The TI-Nspire CAS: A happy-medium mobile device for grades 8–16 mathematics classrooms

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The TI-Nspire CAS:

A happy-medium mobile device for grades 8-16 mathematics classrooms

By Jeremy Zelkowski

Abstract

This article justifies classifying the TI-Nspire CAS Touchpad as a mobile device for grades 8-16 mathematics classrooms equipped with a Navigator system. The 2010 Horizon Report: K-12 indicates virtually every secondary school aged child has some sort of mobile device. Yet, many school policies ban the use of mobile devices, preventing students from using these devices in an educational setting. Further, some teachers have been slow to adopt and use mobile devices to advance the educational setting of their classroom to a 21st century classroom. A classroom equipped with wireless Navigator technology and students equipped with Nspire handhelds presents an engaging 21st century mathematics classroom for all learners. These classrooms present a happy-medium wireless communication setup that prevents students from communicating with each other or browsing the web. Students can instantly communicate with the teacher and vice-verse. Students stay on task while using a mobile device.

Keywords: Mathematics, Mobile Device, Navigator, Preservice, TI-Nspire CAS, Wireless

The 2010 Horizon Report: K-12 indicates virtually every secondary school aged child has some sort of mobile device (Johnson, Smith, Levine, and Haywood, 2010). Yet, many school policies ban the use of mobile devices, preventing students from using these devices in an educational setting. Further, some teachers have been slow to adopt and use mobile devices to advance the educational setting of their classroom to a 21st century classroom. This article makes the case for the TI-Nspire CAS Touchpad as a mobile device in mathematics classrooms, equipped with a Navigator system, expunging the worry of two-way communication between students—a worry of many classroom teachers. This device offers mathematics teachers a classroom platform where teacher and student can communicate and present during class wirelessly via the TI-Nspire Navigator system. For about $40 more than the cost of the traditional graphing calculator (e.g. TI-84 Plus Silver, HP-50g), hundreds less than popular mobile devices (e.g. iPad, iPhone with monthly costs), and about a thousand less than laptop devices (e.g. PC tablets, iBooks), this device packages an exponentially larger capability for students and teachers in mathematics classrooms than the traditional graphing calculator. The TI-Nspire CAS Touchpad in the hand of secondary math students in a TI-Nspire Navigator equipped classroom presents a 21st century wireless classroom without teachers having to worry about two-way communication between students during class time or exams.

Introduction to the Nspire as Mobile Device

As the 21st century began, Clark Quinn (2000) defined mobile learning through hand-

held devices as *wireless, mobile, and in-your-pocket* learning. His definition was ahead of its time. He stated,

> The average mobile device will be a small handheld computer with a personally chosen suite of applications. My preference would be something with about an 800 x 600 color screen, a pen, a foldout keyboard (when necessary), fully networked, with a microphone and a speaker. It might be 3 x 5 inches when the keyboard is not extended, and would have a slot to plug in additional capability (for example, a camera). It would either have an advanced browser or a dedicated learning application as one of the software packages installed. (p.1)

His foresight sounds a lot like the iPhone, but he predicted this seven years earlier. Yet, the idea of using such a device in the high school classroom requires a different idea of wireless, mobile, and in-your-pocket.

In the age of high stakes assessment and accountability, classroom teachers have clear concerns about students being distracted or communicating outside the realm of classroom material. The worry about mobile devices that work almost anywhere in the United States, including classrooms, is understandable. However, the notion to rule out wireless, mobile, and in-your-pocket type devices for the mathematics classroom must be questioned. The TI-Nspire CAS Touchpad offers a *wireless, mobile, and in-your-backpack* type device for the 8-16 mathematics classroom.

TI-Nspire CAS Touchpad

Texas Instruments' TI-Nspire CAS with Clickpad has been around about three years. Through many operating system updates, recommendations by teachers-researchers-professionals, and feedback from students, the new TI-Nspire CAS Touchpad offers students the latest handheld technology for use in 8-16 grades mathematics classrooms, possibly middle grades as well, some may argue. The TI-Nspire CAS Touchpad is about twice the thickness of the iPhone, has a little less than twice the lateral surface area, and has virtually an identical sized display screen (see Figure 1). While the TI-Nspire CAS Touchpad is larger than a typical in-your-pocket cell phone with lesser quality graphics, this *in-your-backpack* sized device packs mathematical capabilities unlike any other wireless mobile device on the market. These capabilities open the door for teachers to expand mathematics learning in the 8-16 classroom exponentially with wireless communication restricted to the classroom between teacher and student only with a Navigator equipped classroom (see Figure 2). For a short online video introduction, see http://www.education.ti.com/html/navigator/nspire2navigator_animation.html.

Figure 1. The TI-Nspire CAS Touchpad.

The TI-Nspire CAS Touchpad encompasses all the graphing and computational abilities of the more common TI-83 and TI-84 graphing calculators but adds these functionalities:

- A computer algebra system (CAS) provides the ability to perform both symbolic and numeric operations that display in mathematical type-print.
- A spreadsheet capability performs not only numeric calculations similar to what Excel can do, but adds the ability to perform symbolic operations algebraically.
- A dynamic geometry tool similar to Geometer's Sketchpad or Geogebra gives students the ability to dynamically manipulate geometric constructions using the Touchpad navigation pad similar to a laptop touchpad.
- A graphing window adds dynamic manip-

ulation capabilities for transforming functions
- A statistical data analysis tool provides many options for collecting data (manually entering or live data collection with different sensors), analyzing data, and answering tough data driven problems
- A Press-to-Test mode, with LED indicator, offers teachers the capability to restrict some of the functionality of the device during exams or quizzes (see http://education.ti.com/sites/US/downloads/pdf/press_to_test_guide.pdf for details)
- A file-based operating system allows students to save files and lessons for future reference (file access can be blocked with Press-to-Test mode), including notes
- Each file provides the ability to have multiple applications and pages (like multiple internet pages in web browser tabs) working where functions and variables are linked within each of a problem's pages
- Multiple problems can be active within each file providing the opportunity to explore more than a single type of problem
- Alpha numeric keys provide a platform for a notes or instructions page within a problem or file

"This device offers mathematics teachers a classroom platform where teacher and student can communicate and present during class wirelessly…"

- The wireless add-on (TI-Nspire Navigator System, see figure 2) provides the capability for teachers to (a) instantly assess through quick polls, (b) have live student presentations from their seat to a projector, (c) distribute and collect working lesson files from students with assessment questions in many formats, (d) increase student attentiveness and engagement, and (e) instantaneously score, save, and record student data

Teacher Concerns

There are capabilities and features within the TI-Nspire CAS Touchpad unobtainable with any other mobile device on the market today. However, much of the apprehensions to mobile devices in the classroom stem from students' ability to communicate with each other through email, text or photo messaging, or browsing the web. This mobile device alleviates all of these concerns. Classrooms equipped with the wireless navigator system allow teachers to instantly monitor, collect and assess, or present students' live feed from their handhelds with the Navigator. Students can communicate with the teacher's computer and display using the classroom projector. Yet, students cannot communicate with each other, thus keeping students on task since they do not have the ability to text, email, or browse the web. They are wirelessly limited to communicate within the classroom and with the teacher only.

Figure 2. The wireless Navigator system.

Challenges and Resistance to CAS Adoption

Currently, there are four reasons hypothesized (though realistic) as to why there is resistance levels to adopting this device in all 8-16 mathematics classrooms across the United States. First, the cost of the TI-Nspire CAS Touchpad is just under $150. It is not completely realistic to expect every single late middle-grades or ninth grader to purchase one if not all of the teachers within their school system embrace the device. However, the cost is only about $20 above the more typically used handheld graphing technology like the TI-84 Plus Silver. The additional cost is minimal if students were to use this device through their high school math classes and even their college mathematics classes. Schools in lower socioeconomic status (SES) communities can purchase classroom sets (in bright yellow plastic) at discounted rates to provide less fortunate students the ability to learn from devices easily obtainable in higher SES community schools.

Second, teachers have to rethink how they assess student learning when the CAS capability is in the hands of their students. This fact

requires non-users to learn a new device and assessment techniques through professional development. It can be costly for an entire school's mathematics faculty to receive such training if teachers do not do it on their own. Teachers now have to increase their own knowledge and ability as a teacher in the 21st century. Resistance to change is easily witnessed in routinely traditional math classrooms where low-level cognitive tasking (see Stein, Smith, Henningsen, and Silver, 2000) exists almost exclusively. Teachers are forced into high-level cognitive thinking and assessment tasks in the CAS environment.

Third, many 8-16 mathematics teachers with ten-plus years of teaching experience most likely experienced their own high school and possibly college mathematics studies without the use of advanced technology. Many current high school and college math classrooms do not use of newer technologies. It is hard for educators with many years of experience in learning and teaching mathematics without technology to "flip a switch" and change their approach within their own classrooms. Without a firm foundation in teaching with technology, many educators can view a TI-Nspire CAS Touchpad classroom as an *easy way out* for students in today's world because this type of classroom requires teachers to rethink and re-plan most or all of their lessons they have been using for years. A major shift in pedagogy is required for such an adoption.

"Classrooms equipped with the wireless navigator system allow teachers to instantly monitor, collect and assess, or present students' live feed from their handhelds with the Navigator."

Last, standardized tests pit resistance to CAS adoption. At the time of this article submission (see Table 1 for exam descriptions), the ACT college entrance test and IB exams did not permit the CAS version of the Nspire. ACT and IB do permit the non-CAS version of the Nspire (see

Summary of National Exams and Permitted Technology

Exam	Acronym	Technology Permitted on Math Component
Scholastic Aptitude Test	SAT	CAS technology (e.g. TI-Nspire CAS)
ACT (formerly American College Testing program)	ACT	Non-CAS technology (e.g. TI-Nspire)
Preliminary SAT/National Merit Scholarship Qualifying Test	PSAT/NMSQT	CAS technology
Advanced Placement calculus exams	AP AB&BC	CAS on technology portion of exams
Praxis exams	Praxis	CAS technology
International Baccalaureate exams	IB	Non-CAS technology

Note: Information obtained through primary website for testing authorities listed.

Table 1. Summary of National Exams and Permitted Technology

http://education.ti.com/educationportal/sites/US/productDetail/us_nspire.html) that only takes away the *symbolic manipulation and computation* capability from CAS users. All of the other national standardized exams permit the CAS version of the Nspire.

Addressing Concerns & Challenges

It is unrealistic to expect many or all of the experienced mathematics teachers in grades 8-16 to adopt the use of the TI-Nspire CAS Touchpad universally. However, immersing preservice teachers (PSTs) in this technology can result in adoption and classroom practice

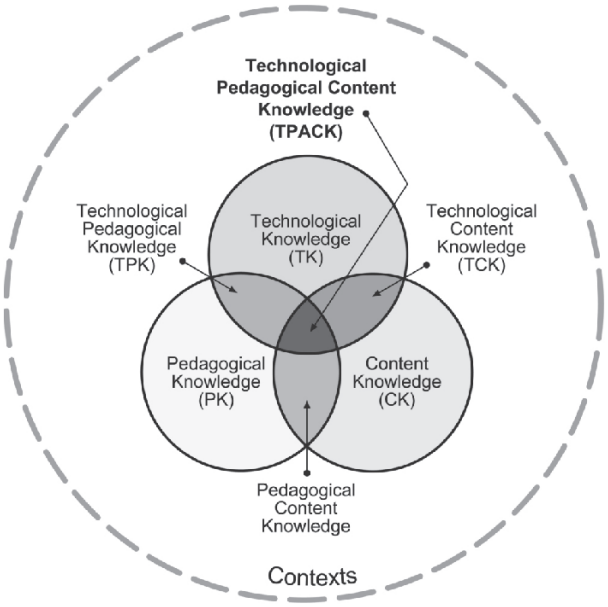

Figure 3. Venn diagram and visual representation of TPACK framework.

(Zelkowski, 2011). Mishra and Koehler (2006) theorized the knowledge domain of technological pedagogical content knowledge (TPACK) based on Shulman's (1986) work introducing the knowledge domain of pedagogical content knowledge (PCK). The domains of knowledge for teachers of mathematics are interrelated and interconnected (see Figure 3). Theoretically, TPACK is a domain of knowledge for teaching secondary mathematics that intersects the knowledge domains of technology (T), pedagogy (P), and content (C).

Educating teachers to use technology effectively to advance student learning is difficult and requires rigorous and continual development (Merfendoller, 1994; Waits & Demana, 2000). Moreover, it has been demonstrated that it takes about three to five years of working with technology to become comfortable enough to use it regularly (Dwyer, Ringstaff, & Sandholtz, 1991; Means & Olson, 1994)—yet this research is from a time when technologies for teaching secondary mathematics were still developing early versions of the handheld graphing calculator. By immersing secondary mathematics PSTs into an environment advancing their TPACK through more than a year of TI-Nspire CAS use, concerns and challenges are being addressed.

Through the Texas Instruments preservice teacher discount purchase program, PSTs can obtain a handheld TI-Nspire CAS Touchpad and Teacher Edition (teacher bundle) computer software for the cost of the handheld alone—a $100 savings. The teacher edition software gives PSTs the capability to emulate the handheld on a computer (see figure 4). The computer software makes the creation of lessons, assessment items, notes pages, and classroom display seamless and easy. PSTs begin using the teacher bundle in a mathematics education technology course more than a year before their student teaching semester.

By giving PSTs more than a year of experience using the advanced technology in a mathematically latent environment, some PSTs have begun to see the *essential need for technology* (see NCTM, 2000), such as the Nspire, for creating an engaging 21st century secondary mathematics classroom.

The practice to equip PSTs with this mobile device early in the teacher education program aims to combat inservice teacher resistance to adopt. Equipping PSTs early and immersing them in a mathematically intense environment where they build their TPACK knowledge domain seen in Figure 3, theoretically breaks resistances that inservice teachers may possess. PSTs learn how to use the device early, often, and effectively, so they do not need extensive professional development as an inservice teacher during their first years of teaching. They own the device. They can use the teacher edition software in classrooms. They can work with cooperating/mentoring teachers during their clinical experiences. They can be advocates for the technology in their first school of employment. They can be leaders early in their careers.

Promising Results

During the newly revised teacher education program, PSTs complete nine semester hours of secondary mathematics education coursework in three consecutive courses (see figure 5 on the following page). Presenting ad-

vanced technology up front in course-1, allows extensive opportunities to learn, use, refine, implement, and assess classroom practice. One cohort of PSTs has completed the program's final two years of coursework and a second cohort has finished the first year of coursework. There have been a number of promising findings. Some graduating PSTs have voluntarily enrolled themselves in summer professional development workshops focusing on using the TI-Nspire CAS for teaching algebra-1 and geometry before they begin their first year of teaching. Some graduating PSTs and some current PSTs have implemented lessons in the classroom using this technology.

Follow-up interviews and casual conversations with PSTs have yielded qualitative research findings indicating some positive growth in TPACK and beliefs about using this technology to teach secondary mathematics. As one PST put it, "I will feel like I'm not an effective teacher if I don't have this [technology] stuff in my classroom." Another PST confessed, "Schools that have more technology [to teach with] will be a school I think is better to teach at. I think I understand why poor schools don't do well. They don't have as much technology."

Future Work

The availability of the Nspire Navigator wireless system only became available to the general public during the 2009-2010 academic school year. However, there were some beta-versions and pilot-testing prior to that. Beginning with a new cohort of secondary mathematics PSTs in the fall of 2010, the Nspire Navigator will be a large part of the technology course. The summer of 2010 sees the development of many classroom lessons for use with this technology. Plans exist for program faculty to pilot lessons in local 9-12 classrooms where PSTs would have the opportunity to use the Nspire technology.

"By readily immersing the latest emerging technologies into pre-service teacher education programs, we can produce a new generation of teachers who will advocate for new technologies…"

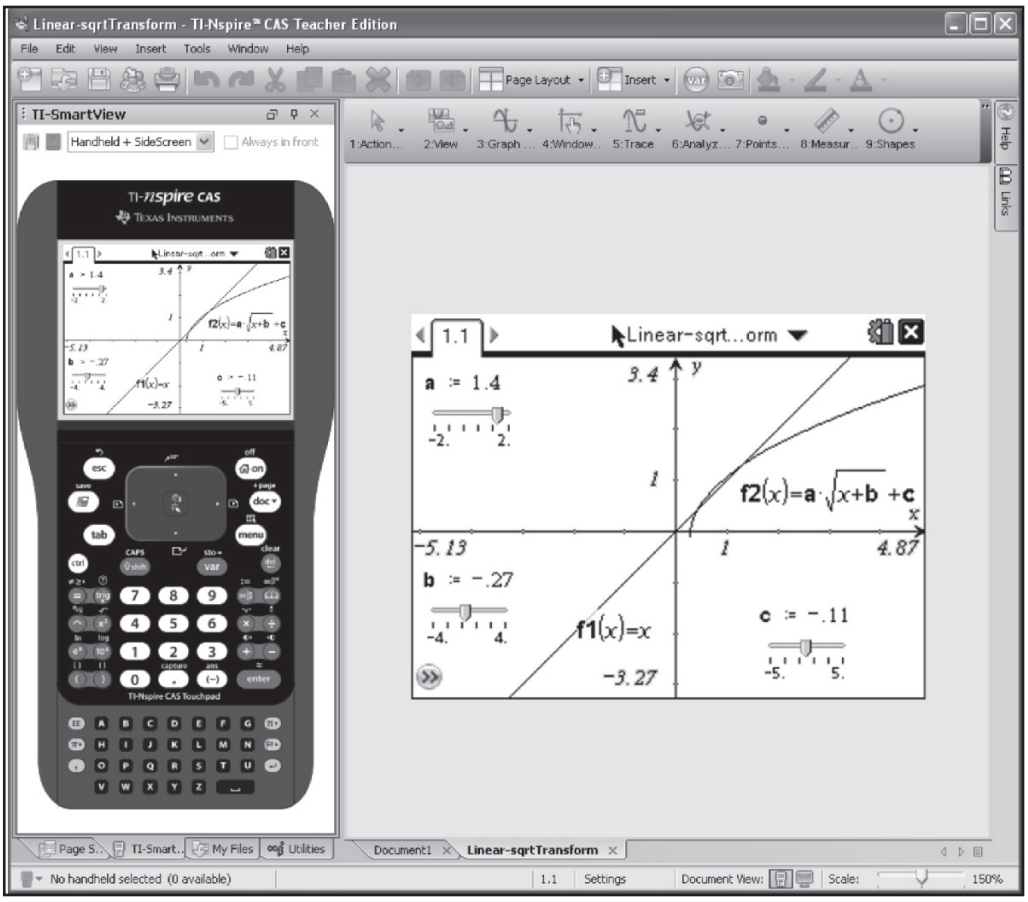

Figure 4. Screen shot of the TI-Nspire CAS Teacher Edition software.

As teacher educators, we must rethink how we prepare PSTs to be capable and ready to embrace new and emerging technologies into their initial years of teaching. By readily immersing the latest emerging technologies into PST education programs, we can produce a new generation of teachers who will advocate for new technologies (Zelkowski, 2011; Meagher, Ozgun-Koca, & Edwards, 2008). Technology has proven to engage more students and produce higher achievement (Center for Technology in Learning, 2008; O'Mahoney, Baer, & Quynn, 2008; Owens et al, 2008) in a time when schools are the scapegoats

Figure 5. Coursework outline

for many of the nation's educational deficiencies and lack of extensive use of technology (NCES, 2010).

The Nspire as a Mobile Device

The Nspire with a Navigator equipped classroom may not fit the general public's definition of a mobile device (e.g. iPhone, laptops, netbooks). Yet, this device offers 8-16 mathematics classrooms the ability to communicate wirelessly in the classroom with the teacher, students can present their thinking instantaneously, students can send and receive files with the teacher, and students can quickly store the mobile device in their backpack with room to spare!

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MI-aect

Upcoming Events

March 9 - Panel Discussion - "Are you socially network savvy?" MI-aect wants to make sure your social networks skills are up to par. Join a panel of social networking gurus from business, health care, higher education, and K-12 as they discuss how social networking has impacted their work. They will provide advice on integrating social networking into your profession.

April 13 - MI-aect members share their cutting-edge research. Not only is this event for the members, it's run by the members. Here is an opportunity to showcase your hard work and interests. It's a great venue to see what others are doing, and find ways to collaborate or assist other members. Contact us if you are interested in presenting your research.

May 11 - Celebrate the accomplishments of the Chapter and it's members by attending an end of the year dinner and strolling auction.

** For more information on upcoming events please contact Kelly Unger at kellyunger@wayne.edu **

What is MI-aect?

MI-aect is the state chapter of the Association for Educational Communications and Technology. A state association for students, academics and future academics, and professionals who are interested in researching and improving instructional design and education practice through all forms of technology.

Who should join MI-aect?

- Instructional designers or educators/ trainers in business or academe
- Future or current academics in instructional design and technology or education
- Educators interested in applying technology to improve teaching and learning

What can MI-aect do for you?

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- Collaborate with other professionals on instructional design and educational technology research and practice
- Become part of the technology movement in education and business

Upcoming Events

March 9 - Panel Discussion - Are you socially network savvy?
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January 12 - Ring in the New Year with fellow members
December 15 - aect Conference Presentation Writing Workshop
December 8 - End of the year celebration
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