Techtalk: Mobile Apps and College Mathematics

By Theresa V. Hoang and David C. Caverly

In the last column, Caverly (2013) discussed mobile apps for fostering literacy development. In this column, we will discuss apps useful in developing mathematical reasoning.

To place these apps into a theoretical framework, we will suggest how these apps could be used in an instructional model such as the Algorithmic Instructional Technique (AIT) developed by Vasquez (2003) which includes four stages: modeling, practice, transition, and independence. The instructional goal with AIT is to help students develop algorithms to approach different math situations. We chose AIT because it is a balance between behaviorist and constructivist instructional models. Behaviorist models typically focus on teacher-centered knowledge transfer, whereas constructivist models typically direct students to an active construction of knowledge from information provided (Grubb et al., 2011). Because of the low success rate of students in developmental math coursework, Grubb et al. argued for a more constructivist or balanced approach rather than what he and his colleagues saw as a behaviorist, remedial pedagogy. Instruction through AIT provides that balance because it allows students to see how an instructor develops an algorithm and how she or he gives opportunities for students to create, use, and refine the algorithm when encountering different situations. Since instructors using the AIT model expect students to be active in their learning, faculty could easily integrate technology into the four stages so that students could use their mobile devices to collaborate and deepen their learning.

Integrating Technology into AIT

Modeling

In the modeling stage of AIT, the instructor demonstrates how to create and use algorithms to solve a problem based on observations and critical thinking. For example, when discussing how to solve quadratic equations, the instructor analyzes a given mathematical problem through think-alouds. Using mathematical language with specialized vocabulary, the instructor shows the students an algorithm by describing the thought process behind choosing factoring, completing the square, or using the quadratic formula to solve the problem. Understanding this language can be fostered by capturing the instructor's think-alouds and language usage. Apps like *Super Note* (Clear Sky Apps, n.d.; Apple operating system, henceforth iOS), *Smart Voice Recorder* (Smartmob Development, 2013; Android operating system, henceforth Android), or the camera and microphone apps built into smartphones or tablets can record the lecture or take snapshots of instructor board notes. For class notes, students could use *Noteshelf* (Fluid Touch PTE. LTD, 2012, iOS) or *Handwriting* (Appest Inc, 2013; Android). These apps capture the students' handwriting, making the writing of mathematical symbols easier than keyboard-based, notetaking apps. When the instructor finishes modeling a useful algorithm, students then share their notes via *Evernote* (Evernote Inc., 2013; Android, iOS) to compare their understanding of the material with their peers.

Guided Practice

During guided practice for AIT, the instructor supports students in their initial creation, use, and implementation of the algorithm. Various activities facilitate this process, such as error analysis. For example, the instructor could provide a worked example of a solved quadratic equation that contains errors and ask students to describe the algorithm used, locate the mistakes, and discuss potential corrections. The instructor could share a worked example as a PDF via *DropBox* (Dropbox, Inc., 2014; Android, iOS) or *Drive* (Google, Inc., 2013a; Android, iOS). Students individually could then use *Adobe Reader* (Adobe Inc., 2014; Android, iOS) to annotate where they believe the error is located and add comments to describe the error, discuss potential corrections, and create an appropriate algorithm for the problem. Afterwards, students could share their annotations and comments with peers before sharing with the instructor using *DropBox*, Google *Drive*, or *EverNote* (Evernote Inc., 2013, Android, iOS). Another way to use apps during guided practice is to refer to sample math videos such as *Khan Academy* (Khan, 2014) using an app like YouTube (YouTube Inc., 2014; Android, iOS). Many of these videos show examples of problems, but they do not explicitly share the algorithm used to solve the problem. Students could watch these videos in teams and practice creating algorithms that would work in different situations, document their algorithm choices and logic via a tweet, and verify with the teacher if their mathematical logic is accurate.

Transition

During the transition stage, the instructor facilitates students' efforts to create and use algorithms several times before giving feedback. For example, an instructor posts a quadratic equation on the board, solicits feedback from the students to determine the best algorithm to solve the problem, and asks for the reasoning behind their selection. Students can benefit by getting into pairs or groups to discuss their opinions and then share their answer in a survey created by Google *Forms* (Google, Inc., 2013b) or by sending their response using *Twitter* (Twitter Inc., 2014; Android, iOS). Both methods allow the instructor to present answers on a projector screen used for student—instructor discussion of their thought process and answers. An instructor could also see common confusions within the class, and a discussion could then take place based on these responses. In addition, to refine their algorithms used for solving quadratic equations, students could practice with problems generated by *Algebra Tutor* (Fulmer, 2012; Android) or *Algebra* (Yourteacher.com, 2013; iOS). If students answer practice problems incorrectly, they have an opportunity to refine their algorithm to fit these different scenarios. Students could also use *WebMath.com* to determine whether they applied their algorithm appropriately by checking their answers.

Independence

During this stage, the instructor provides students with opportunities to independently create and use algorithms. For example, an instructor might provide students with word problems involving parabolic motion without explaining how to solve them. Students then attempt to create and use algorithms that would work with word problems involving quadratic equations. Students could also collaborate during the independence stage using Google *Drive* (Google Inc., 2013a; Android, iOS); they can post questions about particular word problems that they do not understand and share information that could help in the creation and use of algorithms. Another helpful app during this stage of independence is the calculator app available

on all mobile devices. For example, to verify whether they used algorithms correctly to solve a quadratic equation, students could enter the equation into *Algeo Graphing Calculator* (Veges, 2013; Android) or *Desmos* (2012; iOS) and view the resulting graph to check their answers. To do more basic calculations, students could use *MyScriptCalculator* (Vision Objects, 2013; Android, iOS), which recognizes handwriting and provides simplified input for mathematical symbols such as square roots and exponents.

Conclusion

The AIT model does not require an instructor to cycle through each of the four stages. Rather, an instructor can select the appropriate stage to use depending on the content and the students' background knowledge. For example, instead of modeling, an instructor can begin a lesson with guided practice in error analysis if the students already know the basics of solving quadratic equations. Similarly, these recommended apps do not have to be used at a particular stage; their purpose could be adapted to fit different stages. For instance, *Evernote* (Evernote Inc., 2013; Android; iOS) could be useful at any stage, so that students can share their algorithms and collaborate with each other.

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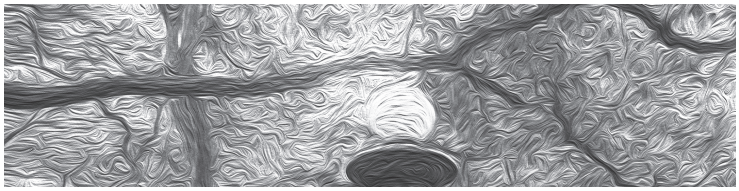

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