Shalom M. Fisch/Richard Lesh/Elizabeth Motoki/Sandra Crespo/Vincent Melfi

Cross-platform learning

Children's learning from multiple media

Using the example of *Cyberchase*, the authors examined in a 3-year study among 672 US-children aged 8 to 11 years how they use and learn from multiple media platforms.

Numerous research studies have demonstrated that children learn from watching well-designed educational television programs. Viewing of educational TV has been found to contribute to children's knowledge, skills, and attitudes regarding subjects such as literacy, math, and science (for a review of this research, cf. Fisch, 2004).

Often, however, producers do not create "just" a TV series. Amid buzzwords such as "multiple platforms" and "transmedia", it is increasingly common for projects to span several media platforms so that an educational TV series might be accompanied by a related website, hands-on outreach materials, or even a museum exhibit or live show. From an educational standpoint, producers and funders assume this combination of media yields added benefits for children's learning, beyond those that might be provided by one medium alone.

But is this assumption true? Past research has focused almost entirely on the impact of one media component, such as a TV series or a computer game in isolation, not a group of components that span multiple platforms. The lack of research on learning from multiple media – what we shall refer to as "cross-platform learning" – leaves open a number of important questions: How do children use multiple media? How does learning from multiple media platforms compare to learning from a single medium? How can cross-platform educational media projects be designed to build on the strengths of each medium, so that the media components best complement and support each other?

The study

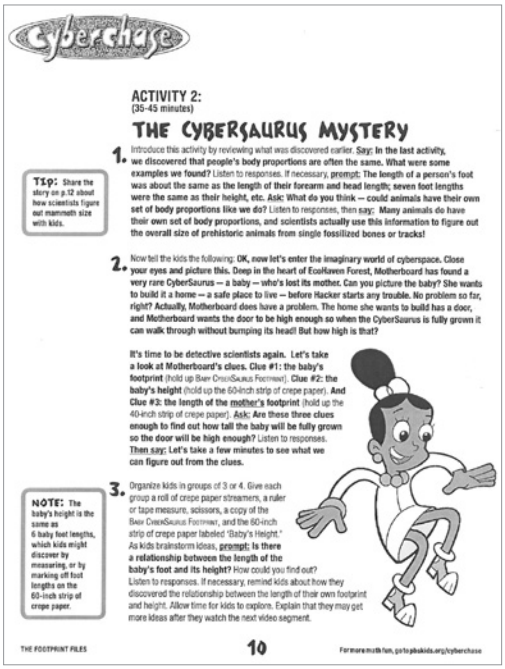
To find out, we conducted a major, 3-year study of cross-platform learning, using *Cyberchase*.[1] Produced by Thirteen/WNET in the United States, *Cyberchase* promotes mathematical problem solving and positive attitudes toward mathematics among 8- to 11-year-olds. The components of *Cyberchase* include an animated television series that airs daily in the PBS Kids Go! block, a website that offers interactive games and puzzles (www.pbskids.org/cyberchase), and a variety of hands-on games and activities that teachers or parents can use with children (see ill. 1-3). Other components include family activity books and a traveling *Cyberchase* museum exhibit, among other materials.

672 children, in Michigan and Indiana, participated in the research. All of the children transitioned from 3rd to 4th grade during the study. They were fairly evenly divided by gender (52 % girls, 48 % boys), mathematics ability (31 % high, 42 % medium, 27 % low), and whether math was their favorite school subject before the study (43 % yes, 57 % no). Approximately 29 % were minority children (17 % African-American, 6 % Latino, 4 % Asian, 3 % other).[2]

Naturally, unique benefits of cross-platform learning can arise only if children use more than one of the available media platforms. With this in mind, the first phase of the research (the "naturalistic phase") investigated children's spontaneous, everyday use of *Cyberchase* media. Is children's use of *Cyberchase* primarily a one-shot experience or sustained over time? Does use of *Cyberchase* span multiple media, or do children typically limit themselves to one medium?

We tracked children's naturalistic use of *Cyberchase* via a weekly "*Cyberchase* journal". Over a period of 3 months (half in the spring and half in the fall), children used their journals to record the number of times they used the *Cyberchase* TV series and/or website, the amount of time they spent, and what (if anything) they did on the website. For comparison, we had them do the same for a highly popular, non-educational series, *SpongeBob SquarePants*.

After the naturalistic phase concluded, an "experimental phase" explored children's learning from *Cyberchase*, and how cross-platform learning



Screenshots from *Cyberchase* © PBS Kids

Ill. 1-3: **Proportional reasoning and "body math" (comparing the sizes of different parts of the body) in the *Cyberchase* TV series (top), an interactive game on the *Cyberchase* website (bottom), and a hands-on activity (right)**

compares to learning from a single medium. For 8 weeks, children were divided into 5 groups:

- DVD only group: Each week, this group watched 3 half-hour episodes of *Cyberchase* in school (a total of 24 episodes).
- Web only group: Each week, this group played a new mathematical game on the *Cyberchase* website (a total of 8 games), but were not shown the TV series.
- DVD + Web group: This group used all of the above video and online materials.
- All materials group: This group used all of the above materials, and also did one hands-on *Cyberchase* outreach activity per week (a total of 8 hands-on activities, ill. 3).
- No exposure group: This group did not use any *Cyberchase* materials. Instead, they watched *Liberty's Kids*, a series about American history.

Before and after the 8 weeks, we measured the children's problem-solving via rich, meaningful problem-solving tasks similar to those used in math education research (e.g., Lesh et al., 2000). In addition, we developed an innovative new approach to assessment: Online tracking software automatically recorded every click children made while playing 3 games on the *Cyberchase* website. Detailed coding schemes enabled us to use these data to gain insight into the evolution of children's mathematical thinking over the course of each game.

Highlights of results

As noted earlier, the benefits of cross-platform learning can arise only if children choose to use multiple media platforms in the first place – and the results of the present study suggest they do. Data from the naturalistic phase indicate that children's use of *Cyberchase* was consistent over time and spanned multiple media. Those children who chose to use *Cyberchase* typically did not engage in one-time use. Instead, they became "*Cyberchase* fans" whose interest in *Cyberchase* sustained itself over a period of several months and carried across television and the Web.

Certainly, we must be careful in attempting to generalize from *Cyberchase* to children's use of other educational media projects. Every project is different and may be used differently. However, there are good reasons to believe the patterns of use observed for *Cyberchase* may be typical of children's media use as a whole. First, data from children's use of *SpongeBob SquarePants* during the naturalistic phase followed similar patterns to those found for *Cyberchase*; it was consistent from month to month, and significant relationships were found between use of the *SpongeBob SquarePants* TV series and website. Second, other research on children's Web use also supports the relationship between TV and the Web; approximately one-half of 2009's 10 most popular children's websites were associated with TV programs or characters (Kido'z, 2009).

Gains in problem-solving performance

Benefits for learning

Like past research (e.g., Clements, 2002; Fisch, 2003, 2004; Rockman et al., 2002), this study attests to the educational power of television and computer games. Users of *Cyberchase* media showed significantly greater gains in problem-solving performance than non-users. While working on problem-solving tasks, they used a wider variety of strategies and heuristics, applied them more effectively, worked well in groups, demonstrated persistence, and engaged in top-down planning. Indeed, approximately one-third of the children who used *Cyberchase* spontaneously mentioned *Cyberchase* explicitly (without any prompting from us or their teachers)

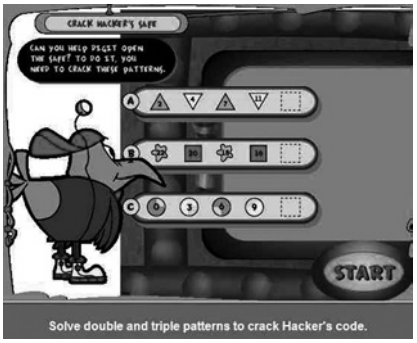
while working on one of the tasks. In addition, while playing *Cyberchase* games online, children engaged in the same sorts of increasingly sophisticated cycles of problem solving that have been found in classroom learning (e.g., Lesh et al., 2000).

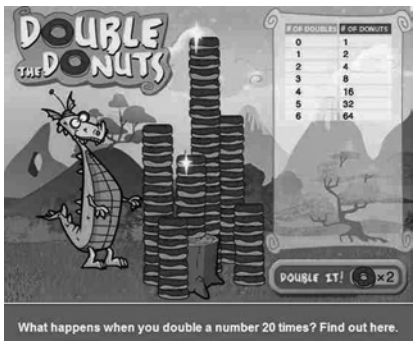
Many of the problem-solving effects appeared to be driven more by the *Cyberchase* TV series than by the website. Perhaps this is to be expected, since television is the central component of the *Cyberchase* project. Not only did the children in the present study spend more time with the TV series than the website (because our experimental treatment was designed to simulate real-world use, in which the TV series is used more often), but the *Cyberchase* TV series carries far more explanation of embedded math concepts than the online games do. The story-based format of the *Cyberchase* TV series also may have played a role, by presenting models of successful problem solving in the context of compelling stories. As one participating teacher put it, "They sometimes say, 'This is like when [the *Cyberchase* characters did something]'."

Cross-platform learning

Gains in problem solving were found more consistently among children who used multiple media. Many effects were stronger among the DVD + Web group than among either the DVD only or (especially) the Web only group, supporting the idea of greater benefits from cross-platform learning. Surprisingly, these benefits did not hold up as strongly for the All materials group, even though they used the same materials plus hands-on classroom activities. We cannot be certain, but the less consistent performance of the All materials group may have been influenced by the demands of their teachers' having to make time for so many *Cyberchase* materials (within the demands of a full school schedule).

The benefits of cross-platform learning were even more apparent in our online tracking data. Children who used multiple media employed more sophisticated strategies to play the 3 online games, and produced more correct responses while playing 2 of the 3 games. It appears that children took the educational content they encountered in one medium (TV and/or hands-on activities) and applied it





Ill. 4 and 5: ***Cyberchase* games aim at promoting children's reasoning (top) and mathematical understanding (bottom)**

Screenshots from *Cyberchase* © PBS Kids

while engaging with math content in another medium (online games). This transfer of learning supported their interaction with the second medium, allowing children to apply more sophisticated approaches and producing a richer, more successful engagement with the games.

To some degree, the benefits of cross-platform learning might be attributed to the fact that children who used more *Cyberchase* media simply spent more time with its mathematical content. However, time clearly cannot explain the present findings by itself, because the All materials group spent the most time in *Cyberchase* activities, but their problem solving did not improve as much as that of the DVD + Web group.

Rather, we believe the added value of cross-platform learning stems from 2 factors:

1. Exposing children to similar educational content in multiple contexts not only reinforces their learning, but also helps them to recognize that the math content can be applied in a wide variety of situations (a concept that is similar to educational researchers' discussions of "varied practice" and "transfer of learning" in classroom instruction; e.g., Singley/Anderson, 1989).

Transfer of information and skills

2. As our online tracking data attest, children who use multiple media can apply the content learned from one medium to help them "while they are in the process of learning from the other". Thus, not only can children gain additional, varied practice by using multiple media, but their engagement with the latter medium may itself be richer and more sophisticated. For example, encountering *Cyberchase* characters in an online game might lead children to think of other times when they saw the same characters (e.g., on TV). This could facilitate the transfer of information and skills from one medium to another, in a way that seeing different characters on TV and in a game might not (an idea that is supported by academic research on education and cognition; cf. e.g., Gentner/Forbus, 1991).

Implications for the design of educational media

The moral for future multiple-media projects is that there are benefits to cross-platform learning, but "more media" may not always be better. Further research is needed to determine whether there may be an optimal level of educational media use – and, if so, what that level might

be. In the meantime, our data also suggest ways in which media can be designed to maximize their educational power:

- Explanation and scaffolding: One reason why effects were often driven by the *Cyberchase* TV series may be that it presented explanations of the relevant mathematical concepts, and used characters and narrative to model successful problem solving. If so, this argues for the need for educational media (in any medium) to provide, not only opportunities for children to exercise their emerging skills, but also explanatory support and scaffolding when needed.
- Narrative: Researchers such as Schank and Abelson (1995) have theorized that narrative can serve as a powerful means for conveying information, and for organizing and storing information in memory. This view is consistent with the fact that our effects were often strongest among children who viewed the *Cyberchase* TV series, and that many children explicitly referred to *Cyberchase* stories and characters as they worked on problems. This is not to say, of course, that non-narrative formats (e.g., games, live demonstrations) cannot also convey educational content effectively. However, our findings are a useful reminder of the power of narrative as an educational tool – even in subjects not typically associated with stories, such as mathematics.
- Complementary media: Conveying the same educational content in different media opens opportunities for children to build connections between the concepts presented in these media. In *Cyberchase*, television supplies explanations of content and models of successful problem solving, whereas interactive and hands-on media provide opportunities for children to exercise these skills themselves. The use of a common world and common characters can encourage children to connect content from one medium to another. And the appeal of children's experience in one medium can enhance their motivation to engage with other educational media that employ the same characters.
- Convergent media: These points suggest intriguing possibilities for convergent media, in which the narrative and explanatory power of video, the participatory strength of interactive games, and the in-person support provided in hands-on media can be combined in a single experience. For example, consider an interactive game in which the "hint" button pulls up an explanatory video clip, or imagine a video with an embedded interactive game that allows the viewer to use mathematics to help the protagonist achieve her goal in the video.

Possibilities for convergent media

In these ways, we can build on the lessons learned from past and current research, both to stimulate future research and – even more importantly – to build projects that will take even better advantage of the power of educational media to help children learn. ■

NOTES

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[2] *A demographic mix was important, because research in mathematics education often finds that math performance differs as a function of children's gender, ethnicity, mathematics ability, and interest (e.g., NCTM, 2000). In this study, however, none of these factors influenced children's learning from* Cyberchase*. Boys and girls of different ethnicities and different levels of ability all benefited from using* Cyberchase*, suggesting that the series is successful in its mission of reaching a diverse audience of children.*

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THE AUTHORS

Shalom M. Fisch, PhD, is president of MediaKidz Research & Consulting in Teaneck, USA.

Richard Lesh, PhD, is Rudy Distinguished Professor of Learning Sciences at Indiana University and president of PRISM Learning, USA.

Elizabeth Motoki is a doctoral student in the Mathematics Education program at Indiana University, Bloomington, USA.

Sandra Crespo, PhD, is an Associate Professor in the Department of Teacher Education at Michigan State University, USA.

Vincent Melfi, PhD, is Associate Director for the Mathematical Sciences at Michigan State University, East Lansing, USA.