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Implementation of a One-to-One iPod Touch Program in a Middle School

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Abstract

The purpose of this study is to investigate the implementation of a whole school one-to-one iPod Touch project in a middle school in the southeastern United States. While some focused studies have been undertaken in this new field of learning, there has been little research to date that documents activity within a whole school implementation (Chen, Kao, & Sheu, 2003; Conti-Ramsden, Durkin, & Simkin, 2010). Using Rogers' (1963, 2003) theory of diffusion of innovation as a lens for this research, we gathered data from observations, focus groups, and interviews. Our findings indicated that teachers focused on internet-based research activities, formative assessment, innovative practices, and remediation, but they often had difficulty finding appropriate applications. Teachers and students were both positive and critical regarding efficacy of this device in middle schools.

The purpose of this study was to investigate the initial phase of the implementation of a one-to-one iPod Touch project in a middle school in southeastern United States. Studies of projects, which utilize mobile devices in schools, have shown the tremendous potential these tools have for teaching and learning (Chen, Kao, & Sheu, 2003; Conti-Ramsden, Durkin, & Simkin, 2010; Keengwe, Pearson, & Smart, 2009). However, there is little research to date that focuses on activity within a whole school implementation or provides in-depth qualitative data that creates a complete picture of how teachers and students are integrating these tools into their daily instructional practices and routines. The goal of this case study was to observe classroom practice closely, conduct multiple focus groups with students and teachers, and interview administrators to develop a more complete picture of the use of mobile devices in a middle school.

Three research questions guided the study and reflected its broad investigative goals:
1) How are students using iPod Touches in the curriculum?
2) How are teachers integrating iPod Touches in the curriculum? What applications, procedures, and activities are utilized?
3) What were the successes and challenges faced by teachers and students as they used the iPod Touch as part of everyday schooling?

Background

Mobile Learning, or mLearning, refers to any device that can be used on the move (Geddes, 2004; Sharples, Taylor, & Vavoula, 2007). These technologies include, but are not limited to, the iPod Touches, iPads, mobile phones, and laptops. The affordances of mLearning are unique in that these transportable, convenient devices provide a new method of teaching and learning (Matthee & Liebenberg, 2007; Sharma & Kitchens, 2004; Kammas, 2009; Kearsley, 2000). Used to their full potential, technology-based tools can allow students to become critical users and thinkers (ISTE, 2000; Johanssen & Yueh, 2008; Jeong, 2003). While mLearning can provide positive learning opportunities through the seamless learning that handheld computing provides (Sharples, 2003; Waycott, Jones, & Scanlon, 2005), some studies found that mobile technologies can also be a focus of disruption in schools (Perry, 2003; Mifsud, 2003), particularly when teachers need more professional support in the effective integration of technology into their classroom teaching (Culp, Tally, Ba, & Nudell, 2005; Dede, 2008; Jonassen, Peck, & Wilson, 1999; Cuban, 2000). These findings are especially true for the effective implementation of new devices (O'Bannon & Puckett, 2007).

For this study we were able to observe classrooms and conduct focus groups with both teachers and students. The data we gathered revealed insights into the integration of mobile devices into existing curriculum and illustrated the opportunities and challenges of innovation in schools. To adequately frame the qualitative data that was collected for this study we reviewed literature on current implementation of mobile devices in classrooms. In addition, the one-to-one implementation in this school required understanding the nature of innovation in schools; therefore diffusion of innovation theoretical frameworks (Rogers, 1963, 2003) were also incorporated.

Mobile Learning

Rigorous studies of mobile learning are still in the pilot and/or trial phase, and explorations of wider institutional issues are still developing (Traxler, 2005; JISC, 2005). However, several studies identify the opportunities that these devices provide as well as the potential hurdles related to schools' infrastructure and support (McFarlane, Triggs, & Yee, 2008). Studies have shown a variety of learning opportunities with the use of handheld devices: they can deliver quizzes and courseware and serve as an intelligent tutoring system (Kazi, 2005); provide computer supported collaborative learning (Lui et al., 2010); collect data during authentic learning for outdoor and indoor instruction supporting critical thinking skills (Chang, Chen, & Hsu, 2011); and allow teachers and students to simultaneously view and share files (Kennedy, Judd, Churchward, & Gray, 2008).

Although these studies identify the support these devices can provide, schools wishing to replace PCs or laptops with smaller handheld devices may find that they do not have equivalent functionality. However, these devices are evolving quickly as more software applications are produced and more hardware features are integrated. For the moment, the affordability of these handheld devices means that the technology is within the reach of students who could not afford other forms of computing. In schools, the availability of handhelds can potentially reduce demands on computer labs by providing anywhere, anytime access to the Internet, while additional reference materials such as e-books and simulations can be installed onto the handhelds, allowing for independent learning (Crompton, Goodhand, & Wells, 2011; Ng & Nicholas, 2009)

The availability and accessibility of the iPod Touch can provide opportunities for meaningful use to support teaching and learning, but it also calls for a fundamental shift in pedagogical practice. The pedagogy associated with the technology also requires substantial change from current approaches to education since "a world in which children own powerful multimedia communicators and where they practice new skills of online file sharing and informal text communication does not fit easily with traditional classroom schooling" (Sharples, Taylor, & Vavoula, 2006, p. 21).

In two recent studies of mLearning classroom implementations, several important findings describe how these devices are currently being used and illustrate some of the challenges associated with their integration into curriculum. Franklin and Peng (2008) developed a case study in which the iPod Touch was used to help middle school students learn about algebraic equations, specifically focused on concepts such as slope, absolute value, and elimination. Building on the effective use of podcasting (Borja, 2005; Warlick, 2006), teachers and students developed math movies for use on the iPod Touch. Researchers found that students reported deeper understanding of mathematical concepts and had increased opportunity to access mathematics instruction beyond the hours of the school day. Teachers reported that the process of creating the lesson plans and videos gave them new perspectives on the content and pedagogical strategies to teach difficult algebraic concepts.

Ng and Nicholas (2009) tracked the introduction of pocket PCs into three primary and two secondary schools (four of these schools were described as serving low socio-economic communities), from purchase of the devices to preparation and planning for classroom teaching to six to seven months of actual integration into classes. The focus of the study was on how attitudes and beliefs evolved over the months of usage in the classes and what shaped these attitudes and beliefs. Overall, the primary schools (ages 5-11) were more successful in their implementation. The researchers found that while the primary and secondary teachers both believed in the motivational aspect encouraging student engagement, primary teachers had mixed feelings toward the full efficacy of the devices while the secondary teachers were uncertain about how useful they would be. Varied and substantive use across the curriculum was reported in focus groups, interviews, and in observations in primary classrooms, while the secondary teachers were more resistant to use and faced more technical challenges. Primary level teachers used them in mathematics to develop numeracy and graphing, but secondary teachers reported no integration with more advanced mathematics. The primary teachers reported increased engagement and found that students with low levels of literacy benefitted the most from the use of their pocket PCs. These findings in some areas corresponded to the evidence reported below: notably, resistance to use in mathematics beyond simple numeracy activities. The majority of studies have taken place on a relatively small scale, usually involving small groups or a classroom. In a recent study, Wan and Howard (2009) described how few studies have tracked classroom adoption of handheld computer from their introduction into that environment to the actual implementation. We wanted to take this one step further and research a whole school implementation of mobile devices in one of the first middle schools in America to adopt a one-to-one iPod Touch program.

Diffusion of Innovation

Due to the unique nature of a project that provided each student and teacher with an iPod Touch, Rogers' (1963, 2003) diffusion of innovation theory provided a useful lens to understand the successes and barriers of this implementation. There have been a number of theoretical

models on the diffusion of innovations within the field of technology (Dooley, 1999; Hall, Wallace, & Dossett, 1973; Rogers, 1963, 2003). Rogers' (1963, 2003) model is the most commonly cited; his theoretical framework has been used to explain and predict factors that hinder or support the dispersion of technologies, and has been incorporated into other educational technology studies for this purpose (Berger, 2005; Kebritchi, 2010; Martins, Steil, & Todesco, 2004).

Rogers (2003) posited four elements to the diffusion of innovations: innovation, communication channels, time, and social system. The innovation element relates to a practice, idea, or object perceived as new to that individual. Sahin (2006) noted that throughout the description of the theory, Rogers often talked about technology and even used the words innovation and technology interchangeably. Another element that runs throughout Rogers' model is that of communication; this includes mass media and personal communication. Time is an element and Rogers even labels users to describe the rate in which they adopt the innovation. These labels are *innovators, early adopters, early majority, late majority* and *laggards.*

- *Innovators* are risk takers who have often had prior experience with the technologies.
- *Early Adopters* are those who respect the opinions of role models and leaders in their systems (e.g. schools). They are willing to use the technologies and will also encourage and support others to do so.
- *Early Majority Adopters* are often willing to adopt a technology but prefer to see others using it first.
- *Late Majority Adopters* will adopt under pressure, but are skeptical about the technology until it is in commonplace usage.
- *Laggards* are usually the last group to adopt if they ever choose to do so. This group is often critical of change and often in opposition to leadership, in particular "*Change Agents.*"

Change Agents are those who those who are responsible for facilitating (e.g. coordinating or directing) the change initiative.

Rogers' (2003) innovation decision process involves five distinct steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. These steps are chronologically sequenced. This process can be seen in Figure 1.
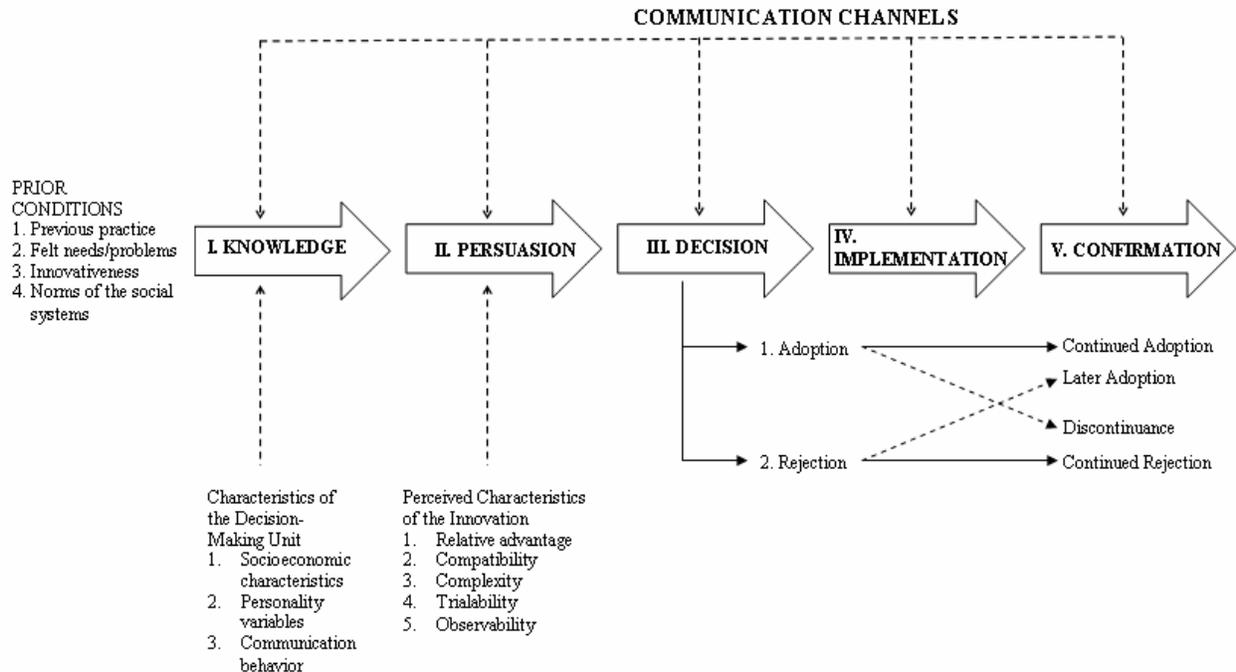

Figure 1. A Model of Five Stages in the Innovation-Decision Process (Source: *Diffusion of Innovations, Fifth Edition* by Everett M. Rogers.)

As the individual or organization begins the five steps, decisions are influenced by prior conditions, including previous practice, felt needs/problems, innovativeness, and norms of the social system. The knowledge stage is the first stage in the innovation decision process. This is when a number of questions are asked, and according to Rogers (2003), the answers will provide three types of knowledge: (1) awareness-knowledge, (2) how-to-knowledge, and (3) principles-knowledge. The awareness-knowledge provides information on the existence of the innovation. The how-to-knowledge is literally how to use the innovation; Rogers described this as an essential variable in the process. The principles-knowledge describes how and why that innovation works. An innovation can be adopted without this piece, but the adoption will often be ephemeral. The characteristics of this stage include socioeconomic characteristics, personality variables, and communication behavior.

The persuasion stage is when the innovation is perceived with a negative or positive attitude. Affect is central to this stage, with opinions and beliefs being formed through social reinforcement from outside expert opinions or close peer subjective evaluations. The decision stage is where the choice is made to adopt or reject an innovation.

During the implementation stage, the innovation is practiced. There can be uncertainty in regards to what is expected of the innovation. Reinvention often happens during this stage of the model; this is where the innovation is changed or modified to better fit the needs of the users. The final stage is where a decision confirmation is sought from other individuals. This can cause

the users to ignore opposing views, and seek confirmation from those who agree with their decision. Alternatively, comments can cause later adoption, or discontinuance to fit with a different opinion. Rogers' (2003) diffusion of innovations theory provided a general lens with which to explore the administrators, teachers, and students' attitudes and implementation of the iPod Touch in the school environment.

Methodology

The participants in this study belonged to a middle school that implemented a one-to-one iPod Touch program in January 2010. This project represents one of the first one-to-one school wide implementations both nationally and internationally. To capture the unique experience in the first phase of implementation, researchers conducted weekly classroom observations and six focus groups with teachers and students. IRB approved the study before it began.

The School

The school is located in the southeastern United States. It has approximately 580 students and 55 teachers. Demographic data show 21% of the students are eligible for free or reduced lunch and the students are 67% white, 19% black, 8% Hispanic, 6% Asian/Pacific Islander, and 1% American Indian/Alaskan Native. The school met AYP (Adequate Yearly Progress) goals in many areas, but was struggling to meet the needs of black students who did not meet proficiency goals.

Participants

There were 350 participants in this study: nine core teachers (science, math, language arts, and social studies) and approximately 115 students each in sixth through eighth grades. Teachers were selected to provide a sample that included active and resistant users of mobile devices. The principal was primarily responsible for this selection, making decisions from regular classroom observations and teacher evaluations. A sample of 21 students (seven 6th graders, six 7th graders, and eight 8th graders) volunteered and then were asked to participate in focus groups by their teachers. The student participants represented a diverse range of students racially and socio-economically. However, the focus groups participants were either self-selected or were actively recruited by their classroom teachers. Future research will require a broad sampling strategy to include more diverse students in focus groups and interviews, particularly those who struggle academically. To participate in the study, the teachers had to sign consent forms for the classroom observations and the interviews. The school district had a blanket policy for general observations, which did not focus on individual students, which met the requirements for this study. Assent forms and parental consent forms were signed for students included in the focus groups.

Procedure

Researchers conducted 15 classrooms observations across a range of subject areas over a four-month period in order to capture a diverse sample of subject areas, curriculum, and iPod Touch use. Table 1 provides a breakdown of the grade, subject, and number of observations. Upon completion of the observations, focus groups were conducted with nine teachers (three per group) across grades 6, 7, and 8, and 18 students in homogenous grade level clusters of six students per focus group. The focus groups were audio recorded to ensure accurate accounting.

Table 1

Classroom Observations

Grade	Subject	Number of observations
6	Math	3
6	Science	3
6	Social Studies	1
7	Math	1
7	Science	1
7	Social Studies	1
8	Math	2
8	Science	1
8	Social Studies	2

Data Sources

Observations

 The researchers acted as both non-participant and participant observers to adapt to the situation in order to become subjectively and objectively involved in the setting (Creswell, 2008). The data collection for the observations and analysis was an inductive process, although a basic observation protocol was used to collect information such as the layout of the room, subject area, and number of students in the class (Appendix A). The extensive notes from the observations were open coded to identify an initial coding scheme. At a later stage axial codes were defined to provide a more precise coding structure. In addition, the Innovation Diffusion theoretical framework provided thematic areas that were utilized to code and broadly understand observation data.

Focus Groups: Teachers and Students

 Specific questions were initially provided to the focus group participants (Appendix B & Appendix C) and then probing questions were used to follow up on themes that emerged. The focus groups were recorded and fully transcribed by the research team. Initial coding schemes were developed based on current literature on mLearning that aligned with our broad research questions, which focused on understanding how these devices were deployed in the classroom.

 The data was coded separately for the observations, which the focus groups then reviewed collectively to find themes across data sources. The data was triangulated through a process of inter-rater reliability and data sourced for accuracy and credibility (Creswell, 2008). Qualitative software, MaxQDA, was utilized to code and analyze data using themes outlined in Diffusion of Innovation theory (Rogers, 2003) and guided by the three broad research questions.

Findings

 The research was undertaken during the spring of 2010, three months after students had been given their iPod Touches. This period can be characterized as the Implementation Stage (Rogers, 2003). Teachers and students were practicing the innovation of employing a mobile device in their classroom; whether teachers were *reinventing* use to tailor to their own particular classroom use was based on their curriculum, their views related to its relevance, and their knowledge of specific applications. Teachers were categorized using Rogers' adoption categories, both by observations and self-reports collected in the focus groups. We are defining

adoption as participants who have made the decision to use the innovation. This includes the mental process, which an individual takes from first hearing about the device to actual adoption (Rogers, 2003). Of the nine teachers observed, four teachers used iPod Touches often in their classroom practice; they were categorized as early adopters using Rogers' adopter categories. Two teachers were categorized as early majority, and three were resistant to their use in the classroom and were defined as laggards. The principal and the assistant principal were categorized as "change agents."

The Change Agents
        Both the principal and the assistant principal promoted the use of the iPod Touch through a specific policy that allowed students to carry and use the device in classes, under the instruction of the class teacher. During the school-wide grade level meetings, teachers were instructed to spend time in sharing best practices in the use of the device, and support group membership in pedagogical practices around the use of the iPod Touch. The role of change agent was further enforced through "classroom walk through," a practice in which the principal enters into classrooms unannounced to collect general data, including the pedagogical practice implemented by the teacher during the spot check. While the principal and assistant principal were change agents in the school, several students had negative opinions about the leadership style of the principal, who they believed was overly harsh and punitive. They felt that this caused a lot of tension at the school, which influenced how the project was perceived. In particular, they felt that there was a new level of intrusiveness and surveillance. For example, one student said:

> But like I actually got in trouble for trying to go on Facebook. Like we were just watching a movie in math. And so like I didn't know that Mobi-clip (surveillance program) had a restriction on it because nobody had told us about it or anything. And so I just thought it was another Internet source or something. And I went on there and then I got called up to the office the next day. And you know, like their punishments for that are kind of serious. I mean they like, I lost my iTouch for I think a week. And then, you know, I was watching my tail because I know that [principal]; she had her eye on everybody who got in trouble.

Early Adopters and Early Majority Adopters
        Observations, interviews, and focus groups transcripts were coded for classroom use using general categories to allow themes to emerge. Three areas of classroom iPod Touch usage were revealed: to access the Internet for research, to assess formatively, and to remediate. These themes were observed in the classrooms taught by Early Adopters and Early Majority Adopters.

        A computer in your pocket. Overall, both teachers and students reported using the iPod Touch to access the Internet for research on projects or to access content area websites. This represents an important affordance of the "computer in your pocket," relieving the difficulties teachers and students face when trying to use the laptop cart (which can be time consuming and can cause multiple technical problems for teachers) and/or accessing computer labs that are over-scheduled. However, the interface of the iPod Touch made many Internet sites difficult to navigate. For example, one teacher reported, "They have to move back and forth, scroll up and down and enlarge to be able to see an entire answer."

Formative assessment. The teacher that was most enthusiastic about the use of the device for instruction and assessment incorporated the iPod Touch every day in his teaching. The lesson warm up was a formative assessment of prior concepts. This teacher immediately calculated and reported the classroom data using his computer and projection. He presented this information to the students so they could see the concepts that were understood, and where more support may have been needed. Prior to the introduction of the iPod Touches the teacher admitted that he was never able to make good use of the data because of time constraints that prevented data entry and analysis, so it just sat on his desk. As he said:

> I set this up on Google Docs, the kids come in and it takes 10 minutes, and that's the main thing I do with them (iPod Touches) and it has been a huge success for me. Before I would just do paper and pencil and had a hard time keeping up with it.

Remediation. Several early adopters and early majority adopters employed the iPod Touch for remediation. For example, the 6th grade math teacher would have struggling students use math games applications that gave them more practice on particular concepts. These students also accessed state-based software systems that are designed to take them through self-paced exercise in content areas they struggled with. The use for remediation, however, was also tied to the math teacher's inability to incorporate the iPod Touches into her teaching. For example, she stated:

> I don't use it for teaching per se, but more for remediation or for practice at the end of a lesson. I found it difficult to find math ways to incorporate it into lessons and objectives for the state so I use some of the math games when they finish something early so that they can do practicing math, but it's a little bit more difficult [because] they have to kind of scroll back and forth.

Late Majority Adopters and Laggards

During the observations it was clear that the iPod Touch was utilized less frequently in particular subject areas. Teacher comments gathered during focus groups often concentrated around the lack of available applications that were relevant to their curriculum.

Insufficient applications. Some mathematics teachers described a lack of appropriate applications available for the iPod Touch for middle school students and several reported difficulties in finding ways to integrate the iPod Touch into mathematics. As one teacher said, "It has been hard to find applications that I can feel that I can justify [students] using them." However, this could also be a result of a curriculum that stresses algorithm and places less emphasis on conceptual thinking and visualization. For example, both teachers and students reported, "Why would we use the iPod Touch when we have graphing calculators?" However, several teachers wanted applications that allowed them to create content more easily (such as tools for drawing), and allowed students the ability to display their own thinking and reasoning. For example, one teacher said, "As far as finding math things, I do find it very difficult because I want them to show their work so I can see what they are doing wrong." This comment reflected a frustration that often students are working on problems that require notation and the interface does not allow for this kind of work. Both the seventh and eighth grade math teachers needed more support both to find applications that would address the content and to integrate them with what they were covering in their curriculum.

While these teachers were categorized as late adopters and laggards, this had more to do with their lack of professional development than with their own attitudes. These were teachers that required more direction in understanding how these tools could fit their curriculum, and were not going to take the initiative or experiment. Therefore professional development that supports the use of mobile devices needs to address both early and late adopters, specifically addressing diverse teaching styles and curriculum needs.

Student Feedback: The influence of Early and Late Adopters and Laggards

Data collected during student focus groups described use that substantiated classroom observations and were similar to teacher reports of classroom use. During the sixth and seventh grade focus groups, students reported a range of uses. For example, one sixth-grade student said, "In science we do tests, warm-ups, and quizzes. We do word games. We have an app called iNote trainer. For Spanish we can use it to translate things and sometimes in social studies we just look up things." When asked about the main required use of the iPod Touch, most students answered, that they spent the most time researching and doing warm-ups.

In regards to note taking, there was some disagreement amongst the students. One said, "although it can be helpful to kind of write down stuff on the notepad, it still takes up a lot of time because it's not very quick to like type out all the letters on the iPod." However some students found the device useful for note taking. For example, one said, "Every time I go into like science because I hardly have paper I'm normally asking. So instead I just take out my iPod and take the notes on that."

While many students were positive and found that there were substantial benefits to use, there were differences between 6th and 8th grade students. The sixth-grade students were enthusiastic about the integration of iPod Touches for everyday classroom use, while the participants in the eighth-grade student focus group were quite negative about their experience with them. This is not a surprising result, given that the sixth-grade teacher team, most notably the science and social studies teachers that were considered early and majority adopters (Rogers, 2003), used the iPods Touches for a variety of instructional activities and presented a clear rationale for how these uses furthered their instructional goals. The eighth-grade teachers (late adopters and laggard) were supportive of their use in the classroom (although the math teacher had many reservations) but were generally unsure of the applications available, and how best to integrate them into existing curriculum.

Students' Critique

Students' criticism was focused on two main areas:

1) Teachers who were unsure of how and when to implement them into the curriculum. Students reported that their use sometimes seemed ill timed and irrelevant. As one student reported, "The teacher just didn't have a good use for it, so there was no point and it was just a distraction."

2) Students felt that is was a distraction with significant time wasted as teachers yelled at students who were playing games on the iPod Touches.

Students in eighth grade seemed to be more critical than students in grades 6 and 7. The eighth grade students critiqued the way teachers only wanted the students to use the tool for Internet access and formative feedback in the form of quizzes. As one student reported:

Yeah. Like I really can't think of another way we use 'em except for like in science cause it's really the main time we use 'em is like for the social studies like warm-up. And he has

> like a little quiz thing that we use. And it's just like we'll take that. But I think most of it
> is just people playing things on it and fooling around.

It was unexpected that the issue of classroom management came up in student focus groups, *not* in teacher interviews. A typical comment from the 8th graders was, "And also I think that it takes away from our learning more than like it brings to use because every second in class our teacher like has to tell us, someone to put their iPod away and it's just really annoying." Another students agreed, "I think more since we've gotten the iTouches, like all of our time is revolved around being yelled at by a teacher for using them or like not even using them for the right reason, you know." Another student expressed real concern and said, "because it's just like in class we'll sit there and play games constantly. We don't ever pay attention anymore. I think it's definitely like lowered, overall it's lowered a lot of people's grades because of the iTouch." There was also an assumption that students know how to use this technology and do not need support. For example, one student complained:

> But it is like, they are kind of like forcing us to use them because if we don't,
> we'd have to go down to the computer lab and that's already booked. And it's like
> I know there's not a lot of people but like people that do have trouble using like
> technology and stuff like that. It's just like it's kind of like they didn't really teach
> us how to do anything. For no one that's ever had an iTouch before, they just kind
> of like gave it to us and said 'Here.'

Overall, students reported the main use of the iPod Touch during classroom instruction was for Internet research and they believed that computers were better tools for this purpose. Several students made comments about scrolling around websites that were not designed for mobile devices, such as, "but when you're researching on some site it's really annoying because when you scroll down, you keep on clicking on lots of links and things like that [agreement] and then you have to go back all the time and it just takes up a lot of time." However, several students reported positively on this aspect given the lack of access they have to laptops during the school day.

Discussion

The opportunities that handheld devices provide for schools are extensive. But too often there is little connection made between small innovative projects and large-scale implementation that brings an innovation to large groups of students and teachers instead of only the fortunate few. However, this level of scalability is only possible when in-depth investigations are conducted to understand the complexities of the school environment and how these devices are integrated into everyday practice. When these devices are observed as they are implemented in the classroom, practitioners, researchers, and software and hardware developers can better understand how to make these devices useful and innovative.

To this point, researchers have only been afforded the opportunity to investigate the small-scale use of the iPod Touch. This study not only provides further insight into the early implementation of this device, but also the unique opportunity to investigate a school-wide implementation. Through observation and focus groups, we investigated teacher and student use in the classroom and their thoughts in regard to the adoption of the device. Rogers (2003) offered a useful framework through which to view teachers' adoption and use. The teachers specified a couple of advantages; specifically, the iPod Touch provided a quick and easy method for teachers to assess students, and students had immediate access to the Internet. Negative comments were particularly prevalent from the mathematics teachers, who had little use for the device beyond the calculator functions. This concurred with the findings of Ng and Nicholas

(2009), which reported that mathematics instructors of students older than 11 used the iPod Touch minimally. Students in the eighth grade agreed, suggesting that the work they do in mathematics is almost impossible to do with the iPod Touch. As one student remarked, "You can't even like use them in math because you can't really take notes on them with all the numbers and like trying to write out the equations and stuff. And if you do, it's just like hard to follow." This was observed in the classroom, as science and social studies teachers reported a far higher usage of the devices than mathematics teachers did.

These data show that students in grades six and seven had positive attitudes toward the devices and noted particular activities, such as the assessments, were effective and quick. All students noted that the immediate access to the Internet was a great advantage over waiting for computer availability, although the 8th grade students noted that their classes only used the iPod Touches for searching the Internet, which they described as a poor use of the multifunctional devices. Student attitude was largely determined by the teachers' use. Students in Early Adopter classrooms were enthusiastic; they understood how the devices fit into their instructional activities and the ways it supported their understanding of key concepts. Students in Late Adopter or Laggards classrooms in the eighth grade were frustrated by their perception that the devices were disruptive and offered little additional instructional benefits, and thought school resources could be better spent elsewhere. These students also held negative attitudes about the change agents in the school and this also influenced their perceptions of iPod Touch use in school.

Pedagogical practice determines what technologies will be used in the classroom and how they will be used. Teacher perceptions, teaching styles, technological competence, and many other factors influence this choice (Clifford, Friesen, & Lock, 2004; Jonassen, Peck, & Wilson, 1999; Keengwe, Pearson, & Smart, 2009). School administrators should gauge teachers pre-existing technology use and pedagogical practices to determine the most effective use of professional development. Specifically, Rogers' (2003) adopter categories were useful in describing how teachers approached the use of the iPod Touch in their instruction and could contribute to a differentiated approach that would meet the specific needs of particular teachers. For example, if teachers are resistant to technology in general, a targeted workshop that clearly demonstrates how particular apps fit into specific areas of the curriculum may be necessary. A good example of this would be to provide support for the math teachers through demonstrating how algebra apps can help students visualize difficult concepts.

Overall, the data findings confirm the importance of pedagogical practice and can contribute to better professional development so that teachers and students can take advantage of the unique affordances of these tools. Otherwise we run the risk that once again, technology is oversold and underused (Cuban, 2000).

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Appendix A
Observation Protocol

Name of observer: _____

Date of observation: _____

Pseudonym for teacher: _____

Number of students in the class today: _____

How is the classroom laid out? (Where are the iPod Touches?)

How is the teacher introducing the activity?

How are the students using the iPod Touch during the lesson?

Appendix B
Student focus group questions

Semi-structured questions for the students

1. How have you been using the iPod Touches?
    Probe for academic, organizational, fun use.

2. What do you spend the majority of your time using the iPod Touch for and why?

3. Do you think it is better using the iPod Touch than other non technology methods? (Example: Do you think it is best to take notes on the iPod Touch or with paper and a pencil?)
    Probe for different examples based on what they have chosen to use the iPod Touch for in earlier questions.

Appendix C
Teacher focus group questions

Semi-structured questions for the teachers

1. Do you use the iPod Touch in your classroom teaching? If yes what do you use it for and why? If not why do you not chose to use this device?

2. Have you see any success using the iPod Touch in your classroom?

3. What challenges have you faced using the iPod Touch in your classroom?