

# Teaching and Learning with iPads, Ready or Not?

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## Abstract

Within weeks of becoming available, the iPad reportedly sold over 3 million units, a brisker pace than other tablets in the personal computer realm. Much of the early success might be attributed to the almost 250,000 applications that could run on the device and a similar interface to the popular iPod Touch and iPhone. This article considers whether the sales spark that has ignited a hardware revolution (numerous device manufacturers have launched—e.g., HP, RIM, Samsung, Motorola, and HTC—or have plans to launch tablet devices over the next year) is being matched on the software front, with a particular focus on K-12 teaching and learning. Authors consider the potential affect both the iPad and its applications might have on teaching and learning in K-12 settings and whether these technologies allow educators and students to accomplish what they otherwise could not, from a teaching and learning perspective.

**Keywords:** tablet, educational technology, one to one computing, 21st century skills

**W**ith the introduction of the iPad, Apple has succeeded in establishing a new form and input/output factor in the personal computer arena. Within a few weeks of becoming available, the iPad reportedly sold over 3 million units, a brisker pace than other devices in the smaller than a notebook computer, but larger than a media player realm. Much of the early success might be attributed to the almost 250,000 applications that could run on the device and a similar interface to the popular iPod Touch and iPhone (now referred to as iOS devices after a renaming of the operating system). The purpose of this study is to consider

whether the sales spark that has ignited a hardware revolution (numerous device manufacturers have launched—e.g., HP, RIM, Samsung, Motorola, and HTC—or have plans to launch tablet devices over the next year) is being matched on the software front, with a particular focus on teaching and learning in K-12 environments. A central concern of this study is to consider the potential affect both the iPad and its applications might have on teaching and learning in K-12 settings. The principal question guiding this study is whether these technologies allow educators and students to do things in educational settings that they could not otherwise do, from a teaching and learning perspective.

## Relevant Literature

Given the iPad's popularity, it is likely that educational technology proponents will re-tool well worn arguments about the potential for technology in classrooms, and skeptics are likely to re-emerge as well. In a recent book focused on education and technology, Collins and Halverson (2009) present the “enthusiasts and skeptics” arguments, which appear to be little changed since Means (1994) outlined these positions in an attempt to focus on how technology might be used to improve teaching and learning in schools. Becker and colleagues (Becker, Ravitz, & Wong, 1999) and Cuban and colleagues (Cuban & Kirkpatrick, 1998; Cuban, Kirkpatrick, & Peck, 2001) note that the actual use of technology in schools typically falls well below the expectations set by technology proponents. There is also a growing sense that games and gaming devices like Xbox, PSP and Wii are being considered viable learning technologies in K-12 settings, both in a formal and informal sense.

As acquisition costs have dropped and as arguments about technology preparation of students take on increasing urgency given trends in global competitiveness (e.g., Levy & Murnane, 2004) the number of portable computers in learning environments has exploded (consider for example the number of 1:1 computer programs school districts and states across the country have launched over the last 5 years, e.g., Maine, Michigan, Pennsylvania). Low acquisition cost for modern digital technologies, increased capability and a lack of compelling counter arguments are leading politicians and administrators to be swayed by technology enthusiasts like Allan Collins who have called for PDAs or some other small portable computing device in the hand of every student. Although the One Laptop Per Child effort has not directly caught on in this country, Nicholas Negroponte continues to make headway on this effort in developing countries.

Proponents of technology frequently paint pictures of technology use in schools that suggest it can transform teaching and learning. The reality of how technology is used in actual learning environments is often both more prosaic and less transformative (see for example Becker, Ravitz & Wong, 2009; Cuban, Kirkpatrick, & Peck 2006). The fact that past efforts to transform education with technology have had little effect (e.g., Tyack & Tobin, 1994) is a central feature of the “skeptics” argument. Opponents, on the other hand, take the skeptics’ argument one step further by pointing out that resources expended on modern digital technologies are better spent on analog equivalents. This study considers whether the iPad and its attended software constitutes a set of resources for which there is no analog equivalent, thus allowing teachers and students to do things in learning environments that could not otherwise be possible. By focusing our study on things that could not otherwise be done, we hope to avoid the morass associated with whether technology allows one to do something “better.”

## Method

Shortly after the iPad shipped, we began this study to consider both the hardware and its applications as an educational technology. The principal guiding question of this article is whether or not the iPad and its software environment allow users to do things in educational settings that they could not otherwise do. Our rationale for framing our question in terms of what educators or learners might not otherwise be able to do is predicated on the notion that

technologies prosper when they extend what users are able to do in productive ways. For this study, we analyzed the categories Apple and its developers use to categorize their applications and other criteria designed to help users find appropriate applications for use on their iPads.

### Categorizing Applications

In order to consider these applications and the iPad as a learning technology in K-12 settings, we drew on categories offered by Means (1994). In Technology and Education Reform, Means proposes four categories to organize educational technologies: tutor, explore, tool, and communicate. For example, Means writes, “technology is used as a tutor when it does the teaching directly, typically in a lecture-like or workbook-like manner” (p. 9). In contrast, technology is utilized to explore when users can make decisions about the information they access and gain. Technologies represent a tool when they “are not designed explicitly for school use but can be put to educational purposes” (p. 10). This includes educational aids like word processors and video equipment that is not explicitly designed for education but can be instrumental in the classroom environment. Finally, technologies used to communicate are “programs and devices that allow students and teachers to send and receive messages and other information through networks or other technologies” (p. 10).

In addition to utilizing Means’ (1994) categories, we have also developed one of our own that relates to 21st Century learning, because many ubiquitous computing efforts in K12 settings are connected in one way or another to 21st Century Skills (see for example [www.P21.org](http://www.P21.org)). In addition to tutor, explore, tool, and communicate, we considered whether the applications were for individual consumption or whether they fostered collaboration. This additional category enables us to explore the extent to which the software supports a key 21st century skill—the idea that knowledge is socially constructed and negotiated. Finally, we

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also sought to understand the extent to which an application might be useful in a particular subject area or grade, whether it supported projection and which of the iOS devices it was supported on.

At the start of this study in early June 2010, there were almost 30,000 applications categorized by developers of iPhones, iPods and iPads under the heading of “education.” Initially, because the number of applications created specifically for the iPad was small, we developed a plan to consider a representative sample of all applications. Looking at applications in the education category led us to conclude that such a plan was flawed for several

reasons. First, several developers generate large numbers of applications that were functional copies with some change in content. For example, apps that have a test preparation focus typically have a framework that is the same and the only thing that changes is the content (e.g., one developer offered preparation software in SAT, LSAT, GRE and sub-sections of these exams). We also concluded that the average user, or even a K-12 teacher would have difficulty finding relevant application by searching through the only place we found ready access to all the applications created for iPads: a website hosted by Apple that includes all applications. Initially, we looked at this site: (<http://itunes.apple.com/us/genre/mobile-software-applications/id6017?mt=8>) to gain a sense of how many applications were listed under the education category. The website listed well over 30,000 applications.

Given that the interface of Apple’s website was not particularly user-friendly in terms of learning about or selecting applications, we chose an approach that fit what we felt a typical person might use in terms of selecting applications. We searched for applications through the iTunes app store on an iPad, by visiting the app store on a computer, or by visiting app aggregation sites (e.g., appshopper.com). In the course of looking at applications initially designed to work on an iPhone or iPod Touch, we noticed a difference in those specifically designed for the iPad interface. Over time, we tended to focus on applications that were specifically designed, or re-designed to take advantage of the larger

user interface of the iPad. From May 15 through August 15, we checked appshopper.com and the iTunes application store Monday through Friday to track newly launched applications. We decided to look for applications from a number of sources, choosing some that fit our interests, i.e., general productivity, drawing, reading, math, science and music, in addition to those that were touted as “education.”

### **Collection and Analysis**

The process of collecting and analyzing the applications was multi-layered. First, the applications were paid for (if they were not free) and downloaded. They were then installed on three iPads. One particular iPad device was used as the principal repository for the application testing. Once the applications were downloaded onto the iPads, we rechecked the iTunes application store to confirm which category the application was listed under. We utilized a database application, Bento, to record each application’s established Apple category and other pertinent information like date released, seller information, grade/rating, and application description. After recording the Apple-provided information in the Bento database, the applications were then operated from a users’ perspective. This included entering text, answering questions, interacting with and creating content when applicable to the particular application.

After a firm understanding of how the application worked was developed, we worked to categorize the application according to Means’ adapted categories (tutor, explore, communication, and tool). This was accomplished by asking the following questions: can users decide on or choose information to learn or interact with?; can users utilize the application as a tool for a greater purpose, i.e., composition, data organization and/or analysis?; can users add or create information?; can users collaborate with other users of the application? Depending on the answers to those questions, we entered the corresponding information into the database. For example, the Memory Match Game application was categorized as a tutor application because it provided users with a static format for interaction in which they engaged with a pre-determined memory game. Missing from users’ interaction with the application were choices concerning material learned or applied and a collaborative feature that allowed users to engage in use of the application with others, so it was clear that the application did not qualify for the other categories. This systematic review of applications led to finally testing them to see if

they could be projected on a screen. This process was repeated for each application.

## Findings: iPad Capabilities, Looking at the Hardware

What is fairly clear is the capability of the iPad's hardware. Using a multi-touch interface, the iPad's 9-inch screen serves as the primary mode of interacting with the device. The multi-touch display can handle more than one touch simultaneously, meaning users can type on a virtual keyboard or play multiple keys (and hear multiple notes) on a piano application. The touch interface also allows for various gestures (pinch, flick and stretch) to be used in applications. An accelerometer allows the iPad to measure acceleration or movement. The most obvious use of this functionality is the rotating screen as one turns the device around, but the built in accelerometer is also capable of recognizing motion, thus allowing one to measure distance and speed. In addition to being able to connect to wireless networks, the device also supports Bluetooth networking. The WiFi networking allows the device to connect to the Internet, but can also be used to support peer-to-peer sharing over WiFi networks. The Bluetooth networking capability also supports peer-to-peer networking, as well as Bluetooth devices (e.g., headphones, microphones and keyboards). Models that are equipped with a 3G cellular radio can also connect to the Internet via cellular modems. And, these 3G capable systems have a GPS receiver that supports many of the capabilities of a stand alone GPS. Apple states that the battery life of the device is approximately 10 hours, and many independent reviews support this claim. The iPad also has a built-in microphone and a built-in speaker. Apple ships the iPad with an e-mail application, a web browser, a photo management tool, a tool to view videos on the device, access to YouTube, the ability to manage and listen to audio from iTunes, a maps program, notes program, a calendar, the ability to search across applications and some accessibility items. An eReader in the form of iBooks is also included.

## Software and Categorization of Applications

As is the case with all hardware, what makes a difference in how devices are adopted is how and what applications are developed to take advantage of the hardware specifications. When introduced, the iPad stood ready to take advantage of the over 250,000 applications that developers

created to run on iPhones and iPod Touches. In fact, one early criticism (sight unseen) of the iPad was that it was nothing more than a large iPod Touch. Much of the early application development for iPhone and iPod touch focused on productivity applications and some games. The application universe for the iPad was rooted in the iPhone and iPod Touch application development and has led to an emphasis on a type of use that is principally individual-based. There are applications, many web-based, that focus on socializing (e.g., Facebook, Four-square or Twitter), but generally developers are not focused on collaboration that takes advantage of the capabilities of the device and its operating system. For this study, we analyzed in detail applications spread across Apple's 20 established categories. Out of a total of 315 application considered only 56 were categorized under Apple's "Education" heading.

Using Means' categories we cataloged 112 of the applications we analyzed as tutor, 79 as exploration, 73 as tool, 38 as communicate, and 15 as collaborative educational technologies. These categories provided us with a framework to be able to investigate the applications and assess application usage for educational purpose. Many of the 56 iPad applications categorized by Apple as "Education" fall under Means' "tutor" category, and are meant for an individual users' use. According to Means, an educational technology is used as a tutor when it is a "system designed to teach by providing information, demonstrations, or simulations in a sequence determined by the system. A tutorial system may provide for expository learning (the system displays a phenomenon or procedure) and for practice (the system requires the student to answer questions or solve problems)" (1994, p. 11).

After categorizing application according to Means' categories, in the context of using and interacting with the various application, we sought to understand the extent to which applications provided opportunities to collaborate or extend what users might otherwise be able to accomplish. One way to characterize most of the applications we considered is that they focus on the consumption of various forms of content, in various media types (i.e., text, audio, still image, interactive image and video). Some of the productivity applications, like those that are part of the iWork suite (i.e., Pages, Keynote and Numbers), have a content creation focus, but among applications categorized as "education," few, if any, provide more than consumption modes. There are a class of



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applications that fall into Means’ tutor category which have elements of creation (e.g., tracing letters or numbers or coloring by recognition of letters or numbers as in Alphabet Tracing, Letter Lab and 123 Color HD), but in many cases these look like drill and practice and not necessarily creation, in that what one is creating is always the same.

In the context of a K-12 classroom, there are few examples of iPad applications that we studied that support truly innovative teaching and learning (in either a formal/traditional learning environments or informal environments which might range from home schooling to museums), in the sense that they represent resources that extend what educators and students could otherwise do. Many represent material akin to digital flashcards. For example, the application Letter Lab prompts users to use the iPad like a sketchbook for tracing letters. ABC Phonics functions very much like traditional flash cards with the added benefit of having audio and phonetic representations of words to be learned, as does Food Cards. In this way, the applications take on the “workbook” elements that Means (1994) categorized as tutor (p. 9). This finding applies not just to developers new to education, but also to content providers that are well known. For example, National Geographic GeoBee Challenge HD makes use of the tap and pinch function of the iPad, yet falls short with its content. While its developers refer to the map it provides as “interactive,” it merely quizzes users on continent and country names while providing visual and photographic representations of those places. NASA also has an application that is little more than a portal to content available on the NASA website (note that this application has been updated to include more functionality, but still feels like content is piled on with little regard for functional use by educators or learners). Some of the utility applications analyzed simply replicate existing analog or even digital capability. The Real Caliper application functions much like a stand-alone caliper, utilizing the iPad screen as a ruler for measurements. The iHandy Level Free application uses the iPad’s accelerometer function to provide a calibrated level. The Multi Measures HD application also joins the movement; it boasts iPad replacements of the protractor, ruler, surface level, spirit level, plumb bob and seismometer.

## Extending What We Can Do

Once again, our pervading question was: What can iPad applications help users do that they could not otherwise do, from a teaching and/or learning perspective? Many application creators note that theirs are made specifically for the iPad, yet their descriptions and what they actually do do not explicate this. For example, The Guardian Eyewitness maintains: “The Guardian Eyewitness app has been specifically developed to offer a customized iPad experience, bringing thought-provoking imagery direct to your device on a daily basis.” The idea that information is automatically updated, like in NYT Editor’s Choice, is provocative, but it is also something that can be accessed with other devices like a notebook or netbook computer. There are, however, some functions that provide users with advanced paths to interaction. As advertised, the iPad offers users a way to connect to others via Bluetooth and collaborate via the Internet through popular social networking services like Facebook and Twitter. It also offers applications that connect to rapidly expanding cloud computing services, like MobileMe, iDisk or Dropbox, where data can be navigated beyond the constraints of a single device. Applications like these allow users to synchronize data across devices, share with multiple users and access resources like email and various file types from various locations and devices with few constraints.

Overall, much of what we observed as beneficial was a product of the hardware and operation system capabilities as opposed to the design of the applications developed for the device. In an educational sense, there are examples of applications that can replace cumbersome supplies. For example, the 3D4 Medical Images and Muscle and Bone anatomy applications showcase the high definition properties of the iPad; this can be extremely beneficial for science and medical classes in the sense that it can replace unwieldy and costly textbooks and reference materials. Applications like Math Board and Free Books follow in this tradition. Teachers of subjects from English to Family and Consumer Science can take advantage of this feature, as the iPad has the capacity to allow for large amount of data to be aggregated. Many of the applications focused on music offer users the ability to bring a cornucopia of instruments to learning environments. In each of these examples, replacement is done in a manner that achieves a bona fide measure of extensibility.

The Craft Finder on iPad: Great Crafts from Disney FamilyFun application offers an interface that allows users to track their progress on projects; it also provides a personalized page where step by step procedures can be logged and saved for future reference. Factzilla functions much like a wiki where multiple users can collaborate and create discussions on fact versus truth scenarios. Many of the read-along book applications, like Beautiful Moon Story Chimes, provide multiple language adaptability and availability to have the book either remain as static text or be read aloud from a prerecorded voice record. Multi-language ability is also built into 123 Color HD, where young users can learn the names of numbers in English, Spanish and French, but in both the case of books or coloring applications, multi-lingual reading is neither unique to the iPad nor provides an innovative implementation of this capability.

## Stand Out Applications

While many of the applications we analyzed did not appear to provide users with opportunities to expand what might otherwise be possible, there were a few that stood out in the area of extending capability. Some music applications, e.g., Leaf Trombone and Ocarina, let users perform on a larger, virtual stage, providing users with entry to a global community that they might not otherwise be accessible. Star Walk allows users to navigate the sky, exactly as it is seen from either the present location of the user, or a chosen location, to enhance learning about stars and planets. It takes advantage of the accelerometer and location awareness hardware (GPS in devices that support it) to depict a map of stars and planet that are both above the horizon or below, day or night (Educators who are introducing their students to the moon or other celestial objects might finally have a compelling way to help students shake the misconception that stars or the moon only come out at night). Shakespeare in Bits utilizes side-by-side text and video functioning that exposes students to original Shakespearean language while also providing important contextual and conceptual understanding via a corresponding video visual of the scenes within the play. Sundry Notes is an interactive note taking application in which users can draw, write text, upload voice and sound recordings, and include pictures to create a multi-modal note taking experience. Users can then share their notes using the cloud, email, or social networking services like Facebook and Twitter.

The OmniGraph Sketcher application gives users the ability to create complex graphs from new or preexisting data that can then be share via email. Paper Map provides a map template provided by Google that users can write on and mark for their personalized destinations. Users that have GPS capability in their devices can also save their maps and allow the GPS to reference them when planning trips.

Good Reader for iPad allows users to upload large PDF and other files using a WiFi or 3G connection that enables them to connect to popular servers like MobileMe, iDisk, Google Docs, and Dropbox. It also provides text wrap-around so that the complete document is easily read on the iPad screen. SpeedTest X HD provides a tool for users to evaluate their Internet connections. G is an application that simulates gravity. Jungle Time, while taking on the tutor distinction for its structured teaching of clocks and time, utilizes the iPad's unique accelerometer capability by prompting users to shake the device when they want to go on to the next question.

## Collaboration and Support of 21st Century Skills

Keeping in mind the importance of developing 21st century skills that support collaboration, we developed a database entry point that allowed us to note the collaborative (or non-collaborative) status of applications. Whiteboard, for example, illustrates the collaborative potential inherent in iPad applications. It allows multiple users to create and share material simultaneously using either a WiFi peer-to-peer function. It also provides an opportunity for multiple users to work on the same document at the same time, a function that has given cachet in the classroom to online collaborative offerings like Google Documents. Scrabble's application also enables users to collaborate playing together using Facebook or a shared local network.

## Potential

We understand that current application development has potential to not only extend what can be done in classrooms but also strive for better connection to learning theories and hardware capabilities. Stickyboard, for example, falls short of expectations. It has the capacity to enable users to email its stickies as PDFs to other users but does not include a real time

collaborative component. Surprisingly, one missing element in numerous applications is a connection or link to the web. For example, while 3D4 Medical Images has great imaging, there is no collaboration component at all and no way to connect to the web. In the case of the National Geographic Bee, links to the geographic areas highlighted in the game could provide users with further, self-directed experience with the data. Another example of this is the Professor Garfield Online Safety application. While it provides users with a lecture-based account of why Internet safety is important, it fails to connect to the very Internet it is focused on teaching users about.

Good Guide is an application that has potential if the hardware of the iPad enabled it to function as it was intended. Set up to scan bar codes of commercial products for consumers, the application on an iPad fails to work fully. While users may still look up information about the products they see in stores, the loss of the camera and therefore scanning function prevents the application from working to its full potential.

In many respects the iPad is pushing the edge of both hardware and software innovations, from multi-touch interfaces and energy consumption to distribution models for software. Our study suggests, however, that these advances are underused in application applicable for teaching and learning. While our ideas of how people learn has greatly expanded, the bulk of the applications written to run iOS devices are woefully out of sync with modern theories of learning and skills student will need to compete in the 21st century.

## Discussion and Conclusion

That the iPad has generated considerable commercial interest is indisputable. Apple has broken new ground in form factor, software dis-

tribution and user interface with the iPad and other iOS compatible devices. Our review of applications written to run on the iPad and other iOS devices suggests that the innovations Apple has brought to market are not being taken up widely by the software development community. As a result, we do not think the iPad will ignite a revolution in schools. Although there has yet to be a textbook commercially available specifically for the iPad, major textbook publishers have all suggested that they have plans to launch iPad-specific applications. From our study it is clear that the number of applications developed to run on the iPad are principally targeted at the consumption of content within various media and not necessarily the creation or collaboration of that content. The categories offered by Apple are of little use to educators in helping them make decisions, as many of the more useful application exist outside the education category. In this sense, to date, most of what exists in the iPad application space does little to take up the hardware and software innovations of the device and its operating system. Moreover, we cannot point to a single application that steps up to modern understandings of how people learn. Our study suggests that there is a paucity of applications that truly extend capability, much of what these application allow can be done with other devices, and this leads us to conclude that the current trajectory will not revolutionize teaching and learning. The lack of collaboration capabilities underlie this point, as do the overwhelming number of application that are simply drill and practice or focused on delivering content for consumption, not creation or re-use.

Collaboration in ways that take advantage of the iPad hardware and operating system capabilities could support 21st century skills. We think that one of the reasons why applications do not do more in this area is due to a dearth of good examples of the application of technologies that are either built on or support anything more than a behaviorist or proto-cognitive theory of learning. Moreover,

while many of today's educators talk about collaboration and knowledge construction in a social context, they frequently rely on behavioral models of teaching. To be certain, there is room for behavioral models of teaching. The problem is that in order to prepare current K-12 students for productive lives in the 21st century more emphasis is needed on models of teaching that take into consideration more modern theories of how people learn. And, while the core of education--reading, writing, reasoning and computing mathematically--has not changed, how, where and why these core principles are engaged in is vastly different today than it was even a few decades ago.

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