BEYOND TEXTBOOKS

The HMH Fuse: Algebra / App Pilot Report

EVALUATION REPORT | 2012

A project of VIRGINIA DEPARTMENT OF EDUCATION

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Prepared by John D. Ross, Ph.D. • 2012

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The HMH Fuse: Algebra / App Pilot Project

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INTRODUCTION

The Virginia Department of Education has embarked upon a series of exploratory pilot studies to investigate the use of digital content and curricular materials on multipurpose portable devices. *Beyond Textbooks* is a project of the *Learning without Boundaries* initiative—overseen by the Virginia Department of Education's Office of Educational Technology—which seeks innovative ways to provide ubiquitous access to educational resources that support teaching and learning.

As part of this initiative, the Department initiated a short-term pilot of the *HMH Fuse: Algebra I* application (app) for the Apple iPad in spring 2012. It was developed by Houghton Mifflin Harcourt. Teachers and students in classrooms at two schools—one high school, one middle school—had access to iPads with the app installed. The app is a digital application based on an existing textbook, *Holt McDougal Algebra I,* which contains additional media and other features designed to promote both independent student learning and collaboration. This pilot was intended to investigate the app's impact on teaching practice and student academic behavior in terms of learning and demonstrating algebra skills and knowledge.

This report provides findings from interviews with teachers and students at both schools as well as some instructional and educational technology staff. It focuses primarily on how teachers and students used the *HMH Fuse: Algebra I* app and mentions the use of additional features and apps on the iPad.

Purpose of the Evaluation

The Virginia Department of Education selected two sites to pilot *HMH Fuse: Algebra I* to determine how the app might support teaching and learning. The limited trial was focused on the app's impact on teacher practice and whether it provides observable changes in student academic behaviors in school and at home as it relates to studying for and participating in algebra instruction. Based on these self-reported data, consideration will be given as to whether the pilot might be expanded in subsequent trials.

Evaluation Question

How does the use of the Algebra textbook app support teaching and learning?

OVERVIEW OF THE PROGRAM

Program Description and Content

Prior to beginning the pilot, algebra teachers from both schools attended a full-day professional development session offered by trainers from Houghton Mifflin Harcourt. This session provided an overview of the *HMH Fuse: Algebra I* app and its features.

The teachers were asked to incorporate the app into their instruction as they saw fit. They were not required to address any particular standards or activities but were allowed to use the app to support their existing curricula and planned activities.

The teachers in both schools provided a short overview of the app and the iPad to their students through activities such as a scavenger hunt but offered very little additional explicit instruction on the new resources. Every student in the pilot had access to the iPad. Pending approval from parents and the attendance by parents at an orientation meeting held at both schools, students were allowed to take the iPads home or to other classes, if the teachers in those classes approved. Not all students elected to take the iPads from the algebra classrooms.

The teachers used the *HMH Fuse: Algebra I* app approximately two to three times a week, depending on scheduling and the planned activities. The classes had access to the iPads with the app for approximately 18 weeks.

Resources

Each teacher and all students had access to an Apple iPad that included the *HMH Fuse: Algebra I* app. Students at the middle school used the original iPad, while the high school students had access to an iPad2, which includes a camera. In addition, the high school students had access to a printed copy of the corresponding textbook, *Holt McDougal Algebra I*, in the classroom and a textbook from a different publisher for use outside class. At the middle school, the teacher used a different algebra textbook in her other classes and had to spend extra time preparing similar instruction for two different versions. The iPads had additional apps installed that supported general teaching and learning activities, along with tools commonly found on the devices, such as a calculator, camera (on the iPad2), notes, a calendar, and collaborative tools available only if students had been provided e-mail accounts. No additional content-specific apps were installed.

The teachers continued to incorporate typical activities and resources into their instruction while supplementing and sometimes supplanting activities with those made available by the *HMI Fuse: Algebra I* app and others. As the teachers became more comfortable with the app and the devices, they increasingly integrated new activities or experiments with different teaching strategies, especially grouping strategies and more opportunities for independent learning.

Participants

The pilot program was implemented in two schools in Virginia: Powhatan High School and Kenmore Middle School. Powhatan High School is located outside the metropolitan area of Richmond in an area that transitions from suburban to more rural settings. In 2011-12, the school's 138 faculty and staff served approximately 1,400 students in grades nine through twelve. The student population was nearly equally split by gender. Eighty-nine percent of the students were white, 10 percent were black, and one percent (1%) were Hispanic; 12.7 percent qualified for free or reduced-price lunches.

Twenty-two students in one of Powhatan's Algebra I classes were selected to participate in the Algebra Fuse pilot. Two teachers cotaught this collaborative class, which included seven girls and 15 boys. Of these, 19 were ninth graders, and three were tenth graders. Three of the students were repeating the class. Both teachers reported high levels of personal technology proficiency, with one having more than 20 years of experience as an information technology (IT) professional before switching to teaching through a provisional licensing program. She has been teaching for nine years. The second teacher was a special education teacher who was highly qualified in mathematics. She had used technology in her instruction prior to the pilot.

Kenmore Middle School is located in the suburban area of Arlington, Virginia, near Washington, D.C. An arts and communications technology focus school, Kenmore was recognized in 2011 as the SMART Showcase School of the Year because of innovative technology use. During 2011-12, the school served approximately 790 students. Of these students, 38.6 percent were Hispanic, 28.8 percent were white, 18.1 percent were African American, 14.2 percent were Asian, and less than one percent (1%) were American Indian; 49 percent qualified for free or reduced-price lunches.

Twenty-three students in one of Kenmore's eighth-grade Algebra I classes participated in the Algebra Fuse pilot. Within this class, 12 students were English language learners, and two had Individualized Education Programs (IEPs). Many of these students had not been successful in their previous mathematics course. The mathematics teacher also had experience outside of education—electrical engineering—prior to becoming a teacher. This was her eighth year teaching mathematics. She reported being comfortable with technology.

EVALUATION DESIGN

Methods

Interview data were collected from all teachers, an instructional technology resource teacher at Powhatan, and the instructional technology coordinator at Kenmore. Students at both schools participated in focus group interviews in groups of four-to-six students. (See the Appendix for student and teacher interview questions.) These qualitative data were reviewed using the process of domain analysis (Spradley, 1980), which examines trends that could identify changes in teacher and student practices, especially when they are triangulated by data from other sources.

Data Collection

Interview data were collected during a one-day visit at each school: March 20, 2012, at Powhatan and April 2, 2012, at Kenmore. A follow-up online survey was administered to teachers and students by the Department. Two teachers and 27 students responded.

Limitations

This report is based on data collected during a small number of individual and focus-group interviews and an anonymous online survey. While attempts were made to keep questioning consistent across groups and sites, it should be acknowledged that personal and group dynamics can influence responses during an interview. Sometimes, the interview process itself generates new ideas or perceptions. Some of the students participating in the pilot also had limited proficiency in English, and so some interpretations had to be made about their responses. Every intent was made to draw reasonable conclusions and interpretations from the data, especially noting points of high agreement; however, caution should be applied in generalizing this information beyond this pilot and these participants. These data do provide insight into the use of the *HMH Fuse: Algebra I* app and the iPads by teachers and students in these classes, but similar results may not be experienced in different settings.

Data Analysis

Technology Proficiency

The teachers at both schools reported moderate-to-extensive levels of personal technology proficiency. One teacher at the high school had been in the IT industry in various roles for more than 20 years prior to teaching. The middle school teacher previously had been an electrical engineer; she teaches in an arts-and-communications technology magnet school that has won awards for its technology use. She had greater access to technology resources, although all the teachers reported using technology in their instruction prior to the pilot. All were familiar with interactive whiteboards and desktop/laptop

computers, but access was limited in the high school, with one teacher reporting that her students could visit the school lab only "once or twice a semester." One of the high school teachers had never used an iPad prior to the pilot. The middle school teacher had prior experience with a personal iPad.

In terms of professional development, all of the teachers participated in a full-day session provided by Houghton Mifflin Harcourt that focused on the use of the app. None of the teachers received any other professional development related to the iPad, but all reported being comfortable with general operations of the iPad fairly quickly by "playing around" and experimenting with it. These teachers suggested that others who may be reluctant to experiment on their own might need structured training on basic iPad operations.

One of the teachers reported having initial concerns that the students might have some difficulty with the device and the app, but these concerns were not realized. In fact, all of the teachers reported, and the students confirmed, that the students required little or no training or guidance to use the basic functions of the iPad and the *HMH Fuse: Algebra I* app. As one teacher noted, "The students probably used these with more ease than the laptops." This teacher reported that the students seemed more interested in using the iPads than the laptops; her coteacher observed that the students exhibited "more excitement" in class when they were told they were going to use the iPads.

The students at both schools agreed and said they already knew how to use the iPads due to their familiarity with iPads or similar devices (such as iPod touches or smartphones). The teachers did prepare some introductory activities to help the students become more familiar with the devices, but most students reported that these were not necessary. As one student stated, "They taught us some things. We taught them some tricks." The teachers confirmed that the students often would figure out new functions or explore new apps on their own and then show the teachers and the rest of the class. One student said that he hoped to receive an iPad for his birthday as a direct result of using it in this pilot.

Impression of the HMH Fuse: Algebra I App

All of the teachers noted that the *HMH Fuse: Algebra I* app was similar to a printed textbook in format. One was surprised and called it "basically just an electronic textbook." She had hoped it would be more interactive with "flashy animations and games to teach algebra." The other teachers and many students shared this same idea—that the app was very similar to a print-based textbook. One teacher noted, "It's a good start."

One feature that differs from a printed text is the inclusion of videos. The teachers and students reported through interviews and the follow-up survey that the videos were helpful. They noted that while there may be a narrator or "teacher" on screen, the videos also demonstrated concepts or sample problems being worked out at the same time. Teachers reported incorporating more videos into their instruction. The student reaction to the videos was very positive. They liked that the videos could be stopped, rewound, and replayed as often as needed and that they could do this on their own.

As noted, the text was formatted similarly to printed textbooks, but teachers and students indicated it was a helpful reference. The students, in particular, wanted less text and for the app to be more

engaging, but the teachers and students reported using the text as a reference. One teacher noted that although the text would support those who are already familiar with teaching from a textbook, she did not use it in this way; instead, she incorporated centers, manipulatives, and individual- and small-group instruction.

Depending on network capacity, it can take a significant amount of time to download chapters and videos—students and the technology director at the middle school noted that 30 minutes is not unusual. Teachers learned to work around long download times by starting the download process at the end of the day a day or two before the content was required and letting the content download while the devices charged. Students who took the devices home, though, expressed frustration with long download times.

Another feature that the teachers liked were the interactive problems called "View in Motion" and "Check It Out." Some of these problems allow students to receive feedback as they work through them; however, many of the problems are static and displayed as they would be in a printed text. One teacher expressed that while the problems were helpful, she hoped that in future versions, *all* the problems would have the interactivity and feedback component.

There are also multiple-choice quizzes that were not used at the high school because of network issues. The school was undergoing network modifications, and the iPads had not yet been assigned individual access to the network. The teachers were optimistic that once an Internet connection is available, students will be able to complete the quizzes and send their work to the teacher for review.

The reaction was mixed as to how easy it is to find specific information in the *HMH Fuse: Algebra I* app. The text is not searchable. Some students reported that it was easy to drill down through the "table of contents" (menus of topics) to find information; although, one student mentioned that if you accidentally touch the screen while you are doing this, the menu could disappear and you have to start over.

The *HMH Fuse: Algebra I* app includes note-taking and organizing functionality, but teachers and students reported that these features are limited. The feature for note taking is called "Scratchpad," but several students confirmed that they often ran out of space when using this feature. Another feature, called "Know-It Notes," allows students to create brief notes linked to pages in the text—much like adding a sticky note to a printed textbook. One teacher described these as "tags" rather than notes. Few of the teachers and students used this feature after initial experimentation. Most preferred to take notes on third-party apps (see the Other Applications section). Some students took notes by taking photos of their screens or other information.

Teachers and students had many ideas for adding functionality to the app. While building from a traditional textbook may have been a first step, teachers suggested that the app not look and feel so much like a printed textbook. Students agreed. "It's like a book now," said one high school student. "We'd be more driven to use it if it were more like the iPad." One student suggested that additional functionality, such as a calculator, be embedded in the textbook app so they do not have to close the app to open the other functions. Teachers and students expressed that some of the tools, such as the

graphing feature, were limited. As one teacher noted, "You can graph a line, but you can only graph it in one form." One student added, "I wish we could write with it better, like using a stylus to create graphs and equations."

One teacher who created manipulatives to support her instruction mentioned that she does a lot of sorting activities and that she would like to have a way to create similar manipulatives and custom sorting activities. She also noted it would be helpful to be able to go to a list, page, or bank of items and pull them together in a separate location based on student needs. These could be organized based on a particular method for solving the problems, and then a custom set of problems could be provided to students.

One teacher wished that the app better supported investigation. She also wanted the app to support greater collaboration or communication with other teachers regarding algebra. She suggested that it include a list (what might be called a crosswalk) of other apps available for the device, with details about how each corresponds to chapters and activities in the textbook. These could be content-based apps that explore a concept more fully or general applications that allow students to apply algebra concepts in different settings.

The student suggestions for change focused on making the app more entertaining or interactive—such as "add more color" and "make it more attractive." It was difficult to discern, however, what would be considered more attractive. Students in several groups asked for more animations and expressed variations of the following: "It should keep your attention more. It's a little boring."

One student noted about the *HMH Fuse: Algebra I* app, "It should be easier to get to everything." Another student responded that maybe it could be voice activated so it could immediately find the content you are looking for.

One group of students encouraged greater use of "real-life situations." This was elaborated upon by others: "Certain word problems are more interesting than others. If you have a real-life situation, it's more interesting, to be honest. It's easier to do it when you can relate to it." This was a popular idea in this group, with one student suggesting that when there are good stories, "you want to find out the solution."

Pedagogical Applications

In terms of pedagogy, the high school special education teacher noted she routinely created manipulatives, with or without technology. These manipulatives would be mini-lessons or activities customized to the needs of specific students, but she found that this process was difficult to replicate with the iPad.

The students at both schools were not allowed to install their own apps; however, they could suggest apps for consideration. Students at the high school could upload music to the iPad and were encouraged to use it in other classrooms; although, few students took the iPads out of the classroom at first. The technology coordinator mentioned that functionality on the devices could be manipulated,

such as turning off the cameras and location finders or using a filter on song lyrics—this could combat some parents' concerns about their students using the devices. A few students reported bringing their iPads to other classes to take notes.

The teachers and students reported that having all of their information available in one place was a plus. Students at the high school had paper-based planners, but some did not use them well. The iPad's ability to store information through the content-based application, external notes, or pictures helped some students stay more organized. Teachers at the high school encouraged students to take photos as reminders, and students reported using the iPad to take photos of handouts, sample problems, or even their own handwritten work.

Student reaction to the iPad itself was very positive during interviews, but the online survey had mixed results. On the survey, more students reported increased interest in algebra than those who said it had stayed the same. No students reported that their interest levels decreased. Some reported that they were "more excited about going to class" or that they paid attention more. One mentioned that algebra became his or her favorite class. Responses during interviews were more universally positive, and students reported that it was "awesome," "[kept] them interested," and "[made them] excited about coming to school." During the interviews, one student mentioned not liking the device and reported that it didn't "feel right in this environment."

At the high school, the teachers had looked forward to implementing the concept of a "flipped" classroom in which students gain foundational knowledge at home through digital assets, such as the textbook, accompanying videos, practice problems, and online resources. The intention is that time spent in class can then focus on individualized or small-group work that targets individual needs and that digs deeper into the content. Because many of the students did not bring the iPads home—some never got permission to do so—this particular concept never transpired. However, on the follow-up survey, 33 percent of the students who responded did mention using the iPad at home to support studying.

One teacher at the high school noted that as teachers, "We don't know what these kids go home to." so they were unaware how many students routinely completed schoolwork at home. The students in the pilot may just not be used to completing homework and were not intentionally eschewing the new device. Getting the students to develop foundational knowledge at home can be a challenge if they have not established homework routines. According to this teacher, "The idea that kids are going to get the bulk of their learning at home may be wrong," at least for this particular population.

That does not mean that the iPads did not affect pedagogy. The special education teacher at the high school noted that she and her coteacher spent time explicitly training students to learn with the new device and its resources. She suggested that students had to learn to think mathematically with the given resources and to be more self-directed in their exploration of mathematics concepts. They encouraged students to use the videos that accompanied the *HMH Fuse: Algebra I* app to explore the background information—both in and out of class, if possible—and students reported that the videos were one of the most engaging and helpful features of the app.

All students reported viewing the videos, especially in class, with one noting that since she did take the iPad home, she often reviewed the videos on her own and felt better prepared for class. She noted, "If you forget something and you're at home, like if you have a test the next day, you can go into the app and it shows you. I've been practicing a lot." Her teacher corroborated that she had observed this student appearing more confident during class in small-group discussions and that the accuracy of her work had generally improved. There was a similar story at the middle school, where the teacher documented that the confidence level of one of her students was "obviously higher." This student had taken the iPad home and reported back that she enjoyed the videos. Another middle school student noted that she and her brother had watched the videos together so he could help tutor her at home.

In terms of overall impact on pedagogy, the teachers reported that they probably used the same or similar instructional activities; however, the iPad and the *HMH Fuse: Algebra I* app allowed more students to work independently. In the follow-up survey, students described a difference between their more traditional mathematics classes and the pilot class. Several mentioned a reliance on worksheets in their previous mathematics instruction but confirmed conducting more hands-on activities, being more self-directed, and working independently with the iPad app. One student noted, "Sometimes we can teach a whole lesson to ourselves and come to class the next day and know it." Another added, "With the iPads, it's a lot more self-guided learning and keeps me more interested in it. I like (the) freedom to almost teach myself."

At the high school, the teachers reported being able to work with small groups of struggling learners more often. They were already using this strategy, but the new resources allowed more students to work independently, freeing up time for additional small-group work. The students confirmed that they engaged in individualized learning more often. Several students noted that the app "definitely speeds things up" and that their teachers can often get through content faster.

Other Applications

In terms of applications other than the *HMH Fuse: Algebra I* app, teachers and students at both schools reacted positively to two apps with similar functionality. *ShowMe* is an interactive whiteboard app that allows users to draw and record changes to their drawings. This is useful for working out and demonstrating mathematics problems. These videos can also be shared—on a single device in pairs, with small groups of students, via a projector, or online through the *ShowMe* Web site. *ScreenChomp* by TechSmith also functions like an interactive whiteboard. With it, users can insert backgrounds (images, documents, or text), annotate or draw on them, or create short screen-capture videos that can illustrate a process.

While the videos accompanying the *HMH Fuse: Algebra I* app were popular at both schools, students at the middle school also reported accessing the popular video-based Web site *Khan Academy,* which features short tutorial videos on a range of topics.

Overwhelmingly, the most memorable activity at the high school for teachers and students was a lesson that required students to model equations in real-world settings. The students worked in groups and had to provide instruction on how to solve the problem. Several groups opted to create videos with their

iPads, and students became quite animated when talking about the different projects—noting their favorites. One of the teachers echoed the students' excitement and said that some of her students who had rarely been engaged in the past were now eager to come to class to share their skits. She noted that the real-world context and the flexibility to act out the problem garnered more interest—and hopefully deeper learning—than if the activity had been conducted in more traditional ways.

FINDINGS

Interpretation

The teachers and students reported ease in terms of operating the iPad and many of the functions of the *HMH Fuse: Algebra I* app. The teachers noted that they took it upon themselves to explore and practice with the device—having received no professional development specific to the iPad—and that others who might not be willing to conduct this personal exploration would benefit from professional development related to basic operations of the device.

Recommendation

Some professional development may be necessary for teachers with limited experience using devices like the iPad and for those who are less willing to experiment on their own. This professional development could be combined with training on selected apps, pedagogical uses of the devices, and classroom management issues.

Interpretation

Students reported needing no training to use the devices and overwhelmingly reported familiarity and high levels of comfort with using the iPad. Teachers noted that any specific training for students should focus more on the use of the device as a learning tool rather than on basic operations.

Recommendation

Instructional materials for students should focus on using multipurpose portable devices in the context of supporting learning.

Interpretation

In its current version, the *HMH Fuse: Algebra I* app closely resembles a printed textbook in format. It does include some additional functionality; however, some of the teachers and students found it limiting and relied on third-party apps to complete certain tasks. The app appears to be used most often as a reference.

Recommendation

Publishers and content app developers should consider moving beyond the metaphor of a printed textbook as a vehicle for imparting information. Print-based books have restrictions in terms of layout and functionality. Apps should take better advantage of the functionality provided by multipurpose portable devices, incorporating various media and alternate approaches to content presentation while connecting students and teachers within and beyond a given classroom.

Interpretation

The teachers and students enjoyed the videos and found their inherent functionality helpful. The videos include samples or worked problems, not just a narrator, and teachers and students commented positively about these. The students reported the following benefits: being able to stop, rewind, and replay the videos. Although these are the same features that most videos include, they were a very valuable component with this app.

Recommendation

Videos that follow the principles of high-quality instructional media design can be a valuable means for providing key content knowledge. Educators seeking to implement this or similar projects should investigate the potential for high-quality video to support student learning in order to fully leverage its potential.

Interpretation

File sizes may be an issue for some of the content components. Teachers and students reported long download times for chapters and videos, and some concern should be given to how much storage space is necessary to support such an app, or a suite of six-to-eight apps that support a full student course load.

Recommendation

Publishers and adopters of these technologies should give some consideration to how file sizes can be managed to provide all of the content and supporting applications necessary to support student learning without using up available storage space on a device, or space that could be assigned to apps that extend learning. Some consideration also should be given towards providing more links to content not stored on the device, unless necessary, due to lack of Internet access at some students' homes.

Interpretation

Features that provide individualized feedback, such as the interactive problems and multiple-choice quizzes, were seen as valuable teaching and learning components. Teachers requested that *all* problems provide this type of feedback and that teachers possibly have the ability to organize or group problems on the fly to support individualized instruction.

Recommendation

Some consideration should be given to providing heuristics, design considerations, or connections to external resources that allow as many sample problems as possible to be interactive and provide individualized feedback—and to allow teachers to manipulate or group these, thereby leveraging the interactive capacity of multipurpose digital devices.

Interpretation

A search feature, possibly voice activated, might make it easier to find relevant content.

Recommendation

All content should be easy to search and should not be accessible only through a series of menus or table of contents.

Interpretation

Teachers and students found the note-taking features, including the "Know-it Notes" and "Scratchpad," to be limited. Students often relied on third-party solutions, including built-in cameras (in the iPad2), for note taking outside the app.

Recommendation

Consideration should be given as to how students routinely use notes, how they are stored and aggregated, and what happens to those notes once a class is over. The concept of notes should be expanded beyond the limitations of paper-and-pencil notes and consider the affordances of digital cameras, audio, video, and other means to capture notes in a variety of formats. Some consideration should be given as to whether this functionality should exist within a content app or could be linked to a third-party app.

Interpretation

The most common request for different functionality was that the app acted less like a printed textbook and, instead, leveraged the inherent functionality of the iPad and the apps it supports.

Recommendation

Consideration should be given towards better understanding the affordances of multipurpose portable devices and how they can support teaching and learning beyond the metaphor of a printed text. These devices allow for connections within and across content in varied formats as well as connections among students and between students and teachers—both within and beyond a single classroom. Designers must consider the steps required to move to the next level of digital-content delivery, which may include abandoning or moving beyond methods and strategies common to print-based resources.

Interpretation

The *HMH Fuse: Algebra I* app itself had little reported impact on changing pedagogy; although, some extenuating factors might have had some influence. Teachers reported conducting the same types of activities and lessons in their classrooms with or without the app; however, they did report using videos more often and allowing students to work independently, which provided greater opportunities for small-group or individual remediation. Not all students took the iPads home, so the desire to "flip" the classroom at the high school and engage in different classroom instructional patterns did not occur. The high school lacked Internet access, which limited some of the potential collaboration.

Recommendation

Adding a new device alone is insufficient for impacting pedagogy. These devices operate within technological, pedagogical, and human infrastructures. Pilots such as this one help to identify additional conditions for using new devices that can suggest how digital content and devices can best be used to promote student learning within these larger infrastructures. Digital devices and content that introduce new metaphors for content acquisition and support for learning may require additional support for teachers in terms of pedagogy. While many teachers may begin by replicating known and familiar activities, exemplars and suggestions for pedagogies that go beyond those limited by print-based resources should be suggested to and modeled for teachers. This may require models, exemplars, job aids, directions, and professional development.

Interpretation

Teachers described pedagogical strategies they used specific to their mathematics instruction, such as using manipulatives, grouping and sorting problems by characteristic, and investigation. These strategies are not currently supported by the *HMH Fuse: Algebra I* app.

Recommendation

Publishers should investigate additional pedagogical strategies common to content areas—in this case, mathematics—so that resources match current thinking and practice about delivering instruction.

Interpretation

Additional suggestions for functionality for teachers included the ability to connect with other teachers around the content and instruction as well as connecting to additional resources.

Recommendation

Wireless multipurpose digital devices can help connect with others—both in the classroom and beyond. This may include communications between teachers and students, students and students (both in the same and other classrooms), teachers and teachers, and teachers and other experts. Consideration should be given to leveraging the capacity for these devices to connect people within and beyond the classroom, especially in terms of student learning and teacher growth, and to connect with other digital-content resources.

Interpretation

Students requested changes to the *HMH Fuse: Algebra I* app to make it more entertaining and interactive, such as more animations and color as well as additional "real-life situations."

Recommendation

Developers should investigate ways to incorporate digital content that is more entertaining and interactive to students but that still promotes greater understanding of skills and knowledge. The emphasis on "real-life situations" cannot be underestimated in terms of increasing student engagement.

Interpretation

While not a focus of this evaluation, several tips, tricks, and lessons learned were reported in terms of managing and implementing the iPads at the classroom, school, and division levels.

Recommendation

Some consideration should be given to collecting and disseminating implementation and management strategies to help promote wide-scale adoption of new digital-content resources and devices.

Interpretation

Having the algebra content and several learning resources embedded in one device helped some students to be more organized. Some features of the device, such as the camera in the iPad2, led to increased organization and support for learning.

Recommendation

Alternate forms of documentation, such as imaging, can be incorporated into common functionality possessed by multipurpose portable devices. Developers should consider ways to promote organization, including digital calendaring with the support of notifications, through e-mail and other means, organized file storage or connections to organized student work, and the ability to support multiple media formats.

Interpretation
Student and teacher reaction to the device was positive overall, especially with the students. Very often, it was difficult to focus the students on commenting on the app as opposed to the device.
Recommendation
Developers should consider ways to continue leveraging the interest and excitement for multipurpose portable devices to promote student interest, engagement, and ultimately achievement.

Interpretation
When considering pedagogical methods that incorporate portable devices and that place increased demand on learning outside the classroom, some further exploration may be necessary in terms of understanding student and family behaviors and routines outside class.
Recommendation
Schools and teachers interested in implementing strategies that require additional support from families should consider the following: (1) conducting a needs assessment to determine appropriate strategies families can engage in to help encourage student participation and (2) providing training and/or access to resources to families so they better understand how to support new pedagogical models.

Interpretation
There were several "success stories" that should be documented.
Recommendation
Schools and programs that implement new and emerging technologies should consider ways to capture and disseminate success stories and promising practices to concerned stakeholders and to help others who may be considering similar technology initiatives.

Interpretation
While the *HMH Fuse: Algebra I* app provided both text and video-based content and some accompanying tools specific to supporting student learning of algebra, some (free) third-party apps proved to be of great benefit.
Recommendation
Some consideration should be given as to whether digital content resources should contain all relevant functionality to support teaching and learning or whether third-party solutions can be leveraged.

Interpretation
The most memorable event described by the high school students and teachers was not related to the use of the *HMH Fuse: Algebra I* app but could be considered an application of content knowledge. The teachers and students excitedly recalled the real-world problem students had to solve and the creative ways students used the devices to act out and record skits.
Recommendation
Focusing on profound and deep learning should take precedence over the affordances of technology. Consideration should be given towards identifying and supporting effective pedagogy made possible by the devices and digital resources.

CONCLUSION

The pilot of the *HMH Fuse: Algebra I* app provided several insights into the ways that multipurpose portable devices can support teaching and learning. The good news is that teachers and students adopted the multipurpose portable devices with little or no training—or at least limited experimentation. The Apple iPad appears to be easy for teachers and students to adopt for common pedagogical uses.

The content materials, specifically those similar to the *HMH Fuse: Algebra I* app, are in the early development stages in terms of capitalizing on the affordances of these new technologies. Just as teachers often progress along a continuum of adoption from replication to adaptation to transformation, the digital resources in question may also be at the early stages of a continuum. They are operating from an older print-based metaphor that may give way to new designs that better leverage the functionality supported by newer digital devices. These may include increased interaction, additional media, and opportunities for collaboration.

Ultimately, design considerations for new digital resources may best focus on accepted and successful pedagogies in relevant content areas and determine how these new tools can support and possibly extend the effectiveness of teaching and learning. School personnel will need guidance with implementing these devices and curricular materials on a large-scale basis, and lessons contributing to this guidance can come from pilot schools and the resource developers. Hopefully, content providers and resource developers could work together to build a new generation of digital materials that help encourage student achievement and support pedagogies that promote student academic success.

APPENDIX

Algebra I Fuse iPad Interview Questions

Thank you for agreeing to talk with us about your use of the iPad and the new Algebra app. We're collecting information to help people better understand how you're using them here at xxx School and how we might make them better. We won't share your answers with your teacher or school by name. We will share general information we collect, but no names will be included in order to protect your identity.

1. Please describe any technologies you use on a regular basis at home and at school. What are they and how do you use them?
    a. How often do you use . . . ?
    b. Do you use any technology specific for helping you in Algebra?

2. Before this class, have you ever used an iPad? What do you think of it?
    a. How did you learn how to use it?
    b. Is there anything you really like about it?
    c. Is there anything you don't like about it?

3. What do you think about the Algebra app?
    a. How is it useful or helpful?
    b. Is there anything about it you don't like?
    c. Do you have any suggestions for what you think it should do that it does not do now? OR If you were to design an app like this, what should it do to help you better?

4. Is there anything different about using the iPad app in your Algebra class compared to not having it?
    a. How do you use the iPad outside of Algebra?

Is there anything else you'd like to share about the iPad or the app that we didn't ask you?

Algebra I Fuse iPad Teacher Interview Questions

1. Please describe your use of technologies before the iPad pilot. What are you likely to use and how do you use it? (examples may relate to personal productivity or instruction)

2. Before this class, had you ever used an iPad? What do you think of it?
    a. How did you learn how to use it?
    b. What kind of professional development did you receive?
    c. Is there anything you really like about it?
    d. Is there anything you don't like about it?

3. What do you think about the Algebra app?
    a. How is it useful or helpful?
    b. Is there anything about it you don't like?
    c. Do you have any suggestions for what you think it should do that it does not do now? OR If you were to design an app like this, what should it do to help you better?

4. Please describe how you use the iPad and the Algebra app in your instruction. How did you introduce it to your students?
    a. How does it support your instruction?
    b. Has it changed your instruction?
    c. What challenges have there been, if any, and how did you overcome them?
    d. Please describe any "a-ha" or surprising moments that occurred when using the iPad or the app?

Is there anything else you'd like to share about the iPad or the app that we didn't ask you?

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