We're in this together! What children can learn about collaboration and equity from educational media

Abstract

This paper presentation examines the potential of educational media to teach children about collaborative learning that can inform both designers and educators that work with children in formal and informal educational contexts. We focus on *Cyberchase* (http://pbskids.org/cyberchase/videos/), a public television NSF-funded and Emmy-Award winning animated series for children ages 9-12, because it is specifically designed to provide young viewers with a positive representation of diverse youngsters (Inez, Jackie, and Matt) creatively and collaboratively doing and succeeding with mathematics. In this paper we first discuss the lessons about collaborative mathematics learning that the show makes available for children to learn. We connect this analysis to observations we made about the ways in which students who participated in our larger project were noticing and taking up from the Cyberchase kids' approaches to collaboratively working together in mathematics. We then close with lessons and implications for educators and media designers.

Introduction

In a second grade classroom children are set up in small groups at their tables. However not all of the groups are working together in productive ways. One group has divided up the work so as to complete it as fast as possible thereby undermining the whole point of the lesson. Another group has not even started as they are still arguing over who gets the first turn at using the cool tools the teacher has set up at the table and no one wants to be last. Scenes like this happen every day inside school classrooms (at all grade levels), especially when the teacher sets up a collaborative task that children are to complete together as a group. These kinds of scenarios also happen in the school playground when some kids are included while others are excluded from participating in a fun activity. Unless set up explicitly as spaces for collaboration and teamwork, the playground as well as the classroom become places where children learn to sort themselves as winners or losers based on assumptions about their own and each other's capacity for success in completing given tasks.

Considering the many challenges of setting up children to do productive collaborative work, it is not surprising that many educators soon give up on collaborative learning as an instructional goal and approach in their classrooms. Yet in the world of education, we know that learning happens in interactions and research on classroom learning is clear that students who participate and talk more will achieve and learn more. Over the past four decades, many educators and psychologists have argued that children and adolescents can learn a great deal from working in small groups (see, for example, Esmonde, 2009; Featherstone *et al*, 2011). In addition to the obvious opportunities to learn and practice social skills like listening, questioning others, and cooperation, these educators contend that the extended opportunity to articulate ideas, to work on making sense of the ideas that others struggle to express, and to frame new ideas based on the multiple perspectives of groupmates leads to conceptual development and cognitive growth. The problem is that in a classroom not everyone can speak at the same time or is given equal opportunity to participate. A whole class discussion offers space for active engagement to only one or two children at a time, and 10 children at most will have a speaking turn. Organizing students in groups distributes classroom talk more widely and equitably. In a group of 3 or 4, each student could in theory be talking 25% of the time and just by virtue of talking more, being able to learn more. In short, even though collaborative learning may seem like an impossible activity for children and their teachers, the benefits are worth the effort. In this presentation we consider what children can learn from educational media about doing collaborative work.

This proposed paper presentation examines the potential of educational media to encourage collaborative learning that can inform both media designers and educators. We focus on the public television program *Cyberchase* (http://pbskids.org/cyberchase/videos/), an NSF-funded and Emmy-Award public television animated series for children ages 9-12 specifically designed to provide young viewers with a positive representation of diverse youngsters (Inez, Jackie, and Matt) creatively and collaboratively doing and succeeding with mathematics while solving fictionally contextualized mathematical problems.

We share a spinoff analysis of a larger project focused on the effects of multiple media on children's learning of mathematics. Here we discuss the ways in which Inez, Jackie, and Matt embody what Carol Dweck (2002) calls a growth mindset towards individual and group challenges. We also discuss the ways in which the show illustrates what Elizabeth Cohen (1994) calls equal-status interactions among peers, which are crucial to ensure that everyone participates and learns from each other when working on a group task. Finally, we connect this analysis to observations we made about the ways in which students who participated in our larger project were noticing and taking up the Cyberchase kids' approaches to collaboratively working together in mathematics. We then close with lessons and implications for educators and media designers.

Competition vs. Collaboration in Educational Media

The perils of poor collaboration and teamwork are timeless tales told in ancient storybooks as well as in today's media. In the 2012 Avengers movie we saw six superheroes having to set aside their differences (and big egos) and learn how to productively work together to save the Earth from destruction. Similarly, in the Cyberchase television program we can easily see representations of good and bad teamwork. Team Hacker is composed of The Hacker who is the evil bossy leader, with Buzz and Delete unquestioningly carrying out his orders. Team Mother Board composed of Matt, Inez, Jackie, and other characters from the Cybespace world, in contrast, negotiate strategies and take turns leading and following the group. Each of the kids has strong personalities and styles of approaching challenges. Matt tends to favor trial and error, Jackie prefers to plan it all out before taking a first step, and Inez is the resident skeptic who questions and rechecks everything. We often hear them realizing that they need to stick together and help each other to conquer the problems that Team Hacker have created in their attempts to take over the world.

Cyberchase features three diverse youngsters (Jackie, Matt, and Inez) who are summoned into cyberspace to foil the evil plans of the Hacker. Each half-hour episode sends the team on a mystery based on a mathematics concept. Through their adventures, the series models mathematical reasoning, problem-solving, and positive attitudes toward mathematics. Its underlying themes are that mathematics is everywhere and is infinitely useful. Nearly five million viewers – 40% of them African- American or Hispanic – tune in each week. A web site *Cyberchase Online* (*http://www.pbskids.org/cyberchase)* complements the series with interactive games and puzzles. Paper-pencil activities based on the TV series are downloadable for parents, child care providers, and teachers for use with elementary age students.

Carol Dweck's mindset theory (2010) is helpful in understanding individual and group behaviors. She describes two different mindsets or ways of thinking about our intellectual ability. Those with a fixed mindset engage in tasks that make them look smart and will disengage from tasks that are challenging to them. They consider intelligence as innate and attribute their success to being naturally talented and gifted. In contrast, those with a growth mindset consider intelligence as something that one earns through effort and attribute their success to their work ethics.

These two different ways of thinking about intelligence affect how individuals and groups then approach learning situations. Those with a fixed mindset are threatened when their ideas are questioned, they are devastated when they make mistakes and when they have to put effort to complete tasks because these are seen as evidence of their lack of talent. They tend to give up when they encounter intellectual roadblocks and find the success of others as threatening to their sense of competence. In contrast those with a growth mindset see mistakes and intellectual challenges as opportunities to grow and learn. They are inspired by the success of others and seek to learn from others' strategies and methods.

In the Cyberchase episodes we can see the animated characters exhibiting some of the behaviors discussed in Dweck's mindset theory regarding embracing risks, persevering, and learning with and from the success of others. These can be appreciated *Episode 606:* "Team Spirit" http://pbskids.org/cyberchase/videos/cyberchase-team-spirit-ep-606/ and *Episode 404*: "Totally Rad" http://pbskids.org/cyberchase/videos/cyberchase-totally-rad-ep-202/. In these sample episodes we can see how the characters embrace or avoid taking intellectual risks, how they react to their own and others' mistakes, and how they persevere or give up when their ideas are not heard or taken up by others in the group. This can be seen in the following sample dialogue between the characters in *Episode 102* titled "CastleBlanca" http://pbskids.org/cyberchase/videos/cyberchase-castleblanca-ep-102/

JACKIE: So how come our survey found Dracula instead of Hacker?
MATT: Got me.
INEZ: I'm stumped.
DIGIT: Maybe we got lousy information! Oops!
JACKIE: Well, you weren't the only one, Didge. I did say "large" once or twice instead of "tall."
MATT: I know I said "creepy" once. But I took it back.

INEZ: That's our problem! Because we asked different questions – we found different people.
MATT: And we found Dracula because he looked the most like all the things we said.
INEZ: We need to be more specific! We need to describe Hacker in more detail and ask exactly the same questions!
DIGIT: You mean we have to do our survey all over again?
MATT: If we expect to find Hacker, we do.

In this dialogue we can see Dweck's growth mindset at work. The kids are not blaming each other for the mistaken solution or trying to figure out who was at fault but rather discussed their mistakes as a shared issue in all of their approaches to gathering data. In talking out what might have gone wrong with their questions they take shared responsibility for the mistaken solution and figure they have to try again with a clearer sense of what they need to do to be more precise and consistent in their data gathering method. The moral of the story, then, is that mistakes can help us refine our methods and thinking, and that acting supportive rather than contentious towards our peer's errors is more productive way to do collaborative problem solving with peers.

Elizabeth Cohen's (1997) theory about status characteristic and generalization provides a related sociological lens on the Cyberchase characters' power struggles about whose ideas are going to be followed and whose will be set aside. In general, the Cyberchase program distributes the mathematical smarts among the characters and avoids the gender, racial, and cultural stereotypes about who is expected to be good or not in mathematics, which are ways in which status hierarchies are created in the mathematics classroom. These status hierarchies act as a reinforcing mechanism enabling those who are perceived to be smart to be the most valued and frequent participants thereby reinforcing the notion that they are the most skilled and valuable members of the group.

Status generalizations tend to predict patterns of peer-interactions that make it more likely for certain students to be more or less dominant. In the Cyberchase world, the Hacker is the clear dominant leader who does not seem to value anybody else's ideas or strategies. By contrast, among the series' heroes, the kids seem convinced that together they are more capable than any of them individually. They are each portrayed as capable and smart in different ways that are valuable to their team. They share ideas, they disagree, they question and challenge each other's methods, they try and fail, and they often have to regroup and figure out a better method. Even when one of the characters is too stubborn with his or her own ideas and tries them out under the others' protest, they eventually realize their mistake and have to renegotiate the trust and status within their team.

The Cyberchase Project Context

Have you ever gone to a wax museum? That's a museum where they have statues of lots of famous people – actors, singers, athletes, etc. – and the statues are made out of wax. Let's imagine that I'm a sculptor who makes the statues in a wax museum, and the three of you are visiting me for the day to *help me. The next statue I'm supposed to make is Shaquille O'Neal, the basketball player. But I have a problem. Usually, when I make a statue of someone, the person comes to the museum so I can measure them and make sure everything on the statue is just right. But Shaq can't come now, because his team has a big basketball game someplace else. All he could send us instead was this photo and the outline of one of his sneakers. The photo shows what Shaq looks like, but I still need to make sure to make the statue the right size – all the parts of its body need to be exactly the same size as the real Shaq's body. So I need your help. Your job is to use these clues to figure out as much as you can about Shaq: how tall he is, how big the different parts of his body are, and so on. Then, you'll tell me what you figured out, so that I can make the statue.*

This is the type of collaborative task we gave to the 3rd and 4th graders that participated in our Cyberchase project. Note that this is not a typical school mathematics story problem. It reads more like the start of a fairy tale book than a math problem. It is wordy, it has lots of information, it is open ended with no clear solution path, and it is too challenging to tackle alone, and therefore requires teamwork to figure it out. Over 600 fourth graders in Indiana and Michigan worked on this math problem and similar kinds of tasks very successfully as part of a research project involving the animated *Cyberchase* television series. Results of the study indicated that, after watching Cyberchase for several weeks (and, in some experimental groups, playing online Cyberchase games), children used a greater number and variety of problem-solving strategies and heuristics, and reached more sophisticated solutions than children who were not exposed to Cyberchase. (Authors, year, concealed for review - we will include more details about this in paper and presentation).

More central to the present paper is the finding that observations of children working on the above Shaq sculpture task and other rich problem-solving tasks suggested that children seemed to be emulating some of the Cyberchase characters' collaborative learning behaviors. Indeed, in some cases, children explicitly referred to Cyberchase stories or characters while attempting to solve the tasks. This led us to examine more closely some of the ways in which the Cyberchase media could be modeling productive group work and consider the ways in which educators could be more intentional about using this media to help develop rich narratives and positive images about productive collaborative mathematics work.

Teachers of the children in the project mentioned several times how impressed they were with the TV episodes and how much the children were making connections between the Cyberchase media and the mathematics they were studying in the classroom. Additionally, they seemed to be acting out the characters in the show and reciting some of the lines they had heard the characters state in the episodes when working together on a vexing challenging problem.

For me, one of the astonishing things was the length of time that students retained the information from the early episodes. As we talked over new concepts later in the year, they were able to retrieve information and strategies that we discuss and were used in early episode and activities. Also, students *independently used those strategies when they were problem solving during groupwork, homework and the Cyberchase assessment. (3rd grade Teacher*).

Additionally, in the above Shaq sculpture task and others used as project assessment tasks, many of the students who had been interacting more frequently with the Cyberchase videos were observed taking up some of the productive group behaviors represented in the TV program and that exhibited the growth mindset discussed by Dweck and the equal-status interactions Cohen suggests are central to productive group work. The children were observed taking turns leading and following and encouraging each other to participate and share ideas. More importantly when the project was completed a sample of the participants were then interviewed about their experiences with the materials and what kinds of lessons they had taken away from interacting with the Cyberchase materials. Of interest to this paper were questions #6-7 in the interview protocol. These questions asked:

Q6. In the Cyberchase videos, you saw these kids solve a lot of problems. How do the kids in Cyberchase figure things out? What sorts of things do they do? How does that help them? Anything else?

Q7. What about when they try something and it doesn't work, or when something is hard for them to figure out? What do they do then?

Nearly all of the children who watched the videos said they learned something from them, and one of the most prevalent categories of responses concerned problem solving. Many of these student responses reflected an awareness of the sorts of collaborative problem-solving that we have been discussing. For example:

They used tools and they think together and they don't get it right the first time they look at it again to see where they went wrong.

They help each other and they try to figure out clues together without arguing. If they don't agree with each other, they try each other's things to see which will work best.

By working as a team. I guess three is better than one. And if something didn't work they always tried again and they don't quit.

By working together and figuring out what they can use as extra resources. One time they were stuck at this chamber thing and they had to figure out how to get out so they saw these bunch of boards lined up and so they figured out how to use them to push out the rock and move it over. They rethink it, they draw it out, or they use their computer, and they try again.

Implications for Media Designers and Educators

For many years, critics have doubted whether even positive, educational media can succeed in promoting learning, suggesting that the very nature of television and computers impairs attention spans and deep thinking (e.g., Healy, 1990, 1998; Postman, 1985). However, both theoretical analyses (e.g., Gee, 2003) and the empirical research literature (e.g., Fisch, 2004, 2009) have proven these critics wrong. Research shows that children do learn from their use of well-designed educational television programs and interactive computer games. Our Cyberchase project and this current analysis offer empirical research evidence of the positive effects of educational media on children's learning that is valued in school settings.

In the case of the Cyberchase media there is reason to believe that the narrative style of the program has the ability to teach children not just mathematical content as intended by the developers but also about the value of teamwork and of collaborative problem solving as a social skill to succeed in mathematics. 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. The observational and interview data collected in our project are consistent with this view as suggested in the sample quotes above by teachers and also the children who were frequent viewers of the Cyberchase television series. These children explicitly referred to Cyberchase stories and characters as they worked on problems in the project's assessment tasks. This is not to say, of course, that non-narrative formats (e.g., games, live demonstrations) cannot also convey educational content effectively. However, our observations here speak to the potential for narrative to play an important role in mathematics education.

The observations we have shared here have implications for educators. It invites them to consider ways in which they can leverage students' experiences as viewers and players of media materials, such as those in the Cyberchase program, not only to advance curricular goals but also social goals in their classrooms, such as engaging in collaborative group learning. If children can spontaneously notice and internalize collaborative learning processes modeled in a series of videos, then we can imagine that the potential for impact could be even greater if such videos are used as a springboard for discussion by a skillful classroom teacher, who calls examples to their attention and provides live support for such collaboration in subsequent classroom activities.

As our world grows more interconnected, our current and future students will be facing greater challenges to learn to collaborate with a greater diversity of people than ever before. Scientists and futurists predict that the problems that are facing today's and tomorrow's generations will require greater capacity and skills for teamwork than ever before. It is important then for educators to find new ways to tackle the big old problem of how to help students learn to work together to accomplish more for the greater good than (or in addition to) for their individual gain. For media designers this work also suggests that they too could play an important role in designing and producing media that is intentionally developed to promote positive and rich examples of productive collaborations among school age students.

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