Chapter 23
The Integration of Inking, Touch and Flipping Within the Mathematics Middle School Classroom

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Abstract This article discusses the benefits of access to a stylus and Microsoft OneNote in teaching seventh-grade math to students at Cary Academy. While the research presented is based upon the experiences of one teacher in a single classroom environment over an eight-year period, the results of this preliminary exploration suggest that changes to the classroom format facilitated by these technologies produce a richer, and more efficient teaching and learning experience. This article explores advantages of inking for both the teacher and students, including the ability to create videos, resulting in videos tailored for this course to be used when flipping the classroom. With the release of Office 8.1, students and teachers are also using touch input, allowing a more enhanced educational experience. Surveys help to describe the student and adult experience. Microsoft OneNote videos capture the teacher using her resources, stylus input and OneNote with students.

23.1 Introduction

As an Instructional Technology Facilitator and seventh grade math teacher in a one-to-one laptop school, I have had the opportunity to explore both useful and ineffective technology in the classroom. Because of my primary role as a teacher, I am always looking for ways to be more efficient with my time, including the time it takes to teach content, as well as the time it takes to help my students learn effectively and cooperatively. The use of inking, touch, and flipping the classroom have become integral in my teaching not only because they create an efficient learning environment [5, 6], but also because these tools help keep my students engaged and allow me to evaluate that engagement.

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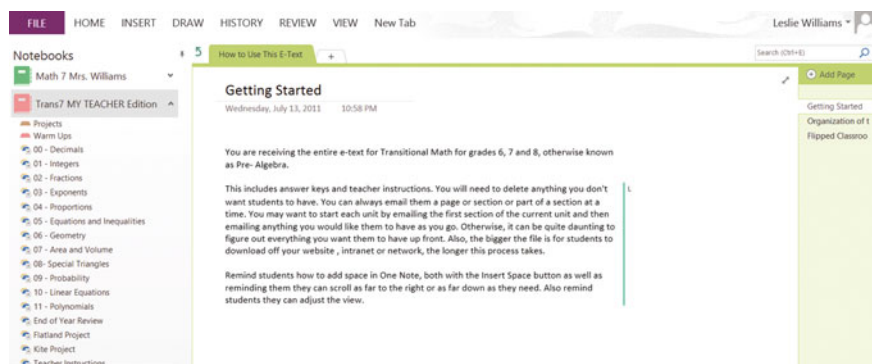Cary Academy, NC Cary, USA
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Fig. 23.1 OneNote digital format of converted textbook, notes, and practice activities

My students and I use these technologies daily for notes, video creations, collaboration, and to build organizational and study skills. In addition, we are now able to incorporate applets, apps and other programs into the teaching of mathematics. This changeover from desktop computers, textbooks and pencil and paper classrooms to tablet laptops and their concurrent technologies began when, as part of a 2008 grant, I converted a textbook to a digital format. Using OneNote [1], Smart Notes and other software, I replaced twelve weeks (one trimester for our school) worth of notes, practice, extra practice, and activities (Fig. 23.1). Videos [2, 3] show how the teachers at Cary Academy in Cary, North Carolina, seamlessly integrate OneNote into their classrooms to elevate the education of students through presentation, organization, and real-time collaboration with both students and other educators. Major benefits included the organization of all materials in one well-structured place that any instructor or student could easily use, and allowing students the tactile experience of writing in a versatile textbook.

23.2 Classroom Methods: Inking

Over the course of three summers, the electronic textbook and other resources were created, including one wiki for videos (Fig. 23.2) and one for discovery based activities (Fig. 23.3). The combination of these resources created new paths to explore pedagogy using inking and touch interface within the classroom. Inking was used throughout the e-text as I completed problems with verbal explanation while screencasting to create the videos.

Now, students use inking daily in my classroom and at home, taking notes and completing practice questions. They also create their own videos, capturing work through stylus and touch input. When screencasting, students must be able to write their steps and explain them, allowing opportunities for increased metacognition, as well as demonstration of mastery. They also collaborate with shared OneNote
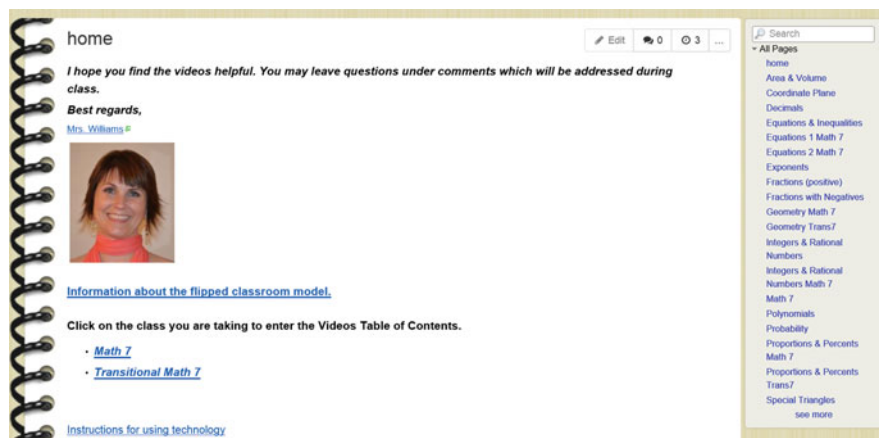
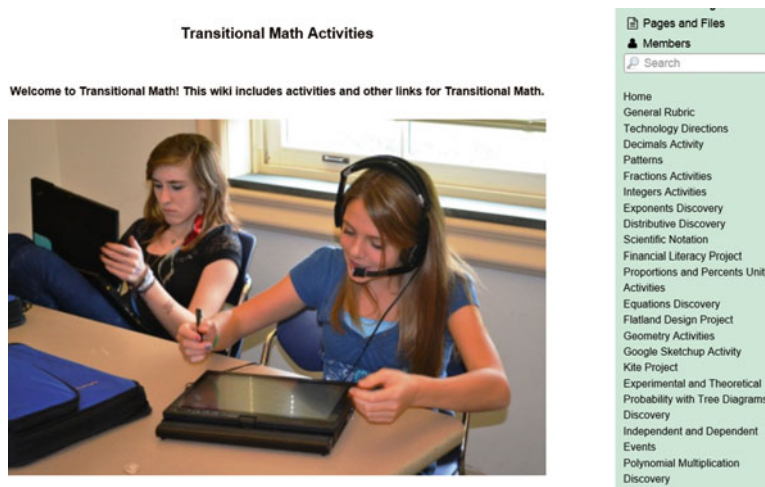**Fig. 23.2**   Wiki page for video resources

Fig. 23.3   Wiki page for discovery based activities

notebooks, using inking when writing symbols. Without inking, electronic devices would only be used for researching, typing papers, or using Microsoft programs and apps, which is a minor part of what we do in math. With inking, resources are now dynamic and are replacing more static learning modalities.

Most of our school community cannot imagine a world without stylus and touch technologies as part of their daily experience with computers. Cary Academy asked students and faculty, in a survey they took midway through the academic year, such questions as "How often do you use your stylus in the course of your studies?" and "How would you feel about giving up a touch screen?" hoping to gauge not only their comfort-level with using a stylus and touch screen, but also how important they find

these features in the learning environment. From 449 responses received, the results showed the success of the technological integration: 83 % use a stylus daily, 87 % want a stylus to be available, and 77 % want the touch interface to exist on their computers. These results mean not only that students and faculty have become familiar with the technologies, but that they would miss them if taken away—demonstrating they would find their learning environment depleted by their absence.

At this point, I was curious about our school's integration of these technologies into the classroom. Microsoft interviewed me, along with other faculty at our school, about our use of OneNote. They also videotaped my classroom, my e-text and the students' use of my e-text. Two of the videos they made are included at the end of this article [2, 3].

Now that we have a touch screen and Lenovo Yoga TabletPC, the students can turn their screen over completely, creating a tablet. This technological flexibility allows the use of inking and touch to complete almost all of their work in math. In other classes, inking is used extensively in subject areas that require a great deal of annotation and/or specific writing skills- such as the sciences and world languages (Mandarin Chinese, Pinyin). The touch capability integrates nicely with inking, so that, while working in tablet mode, students can use the virtual keyboard, stop and start videos, navigate the screen with touch, use swiping to adjust multiples windows, and interact with applets. Between touch and pen input, a computer that can be used as a tablet, and cloud computing, students truly have an all-in-one device, and we have replaced the need for other physical materials. Not only have we reduced the need for paper and other, more traditional learning materials, but also the combination of touch screen, inking, and the Lenovo Yoga TabletPC has prepared the way for exciting changes in how students learn as well.

23.3   Classroom Methods: Flipping

For example, I have used the flipped classroom model and other aspects of blended learning with these resources, along with traditional lecture-based teaching [4]. During the fall of 2011, I began using my videos to flip my classroom. I received some strong indications that home-based learning of these sections through watching videos that could be paused, rewound, and replayed offered at least some students a better absorption rate. My first year using the flipped classroom, students achieved the highest scores on assessments ever throughout the four units taught. Although test scores were higher, there were some unforeseen obstacles. Mainly, some of our parents were not ready for this approach, as flipping the classroom was new and the perception was that I was not teaching. So, over the next few years, I incorporated the videos in smaller increments as a way to be more efficient with time, allowing me to cover the material more thoroughly. I always use the flipped method at the beginning of the year for review, allowing students to work at their own pace when covering basic topics. Whenever the students take a quiz or test during class, I often assign a video for homework to introduce the next topic, in this way making the

best use of our time. Students can also learn my expectations around watching the videos: they must take notes and show all work; they also often work on a few problems that can be self-checked upon completion. As the year progresses, students become accustomed to using videos as part of class.

23.4   Results

This year, I used the flipped classroom for the first part of our equations unit, since equation answers are easy to self-check. Halfway through the unit, students took a survey about their experience. Some of the questions included a scale, such as, "On a scale of 1–5, rate how much you liked the flipped method of blended learning." I also asked open-ended questions. This combination of scaled and open-ended questions revealed the students' likes and dislikes, measurable against each other, as well as opening up discussion for topics I had not anticipated.

Although the evidence of better test scores indicated an increased absorption rate of the material when using the flipped classroom, the open-response feedback for flipping was mixed. Some students indicated that the absence of a live teacher could be challenging because they were unable to ask questions immediately. Other students found taking notes tedious, especially when they felt they had already mastered the concept. When students chose to use completed notes or watching the videos without taking notes, without notes or feedback, some students miss content. Students almost unanimously liked that they could rewind and pause the videos and use them as a reference.

For the scaled responses, out of 45 students, 28 (62 %) rated the flipped classroom with a 4 or 5 out of 5 (5 representing that they "loved" the method). 20 out of 45 (44 %) would like me to continue using it for the remainder of the unit. The year I utilized flipping the classroom for the first four units I had very similar feedback. Therefore, the scaled responses revealed that while some students responded well to the flipped classroom format, others seemed to prefer the more traditional teacher-led structure.

23.5   Summary

Overall, I have found a mixture of flipped and traditional pedagogies to be in my students' best interest. This mixture of teaching methods permits me to offer my students more freedom to pace their learning in ways that work best for them, while also adhering to traditional pedagogy to preserve the question-and-answer format with which students are most familiar. Also, my students are twelve and thirteen and still learning how to collaborate, work at their own pace, and learn without constant supervision. My goal is to help them develop effective strategies for the different types of learning to which they are exposed. This goal can be partly achieved by

becoming used to learning from videos on a student's own time, and collaborating with other students using all available technologies.

In my experience, the incorporation of inking and touch input has revolutionized both teaching and learning. At this point in my career, I cannot imagine my classroom without either of them.

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