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THE PRACTICAL TEACHER

This Month's Topic:

1+1= iPad Math Apps for Teachers

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This issue of **NASET's Practical Teacher** was written by Dr. Joanne Healy, Sanna Turnbough and Mercedes Anderson. The authors ask the question: Should teachers incorporate math applications (Apps) into their classrooms? If "yes", how can this be done effectively? An abundance of math apps for the iPad are available, ten engaging apps, (five elementary and five secondary) have been reviewed. Descriptions of application options and attributes that teachers need to consider in making the right choice in App are included as well as a detailed list of pros and cons of use in the classroom or small groups. iPad accessibility and system preferences to control access and monitor student progress will be clarified. Relevant tips on how and when to integrate iPads into the classroom successfully are examined.

1 + 1 = iPad Math Apps for Teachers

Abstract

Should teachers incorporate math applications (Apps) into their classrooms? If "yes", how can this be done effectively? An abundance of math apps for the iPad are available, ten engaging apps, (five elementary and five secondary) have been reviewed. Descriptions of application options and attributes that teachers need to consider in making the right choice in App are included as well as a detailed list of pros and cons of use in the classroom or small groups. iPad accessibility and system preferences to control access and monitor student progress will be clarified. Relevant tips on how and when to integrate iPads into the classroom successfully are examined.

"There's an App for that!" is a common phrase, but finding the right one can be overwhelming. When the Apple App store first opened in September 2008, there were a mere 800 Apps available. In September 2014, there were 1.3 million apps and, in October 2014, 675,000 apps were out and exclusive to the iPad (Costellow, 2015).

Teachers certainly do not have the time to search all the apps; even 20 would be pushing it, to determine which one(s) would be beneficial to their students. Rubrics for apps do exist, but teachers should determine certain parameters first such as cost, subject, accuracy, or customization (Pei-Lin Weng & Taber-Doughty, 2015). Since students are the end users, enlisting their research skills, developing their presentation and persuasive skills, and letting their voice be heard will create buy in to iPad usage. Schrock (2013), a technology educator, created an iPad for teaching website which has a variety of rubrics for teachers and students to choose. Rubrics can simply rate elements of an app as: perfect match, adequate match, or does not match. Depending on the available time to rate an app and performance concerns teachers can choose from a variety of elements to make a decision to purchase an app or not. Elements such as: Appeal, Motivation, Feedback, Levels, Clear Instructions, Performance, Purpose, Differentiation Capabilities, Customization, Engagement, and Cost are used to make to make decisions about using an app or not (Schrock, 2013). Ultimately it is up to the teacher to find, and possibly customize, a rubric that will work best for them and the students. Math apps are often game based and a teacher must ascertain whether they provide appropriate learning content while being engaging enough to hold student attention.

Understandably, there will be challenges with utilizing iPad apps in the classroom. There will be students who want to leave the app selected for them to look for the games they have played on their own iPad. Or, they may simply enjoy garnering teacher attention by repeatedly quitting the app. Fortunately, there are two iPads features that may be helpful with these problems. Both features are located in the *Guided Access* section within *Settings*.

1. Limit the student's ability to change, quit, or put the program to sleep:
 - a. Turn on Guided Access by tapping three times on the home key
 - b. Trace the area on the screen to turn off the normal response to touch.
 - c. Press start and follow the prompts to set a passcode to prevent the student from being able to quit the app or put it to sleep. If the student tries to figure out the passcode, each wrong passcode attempt will prevent the student from entering another passcode for successively longer periods of time. Eventually, students will realize the iPad use is limited to teacher selected educational activities.
 - d. To turn off Guided Access, press the home key three times again.

There are a plethora of math applications available for early learners, both in preschool and primary grades.

After reviewing more than 20 applications, reviewing online literature, and testing many apps, the following are considered the top five for elementary learners. Criteria for choosing these apps were based on scores of perfect or adequate match for the following elements: user friendliness or customization, cost (low or free), coverage of curriculum, and ability to captivate the student user or appeal. Important information about accessibility, usage, and crossover to other grades is included in this article.

Apps for P-6

Moose Math - Duck, Duck, Moose (cost: \$1.99)

Moose Math, a low cost app, utilizes repetition for early learners. The creators provide a website that specifies extensive breakdown of the Common Core Standards this app addresses. In addition to math standards, the games provide hand-eye coordination practice. There are five high interest activities that cover a range of curriculum for preschool through first grade. As the students progress through the game, it will automatically scaffold into more difficult math questions. Games include: *Moose Juice*, *Pet Bingo*, *Lost and Found*, *Dot-to-Dot* and *Pet Paint*. The skills emphasized include identifying shapes and colors, to counting by multiples, and basic addition and subtraction. Proficiency is rewarded with the ability to construct a personalized city, which appeals to students. Tasks must be repeated ten times to complete a level, at which point a new decoration is earned for the city. This app can be used individually, lab centered or as an activity center choice.

A drawback to this app is that students may not try to figure out the answer. The characters in each of the activities will provide hints after so many incorrect answers. This feature may reduce the motivation to calculate answers to the questions correctly the first time.

From a teacher's perspective, however, Moose Math is superior to other apps because it allows for multiple profiles. Moose Math automatically scaffolds, and it is effective for differentiated instruction, allowing some students to work on patterns of two and five, while others are still working on one. Each student's app extrapolated "report card" identifies student strengths and weaknesses within each game compared to the common core standards, which is a helpful feature to share with parents.

Through the Moose Math website, worksheets can be downloaded (for free) and will provide continuity by bringing the characters into the classroom, or they can be used to provide homework reinforcement.

Telling Time - GiggleUp Kids Apps and Educational Games (cost: \$2.99)

Telling Time contains five levels of difficulty spread across activities that align closely with Common Core standards. It allows for seven different ways to interact with clocks. To allow for various skill levels, different style clock faces are provided including now numbers, only tic marks, quarter hour numerals, or numerals one to twelve which can provide generalization of skills. Motivation to complete tasks is provided by a virtual fish tank. When a student completes ten questions correctly they earn a fish for their virtual aquarium. Students can feed their fish after every set of ten correct answers.

In *Set the Time*, students transform digital time to set an analog clock. *What's the Time*, is the opposite of *Set the Clock*, and requires students to determine the digital time from the setting of an analog clock. *Play Puzzle* requires students to complete a jigsaw puzzle of a digital clock. *Take the Quiz* asks students to select one of four clocks based on an auditory prompt, e.g. "Touch the clock that is twenty past five." Time vocabulary development is a key factor in the quiz with the auditory prompts. *Stop the Clock* cues students when to stop the clock. *Learn the Clock* involves a great deal of reading, but could be used at a station with a paraprofessional, cross-age tutor, or volunteer, to help with the reading, explanations, and clock parts. *Explore Time* allows the student to set a time on the analog clock causing changes in the day/night background scene as well as the digital clock within the scene.

Be aware, when a student answers a question wrong, the app marks the response as "incorrect". Aside from visual clues in some of the activities, such as the amount of daylight through the window, the app does not provide assistance to reach the correct answer. The "?" hint button only gives written instructions, which may be of very limited use for the student. Students are not required to complete a "set" of questions and can exit at any time. Telling Time does not provide a learning experience for elapsed time.

Many of the activities contain verbal prompts, e.g., when the analog clock is set. This can aid in the learning style for auditory learners by providing a set of ear buds or headphones will make sure other students are not distracted by the verbal prompts. This app reinforces skills introduced by the teacher, allows student practice time and provides generalization to various clock models.

Telling Time tracks accuracy for only one student at a time and can be reset at any point. Student accuracy is measured on the percentage of questions answered correctly on the first attempt. While there is a free edition of Telling Time, the inexpensive paid version provides all of the features.

Bugs and Numbers - Little Bit Studio, LLC. (Cost: \$2.99)

The Bugs and Numbers app has 18 different games that cover a breadth of curricula from shape and number identification through basic fractions. Three different screens, each with six games, encompass kindergarten through second grade in their level of difficulty. Despite the fact that the content standards recommend this app for primary grade levels, the graphics are fantastic, and older students with low skills would also enjoy it. Mode one, *Explore*, allows students to choose the games they want. Providing a meaningful progression of skills, Mode two, *Play*, will advance the student to a more challenging level as they correctly complete each activity.

Here is a quick overview of the different game options from stage one to three. At stage 1, students identify numbers and shapes at the *Circus*, practice left and right in the *Arcade*, seek and find bugs in the *Junkyard*, tap and count at the *Diner*, color by number at the *Gallery* and identify matching shapes at the *Hotel*. At stage 2, students will count to 100 at the *Garage*, trace numbers and shapes at *School*, arrange sequencing on a *Xylophone*, make comparisons at the *Theater*, sort, count, and tally at the *Store* and do addition and subtraction up to 10 on the *Ferry*. At stage 3, students will use US currency on the old *Claw Machine*, practice time at the *Train Station*, find patterns in the *Zen Garden*, work with fractions at the *Pizzeria*, measure length and weight in the *Lab*, and practice addition and subtraction on the *Game Show*.

Note, Bugs and Numbers looks and feels more like a game than a learning tool for math. Skills developed may not transfer out of the application without direct instruction. Turn off access to parts of the screen to restrict students to playing in one game. The only method to measure success is to watch a student's high scores within the app.

One of the motivating factors to completing each level is the acquisition of bugs provided as game rewards. Realistic bugs are capable of surprising and laughable feats such as carrying other bugs in an egg carton. The accompanying music is enjoyable and the help voice is not childish. Be sure to have headphones or ear buds available for the students. The app does not have data collection profiles for students, but a teacher can check the number of stars a student has earned to see which games they have played.

Math Ahoy–Eduplus (Free)

The premise of Math Ahoy is really simple; addition is practiced in the lower levels of the game and subtraction in the higher levels all while avoiding the King's ships and collecting the treasure chests from around the world. Students will learn a bit of geography, as treasure is hidden in locations such as Vancouver, London, and Rio de Janeiro. Math Ahoy requires problem solving, addition skills, subtraction skills and focus for the duration of the game. The app has graphics suitable for older students and helps in the development of executive function skills in an appealing way that can be generalized to other problem solving situations. Students must plan ahead to collect treasure while practicing addition and subtraction between 1-9 in order to progress.

There are three levels of difficulty; students need to complete each level three times to advance to the next level. In the second and third levels, storm clouds appear requiring the student to use subtraction. In the higher levels, the King's ships are more aggressive about following the student's ship in order to steal the treasure. Math Ahoy requires taking turns between the student and the King's ships allowing students to experience changes in perspective.

Consider students who are fluent in addition and subtraction will do well and may not be challenged enough with this app. Math Ahoy only monitors how far along students move in the game. To encourage quick thinking, a teacher might have students begin on the same level and "race" to capture all five treasure chests.

DragonBox 5+ – WeWantToKnow (Cost: \$4.99)

DragonBox 5+ introduces the basics of algebra without using "scary" math symbols and terms. DragonBox 5+ uses objects, such as boxes or bugs, to demonstrate the concepts of algebra. The student has to isolate "the box" or the variable most commonly known as "x". As the student progresses, the game scaffolds and starts to incorporate other variables and numbers. Without learning the terminology, students are learning about algebraic principles in a fun engaging way. Additive Identity Property is taught by identifying a specific box as a 0. Allowing boxes to be turned over and making them a negative value, while requiring this action to occur on both sides of the equation, simultaneously explains the Additive Inverse Property. Students are limited to a certain number of moves to earn the first star, all of the extra pieces have to be removed for the second star, and the equation has to be solved for the final star. Without some direct algebraic instruction, students are not going to realize they have been doing math let alone algebra. Pictures in the early levels make it easy to identify isolating "x." DragonBox 5+ would be best used in conjunction with algebraic lessons on the different properties, allowing students to name and claim their innate math ability.

Secondary Apps

Dragonbox 12+ – WeWantToKnow (Cost: \$7.99)

Dragonbox 12+ is a continuation of the original DragonBox app covers more complex algebraic concepts, such as the associative properties of addition and multiplication. While they bear similarities in play, DragonBox 12+ mainly targets secondary level algebra. DragonBox 12+ discreetly teaches higher-level mathematics through gameplay. There are 350 levels to teach twenty-four rules of algebra, giving students ample time to interact with each concept as it is introduced. What is learned at each level is generalized so, by the end, students are employing multiple concepts in order to solve an equation, possibly without realizing the level of work they are doing.

The 12+ version begins play at a lower level than the 5+ version. This means that all students must begin at the same basic level; the additive property of zero. This app allows the teacher to assess individual student performance levels and discern whether the first few levels consist of review or introduction. The company that produced DragonBox apps, WeWantToKnow, provides online resources for teachers such as the rules of game, common core alignment, a teacher's manual, and worksheets to assist in the use of their product within the classroom.

Despite their immense success, DragonBox apps are not without issue. The DragonBox slogan that it ‘secretly teaches algebra to your children,’ is true in a concerning way. With 350 immaculately scaffolded levels, DragonBox 12+ can teach students so secretly that they are not acutely aware of the skills they are acquiring. Without explicit understanding of these concepts taught within the game, students may not be able to generalize their knowledge to other settings.

Another feature of the 12+ version is an added help button. Instead of providing a hint for students, the help button solves the equation for them and then allows them to copy. This is a useful app that has the potential to bring about student engagement, but it requires a structured system to compliment its use and provide the best learning experience for students.

DragonBox 12+ is a great supplemental tool to add to any algebra class, but should not be relied upon as a main mode of teaching. We suggest incorporation of the game into daily lessons with pre- and post-teaching to assure student awareness of the concepts covered. If the classroom does not have a 1:1 iPad ratio, this app would provide a great partner or small group activity. The resources included are extremely supportive for the generalized skills learned. This app makes tracking student data difficult as it uses a three star system that does not indicate whether or not the help icons were used. We suggest using pre- and post-assessments in order to gauge the acquisition of skills as well as the ability to use algebraic skills outside of the app.

DragonBox Elements – WeWantToKnow (Cost: \$4.99)

Dragonbox Elements is another addicting math game that carefully teaches Euclidean geometry. Students will enjoy playing through the levels as they follow a unique storyline involving geometric characters as they take back their home island. DragonBox Elements presents an interactive introduction to geometric properties, shapes, and definitions. This game is much less discreet with regards to its mathematical content than DragonBox 12+. There are 110 levels divided into seven chapters covering concepts including line segments, circles, quadrilaterals, and special pairs of angles. DragonBox Elements offers more of an ongoing storyline including curious characters that each represent a shape or property. These features make the more difficult content novel and engaging to the student. Included is a comprehensive guide that walks teachers through each level, character, and concept, in the order it is presented.

DragonBox Elements, while engaging, does not have a user-friendly help section. It does not model, but maintains written directions. Students who experience difficulty with math or reading will need extra support and guidance from the teacher as they work through the levels, especially when moving into more difficult and comprehensive materials. This game, like DragonBox 12+, uses color coordination to highlight certain points, so teachers must be aware of colorblind students and accommodate them accordingly.

Similar to DragonBox 12+, this program is a wonderful tool to compliment in-class instruction. The company has a comprehensive and easy to read guide for teachers to help guide students through the game. The game content is much more engaging for students, DragonBox Elements would be best implemented in small groups where there is room for discussion and troubleshooting. It would also be a great class activity, allowing teacher direction and modeling through particularly difficult areas.

MyScript Calculator – MyScript (Free)

MyScript calculator is a wonderful free app that calculates handwritten equations. The app automatically solves multi-step equations as they are written, reading even the most illegible of handwriting. MyScript calculator is a great in-class tool to encourage student independence. It allows students to check their own work, and may even pique student curiosity causing them to engage in progressively more difficult problems while giving them access to errorless math.

While MyScript is useful, it also gives students the ability to cheat. If this app is implemented, require students to show their work. While this app calculates equations, it does not show how to come to the correct answer. The app can automatically solve an equation as it is written, but by adjusting the settings it allows the whole equation to be written before the app works its mathematical magic.

MyScript calculator is a great tool to introduce specifically as a way for students to check their own work. For example, the teacher might allow student use of the app only when they have completed their work, and are now ready to check for accuracy. At this point, students may be encouraged to find their own mistakes and perhaps even learn to work equations backwards. Students will enjoy the endless possibilities of writing in crazy problems and in finding out this app can decode even the worst of bad handwriting.

Khan Academy–Khan Academy (Free)

Khan Academy is a wonderful tool for all kinds of students: those who may be self-directed and curious, or those who are confused and frustrated. The app allows students to learn a wide range of mathematical concepts and can customize a sequence of lessons based on performance. Khan Academy is a great tool for a flipped classroom; students can review lessons for homework and then continue with personalized help from the app or their teacher. Khan Academy has over 150,000 interactive lessons and continues to grow. Students do need to become proficient and independent in their skills without using this app as a crutch. Parents who want to provide home support for their children can use Khan Academy as a model.

Explain Everything–Morris Cooke (Cost: \$2.99)

Explain Everything is a powerful tool for educators at any level. Pictures, documents, videos, apps, and links to websites may be imported to Explain Everything. Once imported, teachers are able to customize or comment on the imports by using a pencil to write, add text, and/or insert voice recordings. Teachers can literally explain everything, save it and send the file to a student who is struggling. Explain Everything is especially useful for repetitive directions, lessons, or explanations teachers find themselves doing over and over again as the file can be created once and shared multiple times. Students can also use Explain Everything to share projects or explain math concepts helping to improve their communication skills through the process.

One drawback to this app is that there is no ability to edit recordings. Teachers need to think about what they want to say beforehand and perhaps write a script in advance in order to get it right in one take. The best recordings are done in a quiet area and are kept fairly short. Teachers can break tasks down to multiple steps if needed. Another drawback is that some files can be large and difficult to share.

Discussion

iPads provide access to high interest, fun games that allow differentiated learning to meet students' individual needs. Integrating technology into the classroom is a skill pre-service teachers need to learn. Using applications for math is a wonderful place to begin. Math apps can be used easily in a 1:1 setting, with partners or small groups, or at activity stations.

Teachers need to preview applications prior to using them with students. However, since the students will be the end users, they can be engaged in this process. With a little bit of training, students can be taught how to evaluate apps, and they can be the harshest and most honest judges. Students will develop preferences for certain apps, but should continually be presented with new options.

Data collection of student learning varies from stars to detailed lists of completed objectives. Teachers need to decide what factors they need from an app based on student's needs, interests and skills. Since there is an app for just about everything, teachers can individualize for different students by using different apps to learn similar skills.

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About the Authors

Dr. Healy joined the UAF School of Education in 2008 to develop the Special Education Master's degree and related Certification Programs. She brought 21 years of public school teaching experience to her role as a Special Education Assistant Professor. She teaches a variety of special education teacher preparation courses, is the chair of the Technology Advancement Committee and faculty advisor for Council for Exceptional Children student chapter.

Mercedes Anderson started her Master's of Education in Special Education at the University of Alaska Fairbanks in Fall 2013. She has been preparing for the field over the last several years through classroom experience and participation in the Alaska Chapter of the Council for Exceptional Children. Mrs. Anderson has a love for technology and looks forward to incorporating it into her classroom. She is looking forward to student teaching in the fall.

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