum and teachers' enthusiasm for it makes classroom management easier. Teachers reported that their students are more engaged; "Therefore," said one, "I have fewer discipline problems." According to teachers interviewed, the JASON multimedia science curriculum is an engaging and interesting set of materials for students.

Almost all the teachers (92%) use the curriculum frequently in their classes throughout the year: every day (28%), two to three times a week (47%), and once a week (17%), especially during the months of January and February. The majority (77%) use three to four of the JASON curriculum components with the print curriculum being the most used (94%), followed by the

video materials (87%), the live expedition broadcast (61%) and Team JASON Online (60%). Teachers use complete units in the JASON print curriculum (51%), but in addition pick and choose different sub-units (65%). Their selection of which parts of the print curriculum to teach is often based on the unit topic (90%) and science standards (54%).

The video and live video broadcasts are important components to typical JASON teachers. Most teachers (86% of the teachers who used the videos) use the videos to introduce the new curriculum to their students as an additional teaching tool (70%), and in conjunction with specific lessons and activities (70%). For the most part (60%), they take part in Team JASON Online (TJO). Eighty-one percent of the teachers using TJO go to the JASON Web site at least once a week; also, 68% of the teachers using TJO say their students visit the site at least once a week. Most of the teachers (61%) have seen the JASON broadcast live, and believe it is important that the JASON expedition be broadcast live (87% of the teachers who watched the broadcast live).

DISCUSSION

Overall, results from the surveys and focus group research illuminate several characteristics of JASON-using teachers: they see themselves as learners and are excited about the benefits they believe JASON provides for their students as well as for themselves. Teachers rate their students' experience with the JASON curriculum positively and the online component TJO as good to excellent. In addition, they state that it meets their students' learning objectives in the following areas: collaboration, problem-solving, research, assessment, and technology.

The survey results also provided a broad view of the JASON-using teachers in terms of their personal, educational, community, teaching, JASON, and student backgrounds, and of their effective use of the different curriculum components. JASON teachers teach in the upper elementary and lower middle grades, are experienced teachers, and are comfortable with digital technologies. They use the JASON Project in their classroom frequently during a six-week period, select units from the curriculum to cover in their classroom based on topic and standards, reuse the print curriculum, and meet their assessment objectives using the JASON curriculum. Further, they value the hands-on activities, and the connection to a community of researchers.

Within different school and community circumstances, we found several important factors in the ways teachers made effective use of the curriculum. First, we found that teachers who have more experience with technology use JASON more comprehensively,[9] which is unsurprising given the nature of JASON and its close relationship to technology. Professional development opportunities should therefore focus more on technology uses in the classroom to make it easier for JASON teachers to use more of its components, especially the live expedition and TJO. Second, we found that teachers participated more in local training workshops at the school, district, and regional levels. They indicated that these training sessions were helpful to them in terms of using the JASON curriculum in the classroom effectively. Third, we found that JASON was used more comprehensively at the lower grade levels, not surprising given the nature of elementary classrooms (Cuban, 1993).

JASON teachers like the flexibility, interdisciplinary approach, and aligned standards of the JASON multimedia science curriculum, both of which allow teachers serving different student

[9] This finding was statistically significant.

population to use the curriculum differently. For example, teachers of students labeled gifted or honors have considerable flexibility to tinker with the curriculum; teachers of at-risk or low achieving students have to adapt the curriculum requirements to specific students' reading comprehension and writing abilities; and teachers of special student populations find the curriculum flexible as well as challenging for students with specific learning difficulties or limited English proficiency.

Despite the variations in their use of the JASON curriculum and the challenges teachers face using it in their respective classrooms, they indicated overall that the JASON Project introduced them to technology and helped them integrate technology into their teaching; it also made classroom management easier. As a result, their students benefited from the JASON curriculum. Teachers reported that use of the JASON curriculum improved their students' learning and performance; excited the students, promoted collaboration among students, and helped students with reading, writing, and answering questions; reduced their students' fear of confronting challenges or ambiguity in classroom activities; increased parental participation in their children's schooling; and increased their students' awareness of the world around them and of everyday science in that world.

The findings show that the basic multimedia curriculum components of the JASON Multimedia Science Curriculum is not in need of significant change, according to the teachers who use it. However, the ways the various components are made available to teachers could be improved so that the reach of the project is extended.

Most of the first-year JASON teachers have a range of teaching experience and are not new to teaching, based on a mean teaching experience average of 13 years with a range of 0 to 38

years. This finding has implications for the communication about JASON curricular materials and recruitment of new teachers. The JASON Project must carefully consider its heterogeneous audience. It ought to plan for communication and support to different groups of teachers that teach different populations of students.

This research suggests several considerations for the curriculum developers. First, it is important that the JASON Foundation attend to creating curricular materials that are easy to use in diverse educational settings. Second, the JASON Foundation should consider working to increase teachers' access to the training, especially in terms of its multimedia science curriculum. Finally, we found that teachers who team-teach use JASON more comprehensively. This leads us to recommend that the JASON Project should include professional development that encourages teachers to engage in team-teaching.

CONCLUSIONS AND IMPLICATIONS

This study suggests that the JASON Multimedia Science Curriculum helps teachers address the dilemma of providing rich and interesting science experiences that incorporate multimedia while attending to local performance and learning standards and accompanying high-stakes assessments. Moreover, the JASON Multimedia Science Curriculum is utilized in a diverse range of classrooms, from elementary to high school, from urban to rural, from honors students to those labeled at-risk and those receiving special education services. Teachers report that all kinds of students respond positively to learning with JASON. The implications are that a challenging multimedia interdisciplinary science project such as JASON is not only for well-resourced schools and students performing at or above grade level. Participants in this study are

clearly attempting to take advantage of the flexibility of the JASON Multimedia Science Curriculum to adapt their instruction and assessment to different classroom contexts. The flexibility and richness of the curriculum gave them freedom to be creative as teachers, going in their own directions while addressing their local standards and testing requirements without being controlled by a rigid curriculum.

Implications for the next phase of evaluation research concern how JASON is used in these diverse classrooms and what the impact is on children who study with it, both from their perspectives and also from the perspective of performance on state-mandated tests. Accordingly, the JASON Foundation for Education has commissioned EDC's Center for Children and Technology to investigate in more detail the impact of the JASON curriculum on learners in diverse settings. One study will evaluate how the JASON curriculum is being used in classrooms that serve learners labeled "at-risk," students receiving special education services, students receiving enrichment or gifted services, and those in "mainstream" classrooms, and what students themselves say about the impact of the JASON curriculum on their learning. Another study will look at the impact of studying with the JASON Multimedia Science Curriculum on state achievement test performance.

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