THE POPULAR PROFILE OF THE DIGITAL LEARNER: TECHNOLOGY USE PATTERNS AND APPROACHES TO LEARNING

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ABSTRACT

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The purpose of this study was to investigate the claims made in the popular press about the "digital native" generation as learners. Because students' lives today are saturated with digital media at a time when their brains are still developing, many popular press authors claim that this generation of students thinks and learns differently than any generation that has come before. They urge educators to change their teaching to meet the needs of this supposedly unique generation, but the evidence to support their claims and recommendations is scarce. This study used a survey to gather data on the technology use of university freshmen, the degree to which they identified with the claims being made about their approaches to learning, and the productiveness (in terms of focused attention, deep processing, and persistence) of their approaches to learning. Interviews with a purposefully selected group of participants helped to further illuminate the findings from the survey.

Valid surveys were received from 388 freshmen at a large Midwestern land grant university. The self-report survey consisted of a Digital Characteristics scale (developed by the researcher based on the popular press claims about the digital natives), a Productive Learning Habits scale (developed by the researcher based on the popular press claims about the digital natives), and a measure of the frequency of use of 41 technology tools. The data were analyzed using a factor analysis to identify patterns of technology use, descriptive statistics, and analysis of correlations and extreme group t-tests to explore any relationships between technology use

patterns, Digital Characteristics, and Productive Learning Habits. The findings indicate some positive correlations between use of digital technology and Digital Characteristics, and some negative correlations between some categories of technology use and Productive Learning Habits. The Rapid Communication Technology category, which included texting, instant messaging, and Facebook, had the strongest negative relationship with Productive Learning Habits, and therefore needs to be investigated further. The interviews revealed that some digital natives are very aware of the influence of technology in their lives and are strategic in how they balance its demands against the demands of their university coursework. Overall, however, the small to moderate relationships suggest a less deterministic relationship between technology and learning than what the popular press writers claim.

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CHAPTER 1: INTRODUCTION

Nearly every week the popular press brings a new article about “today's new learners” (often called "digital natives") and how the generation entering schools and the workplace today might be different from any generation that has come before. Because students' lives today are saturated with digital media (Rideout, Foehr, & Roberts, 2010) at a time when their brains are still developing, several popular authors suggests that media use has profoundly affected students' abilities, preferences, and attitudes related to learning. Some popular authors take a pessimistic view, worrying that the new generation of students may be incapable of deep learning and productive work (Bauerlein, 2008; Small & Vorgan, 2008). Others take an optimistic view of the skill set these learners are developing, but claim that educators are failing them by not adapting instruction to their needs (Prensky, 2001a, 2001b; Rosen, 2010; Tapscott, 2009). All of them deliver their claims with urgency and an insistence that educators must respond *today*.

Recently some more moderate voices have entered the discussion on the characteristics of the digital natives. For example, Thomas (2011) published an edited volume that called for evidenced-based discussions of the digital natives and featured chapters focused on specialized areas such as civic involvement, the relationship between technology use and culture, the use of mobile devices, and digital literacy. While these perspectives presented a nuanced and realistic picture of the digital natives, they did not directly address the broad set of claims regarding new ways of thinking and learning attributed to the digital natives that are still prevalent in popular press books and news articles.

Many academic researchers have criticized the popular claims about the digital natives based on the lack of empirical evidence supporting them (Bennett & Maton, 2010; Bennett,

Maton, & Kervin, 2008; Enyon, 2010; Helsper & Eynon, 2010; Jones, Ramanau, Cross, & Healing, 2010). The popular writers make broad recommendations for changes in the school systems and curricula, supporting their claims mainly with anecdotal evidence or proprietary data that is not available for scrutiny (e.g., Tapscott, 2009). Nevertheless the claims influence the thinking of educators and administrators making decisions about technology investment and curriculum design (Jones & Healing, 2010). They may also lead instructors to make unsupported assumptions about their students' needs and mastery of educational technology and therefore neglect to teach students the skills they need for academic success (Buchanan & Chapman, 2009; Guo, Dobson, & Petrina, 2008).

Despite the shortcomings of these popular press claims, the possibility that children who grow up immersed in digital media may think and learn differently from those who grew up with printed text has intuitive appeal, and scholars in fields as diverse as media studies and neuro-biology have made connections that seem to support the claims made about the digital natives. McLuhan, for example, proposed that electronic media, because they emphasize image, sound, and movement rather that static text on the page, affect how we think and perceive the world (Williams, 2003). Research on neural plasticity has shown that our brains do indeed change in response to our repeated experiences (Ebner, 1996; Maguire, Woollett, & Spiers, 2006). Thus, the field of education needs more empirical study on whether and how technology immersion is associated with changes in behavior and attitudes related to learning. This study is a step towards testing the theory implicit in the popular press literature and gathering data to either support or challenge that theory.

The Popular Profile of the Digital Learner

Based on the claims made in the popular press about the digital natives, a set of characteristics I call the *Popular Profile of the Digital Learner* (PPDL) emerges. The 10 characteristics that make up this profile will be described in detail in Chapter 2, but in general include claims about the digital natives' preference for speed, nonlinear processing, multitasking, and social learning, allegedly developed through immersion in digital technology during childhood and adolescence when neural plasticity is high. Since neural plasticity can lead to either adaptive or maladaptive changes (Nelson, 1999), these characteristics could manifest themselves in ways that are adaptive for learning, as suggested by Prensky (2001a, 2001b), Rosen (2010), and Tapscott (2009), or in ways that are maladaptive for learning, as suggested by Bauerlein (2008), Carr (2010), and Small and Vorgan (2008). Thus the PPDL includes both the degree to which the learner displays the 10 characteristics and the degree to which they use these characteristics in productive or adaptive ways. Because not all of the digital natives have the same access to technology or the same patterns of use (Bennett & Maton, 2010; Corrin, Bennett, & Lockyer, 2010; Jones, et al., 2010; Kennedy, Judd, Dalgarno, & Waycott, 2010), there may also be a "non-digital" or "traditional" learner profile, even among students identified by their age as "digital natives." If technology use is actually associated in some way with the kinds of behaviors and attitudes proposed in the PPDL, then the types of PPDL characteristics students display should correlate with their patterns of technology use. This correlation would be most likely to occur when students are pursuing topics of their own interest, giving them the freedom to use their preferred approach to the task rather than adopting "school behaviors" that they believe are expected of them.

Differences between Current Claims and Learning Styles Theories

Some of the claims being made about the new learner overlap somewhat with existing theories about cognitive styles or learning styles. For example, existing learning style and cognitive style theories have addressed preferences for visual and verbal processing (Riding, R. & Cheema, I., as cited in Coffield, Moseley, Hall, & Ecclestone, 2004; Paivio & Harshman, 1983) or deductive versus inductive thinking (Kolb, D. A., 1984 as cited in Coffield, et al., 2004). What the various theories of cognitive styles and learning styles have in common is their focus on understanding and explaining individual differences (Bennett, et al., 2008; Sternberg, 1997). While they vary greatly in whether they assume learning styles are stable genetic traits or more flexible preferences (Hall & Moseley, 2005), they assume distinct differences between people of the same demographic group, and seek to describe differences rather than to explain how these differences developed. In contrast, the current popular press writers claim a uniformity of learning styles and preferences for the digital native generation. They believe that the digital natives have had the same experience of technology immersion and that this immersion, through the effects of neural plasticity and habituation, has produced a unique digital native learning profile. As explained in Chapter 2, however, the technology skills and technology use patterns of the digital natives are not as uniform as claimed. If the popular press claims about a distinct learning profile of the digital natives are true, the characteristics of this profile should show up most clearly in students who have actually immersed themselves in technology in the way the popular writers claim. Rather than simply looking for a new learning style or cognitive style, this study looked for correlations between technology use and the learning habits, preferences, and attitudes currently being claimed for the digital native generation.

Learning for Interest versus Learning for a Grade

Prensky (2001a, 2001b, 2008) and others claim that students employ their digital skills in an adaptive way every day when they are learning about things that interest them, and that it is the school environment that inhibits their digital learning characteristics and the productiveness of those characteristics. He claims that students are engaged learners in their leisure activities but are bored in school. As he describes it, "A kid who has seen lunar landings and rovers working on Mars, who has done lots of research on the Internet on astronomy, and who comes to school excited about space travel may likely hear, 'If you want to go to outer space, learn your math.' But the math she learns is not about space-it's 1,200-year-old algebra and 4,000-year-old Egyptian geometry" (Prensky, 2008, p. 43). Several authors have described digital natives investing effort and developing practical skills through developing gaming "cheats" and modifications and creating and sharing online content (Ito et al., 2010; Prensky, 2001a; Tapscott, 2009). They claim that the digital learners have well-developed adaptive learning habits, attitudes and behaviors, developed through their leisure activities, that are being ignored and squandered in their school learning. The focus of this study, therefore, will be the learning habits, attitudes and behaviors participants report in the "natural habitat" of learning about something that interests them. While the ability to learn subjects beyond one's immediate personal interest is clearly important, the focus on the learning behaviors that digital natives may be developing in the activities they find most engaging can provide a starting place for a better understanding of their approach to learning and identify whether their approach is indeed new or unique.

Purpose of the Study

This study provides data to address the connection between technology use and learning by asking university students to report their frequency of use of a variety of technologies, their habits and typical behaviors when learning about topics that interest them, and the Productive Learning Habits of their learning behaviors. The relationships between patterns of technology use, digital learner habits and behaviors, and the productiveness of those behaviors was explored with correlational analysis and hypothesis testing of extreme groups. In addition, rich descriptive data were gathered through interviews with a purposefully selected group of students to further illustrate how digital native students view their own technology use and approaches to learning. These data help demonstrate how the digital natives themselves see their technology use and learning needs, and may provide an empirical basis for both curriculum design and additional research.

The next chapter introduces the literature used to frame the study, which includes a synthesis of the popular press claims about the digital natives and summaries of current literature on the actual technology use and proficiency of the digital native generation. It also includes the specific research questions addressed in this study. Chapter 3 summarizes the research design and methods used. Chapters 4-5 present the findings from the study. Findings from the survey are presented in Chapter 4 and findings from the semi-structured interviews are presented in Chapter 5. Finally, Chapter 6 presents a discussion of the results, their connection to the literature, and some possible implications for both teaching practice and future research.

CHAPTER 2: LITERATURE REVIEW

Theoretical Support for the Existence of a New Kind of Learner

While the claims about the digital natives originate from popular press rather than academic sources, there are implicit and explicit theoretical foundations underlying the claims. The history of media theory and the study of how media influence thinking are not addressed directly by the popular press authors but are implicit in their claims. The popular press authors do explicitly ground their claims in the concept of neural plasticity.

Influence of media on thinking. Media research has long focused on the potential of media to influence the way we think. McLuhan, for example, believed that media shape society and "become extensions of ourselves" so that "the messages contained in any medium are inseparable from the medium's human consequences" (Laughey, 2007, p. 33). So television, as one example, was much more than just a new way to deliver the daily news. Television transformed the way we experience the news by engaging us visually and aurally in ways that are beyond the capabilities of print (Williams, 2003). McLuhan believed this new kind of engagement would have a profound influence on how people thought and engaged with the world. Similar claims are made today about the power of the Internet to transform social interaction and public life (Bohman, 2004; Wellman, 2004) and how these effects may be particularly salient for the digital natives growing up with this technology as part of their landscape.

Neural plasticity. The relevance of emerging brain research to teaching and learning is a matter still under debate (Bruer, 1998; Wolfe & Brandt, 1998), but some researchers have looked at the specific ways in which the environment and experience influence brain structure and

change. Kleim and Jones (2008) summarize this literature in terms of 10 principles of experience-dependent neural plasticity. The research they highlight shows that training in specific skills can lead to the development and strengthening of the neural circuitry used in these skills, especially when the training is intense, salient (motivating), and repeated over time. Conversely, neural circuitry that is not used eventually degrades. This neural plasticity is stronger in younger brains, though even aged brains change in response to training. Furthermore, they emphasize that it is not just formal training that produces brain change. People with brain injuries find new ways to compensate for lost function in their day-to-day lives even if they do not receive therapy, showing that learning that occurs through everyday activities can reorganize brain structure in both adaptive and maladaptive ways.

In discussing characteristics of the new learner, popular writers rely heavily on neural plasticity as a basis for both the optimistic and pessimistic views of the new digital learner. Prensky (2001a) uses neural plasticity as the main basis for his argument that new learners have superior visual skills, hand-eye coordination, and ability to monitor multiple processes and react quickly to unexpected events. He claims that the intensity with which many young people play video games results in exactly the kind of training that can profoundly affect the development of their young, highly plastic brains. Small and Vorgan (2008) make similar claims, but caution that digital immersion may be overdeveloping certain regions of the brain while neglecting others. In particular, they are concerned that gaming and other digital activities appear to suppress activity in the frontal lobe, the brain region responsible for planning, abstract thinking, and perspective-taking. They fear that the hours spent on the computer instead of reading books might be developing the temporal lobe at the expense of the frontal lobe, leaving a generation of student unable to think deeply and reflectively, control impulses, or feel empathy for others.

Some authors have urged caution in the use of the neural plasticity argument as support for the assertion that the digital natives are different from previous generations. Smith (2011) points out that neural plasticity is involved in all learning, not just learning from technology, and studies such as the often-cited study of London cab drivers (Maguire, et al., 2006) demonstrate that measureable physical brain change also occurs in adult learners. While brain science research has demonstrated specific and rapid changes unique to adolescence, suggesting the possibility that adolescence is a critical period for developing some skills, the direct link between observable physical brain change and adolescent behavior is not yet clear (Blakemore & Choudhury, 2006; Giedd, 2004; Steinberg, 2005). Thus, while many of the popular press authors rely heavily on neural plasticity as a basis for their claims, academic researchers caution that our knowledge of neural plasticity alone is not enough to explain learning or to support prescriptive advice for teaching (Bruer, 1998). Despite the possible over-extension of the concept of neural plasticity and its implications for the digital native generation, however, the undoubted existence of neural plasticity is a reason for concern that immersion in digital technology from a young age *could* alter brain structure.

Popular Press Claims about the New Digital Learner

Building on this theoretical foundation of neural plasticity and media theory, several popular press writers have gained attention in recent years with their claims that the generation entering schools and universities today is different from any generation that has come before. While Prensky (2001b) does not specify an exact starting point for the generation he refers to as digital natives, Tapscott (2009) focuses his work on those born after 1976, and Rosen (2010) defines his "iGeneration" as those born in the 1980s and later. Some of the popular press authors claim that these new learners have new skills that will be important for their future careers but

are being ignored by the schools. Others are more concerned about the maladaptive changes they see, and warn that this generation is unable and unwilling to learn.

With respect to learning, changes that help students properly focus attention (Reynolds, 1992) or process information deeply (Craik & Lockhart, 1972; Watkins, 1983) can be viewed as adaptive for learning, whereas changes that lead to ineffective focus of attention or shallow processing would be maladaptive for learning. Popular press writers are divided on whether adaptive or maladaptive changes are most prevalent in the digital natives. Prensky (2001a) discusses how video games improve learners' ability to monitor multiple simultaneous processes and to sift through large amounts of information quickly. In contrast, Small and Vorgan (2008), while acknowledging these new cognitive skills facilitated by digital media, express concerns about the potential for high levels of digital stimulation and multitasking to provoke or aggravate attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD) in susceptible individuals, causing unbalanced brain development (e.g., stimulation of temporal lobe activity at the expense of frontal lobe activity) in children and adolescents, and impeding the development of the neural pathways involved in empathy and the development of social skills.

Regardless of whether they fall on the optimistic or pessimistic side of the debate, these authors focus on some common themes. The following is a summary of the major claims made about the digital native generation, organized around the "Ten Characteristics of the Games Generation" proposed by Prensky (2001a), but also incorporating the claims made by other popular writers. The potential adaptive and maladaptive (with respect to learning) side of each of these claims is summarized.

Twitch speed versus conventional speed. Prensky (2001a) claims that students' exposure to computer games and MTV has taught them to crave interactivity and immediate

response, and thus they cannot be expected to tolerate an environment that lacks this speed and interactivity. He claims that students work at "twitch speed instead of conventional speed" and that a traditional school environment requires them to "power down" their brains (Prensky, 2008, p. 42). Tapscott (2009) discusses how the ability to have real-time conversations across distance has also contributed to the millennial generation's "need for speed" (Tapscott, 2009, pp. 35-36), training them to expect an instant answer to every question or communication.

In terms of learning, one area where this trait manifests itself, according to Prensky (2001a), is in students' ability to process information quickly, as they do when scanning web pages. Digital natives, he claims, prefer rapid scanning and have little patience for slow careful reading. While he views this change in reading speed and style as an adaptive, or at least neutral, behavior, he admits that some of this speed might be gained at the expense of reflective thought, and that digital natives might require scaffolding in tasks that require deep reflection. Other popular press authors have a more pessimistic view of this change in reading habits. Small and Vorgan (2008), while admitting that experience searching the Web may indeed give learners an expanded working memory for quick processing of large amounts of information, describe how early immersion in video games can lead to a highly developed temporal lobe, but cause a difficulty with abstract thinking and planning due to an underdevelopment of the frontal lobe. Carr (2010) argues that the Internet is inherently designed in a way that encourages skimming and discourages deep reading (Carr, 2010, pp. 137-138). Thus, even when the digital natives do try to read, they have difficulty. The neural circuits involved in rapid scanning are highly developed and become dominant, while those involved in deeper, more reflective reading begin to erode. Bauerlein (2008) discussed the high cost to society of a generation growing up without deep, reflective reading, including a lack of knowledge of history, civics, math and science as

well as literature, replaced by an obsession with peer culture. "When the gifts of life lead to social joys, not intellectual labor," Bauerlein says, "the minds of the young plateau at age 18" (p. 9).

Multitasking versus single tasking. Prensky (2001a) uses the phrase "parallel processing versus linear processing" to describe the characteristic of juggling more than one task at the same time. All of the popular authors address multitasking as a common characteristic of the digital natives. Tapscott describes a typical scene of a student doing homework with a "window for work documents open, multiple Internet windows open for research, IM and Facebook windows open for communication, and earbuds in for music" (Tapscott, 2009, pp. 107-108). The optimistic view of this characteristic is that it is either adaptive, since many tasks have built in "down time" anyway, or that it is helpful for efficiency and engagement or, at the very worst, harmless. Prensky (2001a, 2001b, 2008) and Tapscott (2009) believe that the digital natives have a greater ability, compared to previous generations, to manage several cognitively demanding tasks at once. Prensky (2001b) claims that students immersed in video games and MTV have developed superior attentional deployment – the ability to monitor multiple processes and respond to unexpected events.

Rosen (2010) goes so far as to say that this generation has a genuine need to multitask, and that asking them to put their cell phones and laptops away and listen to a lecture is unreasonable and harmful to their learning. Furthermore, he claims that student can and do regulate their own multitasking behaviors, reducing it to lower levels in situations where they recognize a need for focus, such as reducing the amount of texting they do when listening to a lecture in a particularly difficult class (pp. 91-92).

The more pessimistic view of this multitasking habit is that it not only interferes with performance on the specific tasks being performed, but also leads to maladaptive brain changes that have long-term detrimental effects for learning and mature behavior. Empirical research has shown that multitasking can cause people to remember less (Hembrooke & Gay, 2003) and take more time to complete a task (Bowman, Levine, Waite, & Gendron, 2010), and is associated with lower grades (Fried, 2008). In addition to the immediate decrement on learning when multitasking during class or study time, a habit of constant multitasking may have more far-reaching consequences. Small and Vorgan (2008) distinguish between productive multitasking (managing two or more tasks that each have a specific purpose) and the state of *continuous partial attention* – a state of constantly scanning the environment for any kind of new information or contact with other people. Continuous partial attention puts us in a state of heightened awareness and constant stress, leading to a state of mental exhaustion that Small and Vorgan call "techno-brain burnout" (Small & Vorgan, 2008, p. 19). This state increases stress hormones and over time can impair cognition and learning.

Graphics first versus text first. All of the popular press authors describe the new learners as having a preference for visual imagery over text, though they differ on whether they see this preference as a strength or a weakness. Prensky (2001a) and Tapscott (2009) both claim that because learners from this generation have grown up immersed in the graphically rich technological world of the Internet and video games, their brains are wired to read imagery, and they have a high level of skill at visual processing. Prensky (2001a, 2001b) claims that the first impulse of the digital natives is to look at the pictures first before reading the text and that they have superior visual-spatial skills compared to the generations that grew up with printed text. He sees this as an adaptive trait, since skills in "reading" graphics allow learners to take in more

information in a shorter time (2001a, p. 56). Tapscott (2009) argues that since this generation is good at reading pictures and processing visual information quickly, it is natural that they would ignore text and prefer to learn from images.

On the more pessimistic side of the debate, authors such as Bauerlein (2008) and Carr (2010) express concern over the lack of interest in reading traditional text. Carr argues that while the digital world may support the development of visual processing skills, these skills are "primitive" (p. 139) and are not a good trade when they are gained at the expense of deep, reflective reading of text.

Random access versus step-by-step. Related to, but distinct from, multitasking is the ability to process multiple threads of related information at the same time. Prensky (2001a) claims that the digital natives have "hypertext minds" that function better using a "random access" approach rather than a step-by-step linear approach. Tapscott (2009) also claims that this generation has a special ability to process and read in nonlinear ways. If students do indeed have this ability, it could be adaptive for learning in some situations. While the popular authors take it as a given that nonlinear processing is a good thing and do not elaborate on how or why, Cognitive Flexibility Theory (CFT) (Spiro, Coulson, Feltovich, & Anderson, 1988) has long held that nonlinear processing can be an adaptive strategy for learning in complex domains if it is done properly. Strategic use of hypermedia allows learners to revisit the same concept from multiple perspectives so that "the multidimensional fullness of the content is increasingly approximated with each additional perspective that is presented" (Spiro & Jehng, 1990, p. 202) and the complex interconnections between perspectives can be understood.

An adaptive style of nonlinear processing takes some effort from the learner, however, and a more haphazard approach could result in a scattered, disconnected understanding of a topic

rather than the integrated whole that is described as the ideal in CFT. Carr argues that hyperlinks do not merely give us the option of diverging from our current path, but they actively propel us in new directions, and the ease of clicking on a link makes "our attachment to any one text…more tenuous, more provisional" (Carr, 2010, p. 91). Thus, learners might follow hyperlinks and process material in a maladaptive nonlinear way, getting lost in the divergent ideas and never integrating them.

Connected versus stand-alone. Prensky (2001a) claims that learners growing up with the high level of synchronous and ubiquitous connectivity available through Internet have a higher need for collaboration and a greater ability to learn and be productive when working in groups. They accomplish tasks and solve problems by using their personal online network, rather than looking to a print source as members of previous generations might. Rosen (2010) also discusses the digital natives' preference for "collective reflection" (p. 48), learning through online social interaction where homework help is mingled with the social conversations. Tapscott (2009) claims that the digital native generation's approach to collaboration goes beyond traditional teamwork because communication technology allows individuals to make a real contribution to large-scale collective projects, such as Wikipedia, and that this experience makes them unwilling to accept one-way communication from a teacher.

This characteristic can be adaptive for learning if it expands the repertoire of resources available to learners and enhances their ability to work in teams. It could become maladaptive for learning if students are dependent on an engaging social environment to the point where they cannot (or do not see the need to) take responsibility for their own learning or if they are too distracted by socializing (Bauerlein, 2008) to focus attention on learning.

Active versus passive. Prensky (2001a) claims that the digital natives are more skilled than previous generations at learning by figuring things out rather than waiting for instructions, as when, for example, they learn new software by trying it out rather than reading a manual. This behavior, he claims, is trained by video games that are designed for learning by trial and error. This preference for active learning has left them impatient with more passive learning environments such as lectures. Rosen (2010) also discusses students' need for constant stimulation, interaction, and feedback, and Tapscott (2009) claims that students today have a kinesthetic learning style rather than visual or auditory like previous generations, though he offers no data to support this claim.

While activity and discovery based learning can enhance learning under the right conditions, pure discovery without any scaffolding poses a risk that learners will miss essential content (Mayer, 2004), so patience with more directed learning environments needs to be part of an adaptive learning strategy. Students who demand constant activity, even when they are not able to learn effectively through that activity, would be displaying a maladaptive version of this preference for active learning.

Play versus work. Prensky (2001a) claims that the leisure activities of the digital natives, particularly computer games, develop their complex thinking skills and blur the boundary between work and play. Tapscott also claims that "this generation brings a playful mentality to work" (Tapscott, 2009, p. 35). Others have noted that digitally engaged youth use their leisure time to produce original work (such as original video uploaded to YouTube) or to contribute expertise for the benefit of others, such as when they contribute to gaming strategy sites (Ito, et al., 2010). This expectation of combining work and play can come into conflict with teachers who traditionally expect students to complete all their work before any play is allowed.

Cognitive playfulness – a tendency toward imaginative hypothesis testing – has been shown to enhance learning (Mortocchio & Webster, 1992). Thus, a tendency to merge work and play in this manner could be adaptive for learning. It would become maladaptive, however, if rather than bringing their own playful attitude to the learning task, students had the expectation that teachers would make learning "fun" for them, and therefore withheld effort as soon as they encountered something that they didn't immediately find enjoyable.

Payoff versus patience. Prensky (2001a) claims that since computers in general and computer games in particular do such a good job of providing immediate feedback and rewards for the user's effort, students today expect an immediate and satisfying payoff for all of their efforts. He claims that students today all wonder "why…should I finish college when elementary school kids can design professional Web sites, 20-year-olds can start billion-dollar companies, and Bill Gates, who left Harvard to do something with more payoff, is the world's richest man?" (p. 61). Tapscott (2009) echoes this claim when he discusses students' expectation of choice and relevance in their learning and their unwillingness to submit to teacher-directed learning tasks. Rosen also discusses this generation's demand for "immediacy" (Rosen, 2010, p. 48) and craving for constant feedback, an expectation trained by video games that provide immediate rewards and punishments for each action.

While an impatience to learn and acquire skill might be motivating and lead to better learning, an expectation for constant payoff can have obvious detrimental consequences for learning if students are not able to persevere in the face of difficulties. Small and Vorgan (2008) view students' expectation for constant stimulation and entertainment in school and work settings as a maladaptive attitude that hinders their learning and healthy development.

Fantasy versus reality. Prensky (2001a) claims that technology, particularly games but also realistic movies and television, has provided more opportunities for students to develop their natural affinity for fantasy and role-play, and that learners will be more motivated if these fantasy contexts can be incorporated into the learning environment. While an ability to benefit from these environments through increased motivation or contextualization (Cordova & Lepper, 1996), would be an adaptive learning attitude, a dependence on fantasy or narrative could be maladaptive since it is not practical for all learning to be designed this way.

Technology-as-friend versus technology-as-foe. Prensky (2001a) claims that while even the most technically-savvy members of the older generations see technology as a mere productivity tool, digital natives see it as a "friend" and even a "birthright" (p. 63). Tapscott (2009) also discusses how technology is viewed by the millennial generation as "like the air" (Tapscott, 2009, p. 18), a normal part of their everyday environment, and suggests that it is only the *absence* of technology, as seen in a typical classroom, that is distracting to learners today.

Technology, when used properly, can enhance conceptual understanding (Mishra & Koehler, 2006, 2009), and if students do indeed have a high level of competence with technology it will expand the options for teachers and facilitate pedagogically sound teaching with technology. However, as will be discussed in the next section of this chapter, the belief that digital native students have a uniform and universal technology competence is not supported by research. Some students may be overwhelmed by the use of technology or may be distracted by its novelty, and thus might not benefit from technology unless its use is properly scaffolded for their level of technical competence. Focusing on the technology for its own sake rather than on the content they were trying to learn would therefore be a maladaptive learning behavior.

Technology Use

Recent research has called the existence of the "digital native" into question. Some have argued that the characteristics being claimed for the digital natives are related to technology access and use rather than being unique to the digital native generation. There have also been challenges to the alleged technical savvy of the digital native generation. The following is a brief summary of some of the research on technology use among the digital native generation.

Technology use is not age dependent. A few studies have challenged the notion that immersion in technology is a unique characteristic of students born after a certain year, concluding that while people of all ages show a range of technological savvy, there is no age-related demographic group that qualifies as "digital natives." Kennedy et al. (2008) compared the technology use of university students in Australia (84 percent of whom were age 25 or younger) to university faculty (92% of whom were older than 25) to see if there were significant differences in technology use between the two groups. The two groups completed a survey on their frequency of use of 41 different technologies, which were collapsed via factor analysis to eight categories of technology use. In four out of eight categories – Standard Mobile Phone Use, Advanced Mobile Phone Use, Standard Web Use, and Gaming – they found significant differences in frequency of use, with participants aged 25 and younger reporting more frequent use. There were no significant differences in the categories of Advanced Web Use (a category that included mainly advanced Web 2.0 activities such as contributing to wikis or publishing a podcast), Social Web Publishing (e.g., publishing a blog or website), Digital Media Presentation, and Web-based Services (e.g., online banking). Where differences did exist, they were relatively small and did not represent a complete lack of use by those over 25. As an example, the authors report that the average frequency of Standard Mobile Phone Use for those 25 and younger was

"once per day" whereas for those older than 25 it was "several times per week." While some of the commonly assumed age differences in technology use were supported by the results of this study, the results did not indicate a stark difference between younger people using all types of technology and older people avoiding it.

Guo et al. (2008) studied the self-reported perceptions of information technology competence of students in a teacher education program at three universities in Canada and the United States, representing an age range from 20 to over 60. They divided the respondents into five age groups and compared the mean scores of these groups. The age groups were 20-24, 25-29, 30-40, over 40, and those who declined to report their age. They found no differences in perceived information technology competency between the first four age groups, though there was a significant difference between the four age groups and the group that did not report their age, with the group not reporting their age reporting lower information technology competency. While it is possible that the group not reporting their age was older than all others, this study provided no evidence to support a claim that information technology use, as self-reported in this study, is greater for "digital natives" than for older people.

Immersion in digital technology, then, may not be as age-dependent as the popular press writings seem to suggest. People from older generations can become quite comfortable with new technologies, and those from the digital native generation can restrict themselves to using only a narrow range of technologies. Nevertheless, if technology immersion at a young age affects development and thinking, the claims made about the digital natives might still prove true for at least the subset of the population that makes frequent use of a large variety of technologies.

Technology use may be restricted. Studies suggest that while use of digital technology for basic communication is common among digital natives, very few create text, audio or video

content or play computer games. Kennedy, Judd, Dalgarno and Waycott (2010) looked at the technology use patterns of students from three Australian universities and found that only 14% of them could be classified as "power users" who used a wide variety of technologies with any frequency. The remaining groups used a restricted range of technologies centered mostly on basic mobile phone features and basic web use (e.g., sending email or looking up information), with very few using technology for gaming, multimedia content creation, or advanced smartphone capabilities.

Students may have limited desire for technology integration in the classroom. While Prensky (2001a, 2001b, 2008), Tapscott (2009), and others claim that technology is largely responsible for students' resistance to school, a few studies have shown that many students do not want the technology they use in their leisure time to become part of their school experience. Lohnes and Kinzer (2007) report on a small ethnographic study where they observed nine university students in a summer media institute to see how they used technology in the classroom and in the dormitory. They found that while these students appeared to fit the popular digital native stereotype in their dormitory, they were resistant to the use of laptops in the classroom. They felt that the personal interaction between students and faculty was an integral part of learning in a liberal arts classroom, and found the clicking of keyboards and the visual barriers of open laptop screens on the table to be too disruptive to that environment.

Research Questions

This study explored the relationship between technology use and PPDL characteristics in a group of university freshmen. The mixed methods design included a survey of the technology use and self-reported PPDL characteristic of a random sample of students, followed by interviews with eight purposefully chosen participants. This research contributes towards

separating the facts from the speculation about the new digital learner, and provides a starting point for developing ways to help all learners build on their current media practices to develop effective strategies for learning. The survey portion of the study addressed the following questions:

1. What technology tools do university freshmen use and how frequently do they use them?
2. Which of the digital learner characteristics from the *Popular Profile of the Digital Learner* (PPDL) do students report having when learning topics in which they have personal interest?
3. When learning topics in which they have personal interest, do students report habits and behaviors that are more productive or less productive for learning?
4. Do students' patterns of technology use correlate with their characteristics from the PPDL? (For example, do frequent gamers report different PPDL characteristics than frequent Facebook users?)

The interviews addressed the following research question:

5. How do learners with different configurations of PPDL characteristics describe their own technology use and approaches to learning?
    a. What kinds of connections do they see between their own personal technology use and their approaches to learning?
    b. What similarities and differences do they describe between their own personal approaches to learning and the PPDL claims?
    c. How do they describe their personal reactions to the claims being made about their generation?

CHAPTER 3: METHODS

The purpose of the study was to investigate the claims being made in the popular press about the generation known as "digital natives" and to explore whether their patterns of technology use correlated with their approaches to learning. This study gathered data in three categories: (1) digital learner characteristics based on the claims being made in the popular press about how this generation approaches learning, (2) the Productive Learning Habits of their approaches to learning based on whether or not they make use of adaptive cognitive strategies such as focused attention and deep processing, and (3) the frequency of use of 41 specific technology tools. The relationships between technology use patterns, digital characteristics, and Productive Learning Habits were explored using inferential statistics. Qualitative interviews provided a rich descriptive view to supplement the patterns and trends revealed by the quantitative data. This chapter provides a detailed description of the methods used in this study.

Design of the Study

This mixed methods study consisted of a survey of the incoming freshman class at a large Midwestern university during Fall Semester 2011, followed by an interview with purposefully selected participants. The survey gathered data on the students' self-reported technology use patterns and the extent to which they reported having the learning habits, attitudes and behaviors described in the popular press literature.

Detailed Description of the Survey

Participants. The link to the online survey was sent by the registrar's office at a large Midwestern university to a random sample of 3,000 current freshmen. (The total population of freshmen at this university was just under 8,000.) Freshman status was determined by the

number of credits the student had completed based on the university's criteria. As an incentive to respond to the survey, participants were asked to provide an email address which was entered in a raffle of 15 gift certificates in the amount of $40 to either Amazon.com or iTunes. A total of 492 students responded to the survey (a 16% response rate), but some of these were invalid because the participants quit before completing the survey. A total of 388 complete responses were received, resulting in an effective response rate of 13%. Due to an error in the online version of the survey, demographic information (gender and ethnicity) were not collected on the participants. The distribution of colleges of enrollment for the sample was roughly equivalent to the freshman population as reported by the university Registrar.

Materials. The data collection instrument for the quantitative portion of the study was a questionnaire developed by the researcher (See Appendix A), as no existing instrument was found in the literature that adequately addressed the research questions. The instrument was structured around the ten items in Prensky's (2001a) "ten characteristics of the games generation" described above, and also incorporated claims made by other authors. It consisted of the four parts described below.

Part 1: The Digital Characteristics scale. Participants rated where they saw themselves on an eight-point scale ranging from a more "traditional" learner to a more "digital" learner according to the claims being made about the digital generation.

Part 2: The Productive Learning Habits scale. Participants rated where they saw themselves on an eight-point scale ranging from less productive to more productive behaviors for learning. The questions in Part 2 mirrored those in Part 1 but focused on how the behaviors reported in Part 1 might detract from or enhance behaviors necessary for learning. For example, focused attention can be viewed as more productive for learning than being distracted (Reynolds,

1992), deep processing more productive than shallow processing (Craik & Lockhart, 1972; Watkins, 1983), and seeking multiple perspectives more productive than trusting a single source (Feltovich, Spiro, & Coulson, 1993; Spiro, et al., 1988). In addition, study skills and habits such as persistence, identifying the most important topics in a lesson, and a generally positive attitude toward learning have a demonstrated association with academic success (Crede & Kuncel, 2008; Zimmerman, 1990).

Part 3: Technology use. Participants rated their frequency of using a list of 41 common technology tools.

Part 4: Additional information. Participants provided basic demographic information and answered some questions about their views of learning and how well they believed their own learning strategies met their learning goals.

Validity of the survey instrument. Validity of a survey instrument refers to "whether one can draw meaningful and useful inferences from scores on the instrument" (Creswell, 2003, p. 157). One important type of validity is construct validity, or the assurance that the measure is appropriate for the construct it claims to measure. In this study, a panel of researchers with expertise in educational psychology evaluated the construct validity of the survey instrument. The panel was given a draft of the survey questions and a summary of the claims being made about the digital natives in the popular press literature, and was asked to provide feedback on the clarity of the questions and how well the questions matched the characteristics described in the claims. Several questions were reworded based on this feedback. The revised questionnaire was then entered into the SurveyMonkey software and sent to this same group for additional assessment of the clarity of the questions in this online format. An additional five questions were reworded based on this feedback.

The ability of the participants to answer honestly and accurately is another important consideration in assessing the validity of a scale. The Productive Learning Habits scale in particular could be vulnerable to a specific type of bias known as social desirability bias, "the tendency on behalf of subjects to deny socially undesirable traits and to claim socially desirable ones" (Nederhof, 1985, p. 264). While this bias cannot be completely eliminated, steps were taken to reduce it. First, the survey was self-administered online and the participants had no direct contact with the researcher, which has been shown to reduce social desirability bias compared to situations where an interviewer administers a survey in person or over the telephone (Nederhof, 1985; Presser & Stinson, 1998). In addition, Likert-type scales with a large number of choices and scales that eliminate the midpoint tend to produce lower means than smaller scales and scales that allow a neutral response (Dawes, 2008; Garland, 1991). Because social desirability bias would likely cause *higher* means on the scales used in this study (e.g., respondents trying to make a good impression on the researcher would most likely rate themselves as having more productive, rather than less productive, learning habits), the eight-point design of the scales may help to compensate somewhat for any potential social desirability bias.

Reliability of the survey instrument. Reliability refers to whether the instrument produces the same result each time it is used under the same conditions. The Cronbach's alpha for the Digital Characteristics scale was .62, and for the Productive Learning Habits scale, .72. Reliability of at least .70 is often cited as the minimum acceptable for using a scale. The lower reliability measure for the Digital Characteristics scale was disappointing and unexpected since the pilot data suggested it would have high reliability. However, this was a first attempt to measure a construct that is widely discussed in the popular press and among educators but had no

existing measurement instrument associated with it. It is therefore a situation like that described by Helmstadter (1964), who said that "in some instances a reliability which is far from perfect may be…much better than impressionistic judgment or than simply ignoring the trait because no measuring device is available" (p. 85). Therefore, while the lower than desired reliability of the Digital Characteristics scale indicates that the results must be interpreted with caution, the data from this study still provide at least preliminary information on how the digital natives see themselves with respect to the claims made about them.

Procedures. The survey was delivered online using SurveyMonkey. Participants received an email, written by the researcher but forwarded by the university Registrar, that contained a link to the survey. They provided informed consent on the first page of the survey and then answered the survey questions online. The survey took about 20 minutes to complete.

Participants were asked to provide an email address in order to be entered in the raffle and also so they could be invited for follow-up interviews. Participants who did not provide their email address, however, were still allowed to submit their survey responses.

After the initial invitation to complete the survey was sent, two reminder emails were sent to the same group at two-week intervals. Two weeks after the second reminder was sent, the survey was closed and data were downloaded as a comma-delimited file and uploaded to the SPSS statistical software for analysis.

Data analysis. Descriptive and inferential statistics were used to extract meaningful information from the data. An alpha level of 0.05 was used as the criterion for significant findings.

Factor Analysis of Technology Use. Factor analysis was performed on the technology use portion of the questionnaire in order to condense the 41 technology activities into broader

categories of technology use. A principal components factor analysis with a varimax rotation was used. Varimax is appropriate in situations where there are theoretical reasons to believe the factors are independent of each other because it "maximizes the dispersion of loadings within factors" (Field, 2005). Because past research has shown that the digital natives are far from uniform in their technology use patterns (Kennedy, Dalgarno, et al., 2008; Kennedy, et al., 2010), this method was chosen to capture all of the distinct technology use patterns contained in the data.

Analysis of Digital Characteristics and Productive Learning Habits. Descriptive statistics were computed on the responses from the Digital Characteristics and Productive Learning Habits scales. Means and standard deviations were computed for the entire scale and for each individual question item in the scale.

Computation of Bivariate Correlations. Once these patterns of technology use were established, a series of bivariate correlations was performed to investigate relationships between the individual scale items as well as relationships between Digital Characteristics, Productive Learning Habits, total technology use, and each of the nine technology use factors obtained from the factor analysis.

Analysis of Extreme Groups. Extreme group analysis was used to further illuminate any differences that exist between participants at the extreme ends of the Digital Characteristics scales, Productive Learning Habits scales, and Technology Use Factors. High- and low-frequency users were defined for each technology use factor. For all technology use factors except Rapid Communication Technology and Web Resource Use, the high-frequency group was defined as participants whose average score was five or higher on the eight-point scale, and the low-frequency group was defined as those with average scores below three. Because the

overall mean was much higher for Rapid Communication Technology and Web Resource Use, the criteria for high usage for these groups was an average of seven or higher on the eight-point scale, and the low usage group was defined as those with average scores below five.

Detailed Description of the Interviews

Participants. The results from the analysis of the survey provided a basis for selecting a small group of participants to invite back for interviews. These participants were purposefully selected based on their patterns of technology use, Digital Characteristics and Productive Learning Habits. The goal in selecting participants was not to find "typical" digital native learners, but rather to find learners who appeared to have unique or highly adaptive ways of managing their learning in our current environment of ubiquitous technology. For example, the survey indicated that many frequent multitaskers had trouble controlling their multitasking behaviors, so two participants who had high multitasking scores and high scores on the Productive Learning Habits question regarding ability to control multitasking were selected to be interviewed. These participants were identified as digital native learners who might have approaches that were particularly effective for learning in the 21st century and could be used as models for effective digital learning, providing insights that could help educators develop interventions for learners who are less successful at managing their learning in a digital world. Interview participants were compensated with $20 cash for the 30-40 minute interview. A more detailed description of the specific interview participants chosen will be provided in Chapter 5.

Procedure. The interviews were semi-structured, following the protocol shown in Appendix B but also flexible and adaptive to gather data on the most interesting concepts introduced by the participants themselves. The interview questions consisted of a few questions specific to the participant's survey responses and five questions that were asked of all

participants that asked them to respond to quotations from popular press authors talking about the digital native generation. The interviews were audio-recorded and transcribed for analysis.

Data analysis and reliability. The transcripts were divided into units of analysis, which were defined as the interviewer question with its related response. Small prompts from the interviewer designed to get a more detailed response (e.g., "Can you say a little more about that?") were included as part of the original question for purposes of identifying units of analysis. All eight interviews were analyzed in their entirety.

Interview responses were coded based on the themes that emerged from the data that addressed the specific components of the research question. Thus the coding process was open enough to allow the ideas of the participants to emerge, but at the same time focused on identifying themes relevant to (1) how the participants felt that technology influenced their learning, (2) how the participants felt the claims about the digital natives did or did not sound like them and their friends and classmates, and (3) how the participants reacted to the claims being made about them in the popular press. A codebook of 34 codes, organized into the three categories listed above, was developed during the analysis (see Table 23 in Chapter 5).

Four of the eight interviews were chosen at random and given to a second coder, an advanced doctoral candidate in the educational psychology program, in order to measure reliability. Reliability was measured with both percentage of agreement and Cohen's kappa, a statistic that adjusts for the amount of agreement expected to occur by random chance. Both the percent of agreement and the Cohen's kappa for this analysis were 87 percent.

Findings from the analysis of the survey data will be presented in the next chapter. Findings from the analysis of the interview data will be presented in Chapter 5.

CHAPTER 4: FINDINGS FROM THE ONLINE SURVEY

The purpose of this study was to investigate the popular claims made about the digital native generation as learners. More specifically, an online survey was sent to a sample of university freshmen who were asked to self-report their technology use patterns, the degree to which they identified with the claims made about them with regard to how they approach learning (referred to here as *Digital Characteristics*), and the quality of their study habits and approaches to learning (referred to here as *Productive Learning Habits*). Additionally, this study investigated the relationships between technology use, digital characteristics, and Productive Learning Habits through correlation analysis and hypothesis testing of extreme groups. The survey was followed by short, semi-structured interviews with eight purposefully chosen participants in order to explore in more depth some of the more interesting relationships between technology and learning revealed by the survey data.

Overall Descriptive Statistics

Out of the 3000 invitation emails sent, a total of 492 responses were received, and 388 of these were complete. This translates to a raw response rate (submitted surveys) of 16% and an effective response rate (usable surveys) of 13%. The average age of respondents was 18.22 years. Due to a problem with the online version of the survey, gender and ethnicity information about the participants was not collected as intended. The distribution of college majors in the sample was roughly equal to the distribution seen in the freshman class according to data available from the University Registrar, and is provided in Table 1. The majority of participants (61%) reported GPAs in the 3.5 to 3.9 range. Because the participants were freshmen and the

survey distributed during fall semester, the majority of the participants would have answered this question based on their high school grade point average. Information provided by the University Registrar shows that the middle 50% of freshmen admitted in recent years had high school grade point averages between 3.4 and 3.8.

Given the low response rate, one cannot assume the results found here can be generalized to the freshman population at this university, much less to the entire digital native generation. Nevertheless, a sample of 388 is large enough to perform statistical analysis and to observe patterns and trends to be investigated in future studies.

Table 1. *Distribution of College Majors of Participants*

	Sample		Population
College	Number of Participants	Percentage	Percentage
Agriculture & Natural Resources	14	4	4
Arts & Letters	14	4	3
Business	50	13	21
Communication Arts	22	6	5
Education	25	6	6
Engineering	48	13	12
James Madison College	5	1	3
Lyman Briggs College	34	9	6
Natural Sciences	52	14	14
Nursing	19	5	4
Res. Coll. Of Arts & Humanities	9	2	1
Social Science	31	8	10
Veterinary Med	12	3	2
Other	43	11	9

Technology Use

Research Question 1 asked "What technology tools do university freshmen use and how frequently do they use them?" This question was addressed by analyzing the responses to the technology use section of the survey, both with descriptive statistics and a factor analysis to identify patterns of technology use.

In order to group the individual technologies into meaningful categories of use, an exploratory factor analysis was conducted. The factor analysis of the survey produced a nine-factor solution that explained 62% of the variance. Items with loadings of .4 and greater were retained. One survey item, *receiving text messages*, was dropped from the analysis before the factor analysis was done because it had a .9 correlation with another item, *sending text messages*, indicating that these two items were duplicating each other, and also because, unlike sending a text message, receiving one is not under the user's control. Two other items were dropped after the factor analysis because of their low factor loadings. These items were (1) *commenting on content sharing sites (e.g., YouTube)* and (2) *playing social games (e.g., Farmville) on Facebook*. The nine factors and their assigned labels are shown in Table 2.[1]

Table 2. *Factor Labels and Descriptions*

Factor Label	Description (with survey question number)
Rapid Communication Technology use	Use of technologies that delivered real-time or nearly real-time communication. This included text messaging on a cell phone (31a), checking (31e), updating (31g), or commenting (31f) on Facebook, making a voice call on a cell phone (31c), and chatting in real-time on a computer (31d). Use of several technologies at one time (31k) also loaded in this factor.
Multimedia Creation	Creation and sharing of media files. This factor included creating a digital image (30i), uploading a digital image to a file-sharing site (30k), creating or editing a video (30g), uploading a video to a file-sharing site (30j), and creating an audio file (30h).

[1] The question of why these factors came out so cleanly and appear so intuitive (is it due to the affordances of the technologies themselves, the purposes for which they are used, or some connection in the minds of the users?) is an interesting one but is beyond the scope of this dissertation.

Table 2 (cont'd)

Factor Label	Description (with survey question number)
Active Web Reading and Writing	Activities involving reading or writing text on the Internet. This included reading (30m), writing (30v), and commenting (30w) on blog entries, creating or maintaining a website (30l), and reading long detailed web pages (30s). Reading entertainment web pages (30n) also loaded on this factor.
Gaming	Using a computer to play games, including playing strategy games on computer (30cc), playing action games alone (30aa) or with others (30bb), and playing puzzle games (e.g., Tetris) (30dd) on the computer.
Web Resource Use	Use of web content, including using the web to explore a topic in depth (30p), using the web to look up a fact (30o), watching a video online (30e), and listening to music online (30f).
Collaborative Web Tool Use	Use of technologies that allow sharing or collaborating with others online. This factor included annotating a web page (30r), using a social bookmarking site (30q), using a shared document on the web (e.g., Google docs)(30y), and contributing to a wiki (30x).
Productivity Tool Use	Use of productivity software: word processors (30a), spreadsheets (30b), databases (30c), and presentation tools (30d).
Microblogging	Updating (31j) or reading (31i) a microblogging site such as Twitter.
Book Reading	Reading books for enjoyment (30u) or for learning (30t). While this factor does not pertain to digital technology like the other eight factors, it is useful as a comparison to see if use of this older technology is associated with different approaches to learning than newer digital technology.

Each factor was then converted to a scale (explained in more detail below) so a score on each technology use group could be computed for each participant. A Cronbach's alpha test of

internal consistency was also computed for each factor. The component matrix of the factors, their Eigenvalues and Cronbach's alpha are shown in Table 3.

Table 3. *Component Matrix of Technology Use Factors*

	Factors								
Technology use activity	1	2	3	4	5	6	7	8	9
Factor 1: Rapid Communication Technology									
Comment in Facebook	.785								
Check Facebook	.751								
Send text message	.720								
Multitask	.660								
Update Facebook	.631								
Voice cell phone call	.600								
Computer chat	.545								
Factor 2: Multimedia Creation									
Create digital image		.760							
Create digital video		.702							
Upload video to Web		.659							
Create digital audio file		.654							
Upload digital image	.454	.559							
Factor 3: Active Web Reading and Writing									
Read a blog			.789						
Update a blog			.777						
Create/maintain website			.702						
Comment on a blog			.661						
Read entertainment webpage			.446						
Read long or detailed webpage			.401						
Factor 4: Gaming									
Play a strategy game on computer				.837					
Play an action game on the computer				.830					
Play a multi-player online game				.812					
Play a puzzle game				.569					
Factor 5: Web Resource Use									
Use web to find fact					.780				
Watch video online					.686				
Listen to music online					.671				
Use web to explore topic in-depth					.621	.448			

Table 3 (cont'd)

	Factors								
Technology use activity	1	2	3	4	5	6	7	8	9
Factor 6: Collaborative Web Tool Use									
Annotate a Webpage						.616			
Use social bookmark site						.556			
Use shared doc (e.g. Google doc)						.517			
Update a wiki						.512			
Factor 7: Productivity Tool Use									
Use a Spreadsheet							.793		
Use Database software							.586		
Use PowerPoint							.580		
Use Word Processing software					.419		.535		
Factor 8: Microblogging									
Update a microblogging site								.851	
Read a microblogging site								.849	
Factor 9: Book Reading									
Read a book for enjoyment									.808
Read a book to learn									.800
Eigenvalue	3.98	3.28	3.19	3.07	2.70	2.50	2.21	2.10	1.92
Variance Explained	21.97	10.35	7.00	5.81	4.27	3.84	3.47	2.94	2.73
Cronbach's alpha	.83	.81	.82	.81	.73	.75	.64	.94	.70

Note: Only loadings with values >= .4 are shown.

Participants' scores for the nine technology use subscales were computed by taking the average of the responses for each subscale. This average is conceptually easier to understand than a raw total or the factor score calculated by SPSS because it retains the 8-point Likert-type scale from the original questionnaire items, resulting in the type of intuitive interpretation most useful for an exploratory descriptive study (DiStefano, Zhu, & Mindrila, 2009). This analysis facilitated a systematic look at the patterns of technology use seen in this population. The distribution of technology use scores is shown in Tables 4 and 5. Rapid Communication Technology is shown in a separate table from all others because its eight-point Likert-type scale

used different labels from the other technology groups. Table 4 shows that 73% of the respondents reported using Rapid Communication Technology at least once per day.

Table 4. *Percentage of Frequencies for Rapid Communication Technology Use*

Technology Group	Never	Up to Once per Month	Up to Once per Week	A Few Times per Week	About Once per Day	Several Times per Day	About Once per Hour	More than Once per Hour
Rapid Communication Technology Use	0.8	0.8	6.0	19.8	39.6	25.0	5.7	2.4

Table 5 shows that Web Resource use was the only technology use factor (other than the Rapid Communication Technology mentioned above) where the majority of participants report using it at least once per week. For all other technology use factors, the majority of participants report using it "a few times per month" or less.

Table 5. *Percentage of Frequencies for Technology Use Factors Other than Rapid Communication Technology*

	Never	A Few Times per Year	About Once per Month	A Few Times per Month	About Once per Week	A Few Times per Week	About Once per Day	More than Once per Day
Multimedia Creation	26.6	**36.6**	19.2	10.0	5.0	1.8	0.3	0.3
Active Web Reading & Writing	**30.0**	27.0	16.3	14.7	7.2	3.7	1.1	0.3
Gaming	27.7	**28.8**	14.4	12.0	7.6	6.5	1.6	1.3
Web Resource Use	0	0.3	0.8	6.1	15.7	**33.3**	**33.3**	10.4
Collaborative Web Tool Use	**59.1**	19.3	10.3	6.1	2.9	1.3	0.8	0.3
Productivity Tool Use	1.6	17.6	**31.3**	28.9	16.3	3.2	0.8	0.3

Table 5 (cont'd)

	Never	A Few Times per Year	About Once per Month	A Few Times per Month	About Once per Week	A Few Times per Week	About Once per Day	More than Once per Day
Microblogging	**50.3**	6.2	7.7	10.3	6.2	11.1	4.1	4.1
Book Reading	6.6	**21.8**	16.8	18.4	17.1	11.6	5.8	1.8

Note*:* Highest percentage is shown in bold font.

Means and standard deviations of the average scores for each technology use factor were also computed and are shown in Table 6.

Table 6. *Means and Standard Deviations for Technology Use Scales*

Technology Category	Mean	SD	N
Web Resource Use	6.55	1.07	375
Rapid Communication Technology Use	5.46	1.11	369
Book Reading	4.04	1.74	380
Productivity Tool Use	3.90	1.13	374
Gaming	3.07	1.67	382
Active Web Reading & Writing	2.98	1.51	375
Microblogging	2.95	2.30	388
Multimedia Creation	2.76	1.26	380
Collaborative Web Tool Use	2.06	1.34	379

Note: Scale Range was 1 to 8, where 1 was "never" and 8 was the highest frequency of use.

Digital Characteristics

Research Question 2 asked "which of the characteristics of the popular profile of the digital learner do students report having when learning topics in which they have personal

interest?" The Digital Characteristics portion of the survey provided data to address this question.

The Digital Characteristics scale asked participants to rate themselves on a scale from one to eight, with one being the most "traditional" approach to learning and eight being the most "digital" as described in the popular claims. An average of all 15 items in the scale was calculated for each participant. Participants had a mean Average Digital Characteristics score of 3.88 (N=350, SD=.776) and a range from 2.13 to 6.80. The data appeared normally distributed based on visual inspection of the histogram.

The means and standard deviations of the individual items on the digital scale were also calculated and are shown in Table 7. The scale item "fast expedient web search" had the highest mean at 5.36 (SD = 2.04, skewness = -0.48, SE = .13). This means that many participants rated their web search style closer to the "fast and efficient" end of the scale, a more highly "digital" behavior as defined by the popular press claims, and fewer rated their style as "slow and iterative." The two lowest items were preference for finding versus receiving information (M = 2.90, SD = 1.80, skewness = 0.78, SE = .13), indicating that participants prefer to have information provided for them rather than seeking it out on their own, and nonlinear method of following hyperlinks (M =2.67, SD = 2.02, skewness = 1.15, SE = .13), indicating that participants tend to read an entire webpage before following hyperlinks, rather than clicking on hyperlinks immediately as they read them.

Table 7. *Means and Standard Deviations for Digital Scale Items*

Digital Scale Item	Mean	SD	N
Fast expedient Web search (not iterative)	5.36	2.04	387
Feels technology is necessary for learning	4.86	1.75	386
Nonlinear method of finding answers to questions	4.61	2.34	381
Nonlinear method of explaining to others	4.23	2.36	384
Rapid scanning (not slow deliberate reading) of web pages	4.10	1.86	388
Maintaining constant contact with friends while learning	4.09	1.83	386
Focus on graphics before text	3.99	1.78	386
Multitasking while learning	3.98	2.15	385
Tendency to mix work and play	3.97	1.81	383
Rapid scanning (not slow deliberate reading) of printed text	3.66	1.80	388
Preference for fantasy (game-like) context	3.33	1.99	384
Preference for studying with friends	3.19	2.12	385
Preference for quick payoff versus future reward	3.14	1.72	385
Preference for finding (versus receiving) information	2.90	1.80	388
Nonlinear method of following hyperlinks	2.67	2.02	384

Note: Higher scores indicate more "digital" approaches to learning while lower scores indicate more "traditional" approaches.

Productive Learning Habits

Research Question 3 asked "when learning topics in which they have personal interest, do students report habits and behaviors that are more adaptive or less adaptive for learning?" This question was addressed by the Productive Learning Habits portion of the survey. The term *Productive Learning Habits* refers to cognitive behaviors associated with learning, such as focusing attention (Reynolds, 1992) and deep rather than shallow processing (Craik & Lockhart,

1972; Watkins, 1983), and also to an ability to be flexible and learn from a variety of different situations (e.g., lecture, project work, etc.).

The Productive Learning Habits scale asked participants to rate themselves on a scale from one to eight, with one being the least adaptive approach to learning and eight being the most adaptive. An average of all 14 items in the scale was calculated for each participant. Participants had a mean score of 5.03 (N=354, SD=.951) and a range from 2.07 to 7.79. The data appeared normally distributed based on visual inspection of the histogram.

The means and standard deviations of the individual Productive Learning Habits scale items were also computed, and are shown in Table 8. The item "persistence (versus giving up) in short-term boredom" had the highest mean at 6.16 (SD=1.77). This indicates that when respondents encounter short-term boredom and know that the reward for their efforts will come later, they are able to find their own rewards or just persist. Very few reported that they are inclined to give up in the face of short-term boredom. The item with the lowest mean, at 3.74 (SD=1.65) was "recognizing their own responsibility (versus teacher responsibility) for making learning enjoyable." A lower score on this item indicates that participants rated their opinions closer to "teachers should make learning fun so it never feels like work" than to "it is the student's responsibility, not the teacher's, to make learning enjoyable."

Table 8. *Means and Standard Deviations of Productive Learning Habits Scale Items*

Productive Learning Habits Scale Item	Mean	SD	N
Persistence (vs. giving up) in short-term boredom	6.16	1.77	383
Ability to control multitasking when needed	5.85	2.26	387
Ability to listen attentively to lecture	5.56	1.84	388
Integrating text and graphics	5.51	2.06	381
Finds learning mostly enjoyable	5.41	1.55	386
Staying on-task (vs. socializing) when studying with friends	5.28	2.26	384

Table 8 (cont'd)

Productive Learning Habits Scale Item	Mean	SD	N
Being open to new ideas when learning (vs. focusing narrowly just to complete the task)	5.24	1.80	385
Productive use of imagination when learning	5.12	2.28	387
Reflection while reading (vs. just "gathering")	4.88	2.01	388
Ability to learn from "hands-on" projects	4.62	2.03	382
Multitasking related topics while learning	4.35	2.58	388
Ability to learn with new technology (vs. feeling overwhelmed)	4.25	2.01	388
Seeking out multiple sources of information	4.07	2.12	381
Recognize their own responsibility (vs. teacher responsibility) for making learning enjoyable	3.74	1.65	385

Note: Higher scores indicate more productive approaches to learning.

Relationships between Technology Use and the Popular Profile of the Digital Learner

Research Question 4 asked "do students' patterns of technology use correlate with their characteristics from the popular profile of the digital learner?" This question was addressed by looking at the relationships between the technology use patterns identified in the factor analysis and the Digital Characteristics and Productive Learning Habits scales through the use of bivariate correlations and hypothesis testing of extreme groups.

The bivariate Pearson Product Moment correlation between Digital Characteristics and Productive Learning Habits was computed, and a negative correlation, $r(323) = -.247$, $p < .001$, was found, indicating that a higher score on the Digital Characteristics scale is associated with a lower score on the Productive Learning Habits scale. (A higher score on the Digital

Characteristics scale indicates a higher level of the qualities claimed in the popular press for the digital native learner.)

Bivariate correlations were computed to explore relationships between Digital Characteristics, Productive Learning Habits, and the nine individual technology use factors. Because most of the technology use factors had non-normal distributions (specifically, distributions for most of the technology groups were positively skewed because many participants reported never using them), the non-parametric Spearman Rank correlation was used instead of the more common Pearson Product Moment Correlation. Several statistically significant correlations were found. The strongest correlation was between Rapid Communication Technology Use and Digital Characteristics ($r_s[335] = .29$, $p < .001$). Participants who had higher average Rapid Communication Technology scores tended to also have higher average Digital Characteristics scores. The correlations between technology use and Digital Characteristics are presented Table 9.

Table 9. *Spearman's Correlations between Average Digital Characteristics Score and Technology Use Factors*

Technology Use Factor	Average Digital Characteristics
Web Resource Use	.03
Rapid Communication Technology Use	.29***
Book Reading	-.14**
Productivity Tool Use	.09
Gaming	.13*
Active Web Reading & Writing	.14*
Microblogging	.24**
Multimedia Creation	.18**
Collaborative Web Tool Use	.16**

Note: *=p≤.05, **=p≤.01, ***=p≤.001. N=322 for all analyses

Four of the technology groups, Rapid Communication Technology, Book Reading, Microblogging, and Multimedia Creation, were significantly correlated with the Productive

Learning Habits score. The relationship between Book Reading and average Productive Learning Habits score was the only positive correlation. Participants who reported more frequent book reading also had higher Average Productive Learning Habits scores. The significant correlations between the three digital technologies and the Average Productive Learning Habits score were negative, meaning that those who reported more frequent use of the technology factors had lower Average Productive Learning Habits scores. The correlations between technology use and Productive Learning Habits are presented in Table 10.

Table 10. *Spearman's Correlations Between Average Productive Learning Habits Score and Technology Use Factors*

Technology Use Factor	Productive Learning Habits
Web Resource Use	.09
Rapid Communication Technology Use	-.14*
Book Reading	.22**
Productivity Tool Use	.00
Gaming	.06
Active Web Reading & Writing	-.01
Microblogging	-.17**
Multimedia Creation	-.12*
Collaborative Web Tool Use	-.10

Note: *=p≤.05, **=p≤.01, ***=p≤.001. N=322 for all analyses

Comparisons of Means Between Extreme Groups

In order to further explore relationships between Digital Characteristics, Productive Learning Habits, and technology use patterns, several analyses were performed that measured the differences between extreme groups. The extreme group analysis provided a way to go beyond the correlations and examine more closely the differences between those students who do appear to fit the claims regarding high technology use among the digital natives and those who do not.

Frequent and infrequent users of each technology group were defined based on the distribution of scores for that particular technology use factor. For all factors except Rapid

Communication Technology Use and Web Resource Use, the infrequent users were defined as those with scores lower than three (indicating they use the technology less frequently than once per month) and frequent users were defined as those with scores of five and above (indicating they use the technology at least once per week). For Rapid Communication Technology Use and Web Resource Use, which had much higher means and less skewed distributions, the infrequent users were defined as those with scores lower than five (indicating they use the technology less frequently than once per day) and frequent users were defined as those with scores of seven and above (indicating they use the technology at least once per hour for Rapid Communication Technology and at least once per day for Web Resource Use).

The comparison of average Digital Characteristics scores between infrequent and frequent users of the nine technology use factors are presented in Table 11. The data show that high-frequency users of Rapid Communication Technology, Active Web Reading and Writing, Microblogging, and Multimedia Creation have significantly higher scores on the Digital Characteristics scale than low-frequency users of these same technologies. Frequent Book Readers, in contrast, have significantly lower Digital Characteristics scores than less frequent Book Readers. The largest effect size occurs with the Rapid Communication Technology category.

Table 11. *Avg. Digital Characteristics Score for Extreme Groups of Technology User*

	Frequency of Use				Effect Size
Technology Use Category	Low	High	*t*	*df*	r
Web Resource Use	3.95 (.74)	3.89 (.76)	.36	172	.03
Rapid Communication Technology Use	3.60 (.80)	4.23 (.74)	-3.67***	118	.32
Book Reading	4.04 (.85)	3.78 (.72)	2.42*	221	.16

Table 11 (cont'd)

Technology Use Category	Frequency of Use: Low	Frequency of Use: High	*t*	*df*	Effect Size r
Productivity Tool Use	3.81 (.81)	4.00 .80	-1.36	130	.12
Gaming	3.80 (.71)	3.95 (.83)	-1.29	254	.08
Active Web Reading & Writing	3.79 (.77)	4.10 (.81)	-2.37*	233	.15
Microblogging	3.74 (.74)	4.12 (.77)	-4.11***	285	.24
Multimedia Creation	3.82 (.78)	4.14 (.76)	-2.10*	245	.13
Collaborative Web Tool Use	3.81 (.78)	4.19 (.81)	-2.10*	284	.12

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

The comparison of average Productive Learning Habits scores between infrequent and frequent users of the nine technology use factors are presented in Table 12. The data show that high-frequency users of Productivity Tools, Active Web Reading and Writing, and Collaborative Web Tools have higher scores on the Average Productive Learning Habits scale than low-frequency users of these same technologies, while high-frequency users of Rapid Communication Technology, Microblogging, and Multimedia Creation have lower Average Productive Learning Habits scores. The largest effect occurs for the Book Reading category.

Table 12. *Avg. Productive Learning Habits Score for Extreme Groups of Technology Users*

Technology Use Category	Frequency		*t*	*df*	Effect Size
	Low	High			r
Web Resource Use	4.74 (1.20)	5.07 (.86)	-1.73	175	.13
Rapid Communication Technology Use	5.25 (1.02)	4.73 (.81)	2.47*	120	.22
Book Reading	4.70 (.82)	5.21 (.93)	-4.23***	220	.27
Productivity Tool Use	4.95 (.90)	5.05 (1.04)	-.57	133	.05
Gaming	5.00 (.87)	5.10 (.91)	-.75	252	.05
Active Web Reading & Writing	5.00 (.93)	4.88 (.79)	.87	232	.06
Microblogging	5.15 (.94)	4.84 (.91)	2.69*	289	.16
Multimedia Creation	5.12 (.95)	4.72 (.65)	2.13*	241	.14
Collaborative Web Tool Use	5.13 (.93)	4.66 (.64)	2.08*	288	.12

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

The extreme group analysis was also performed on each individual item in the Digital Characteristics and Productive Learning Habits scales. The statistically significant differences between extreme groups for each technology use factor are shown in Tables 13 through 21.

Table 13 shows that high-frequency Web Resource users, compared to low-frequency Web Resource users, gave significantly higher ratings to the importance of technology for learning, and reported greater ability to listen to a lecture for learning and to persist when faced with short-term boredom while learning.

Table 13. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Users of Web Resources*

	Web Resource Use					Effect Size
	Infrequent	Frequent	t	[*]	df	r
Digital Characteristics						
Importance of technology	4.48	5.22	-2.06*		188	.15
	(1.74)	(1.72)				
Productive Learning Habits						
Attentive during lecture	4.85	5.72	-2.32*		189	.17
	(1.59)	(1.83)				
Persistence when bored	5.58	6.39	-2.27*		186	.16
	(1.82)	(1.67)				

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

Table 14 shows that frequent users of Rapid Communication Technology, compared to infrequent users, are significantly more likely to perform fast and expedient (rather than iterative) web searches, seek answers to questions as they arise (rather than following up later), maintain constant contact with friends while studying, and multitask while learning. They are also significantly less likely to report being able to control their multitasking while studying, and significantly less likely to report that they read in a reflective way rather than merely gathering information. The largest effect size occurs for the Digital Characteristics scale item "multitasking while learning" and the Productive Learning Habits scale item "ability to control multitasking." Thus, more frequent users of Rapid Communication Technology have a greater propensity to multitask and less ability to control their multitasking behavior.

Table 14. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Users of Rapid Communication Technology*

	Rapid Communication Technology Use				Effect Size
	Infrequent	Frequent	t [*]	df	r
Digital Characteristics					
Fast expedient Web search (not iterative)	4.82 (2.03)	5.97 (2.27)	-2.64**	129	.23
Nonlinear method of finding answers to questions	4.10 (2.27)	5.07 (2.33)	-2.04*	129	.18
Maintaining constant contact with friends while learning	3.31 (1.82)	4.57 (1.94)	-3.27***	128	.28
Multitasking while learning	3.02 (1.91)	5.10 (2.20)	-5.05***	129	.41
Productive Learning Habits					
Ability to control multitasking when needed	6.47 (2.21)	4.70 (2.07)	3.89***	129	.32
Reflection while reading (vs. just "gathering")	5.28 (1.93)	4.30 (2.22)	2.35*	129	.20

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

The data presented in Table 15 show that frequent Book Readers, compared to infrequent readers, are significantly less likely to feel that technology is necessary for learning, to focus on graphics before text, or to report a preference for quick rather than long-term rewards for their efforts. They are significantly more likely to report an ability to persist in the face of short-term boredom, control their multitasking, listen attentively to a lecture, find learning enjoyable, stay on task (as opposed to socializing) when studying with friends, and to recognize their own responsibility (as opposed to teacher responsibility) for finding enjoyment in the learning process.

Table 15. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Book Readers*

	Book Reading				Effect Size
	Infrequent	Frequent	t [*]	df	r
Digital Characteristics					
Feels technology is necessary for learning	5.22 (1.69)	4.47 (1.74)	3.42***	241	.22
Focus on graphics before text	4.36 (1.84)	3.64 (1.75)	3.12**	243	.20
Preference for quick payoff versus future reward	3.59 (1.81)	2.94 (1.73)	2.85**	241	.18
Productive Learning Habits					
Persistence (vs. giving up) in short-term boredom	5.80 (1.84)	6.38 (1.74)	-2.53*	240	.16
Ability to control multitasking when needed	5.40 (2.30)	6.09 (2.21)	-2.39*	243	.15
Ability to listen attentively to lecture	5.19 (1.94)	5.71 (1.86)	-2.16*	244	.14
Finds learning mostly enjoyable	5.00 (1.45)	5.73 (1.60)	-3.68***	242	.23
Staying on-task (vs. socializing) when studying with friends	4.93 (2.37)	5.69 (2.24)	-2.55*	242	.16
Recognize their own responsibility (vs. the teacher) for making learning enjoyable	3.41 (1.48)	3.96 (1.70)	-2.67**	243	.17

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

Table 16 shows that frequent users of Productivity Tools, compared to infrequent users, are significantly more likely to report a preference for studying with their friends, a nonlinear method of following hyperlinks on a webpage, and an ability to learn with new technology rather than feeling overwhelmed by it. They are also significantly less likely to report reading in a reflective manner (as opposed to simply gathering information).

Table 16. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Users of Productivity Tools*

	Productivity Tool Use					Effect Size
	Infrequent	Frequent	t	[*]	df	r
Digital Characteristics						
Maintaining constant contact with friends while learning	3.88 (1.67)	4.51 (1.84)	-2.21*		146	.18
Preference for studying with friends	2.69 (1.89)	3.71 (2.24)	-2.97**		146	.24
Preference for quick payoff versus future reward	3.55 (1.92)	2.96 (1.64)	2.01*		146	.16
Nonlinear method of following hyperlinks	2.26 (1.80)	2.89 (1.96)	-2.02*		145	.17
Productive Learning Habits						
Reflection while reading (vs. just "gathering")	4.96 (1.85)	4.32 (2.05)	1.98*		147	.16
Ability to learn with new technology (vs. feeling overwhelmed)	4.25 (1.95)	4.94 (2.00)	-2.11*		147	.17

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

Frequent Gamers, compared to infrequent Gamers, were significantly more likely to report preferences for fantasy contexts and for finding information themselves rather than having it provided, as shown in Table 17. They were also significantly more likely to report seeking multiple perspectives when learning, as opposed to finding an answer from a single source.

Table 17. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Gamers*

	Gaming					Effect Size
	Infrequent	Frequent	t	[*]	df	r
Digital Characteristics						
Preference for fantasy (game-like) context	2.92 (1.87)	3.78 (2.07)	-3.18**		277	.19
Preference for finding (versus receiving) information	2.54 (1.65)	3.12 (1.80)	-2.44 *		279	.14
Productive Learning Habits						
Seeks multiple perspectives when learning (vs. finding one quick source to get the answer)	3.77 (2.15)	4.38 (1.96)	-2.01*		275	.12

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

Table 18 shows that Frequent Active Web Readers and Writers, compared to infrequent users of these technologies, are significantly more likely to report rapid scanning (rather than slow deliberate reading) of webpages, a preference for fantasy contexts, a preference for quick rather than long-term rewards for their efforts, a preference for finding information themselves rather than having it provided, a nonlinear method of following hyperlinks when reading a webpage, and a tendency to seek multiple perspectives rather than finding an answer from a single source. They were significantly less likely to report an ability to persist in the face of short-term boredom and productive use of imagination when learning. They were also significantly less likely to report finding learning enjoyable.

Table 18. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Active Web Readers and Writers*

	Active Web Reading and Writing				Effect Size
	Infrequent	Frequent	t [*]	df	r
Digital Characteristics					
Rapid scanning (not slow deliberate reading) of web pages	3.93 (1.79)	4.54 (1.90)	-2.07*	257	.12
Preference for fantasy (game-like) context	3.17 (1.93)	3.83 (2.22)	-2.04*	254	.13
Preference for quick payoff versus future reward	3.03 1.74)	3.67 (1.79)	-2.27*	255	.14
Preference for finding (versus receiving) information	2.63 (1.77)	3.24 (1.48)	-2.18 *	254	.14
Nonlinear method of following hyperlinks	2.46 (1.91)	3.15 (2.07)	-2.20*	255	.14
Productive Learning Habits					
Persistence (vs. giving up) in short-term boredom	6.26 (1.68)	5.41 (2.04)	2.99**	252	.19
Finds learning mostly enjoyable	5.58 (1.40)	5.07 (1.78)	2.09*	255	.13
Seeks multiple perspectives when learning (vs. finding one quick source to get the answer)	3.85 (2.04)	4.83 (1.95)	-2.97**	252	.18
Productive use of imagination when learning	5.17 (2.32)	4.39 (2.03)	2.10*	256	.13

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

Frequent Microbloggers, compared to infrequent users of microblogging technologies, were significantly more likely to report performing fast expedient (rather than iterative) web searches, finding answers to questions as they arose when learning (rather than following up on them later), maintaining contact with friends while studying, focusing on graphics before text,

multitasking while learning, preferring to study with friends, and following hyperlinks in a nonlinear manner while reading a webpage. They were significantly less likely to report persisting in the face of short-term boredom, ability to control multitasking, finding learning enjoyable, and remaining open to new ideas (as opposed to focusing narrowly on the task) when learning. The data are shown in Table 19.

Table 19. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Users of Microblogging*

	Microblogging				Effect Size
	Infrequent	Frequent	t [*]	df	r
Digital Characteristics					
Fast expedient Web search (not iterative)	5.18 (2.03)	5.85 (2.02)	-2.71**	315	.15
Nonlinear method of finding answers to questions	4.36 (2.29)	5.27 (2.26)	-3.27***	309	.18
Maintaining constant contact with friends while learning	3.95 (1.85)	4.44 (1.75)	-2.24*	314	.13
Focus on graphics before text	3.77 (1.68)	4.35 (1.90)	-2.73**	314	.15
Multitasking while learning	3.83 (2.11)	4.42 (2.25)	-2.26*	314	.13
Preference for studying with friends	3.95 (1.85)	4.44 (1.75)	-2.40*	314	.13
Nonlinear method of following hyperlinks	2.29 (1.77)	2.94 (2.16)	-2.81**	313	.16
Productive Learning Habits					
Persistence (vs. giving up) in short-term boredom	6.37 (1.59)	5.82 (1.96)	2.59**	311	.15
Ability to control multitasking when needed	6.14 (2.18)	5.32 (2.26)	3.06**	315	.17
Finds learning mostly enjoyable	5.64 (1.45)	5.21 (1.62)	2.31*	314	.13

Table 19 (cont'd)

	Microblogging					Effect Size
	Infrequent	Frequent	t	[*]	df	r
Being open to new ideas when learning (vs. focusing narrowly just to complete the task)	5.48 (2.66)	4.78 (2.55)	3.30***		314	.18

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

The data reported in Table 20 show that frequent Multimedia Creators, compared to infrequent users of multimedia creation tools, are significantly more likely to report a preference for a quick (rather than long-term) reward for their efforts, a preference for finding information themselves rather than having it provided, and a tendency to seek multiple perspectives rather than finding an answer from a single source. They are significantly less likely to report being able to persist in the face of short-term boredom, to control their multitasking, to listen attentively to a lecture, and to find learning enjoyable.

Table 20. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Multimedia Creators*

	Multimedia Creation					Effect Size
	Infrequent	Frequent	t	[*]	df	r
Digital Characteristics						
Preference for quick payoff versus future reward	3.03 (1.77)	3.79 (1.78)	-2.18*		264	.13
Preference for finding (versus receiving) information	2.65 (1.70)	3.93 (1.56)	-3.84	***	267	.23

Table 20 (cont'd)

	Multimedia Creation				Effect Size
	Infrequent	Frequent	t [*]	df	r
Productive Learning Habits					
Persistence (vs. giving up) in short-term boredom	6.35 (1.66)	5.45 92.05)	2.69**	264	.16
Ability to control multitasking when needed	6.13 (2.26)	4.72 (1.87)	3.22***	267	.19
Ability to listen attentively to lecture	5.70 (1.82)	4.72 (1.71)	2.73**	267	.16
Finds learning mostly enjoyable	5.53 (1.54)	4.74 (1.48)	2.55*	265	.15
Seeks multiple perspectives when learning (vs. finding one quick source to get the answer)	3.85 (2.17	4.83 (1.78)	-2.33*	261	.14

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

The data in Table 21 show that frequent users of Collaborative Web Tools, compared to infrequent users of these technologies, are significantly more likely to report maintaining contact with their friends while studying, preferring fantasy contexts, preferring quick rather than long-term rewards for their efforts, preferring to find information rather than having it provided, and using a nonlinear method of following hyperlinks when reading a webpage. They are significantly less likely to report being able to control their multitasking, being open to new ideas when learning rather than focusing narrowly on a task, using imagination productively when learning, and reading in a reflective manner (as opposed to just gathering information).

Table 21. *Digital Characteristics and Productive Learning Habits Scale Items for Infrequent and Frequent Users of Collaborative Web Tools*

	Collaborative Web Tool Use				Effect Size
	Infrequent	Frequent	t [*]	df	r
Digital Characteristics					
Maintaining constant contact with friends while learning	3.95 (1.83)	5.15 (1.81)	-2.85**	314	.16
Preference for fantasy (game-like) context	3.19 (1.94)	4.10 (2.40)	-2.00 *	311	.11
Preference for quick payoff versus future reward	2.97 (1.69)	4.20 (1.77)	-3.14**	312	.18
Preference for finding (versus receiving) information	2.72 (1.76)	3.65 (1.57)	-2.29*	315	.13
Nonlinear method of following hyperlinks	2.48 (1.96)	3.55 (1.43)	-2.35*	312	.13
Productive Learning Habits					
Ability to control multitasking when needed	6.09 (2.25)	4.45 (2.09)	3.17**	315	.18
Being open to new ideas when learning (vs. focusing narrowly just to complete the task)	5.40 (1.78)	4.47 (1.68)	2.22*	312	.12
Productive use of imagination when learning	5.32 (2.31)	3.90 (1.71)	2.71**	314	.15
Reflection while reading (vs. just "gathering")	5.06 (2.01)	4.10 (1.78)	2.07*	315	.12

Note: *=p≤.05,**=p≤.01, ***=p≤.001. Standard Deviations appear in parentheses below means.

This chapter presented the findings from the survey of 388 university freshmen regarding their technology use, approaches to learning, and the relationships between them. An exploratory factor analysis identified nine technology use categories (eight digital technology use categories plus one category for reading printed books). The Digital Characteristics scale and the Productive Learning Habits scale were used to explore how the participants rated themselves

with respect to the characteristic attributed to them by popular press authors. Relationships between technology use patterns, Digital Characteristics and Productive Learning Habits were then explored using correlation analysis and extreme group t-tests. The following chapter will present the findings from the semi-structured interviews done with a purposefully-selected group of eight students. Discussion and interpretation of the survey data and the interview data will follow in Chapter 6.

CHAPTER 5: FINDINGS FROM INTERVIEWS

Research Question 5 asked "how do learners with different configurations of the Popular Profile of the Digital Learner characteristics describe their own technology use and approaches to learning?" The goal of this portion of the study was to gather qualitative data on what kinds of connections the digital natives see between their own personal technology use and their approaches to learning, what similarities and differences they describe between their own personal approaches to learning and the PPDL claims, and their personal reactions to the claims being made about their generation.

Selection of Interview Participants

To investigate these questions, ten participants were purposefully selected and invited to participate in interviews, based on interesting information they provided on the survey. Because this study focused on the "best case scenario" of students learning something they found interesting, participants were selected for interview based on survey responses that suggested they were managing their learning successfully. Participants were chosen who represented five types, which I defined and labeled as follows:

- High-Speed Learners. These participants expressed a preference for quick payoffs and timely rewards but who also expressed a general enjoyment of learning. These participants scored at least six out of eight on the Digital Characteristics item "preference for quick payoff versus future reward" and the Productive Learning Habits item "finds learning mostly enjoyable."
- On-Task Collaborative Learners. These participants expressed a preference for studying and learning with friends instead of learning alone, but indicated that when studying with

friends they generally stayed on-task and were not easily distracted by socializing. These participants scored at least six out of eight on the Digital Characteristics item "preference for studying with friends" and the Productive Learning Habits item "staying on-task (versus socializing) when studying with friends."

- Digital Age Readers. These participants had a relatively high score on the Digital Characteristics Scale but still indicated they were frequent readers of books. Frequent book readers were defined as having a score of six or higher on the Book Reading technology use factor. Since none of the frequent readers among those who provided contact information scored six or above on the Digital Characteristics scale, a cut-off of five was used to define these participants as having a high Digital Characteristics score relative to other frequent Book Readers.
- Adaptive Rapid Communication Technology Users. These participants were frequent users of Rapid Communication Technology (scoring six or above on the Rapid Communication Technology use factor) but also had high (six or above) average scores on the Productive Learning Habits scale. Since Rapid Communication Technology use had the strongest negative correlation with Average Productive Learning Habits score, these Adaptive Rapid Communication Technology users were an atypical group.
- Adaptive Multitaskers. These participants reported frequent multitasking but also reported a high ability to control their multitasking when needed. These characteristics were defined as scoring six or higher on the Digital Characteristics item "multitasking while learning" and the Productive Learning Habits item "ability to control multitasking when needed."

To select these participants, records were filtered in SPSS to obtain the subset of all participants who fit the criteria. Participants who did not provide contact information were then deleted from these subsets since there was no way to invite them to participate in the interview. The subsets, which included between three and twenty records each, were then examined to identify the most promising interview subjects. Potential participants were ranked based on their scores on the relevant survey items and any comments they wrote on the open-ended questions. Since thoughtful comments on the open-ended survey questions suggested an ability and willingness to articulate their learning strategies and approaches, those who wrote comments were ranked higher than those who did not.

The two highest ranked participants in each category were contacted by email and invited to participate. When a participant responded, the interview was scheduled at a time and on-campus location of the participant's choosing. If a potential participant declined or did not respond to the email invitation, the next participant on the list was contacted. An attempt was made to interview two participants in each category for a total of ten interviews. Due to the small number of potential participants in some of the categories, combined with a lack of response to the invitation emails and one cancelled appointment, however, only nine interviews were scheduled and eight completed.

Data Collection

All interviews were completed in a two-week period during March 2012. The interviews followed the interview protocol shown in Appendix B, but also included two to four questions unique to the individual in order to follow up on their most interesting survey responses. The interviews were audio-recorded and then transcribed. The transcripts were divided by the relevant unit of analysis, which was defined as the interviewer question with its related response.

Small prompts from the interviewer designed to get a more detailed response (e.g., "Can you say a little more about that?") were included as part of the original question for purposes of identifying units of analysis. All eight interviews were analyzed in their entirety.

Interview responses were coded based on the themes that emerged from the data that also addressed the specific components of the research question. Thus the coding process was open enough to allow the ideas of the participants to emerge, but at the same time focused on identifying themes relevant to (1) how the participants felt that technology influenced their lives and their learning, (2) how the participants felt the claims about the digital natives did or did not sound like them and their friends and classmates, and (3) how the participants reacted to the claims being made about them in the popular press. Codes were determined by the themes that emerged when more than one participant mentioned the same theme or when one participant revisited the same theme more than once during the interview. A codebook of 34 codes, organized into the three categories listed above, was developed during the analysis (shown in Table 23 later in this chapter).

Four of the eight interviews were chosen at random and given to a second coder, an advanced doctoral candidate in the educational psychology program, in order to measure reliability. Reliability was measured with both percentage of agreement and Cohen's kappa, a statistic that adjusts for the amount of agreement expected to occur by random chance. Both the percent of agreement and the Cohen's kappa for this analysis were 87 percent.

The eight participants were all female. Other details about the participants, identified by their assigned pseudonyms, are show in Table 22.

Table 22. *Interview Participants*

Name	Age	College of Enrollment	Category
Cindy	18	Social Sciences	High-Speed Learner
Jan	18	Education	High-Speed Learner
Laurie	19	Education	On-Task Collaborative Learner
Naomi	18	not specified	On-tTsk Collaborative Learner
Olivia	18	Food Science	Digital Age Reader
Marcia	18	Nursing	Adaptive Rapid Communication Technology User
Nicole	18	Social Sciences	Adaptive Rapid Communication Technology User
Lorna	20	Arts & Letters	Adaptive Multitasker

The participants' scores on the Digital Characteristics scores and Productive Learning Habits scores are shown in relation to the mean scores in Figure 1.

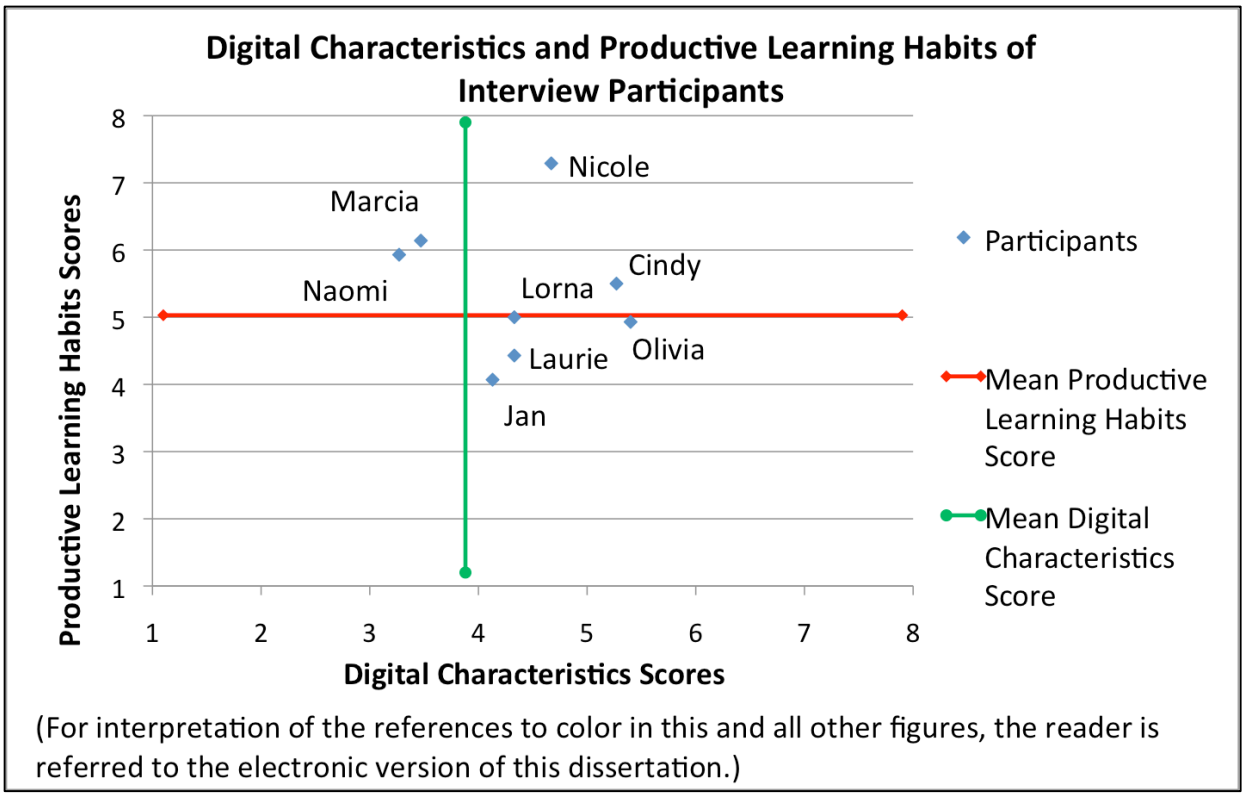

Figure 1. Digital Characteristics and Productive Learning Habits of Interview Participants

The Participants' Stories

The following narratives present a picture of each participant as an individual digital native learner and highlight their responses to the portion of the interview that was unique to each participant. A more general description of the themes that emerged from the interviews will be provided in the next subsection.

Cindy. Cindy is an 18 year old female majoring in a social science field. She exemplified the "High-Speed Learner" type, characterized by a preference for quick payoffs and timely rewards (where Cindy scored six out of eight) but who also expressed a general enjoyment of learning (where Cindy scored six out of eight). Her Average Digital Characteristics score was 5.27, which is 1.8 standard deviations above the mean, and her Average Productive Learning Habits score was 5.50, which is also slightly above the group mean of 5.03. Cindy rated herself particularly high, scoring the maximum value of eight, on her ability to learn from doing projects. Cindy's technology use, compared to the sample mean, is shown in Figure 2.

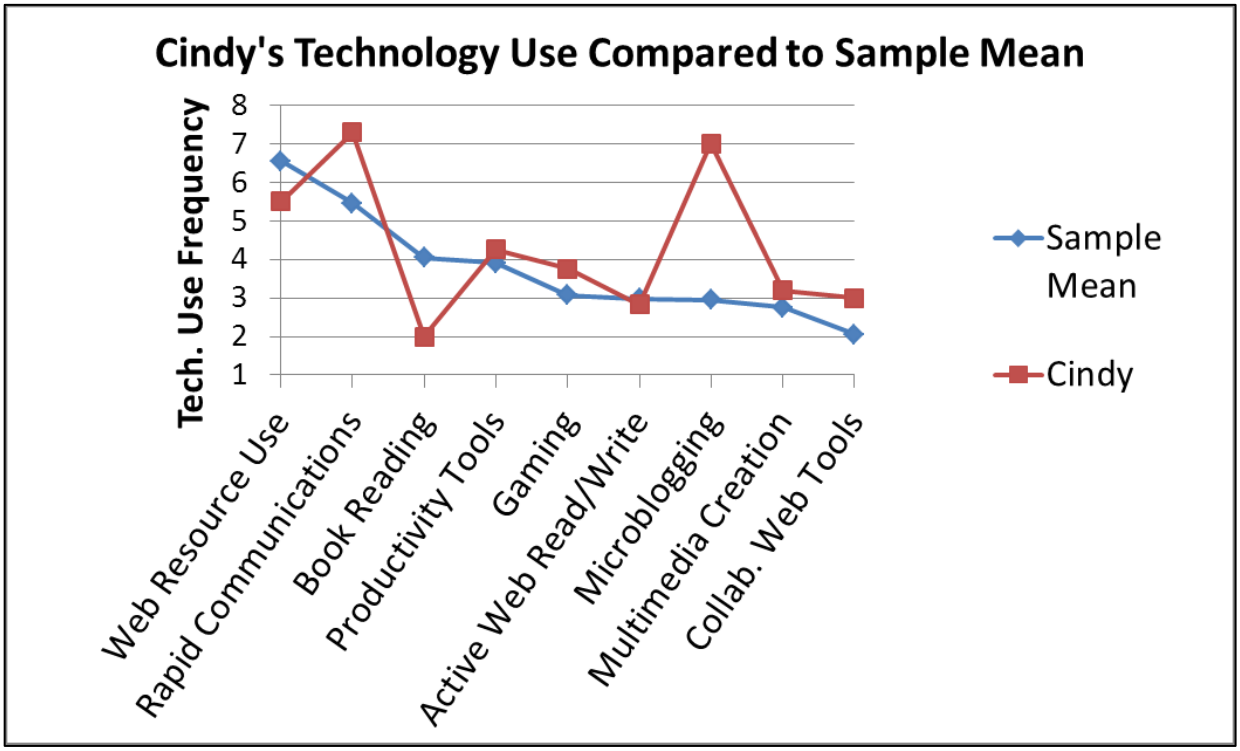

Figure 2. Cindy's Technology Use

During our conversation she talked energetically about her preference for project work, her dislike of reading, and her desire to find quick answers. About writing papers she said:

> I wanta' just find the sources right away and I don't wanta' have to go through the trouble of looking through every single thing that it says in articles and like finding if it's scholarly or everything. Just, it's frustrating to me.

When I asked her how she reconciled her enjoyment of learning with her impatience in following the scholarly process, she explained,

> I enjoy, like, the punctuality and how you have to turn it in on time and I like deadlines and knowing that I'm like doing something for a purpose and that I'm learning things like so I can succeed later on and apply what I'm learning to life later.

One project she described in detail that she felt helped her learn was making a clay model of the brain in her psychology class. She mentioned that some of her classmates had chosen to make the model out of cake but she had chosen clay with labels of the parts of the brain attached to toothpicks. Since project work, if not carefully designed, can be more distracting than helpful for learning (Willingham, 2003), I asked Cindy how she managed to keep her focus on learning while making the clay model. She explained,

> I just try to think about like what it's actually trying to make me learn at the end of the day and like knowing the information after completing the project is more important than the actual contents that make up the 3D image or project.

Cindy scored 7.29 out of eight on her use of Rapid Communication Technology, but when she discussed Facebook she emphasized its value in helping her work team plan meetings and follow-up on work in progress rather than for social communication. She preferred face-to-face meetings when collaborative work needed to be done because she found it a more efficient form of communication. She explained the difference between online and face-to-face communication this way:

> Online, I think, people are really, they don't know how people are saying things and you can get thrown off if it's an order or if they're being polite and it's more like online, you are just saying like blunt things, just to get it done and then in person, you can interact and like communicate how you feel about things and how, like what parts each person should be doing and if it's fair and people's reactions.

In order to clarify her meaning, I asked her, "so online…you might hurt their feelings if you're too blunt, whereas face-to-face you feel like you can go ahead and be blunt?" She agreed that this was the correct interpretation of her comment.

In her discussion of how she feels technology has affected her learning, she once again discussed efficiency and expediency.

> Like we have the efficiency now in that like laptops in the classrooms, especially at college, really help instead of writing on paper and pen and also people like using recorders or things when the professor talks...I think things like that really help students out nowadays.

In her discussions of reading and writing, project work, social media use, and technology, Cindy's comments all seemed to emphasize a desire to get the task completed in the most efficient possible way, with the practical purpose of the work always in mind. When reviewing the four popular press quotes about her generation, she generally agreed that the descriptions sounded like her and like her friends. At first she described herself as a good multitasker, saying "Usually I'm in front of the TV with a computer on my lap with my phone, like answering text messages, while doing homework," but she also said "no one is actually good at multitasking, it's just taking longer." Her multitasking behavior seemed to conflict with the drive for efficiency she had revealed earlier, so I pressed for more detail on how often she actually did her homework under those conditions. She then revealed that she did the majority of her studying during the day in the library, deliberately separating herself from distractions. The multitasking behavior she had described occurred mainly in the evenings when working on "easier stuff I put off for like when I can just relax and sit and watch TV or do other things."

While Cindy felt she was managing her own learning and technology use well, she had concerns about how it would affect the next generation if technology continued to be integrated into children's lives at younger ages.

> I'm worried for my kids' sakes of how far it's gonna' be going that…like babies are asking for cell phones and asking for technology that I didn't get until I was older. Like it just keeps growing younger and younger, I feel like, and it's not a good thing for them…I just feel like people are missing out on their childhoods now and they're just trying to grow up way too fast and they're not even experiencing like the outdoors anymore. Where I used to be outside, like my whole childhood and now they just wanta' stay in and use their laptops.

Jan. Jan is an 18 year old female majoring in education. Like Cindy, she also exemplified the "High-Speed Learner" type, characterized by a preference for quick payoffs and timely rewards (where Jan scored a six out of eight) but who also expressed a general enjoyment of learning (where Jan scored a six out of eight). Her Average Digital Characteristics score was 4.13, which is 0.3 standard deviations above the mean, and her Average Productive Learning Habits score was 4.07, which is one standard deviation below the group mean of 5.03. Jan also rated herself particularly high, scoring seven out of eight, on her ability to learn from project work. While she self-reported a grade point average of 3.5 or higher, she rated herself only three out of eight for how well she felt her learning strategies were meeting her learning goals. Jan's technology use, compared to the sample mean, is shown in Figure 3.

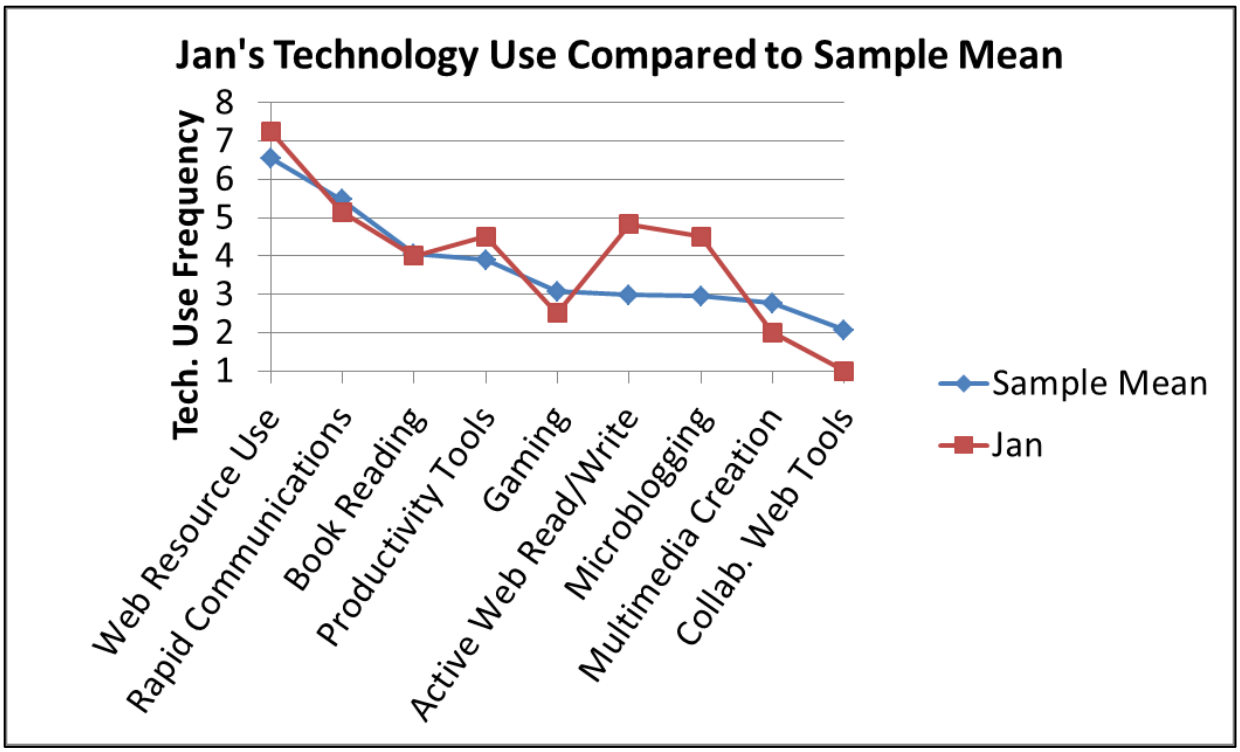

Figure 3. Jan's Technology Use

When I asked Jan how she managed to enjoy the learning process despite her tendency to prefer quick payoff, she emphasized strategies for setting her own short-term goals and rewarding herself for achieving them. As she explained, "I try to plan out by like hour, hour and a half, then I'll go do something else, then I'll come back and do it for like another hour, hour and a half. I can only sit still for so long." When I asked her what she used for rewards during breaks, she mentioned eating and visiting with friends in the dorm, but said her favorite way to take a break was to read a popular novel such as *The Hunger Games*. She emphasized that she only enjoyed reading printed text. She had no interest in e-readers, and when course readings were provided in electronic form she always printed them out to read. At the same time, she found reading for pleasure to be a break from, and a reward for, reading course materials.

When discussing her ability to learn from doing projects, Jan was able to list several examples of times when she had learned through investigating a topic and then presenting what she'd learned in some creative form, either with technology (a PowerPoint with voiceover) or without it (a scrapbook). When I asked how she avoided getting distracted by the technical aspects of creating the project in order to focus on learning, she explained that that project work prevented a distraction that was more troublesome for her: her anxiety about grades. As she explained, "it's a lot less stressful for me to just put it there. Like just have a different output for it than for, like, testing or essay. I'm not a good test taker at all so…I love projects so much more."

Despite this preference for learning by doing, Jan also expressed a strong preference for using books instead of web pages to find information.

> I just kinda' like being able to find exactly what I want in a book whereas on a web page, it'll just direct me… I can just Google anything and it'll direct me to a bunch of web pages that I don't necessarily care much about. Whereas in a book, I can find like a very specific book about a very specific topic and I just really like that…I get overwhelmed by Google searches sometimes.

She revealed a similar preference for traditional over digital technology when she explained why she preferred taking notes by hand in class instead of typing them on her laptop. She felt the process of hand writing her notes encouraged deeper processing of the information, explaining that "when I'm writing them by hand, it just takes me longer to just process it whereas when I'm typing, it's just a lot faster and I'm just… just typing without really remembering what I'm typing."

When I asked about the apparent incongruity between her good grades and her low assessment of the effectiveness of her learning strategies, she explained that, "I'm not a good studier…I have a tendency to just like memorize information and not actually like put it into long-term memory." She described a number of strategies she used, such as highlighting important points in the text and making flashcards, but said all these strategies led to memorizing just for the midterm but not being able to retrieve it again on the final exam. She contrasted this with project work, which helped her remember what she'd studied until the final exam or beyond. She attributed this improved retention to being more engaged in the learning process. "I get bored doing flashcards and I don't get bored when I'm constantly like working at something and enjoying doing it."

When reviewing the popular press quotes about her generation, she generally believed they were good descriptions of her generation, but felt like she was different from others her age. She described herself as being more of a reader than most people her age, less digitally connected, and a particularly bad multitasker. She enjoyed reading for pleasure and found it refreshing to separate herself from the social world temporarily while enjoying a good book. "It's kind of like my alone time," she explained. When discussing Facebook, she initially described herself as conforming well to the quote by Bauerlein (2008) suggesting an obsession with peers above all else. "I don't know why I'm so enthralled by people I don't know that well," she said. When pressed for detail, however, she revealed that she logged on to Facebook only two or three times a week and stayed on for about an hour each time. She had also set up accounts on several other social media sites, such and Twitter and Tumblr, but rarely used them. She also did not see heavy use of social media sites as being a healthy activity.

> When you're on Facebook, you're really just looking at other people. You're not sitting there and being yourself and just doing what you really want to do. You're just looking at what other people have done and I just think that seems kind of silly.

In addition, she reported using her cell phone infrequently, and described this as a deliberate choice. "Sometimes I feel like I should turn my cell phone on more often just because my friends are like why are you so hard to talk to? But…I mean, I'll turn it on when I feel like it." Through her descriptions of her social media and cell phone use, Jan revealed herself to be relatively uninterested in maintaining constant connectivity with her peers, though she felt her behavior was atypical for her generation.

Another way in which Jan felt atypical for her generation was on the subject of multitasking. Though she did not believe anyone could multitask effectively, she felt that she had even less ability than her friends in this regard, and therefore she never attempted to multitask. When she did her homework:

> My cell phone is off; my iPod is far away… I can do one thing at once and that's probably also why I get overwhelmed on the Internet is just because there's so many things happening at once. Like I could have so many browsers open and that's just, that is too much for me.

Even background music was off limits to her because "I can't."

Jan saw herself as being less digital than the average digital native. "A lot of people are so much more technologically advanced than I am," she said. When I asked her if she felt like her lower use of technology was her own choice, she said, "I feel like it was, like all through high school. Like I just kinda' chose…my parents offered to get me a cell phone when I was 13

and I was like, nah." When I asked her if she felt she'd found the level of technology use that was right for her, she replied, "I'm getting there. I'm getting there."

Laurie. Laurie is a 19 year old female majoring in education. She exemplified the "On-Task Collaborative Learner" type, characterized by a preference for studying with friends instead of alone (where Laurie scored eight out of eight) but also a high ability to avoid socializing and stay on-task (where she scored six out of eight). Her Average Digital Characteristics score was 4.33, which is 0.7 standard deviations above the mean, and her Average Productive Learning Habits score was 4.43, which is 0.6 standard deviations below the group mean of 5.03. Laurie's technology use, compared to the sample mean, is shown in Figure 4.

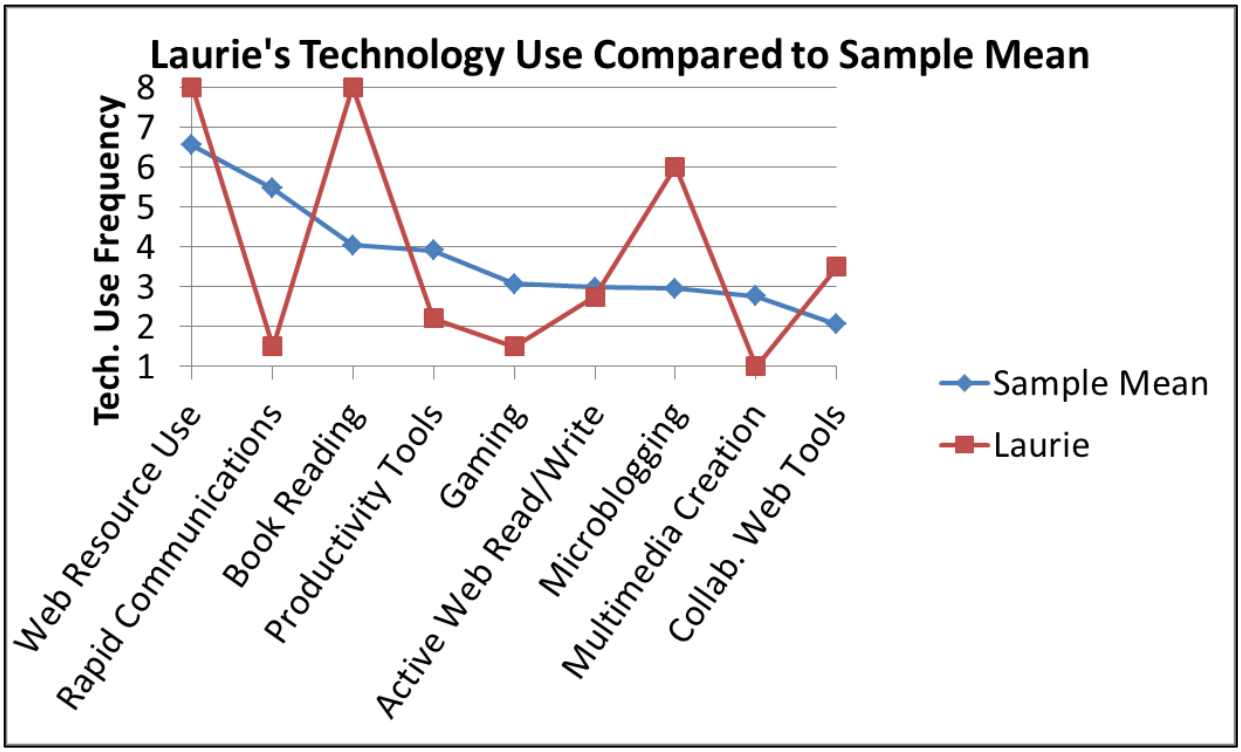

Figure 4. Laurie's Technology Use

Laurie preferred studying with friends over studying alone. As she explained, "I'd rather be in a group, either with people who are in my classes or just other people who are studying. It just keeps me motivated. Keeps me focused." She explained that she lived in a quad-type dorm room with three roommates, and the four of them often studied together. When asked to think about how she managed to stay on-task and avoid the temptation to socialize, she described how both her friends' behavior and her own strategies kept her on-task. She described her roommates as being a task-focused group most of the time. "We'll veer off but we're usually pretty good at, when we know we have stuff to do, we're pretty good at getting it done." She felt the group's behavior had a strong influence on her own study habits, saying that "if they're studying as well, then I'm okay. If they're doing other stuff, then I'll just join them. But if they're studying, too, even if it's not the same thing, I'll, I'm more likely to stay focused." On the occasions when her study group did socialize too much, Laurie described strategically separating herself from the distraction. "So most of the time, if they are socializing, I'm not in there. If I'm trying to do homework …I'll just kind of go to my desk [in the semi-private corner of the shared quad] and close myself off a little bit more."

Laurie also described an awareness of when studying with friends was helpful for her and when it was not. In general, she studied with friends while doing subjects that came easier for her, but sought more solitude when working on her most challenging subjects.

> Usually math doesn't matter…I can do that with other people around me 'cuz it's just one after the other. It's not one big thing. Writing papers, I usually need to be by myself, just 'cuz I need to gather my thoughts. Once I've started the paper, it doesn't matter as much. I can be out there. But when I'm starting it and I'm juggling my ideas and everything, I need to be by myself to write an outline or something like that.

Laurie's preference for group studying did not extend to the online world. She described her experiences with online meetings as "confusing," and rarely used collaborative web tools such as Google Docs for collaborative work.

> Sometimes if we can't all meet up or it's just more convenient to use the internet, we do. So I've only used Google Docs a couple times but it's usually through email that that happens. So we'll send each other stuff back and forth and work on our own stuff on our own time and then email it back and forth.

She described using social media to keep in touch with friends, with Facebook and Twitter serving different purposes. Laurie had lived in several places, including two countries in Europe, and she used Facebook as a way to keep in touch with distant friends. Twitter, on the other hand, facilitated communication with the friends she saw on a regular basis. Her tweet were usually directed at a specific person or group of friends, and were used in specific situations such as "if we already have plans, I'll say I'm excited for it or I'll just say in general, I'm excited to see someone." She also reported occasionally using Twitter to share links to other interesting websites she'd found, such as pictures and quotes she found on the website StumbleUpon.

Though Laurie reported being quite disciplined when studying with friends, she felt she had more difficulty controlling her multitasking with technology. As described earlier, if her face-to-face study companions distracted her, she left them and found a more private place to study. Shutting off the cell phone or ignoring a text message from a friend, on the other hand, was more difficult for her. I asked her why she thought these two situations were so different.

> It might be because I feel like I'm missing something if they text me or call me or something. I feel like I'm missing something. It's also contact with my parents, too. So obviously I don't live at home so I talk to them every day. So I don't know. I think it's

just a feeling like I'm missing something. But I don't feel like that when I'm not with my roommates 'cuz I know I'll see them really soon.

Naomi. Naomi was an 18 year old female planning to major in a natural sciences field who exemplified the On-Task Collaborative Learner category, expressing a strong preference for studying and learning with friends (where Naomi scored eight out of eight) but also reporting a good ability to control socializing and stay on-task (where she scored six out of eight). Her Average Digital Score was 3.27, which is 0.8 standard deviations below the mean of 3.88, and her Average Productive Learning Habits Score was 5.93, which is approximately one standard deviation above the mean. Naomi stood out as an interesting interview participant because of her answer to an open-ended question asking what the participant would include in a definition of learning. Naomi's rough definition of learning was "expanding your knowledge about the way the world functions and gathering new ideas and perspectives from others." Naomi's technology use, compared to the sample mean, is shown in Figure 5.

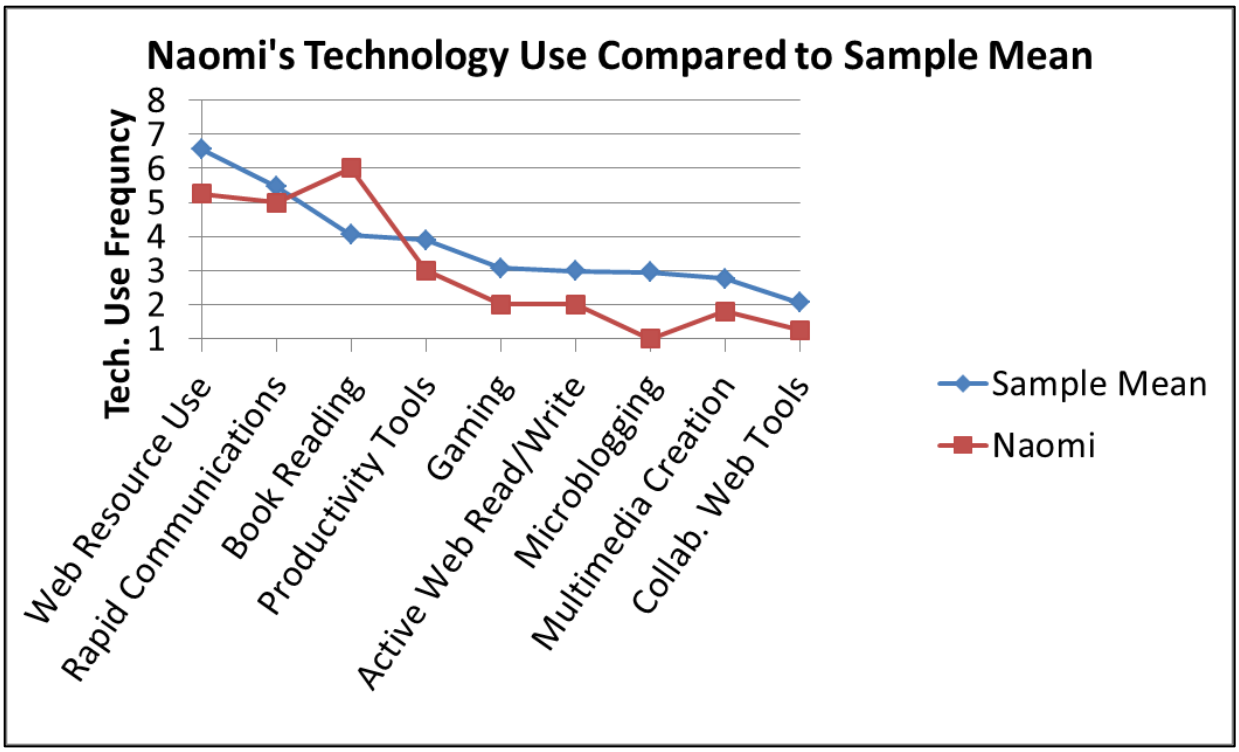

Figure 5. Naomi's Technology Use

I asked Naomi how she managed to stay on-task and avoid socializing while studying with friends. She mentioned both the importance of the task and the work ethic of her friends in her response.

> I think it's mostly because we study a lot under pressure. And it's like, there's a lot of, there's a lot of motivation to actually learn the material. And I also hang out with people who are like more academically oriented and they're also very invested in their grades as well.

Her collaborative study sessions were mostly face-to-face, and she found these in-person sessions more productive than online study sessions she had experienced.

> I feel like we get more off track if we try to study online. But in the past, I have done Skype, like, study dates. I don't think those are as helpful just because it's not, you can't

> show somebody the piece of paper. You can't show them, like work through the problem right in front of their eyes…there's just something about being face-to-face and, like, actually working through the problem with someone right there, saying like no, this is wrong. To catch you like that.

During her Skype study sessions she had tried using the screen sharing feature but found them to be cumbersome.

One of the reasons Naomi found it easier to stay on-task meeting face-to-face rather than online is that a face-to-face meeting discouraged multitasking with other technology, whereas she felt an online meeting encouraged it. "I think we do get more distracted just because usually I'll have Facebook up at the same time as Skype or something, other social media." In a face-to-face meeting her privacy concerns encouraged her to stay off of social media sites. "I think because it's kind of private. I don't know. There's something about Facebook being open for everyone to see. I'd just rather not have other people see my profile."

I asked her about her definition of learning, and if her desire to seek perspectives from others was one of the reasons she liked to study with others.

> Learning how they learn kind of helps me to make more connections to what I'm learning and maybe think about it in a way that I haven't previously thought before which helps learn the material, I think. In my chemistry class especially, a lot of my friends will find patterns that I haven't found. And learning how they approach it from like the pattern helps a lot.

She explained that even later, when she was studying on her own, she would use the new way of thinking about the material that user friends had modeled for her.

Olivia. Olivia was an 18 year old female majoring in a natural science field. She represented the Digital Age Reader category of participants who reported frequent Book Reading (scoring 6.5 out of eight) but had relatively high Average Digital Characteristics scores relative to other frequent Book Readers. Olivia's Average Digital Characteristics Score was 5.4, nearly two standard deviations above the mean, and her Average Productive Learning Habits Score was 4.93, just slightly below the mean of 5.03. Olivia's technology use, compared to the sample mean, is shown in Figure 6.

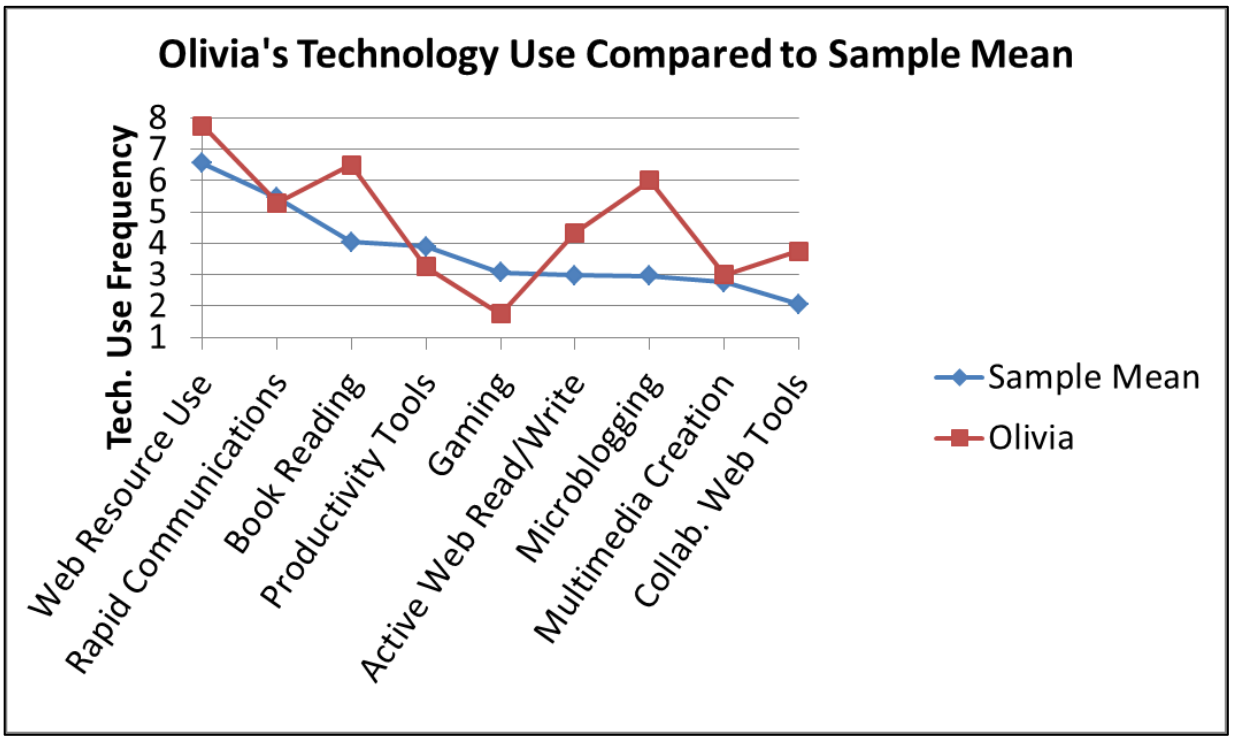

Figure 6. Olivia's Technology Use

Olivia said she had always been a reader, but she felt her frequency of reading for pleasure had increased after she had received an e-reader about six months before the interview. She attributed the increase in her reading to the convenience of the compact, lightweight device. "I think I read a lot more 'cuz I know when I first came to campus, I was reading Harry Potter. I

was re-reading the series and I know I would not be re-reading that around campus, lugging around those giant books if I had to have the real copy." She did not think the process of reading was different for her on the e-reader than it was with printed books. "It still feels the same as reading any old book."

She reported spending an average of three hours per week reading for pleasure, usually finishing the books she started. She felt she was a fast reader but that this was natural for her, and that she was not prone to rush through just to reach the end. The most recent book she had completed was *Galapagos* by Kurt Vonnegut, which she described as "weird…very strange" but she reported that she "loved it."

While she didn't think technology changed her reading very much, she discussed how the Internet had affected her learning of math.

> Like if I'm doing, recently math. Like if I need help, I can go to the internet and say, oh, how do I do this problem and I can look it up that way and then I can figure out how to do it. But sometimes it becomes too easy and I'm not doing it myself…I tend to just Google my problem. See if there's any, like exact copies and shows it step by step. And it can be very helpful but…sometimes I feel like I probably could've done a lot better if I figured this out myself but sometimes it's, these crazy problems, there's no way.

While she acknowledged that, at times, she could learn more from struggling through a problem on her own, at other times finding the solution modeled for her on a website was more productive than a fruitless unsuccessful struggle.

She also found digital video helpful for learning because of the ability to watch portions of it and customize it to her interests.

> I guess, like the History channel, like Discovery channel and stuff, like if you have, like, Netflix, you can watch whatever show, whatever portion of it you want and you can learn whatever you want as opposed to like when you're in class, you're learning this material so you can take a test and then forget it. Essentially. I mean, that's, right now I'm taking my freshman classes, that's what it feels like.

Her survey answers indicated that she enjoyed actively discovering information rather than having it provided for her. As she described it:

> I guess it's just more interesting when you're working and it doesn't stick with you as much when it's just provided, so when you're searching, it's like, oh, wow, look what I found, that's interesting. But when it's provided, it's like oh, I have to read this or oh, I need to know this.

This preference could be seen as a contradiction with her love of reading, since one could argue that a book simply provides information, but Olivia did not see this as a contradiction. "I do feel like I'm finding the information my own way when I'm reading a book. Because you can kind of interpret it however you want, I guess, with most books…especially that *Galapagos* book. I swear, it was so weird."

Marcia. Marcia is an 18 year old female majoring in a health sciences field, and exemplifies the Adaptive Rapid Communication Technology User category, those who report frequent use of Rapid Communication Technology (Marcia scored 7.43 out of eight) but who have high Average Productive Learning Habits scores. Because there was a significant negative correlation between Rapid Communication Technology use and Average Productive Learning Habits scores, these Adaptive Rapid Communication Technology Users are atypical for participants in this study. Marcia had an Average Digital Characteristics score of 3.47, which is

0.5 standard deviations below the mean, and an Average Productive Learning Habits score of 6.14, which is 1.20 standard deviations above the mean. Marcia's technology use, compared to the sample mean, is shown in Figure 7.

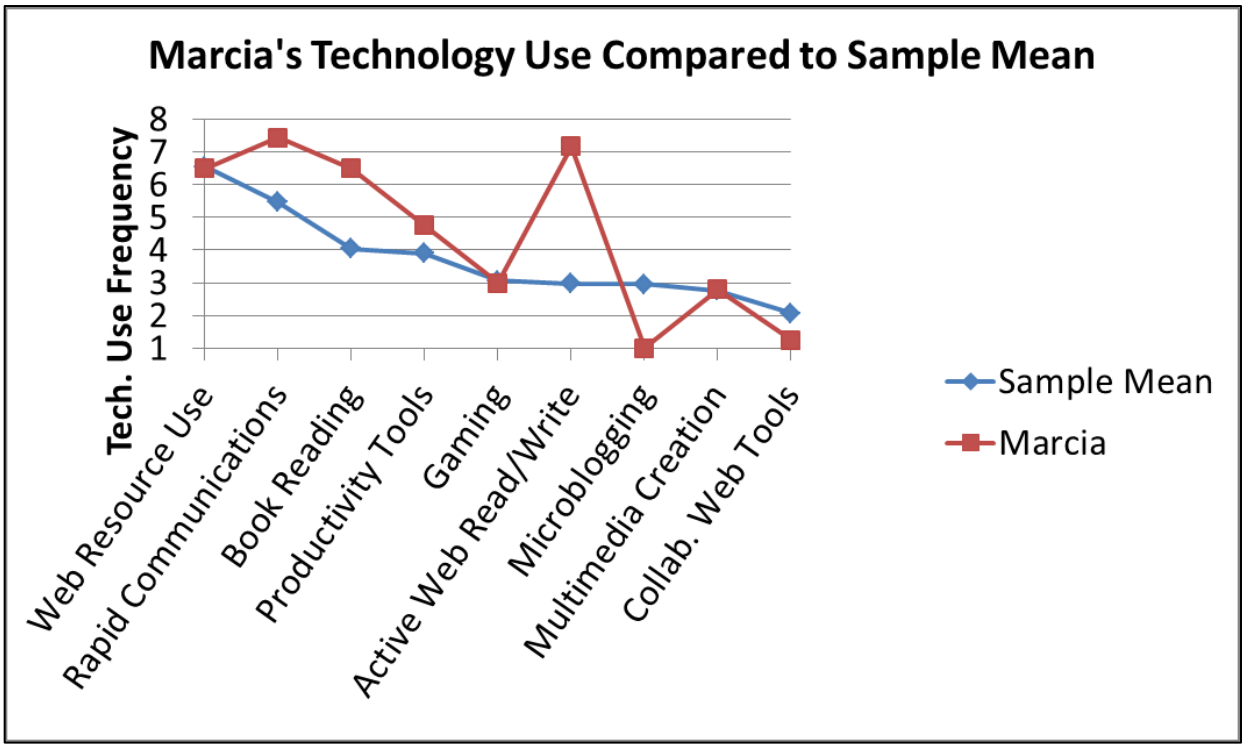

Figure 7. Marcia's Technology Use

I asked Marcia how she managed to keep her focus on learning in the midst of the temptation that Rapid Communications Technology poses. She listed both classic time management strategies and use of technology itself to control her use of technology. Under ordinary circumstances she described budgeting her time and setting up rewards. "I kinda set up, like I guess standards for myself. If I can finish this chapter, I can check for X amount of time." She also mentioned separating herself from sources of temptation by turning her phone off. In higher stakes situations, however, she used technology to assist her with her time management.

"For finals, I know, I don't remember the name of the website but I know there's a website that you can sign up and it won't let your computer access like those sites you list. So I did that for like blogs and like Facebook and all that stuff."

Despite her preference for Rapid Communication Technology, Marcia described herself as a slow and careful reader, both with printed text and online, when she was reading to learn.

> When I like know the information's important, I kinda' like to take breaks and say, like all right, so did I get what was going on here? And like I really do look at like the concept checks at the end of things to kinda' say, wait, I did not remember that and I go back, like and siphon through it. I read through things numerous times and like rewrite them. As I'm reading, I write it down so that it kinda' processes two different ways.

Because some of the popular press writers are claiming that frequent use of Rapid Communication Technology impairs the ability to read in the thoughtful manner Marcia described (Carr, 2010), I asked Marcia how she managed to switch so easily between them. "I have no problem, I guess, like deciding, okay, this is something quick and this is something that's not going to be quick." She also described a deliberate reorienting process she used when returning to her studies after taking a break to use social media. "If I'm going back to reading after I was on Facebook… Like you just kinda' look over your last few sentences and, like, whatever you last highlighted to, like, review so that you kind of, you recognize something and then it leads into learning something new."

Marcia was one of the few respondents to the survey who wrote a thoughtful response on the open-ended question about what she would include in a definition of learning, so I asked her what learning meant to her. Her answer addressed not only gaining new information but also increasing depth and correcting misconceptions.

> It's enhancing in a sense that…when you take a class or when you're re-reading something that you've already learned, you can always add to it. You can always like change it and, I mean, you can always, I guess, fixate things. You can further learn something more than what you knew or you can even change like your mindset… If you were completely wrong in whatever you thought…it's just enhancing 'cuz you already had a knowledge of something and even though your knowledge was wrong, it was a knowledge that you had so… I mean, you can disprove, discredit or you can just further prove.

Nicole. Nicole was an 18 year old female majoring in a health science field. She represented the Adaptive Rapid Communication Technology User category, with a high use of Rapid Communication Technology (scoring 6.57 out of eight) and also a high Average Productive Learning Habits score. Her Average Digital Characteristics score was 4.67, which is one standard deviation above the mean, and her Average Productive Learning Habits score was 7.29, which is 2.4 standard deviations above the mean. Her self-reported GPA was in the 3.5-3.9 range. Nicole's technology use, compared to the sample mean, is shown in Figure 8.

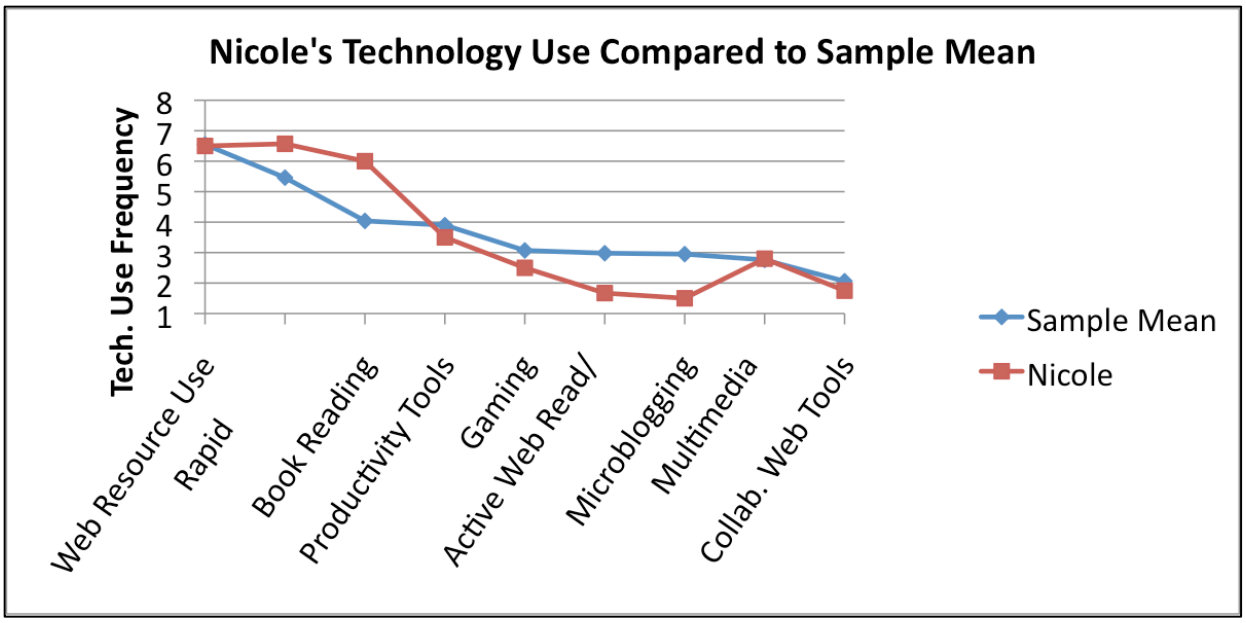

Figure 8. Nicole's Technology Use

When asked how she managed to focus her attention on learning in the midst of her fast-paced interactions using Rapid Communication Technology, she emphasized separating herself from the technology in order to focus on a task.

> If I have like a project or homework to do, I just kinda' like think of what has to be done and I just like, I don't know, I just get it done. And then sometimes, I'll take a break and Facebook or something, but I never have like Facebook open with my homework or something like that 'cuz you can just click over. So I just close it.

The Rapid Communication Technology and other technology she enjoyed sometimes became a reward after a stretch of disciplined study. "If I get it done, you know, maybe I'll watch Netflix or go on Facebook or text someone."

Since Nicole had rated herself as an eight, the maximum score, on her ability to persist when facing short-term boredom, I asked her how she achieved this persistence. She described her ability to focus on longer-term goals and rewards:

> I've always, like, pushed myself in school so when I have homework or tests or stuff, honestly I just think about, like, 4.0, like the 4.0 on the paper, the test or something, even if I don't get it. Like, it's like that, you keep going to get that.

Nicole responded to the open-ended prompt asking for her definition of learning with the words, "getting engaged, active listening, enjoying the topic," so I asked her to elaborate more on her thoughts about engagement and enjoyment of learning. She responded:

> Like for me, like to learn, I definitely have to be active, like paying attention and making sure the stuff's actually absorbing. And like if I enjoy the topic more, I'll learn about it. If I don't, I'll just like temporary learn and then when the exam's over, I have no idea what I just learned.

I asked what specific strategies she used that she considered to be active, and she listed making flashcards, retyping her hand-written notes from class, and highlighting important points from her notes. I asked her what she thought was different about studying topics that interested her versus those that didn't. "I don't know. Like I do the same stuff but I just don't seem to, like, absorb it as long."

Lorna. Lorna was a 20 year old female majoring in a liberal arts field. She represented the category of participants I called Adaptive Multitaskers, those who report a high tendency to multitask (Lorna scored six out of eight) but also report a high ability to control their multitasking when they need to (where Lorna scored seven out of eight). Lorna had an Average Digital score of 4.33, which is 0.7 standard deviations above the mean, and an Average Productive Learning Habits score of 5.0, which is close to the mean of 5.03. Lorna's technology use, compared to the sample mean, is shown in Figure 9.

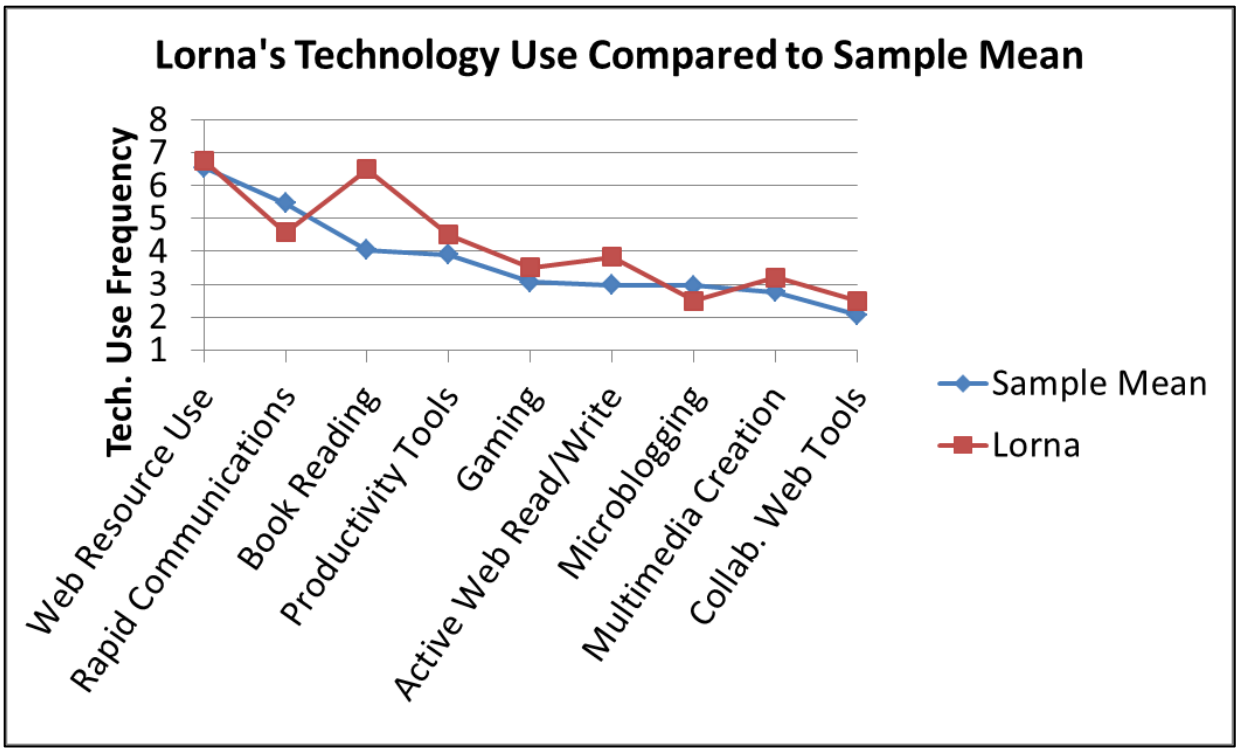

Figure 9. Lorna's Technology Use

She said her most common activities while multitasking were studying while watching TV, but that she used the TV more for background noise rather than truly attempting to attend to both activities at the same time. She also reported sometimes being distracted by websites like Facebook and Tumblr while studying, sometimes switching to these sites for a quick break from homework but then realizing she'd been on longer than she intended. "And like I'll be like, okay, I'll read this chapter and I'll go on Tumblr for a bit and it ends up being, like, more than 15 minutes." Her cell phone, however, was used mainly for arranging meetings with friends, rather than for socializing while doing homework.

Lorna's decisions about when to control multitasking were based on the difficulty or the importance of the task.

> Usually if there's like a test coming up or I have, like, a project or homework due, that's when I really focus on it. And when, like it's not as important is like at the end of the day or I don't have anything due. Like usually I study throughout the day and then when I get back to my dorm around 6, that's when I just kinda' like shut down and do whatever.

When she felt she needed to focus on a single task, Lorna separated herself from the source of temptation. "I usually just try to get away from it or if I need to like really read, I'll go into our study lounge that doesn't have Internet."

Lorna also reported a high ability to focus and listen to a lecture when needed (scoring eight our of eight), and to be persistent when she encountered short-term boredom (scoring eight out of eight). She found listening to a lecture easier when she was interested in the topic or the stakes were high for her. "It usually depends on if I'm interested in it or if I'm, or if I really need to listen… like if a test is coming up." She purposely leaves her laptop at home when attending class in order to minimize the temptation to multitask with technology, but admitted that her mind sometimes wandered in class and her own daydreaming would distract her. Her strategy for dealing with short-term boredom while studying on her own was to find ways to reward herself for her persistence. "I usually use rewards to get through that, like to watch TV or do something fun. Like if I finish a chapter, I'll be like, okay, I get to spend some time on Tumblr or Facebook for a while."

Lorna used an open-ended comment field on the survey to express her opinions about the limitations of technology. On the survey she said, "I like using technology for research, but I think that using technology instead of teachers is not good. I think that learning from a person is better than learning from technology." When I asked her to elaborate on this comment during the interview, she said:

> I do a lot of research papers and it's really helpful for like articles and using, finding like more information. But when it comes to actually understanding something, like I feel a teacher can really explain it better… I just don't like hearing stuff that it's like where they have kids learning from like computer. Like I just think that you can learn from a person better and they can give you different ways to like think of something or understand a problem.

I asked her for a specific example of a time when a teacher had been able to provide new ways to think about a problem.

> Like we would have homework online for math and I just like, there's only, there's one answer but if you don't get it, I don't understand what I did wrong. But a teacher can like help you go through the problem and explain it whereas with like an online math program, it's just like, okay, it's either this number or that number and you just keep guessing and guessing, but then if someone's there, you can actually learn through the whole problem.

Coding of Emergent Themes

Several themes emerged from the interviews, either because several participants mentioned the same concept or because one participant revisited the same theme multiple times. The themes were categorized based on their conceptual connection to each other and also by how they addressed the three parts of Research Question 5. A complete list of all codes, definitions, and examples, and frequency counts can be found in Table 23.

Table 23: *Code Definitions and Examples*

Code Name	Description	Example	Frequency	Number of Participants
Thoughts on Technology				
Technology in daily life	Discusses the benefits of technology primarily for situations other than learning (e.g., convenience, etc.)	"I remember a lot of cool stuff in like high school because of technology...like in prom, at the end, we got a DVD with a bunch of pictures and slide shows and stuff and obviously, that wouldn't be there without technology."	6	3
Technology assists learning	Discusses the benefits of technology for learning	"We have the efficiency now in that like laptops in the classrooms...really help instead of writing on paper and pen and also people like using recorders or things when the professor talks."	11	6
Technology use as choice	Discusses her choices about how much technology she wants to use	"I understand the reward and benefit of functioning without [technology]. But I do use it."	2	2
Technology as challenge	Discusses how technology poses a challenge (but not a threat) to learning	"I guess print books and a lot of the old ways of learning were very standard. They didn't change and now that you have technology, things are constantly changing."	4	3

Table 23 (cont'd)

Code Name	Description	Example	Frequency	Number of Participants
Technology as threat	Discusses the risks or threats that technology poses for them or for the next generation	"I'm worried for my kids' sakes of how far it's gonna be going that like little three, like babies are asking for cell phones and asking for technology that I didn't get until I was older. Like it just keeps growing younger and younger, I feel like, and it's not a good thing for them."	6	5
Comments on Specific Digital Native Characteristics				
Long Term View	Expresses acceptance or acknowledges value of long-term (as opposed to short-term) rewards	"When I have homework or tests or stuff, honestly I just think about...the 4.0...even if I don't get it. Like...you keep going to get that."	10	7
Online versus Print	Discusses difference between reading online and reading print text	"On a web site, you look at the graphics first but in a book, you like, it's like you're reading and then you're like, oh, pictures and then you look at it."	5	3
Strategy: Adaptive Reading	Using different reading techniques in different situations	"If I'm reading like just a novel for fun or something, I'll read really, really fast and not really like think about it. But if I'm reading like a textbook, I read really, really slow."	3	2
Strategy: Writing vs Typing	Strategic decision about whether to use computer or handwriting for	"I started off my first semester like taking all my notes by typing them and I could not remember	4	3

Table 23 (cont'd)

Code Name	Description	Example	Frequency	Number of Participants
	learning	anything that way so I switched over to pen and paper."		
Strategy: Attention Control	Focusing more attention when challenged or when stakes are high	"I text a lot more in math cuz I'm pretty good at it and I put it away, like if I'm doing science cuz it's my worst subject ."	9	6
Strategy: Separation	Separating herself from distraction of technology, multitasking, or people	"For finals...there's a website that you can sign up and it won't let your computer access like those sites you list."	9	5
Strategy: time management	Using technology, reading, or conversation as break or reward; using Facebook blocking software; other novel or traditional time management strategies	"I kinda' set up...standards for myself. If I can finish this chapter, I can check [Facebook] for X amount of time."	5	4
Multitasking: Bad for everyone	Doesn't believe multitasking is good for anyone	"I don't think anyone can multitask efficiently."	9	5
Multitasking: I can't do it myself but maybe others can	Believes her friends are good multitaskers but she is not	"A lot of people can just have [the TV on] in the background but I just get too, like there's too much going on in my brain and I can't handle it."	4	4
Multitasking: I'm good at it	Believes she multitasks as well as the claims suggest	"I remember watching like every episode and whatever happened and then I always did well in high school so I had to be retaining information."	3	3

Table 23 (cont'd)

Code Name	Description	Example	Frequency	Number of Participants
Multitasking: does not actually occur	Believes that instances that appear to be multitasking are really not	"I don't think they pay attention to what's actually going on, on TV. I think it's just kind of something to put noise there."	2	2
Reading: I/we don't want to	Believes her generation is less interested in reading than the older generation	"People read way less for leisure than...they did back whenever. My mom reads a lot still. So there must be some sort of change."	10	4
Reading: I/we don't have time	Believes it is time constraints, not interest, that limit reading for her generation	"High school senior year, I think I read...100 books…[but] in college, like, I don't have enough time to read for fun ."	4	4
Reading: I like to read	Expresses enjoyment of reading	"I think [reading] was kind of just something expected and I ended up growing to love it."	5	4
Connectivity: yes	I like to be connected to my friends at all times	"Even if I'm at home all weekend and I'm studying...you feel like you were there with them almost. You know, you can feel connected."	3	1
Connectivity: no	I don't like/need to be connected at all times	"Gosh, no. I don't really care what my classmates did over the weekend. I don't think anyone cares."	2	1
Solitude	Sees value in solitude	"I do think books can make you feel isolated but I don't think it's in a bad way. I think it's like a good way. It's your own escape, you know ."	4	3

Table 23 (cont'd)

Code Name	Description	Example	Frequency	Number of Participants
Speed	Expresses need for speed and instant results, like claims	"I feel like I wanta' just find the sources right away and I don't wanta' have to go through the trouble of looking through every single thing that it says in articles. It's frustrating to me."	3	3
Overwhelmed	discusses being overwhelmed or confused by technology	"I get overwhelmed by Google searches sometimes."	2	1
Desire for customization and choice	discusses benefits of customization in learning	"If you have like Netflix, you can watch whatever show, whatever portion of it you want and you can learn whatever you want."	2	1
Need for activity	Discusses need for activity when learning	"I get bored doing flashcards and I don't get bored when I'm constantly like working at something and enjoying doing it."	3	2
Preference for face-to-face over online	Discusses preference for F2F teaching or collaborative studying	"It's mostly face-to-face, most… I feel like we get more off track if we try to study online."	5	3
Reactions to the Claims about Digital Natives				
The claim sounds like me	Agrees that a claim is true for her	After reading the Bauerlein quote: "I agree 100%. I don't like reading. I never really have."	16	7
The claim does not sound like me	Says that the claim is not true for her	"That's not me at all."	10	6

Table 23 (cont'd)

Code Name	Description	Example	Frequency	Number of Participants
The claim sounds like my friends or my generation	Agrees that the claim is true for her generation	"I don't know…it's pretty accurate."	31	8
The claim does not sound like my friends or my generation	Says the claim is not true for her generation	"No, not my friends, either."	3	2
The claim is a sad commentary on my generation	Believes this aspect of her generation is unfortunate or "sad"	"It is kind of embarrassing that I come from a generation that can't read a book."	5	3
The claim is insulting	Finds the claim about her generation insulting	"I think they're not giving us enough credit for wanting to learn."	8	4
The claim is true for everyone, not just my generation	Expresses opinion that a claim is universal and not just her generation	"Every generation of kids our age are gonna' prefer games to serious work. So I don't think that has anything to do with our generation specifically."	3	3

The influence of technology. Under the first subpart of Research Question 5, pertaining to the connections the participants see between technology use and their own learning, five themes emerged. The most prevalent theme was "technology assists learning," where participants discussed in general or specific terms how they felt technology helped them learn. There were 11 instances of this code. In some cases participants emphasized how the convenience of technology facilitated their learning. For example, Cindy described how "we

have the efficiency now in that laptops in the classrooms…really help instead of writing on paper and pen, and also people, like, using recorders or things when the professor talks." Others were much more specific about how the affordances of some technologies helped them with specific challenges. One participant, for example, described how she used the mouse to highlight text on a web page in order to better focus her attention and compensate for her mild reading comprehension difficulty.

The second most prevalent code in this category, with six instances, was "technology in daily life," where participants discussed how technology made daily life and administrative tasks more convenient in areas not directly related to learning. Cindy, for example, said that she and her colleagues in the science laboratory where she worked used Facebook to schedule face-to-face meetings and to follow up on administrative tasks between meetings.

A less frequent but interesting code was "technology as choice." While only two participants mentioned this code, it demonstrates that some students from the digital native generation do at least occasionally reflect on their technology use. Jan, a student who uses her cell phone infrequently, stated "Sometimes I feel like I should turn my cell phone on more often just because my friends are, like, why are you so hard to talk to? But…I'll turn it on when I feel like it." Marcia explained that "I understand the reward and benefit of functioning without [technology], but I do use it."

There were six instances of participants mentioning "technology as threat." These students had concerns about how the increasing use of digital technology among younger and younger children might affect the next generation. Cindy explained, "I'm worried for my kids' sakes…babies are asking for cell phones and asking for technology that I didn't get until I was

older. Like it just keeps growing younger and younger, I feel like, and it's not a good thing for them."

The fifth code in this category, mentioned four times, was "technology as challenge," where participants mentioned ways in which technology had posed a challenge to their learning due to the rapid pace of change, but had ultimately neither helped nor hurt them, in their opinion.

Digital Learner Characteristics. The second part of Research Question 5 asked in what ways the participants saw themselves as similar to and different from the popular claims made about their generation. There were 22 codes in this category, and they arose from interview questions that specifically followed up on survey responses and also from interview questions asking respondents to react to excerpts from popular press books written about their generation.

Taking a long-term view. One theme that was mentioned frequently was an ability to take a long-term view in response to short-term boredom. In contrast to claims that digital natives need frequent feedback and rewards for their efforts, there were 10 instances of participants mentioning their ability to work toward long-term goals. Marcia said this in response to a quote claiming that digital natives need instant gratification:

> I don't think instant gratification or frequent rewards are necessarily true. I do see that, like obviously anyone's happy with instant gratification, frequent awards. It's not like something people are upset about but I don't think that it necessarily describes me the best. I think that I have a pretty good sense of long-term benefits rather than just the instant part of it.

Laurie expressed the same theme when she said:

> Honestly, I'd rather, I'd rather know that I'm gonna get good grades if I work hard than know I'm gonna get candy tomorrow, you know? Like, I'd rather, that's more important

to me than anything so...I wouldn't be here still otherwise. I would've lost motivation a long time ago.

Reading. Three themes related to reading were present in the data. In five instances respondents said they liked to read for pleasure, while there were 10 instances of respondents saying they did not like to read or did not believe most people their age liked to read. In four instances respondents stated that it was lack of time, rather than lack of interest, that kept them and their classmates from reading for pleasure.

Multitasking. On the subject of multitasking there were four different opinions expressed. There were nine instances of respondents saying they believed multitasking was harmful for everyone. Jan described her perceptions of her multitasking friends this way:

> I know they do multitask. However, I mean, in my opinion, it just kinda' divides your attention and whatever you're doing, you're not doing it to the full capability that you could be…I feel like when you're texting and doing your homework and listening to music, you're not fully paying attention to all three of those things. So I mean, they don't seem to struggle [but]…then they take a test and don't do well and wonder why.

In four instances respondents said they were personally not capable of multitasking but they believed their friends or classmates were. In two instances respondents expressed the opinion that cases that appeared to be multitasking really were not. In both of these cases the respondents mentioned studying while the TV was on, and stated that the TV was really just "background noise" that was not really being attended to by the person who was supposedly multitasking. There were three instances where respondents said they were good at multitasking, though Nicole said she had quit doing it as a college student because she did not have a TV in her dorm room. She described her high school experience this way: "I remember watching, like,

every episode and whatever happened and then I always did well in high school so I had to be retaining information."

Strategies. Another category of codes that emerged appeared to be a set of strategies for studying and learning that the participants employed regularly. The five strategies were (1) adaptive reading in different situations, (2) strategic choices about when to type and when to write by hand, (3) control of attention for more difficult or higher stakes tasks, (4) separation from distraction, and (5) time management strategies.

There were three instances where participants mentioned adapting their reading strategies to different situations. Nicole, for example, explained, "If I'm reading like just a novel for fun or something, I'll read really, really fast and not really like think about it. But if I'm reading like a textbook, I read really, really slow." Olivia was even more explicit in describing her reflective style of reading when she viewed something as particularly important. "If I'm reading a book or something, I zoom through it but when I, like, know the information's important, I kinda' like to take breaks and say, like, all right, so did I get what was going on here?"

In four instances participants mentioned their strategic choices about whether typing notes or handwriting were better for learning. Jan discussed a change in her strategy for in-class note-taking when she said, "I started off my first semester like taking all my notes by typing them and I could not remember anything that way so I switched over to pen and paper." Laurie had a different strategy, typing notes in class but then copying them by hand as a form of studying. As she explained:

> When I'm studying for exams or something like that, I'll…read…from my Word document and just write everything out. Or write the important stuff out because writing,

like I said, it helps me… I mean, it's like studying over and over and over again. That helps a lot, too.

While their strategies are different, they both describe strategic decisions about when to write and when to type in order to help them learn.

There were nine instances where participants mentioned focusing their attention when working on something they saw as more important or something that was difficult for them. Nicole explained that "I text a lot more in math 'cuz I'm pretty good at it and I put it away, like, if I'm doing science 'cuz it's my worst subject." Laurie separates herself from her friends for similar reasons.

> Like some things that, if it comes pretty easily to me, where I've been doing it for a while, or if it's not as big of an assignment, it's not as big of a deal as being around my friends because I can still stay focused and I know what I'm doing. If it's new or it seems like a bigger project or something that I really need to focus more on, then I'll go by myself so I know I'm putting all my attention into it, not who's around me and what they're doing.

She applies the same standards when working on school subjects that are more difficult for her.

> Usually math doesn't matter. Math, I can do...Writing papers, I usually need to be by myself, just cuz I need to gather my thoughts. Once I've started the paper, it doesn't matter as much. I can be out there. But when I'm starting it and I'm juggling my ideas and everything, I need to be by myself to write an outline or something like that.

Separating themselves from a source of distraction was a strategy participants mentioned nine times. For Lorna technology, specifically the Internet, posed a distraction, and she described how she separated herself from this when she needed to: "I usually just try to get away

from it or if I need to like really read, I'll go into our study lounge that doesn't have internet." Lorna also described how technology could be used to help her separate herself from distracting technology. "I know there's some things on Facebook where you can like turn it out for a week and you won't have Facebook for a week." She also mentioned leaving her laptop at home as a way of separating herself from distracting technology: "I don't bring my computer to classes normally just 'cuz I know that I'll go on something else... And also, I don't know. I just, I'll get distracted if I have my computer there. I'm there to, like, I'm paying to learn." For Laurie the main source of distraction appeared to be people rather than technology, and she used a similar strategy of separating herself:

> So most of the time, if they are socializing, I'm not in there if I'm trying to do homework. We live in a quad so I just go to my little section of the room, which is more like a bedroom. I'll just kind of go to my desk and close myself off a little bit more.

Time management strategies were mentioned five times when participants discussed how they managed their technology use, social lives, and studying. Jan describes planning her work time and break time in order to be productive and deal with boredom: "I try to plan out by like hour, hour and a half, then I'll go do something else, then I'll come back and do it for like another hour, hour and a half. I can only sit still for so long."

Reading online. Three participants addressed perceived differences between reading online and reading from a printed page. Jan stated that she did not like to read from a computer screen, and that when professors provided course readings in electronic format she always printed them out. Nicole also mentioned her dislike of online reading, stating that it strained her eyes and sometimes gave her a headache, and therefore caused her to read less carefully. "On the computer, I'll skim and look around and jump around and in a textbook, I just actually read

it." Naomi, in contrast, said she had been used to reading printed text in high school, but when she got to the university she forced herself to get used to reading from the screen so she would not have to print her course readings. She viewed this as a new digital skill she had to learn in order to be successful.

Digital natives' reactions to the claims about them. The third part of Research Question 5 was to investigate how digital native participants responded to the claims being made about their generation. The themes that emerged in response to this question fell into two broad categories. One category of themes was the degree to which participants identified with the claim, both personally and as members of their generation. The second category was the participants' reactions to hearing the claim.

When asked whether specific claims were true for them personally, there were 16 instances where participants agreed that it sounded like them, and 10 instances where they thought it did not sound like them. When asked if specific claims sounded like their friends or other people their age, there were 31 instances of participants saying it sounded like their generation, while three said it did not. It was common for participants to say that a claim was true for their generation as a whole but not for them personally. Marcia, for example, responded to a quote claiming that digital natives need instant gratification by saying, "I have friends…that if a class doesn't have clicker questions or reward for going to class every day, they don't go. They don't care. And they don't, like they don't put the effort in, I guess, because they're not getting something out of that class whereas I would still attend because I know that there's information that even though I might not get a point for it right now, I'll need it later."

In many cases participants had difficulty deciding if they agreed with a quote or not, and would often begin by saying they thought it was true, but would then go on to describe an

exception. Laurie, for example, wavered between agreeing with a quote about digital natives' multitasking behaviors and finding exceptions to it when she said, "I can't disagree. I don't know. I don't know. I think it's pretty true. It's pretty spot on for… not everyone though. I think there are a lot of people who really don't do that. I know people who turn their phones off and who really remove themselves from situations of any kind. And so I don't think it's fair to say everyone does but in general, I think that's pretty spot on." Instances such as this were coded as believing that the claim was true for their generation, even though the participant's true opinion was ambiguous. There were five instances where participants labeled a claim as being completely false.

In addition to expressing agreement or disagreement with a quote, some participants expressed their reactions to it. There were eight instances where participants found the claims insulting. This occurred not only for the quotes from writers taking a pessimistic view of the digital natives' abilities and motivations, but also in response to quotes (presented out of context) from writers such as Marc Prensky who champions the digital natives' skills. For example, Lorna reacted to Prensky's (2001a) description of the digital natives (see interview protocol in Appendix B) in this way: "I feel like it's bitter. Almost, I don't like the way that it sounds. Like I feel like they're insulting my generation. Like…I understand it can seem lazy, just like researching stuff and getting the answer there. But I just think it's like a new way to do stuff and it seems, yeah, it does seem a little bitter. Like they don't have to work. Yeah, just like the serious work. Just the way it sounds, just makes it sound like we, I don't like to work."

In five instances participants agreed with the claim but then commented that it was "sad" or "embarrassing" that their generation had these characteristics. For example, Jan, in reacting to a quote that claims the digital natives' Facebook use has produced narcissism, says "It's sad. It's,

it's very sad that, I don't know. Just we don't care as much about our lives as much as others' lives...when you're on Facebook, you're really just looking at other people. You're not sitting there and being yourself and just doing what you really want to do. You're just looking at what other people have done and I just think that seems kind of silly." Olivia, an avid reader, agreed with the claim that her generation does not read much and then said, "So I mean, it is kind of embarrassing that I come from a generation that can't read a book."

In three instances participants reacted to the claim with the opinion that the description was true of everyone and not unique to their generation. Marcia said, "Like by choice, if someone was given a computer and say, like, go wherever you want, they'd go to Facebook before they would go to Wikipedia and try and just find something new... I think that it's like a natural instinct that people would head towards that first." Naomi said, "every generation of kids our age are gonna' prefer games to serious work. So I don't think that has anything to do with our generation specifically."

Summary of Findings from Participant Interviews

In addition to presenting brief descriptions of each interview participant, this chapter presented the themes that emerged from coding the interview transcripts. The themes presented here address all three subparts of Research Question 5: (1) how the participants felt that technology influenced their lives and their learning, (2) how the participants felt the claims about the digital natives did or did not sound like them and their friends and classmates, and (3) how the participants react to the claims being made about them in the popular press. The following chapter will present a discussion of the significance of the quantitative and qualitative findings.

CHAPTER 6: DISCUSSION AND CONCLUSIONS

The purpose of the study was to investigate the claims being made in the popular press about the generation known as "digital natives." This study investigated how well the digital natives' self-perceptions matched the claims made about them and explored whether their patterns of technology use correlated with their approaches to learning. This study gathered three types of data: (1) digital learner characteristics based on the claims being made in the popular press about how this generation approaches learning, (2) the potential productivity of their approaches to learning based on whether or not they make use of adaptive cognitive strategies such as focused attention and deep processing, and (3) the frequency of use of 41 specific technology tools. The relationships between technology use patterns, digital characteristics, and productive learning habits were explored using inferential statistics. Qualitative interviews provided a rich descriptive view to supplement the patterns and trends revealed by the quantitative data. This chapter provides a discussion of the findings and how they address the research questions posed in this study. In addition, the potential practical applications of the findings and the questions in need of future research are discussed.

Digital Natives Use a Narrow Range of Digital Technologies

Research Question 1 asked: What technology tools do university freshmen use and how frequently do they use them? Contrary to popular beliefs that the digital native generation is universally proficient on all digital technology tools, this study showed that the range of technologies students use may be fairly limited. Of the eight categories of digital technologies explored in this study, only the groups referred to as Rapid Communication Technology and Web Resources were used frequently by most students. The Rapid Communication Technology

category included using a cell phone for voice calling or text messaging, using social networking sites such as Facebook, and instant messaging on a computer. The Web Resource category included using the web to look up a fact or to explore a topic in-depth, watching online video, and listening to music online. Many other technologies that are often cited as having educational potential, such as blogs (Ferdig & Trammell, 2004), or those cited as being especially engaging for the digital natives, such as games (Prensky, 2001a), are used infrequently or not at all by the majority of participants in this study. This finding is consistent with similar research that has been done in Australia (Kennedy, Dalgarno, et al., 2008; Kennedy, et al., 2010; Kennedy, Judd, Churchward, Gray, & Krause, 2008), Canada (Guo, et al., 2008), and the United Kingdom (Jones, et al., 2010) showing that the range of technology tools used by the digital natives is more limited than what the popular press suggests.

It is important for teachers to evaluate the claims about digital natives' technology proficiency critically and make realistic assessments of the technology proficiency of their students. Claims often made in the popular press suggest that if teachers give their students game-based lessons or technology-intensive project assignments, not only will the students be highly motivated but they will also be proficient and self-directed in their use of the technology (Prensky, 2001a). The data here suggest that this is not the case for most digital natives. Students like the majority of participants in this sample, who report playing online games "a few times per year" or "never," would not automatically understand the logic of an educational game, for example, and would not necessarily develop proficiency with the mechanics of playing the game without scaffolding from the instructor. Furthermore, one cannot assume that students who do not choose to play games or develop multimedia projects in their free time would find them motivating or engaging in educational contexts. As Laurie, a student who readily admitted

she did not like to read, explained during her interview, "I don't know if I'd like doing just games… I don't wanta' just play video games to learn. Like, that's not, to me, that's not the way school should be."

Speed and Efficiency Rather than Deep Learning on the Web

Research Question 2 asked which of the characteristics of the popular profile of the digital learner students reported having when learning topics in which they have personal interest. While the Digital Characteristics scale used in this study cannot claim to measure how "digital" participants are in absolute terms, looking at the means and standard deviations of the individual scale items from the Digital Characteristics scale provides a rough ranking of which characteristics participants identified with most frequently. A tendency toward a fast, expedient web search, rather than a more iterative style of searching for information on the web, had the highest mean (5.36, SD = 2.04) of the 15 items on the digital scale. This suggests that when digital natives use a web search engine, they tend towards a "get in, get the answer, get out" approach. This is consistent with the popular claims about the digital natives, specifically the claim that they are used to "twitch speed" (Prensky, 2001a) and accustomed to gathering information quickly. This approach to learning from the Web among the digital natives, however, lends additional support to the concern of many educators and researchers that students are not taking full advantage of the affordances of the web for learning (Guinee, Eagleton, & Hall, 2003; Kennedy & Judd, 2011; Kuiper, Volman, & Terwel, 2005). A search engine that brings all of the information on the Web to students' desktops (or smart phones) has great potential to support deep learning, but only if students go beyond their simple "find the answer quick" search processes and make use of the learning affordances of the search engine. Deschryver and Spiro (2009) describe the ideal method of learning from the Web as an iterative

search process, where learners "create their own search phrases based on information they encounter on the Web, either by employing specific ideas from the current page as new search phrases, or by conceptualizing novel search phrases based on recent activity, past experience, and/or the related momentum Web learning affords" (p. 4). Thus an iterative search, where search terms are refined in order to fully explore the new information the students gain from their initial search, facilitates deep learning and more fully exploits the benefits of having access to such a wealth of information on the Web. The distance between this ideal process for exploring the Web and the "in and out" process indicated by the survey participants in this study suggests that, notwithstanding claims about the digital natives' supposedly innate comfort with using technology, students still need guidance from instructors to help them use the technology to its fullest advantage *for learning*.

The scale item with the lowest mean (2.67, SD=2.02) was "nonlinear method of following hyperlinks." A lower score on this item means that when reading a web page with hyperlinks, participants tend to read the entire page through from top to bottom before going back and checking the hyperlinks. A higher score would indicate that they follow the hyperlinks as they come up, and then return to the original page, resulting in a less linear style of reading. The relatively low mean on this item suggests that, contrary to one of the popular press claims, students are still using a relatively linear method of reading on the web, even when a nonlinear method is available to them through hyperlinking. This finding is not consistent with the claim made by Carr (2010) that the web encourages a scattered style of reading or the claim made by Prensky (2001a) that students prefer to read and learn in a nonlinear manner. Participants in this study reported a tendency to stay with a single web page from top to bottom, though they still may be skimming rather than reading carefully. While this more linear reading approach might

bode well for reading comprehension for many students, it may also represent a missed opportunity to use the affordances of the web to best advantage if students do not return to explore the relevant links they passed up on the first reading.

In general, the findings from the Digital Characteristics scale suggest that while digital native students may very well feel comfortable using the Internet and other digital technologies, educators should not assume that students are fully exploiting the affordances of the technology or using it in the most productive way for learning. Explicit instruction from teachers in such skills as crafting and refining search terms or evaluating which hyperlinks are worth following might be needed in order to help the digital native students make effective use of the technology that surrounds them.

Digital Natives Do Not Demand Constant Entertainment

Research Question 3 asked: When learning topics in which they have personal interest, do students report habits and behaviors that are more adaptive or less adaptive for learning? The Productive Learning Habits scale was used to address this question. Items on the Productive Learning Habits scale were based on behaviors such as deep processing (Craik & Lockhart, 1972; Watkins, 1983), focused attention (Reynolds, 1992), and being flexible enough to learn from a variety of teaching methods. Of the items on the Productive Learning Habits scale, the three highest means were for persistence (versus giving up) when facing short-term boredom, ability to control multitasking when needed, and ability to listen attentively to lecture. Higher means on these items indicate participants expressed some willingness to submit to situations that were not inherently entertaining, at least when learning a topic that interested them. This finding contradicts the popular perception that students demand constant entertainment (Bauerlein, 2008; Prensky, 2001a) and cannot or will not learn without it. Because this study

used a self-report survey, it does not demonstrate whether students actually *do* persist in their efforts when bored, control their multitasking, or listen attentively to lectures when necessary for learning. The responses to this survey do indicate, however, at least some acknowledgement from the students that these behaviors are sometimes necessary or in their best interest.

This is not to say that innovative methods of instruction are unimportant, that educators do not have to be concerned about student boredom, or that constant lecture is an acceptable teaching technique. Participants in this study do expect instructors to make some effort to engage them, as indicated by the item on the Productive Learning Habits scale with the lowest mean, "recognizing their own responsibility (versus teacher responsibility) for making learning enjoyable." A lower score on this item indicated a belief that the teacher, rather than the student, has the primary responsibility for making learning enjoyable. At the same time, the high scores on persistence, control of multitasking, and tolerance for lecture do suggest that students might be more willing to meet us halfway than the popular press suggests. They expect us as educators to use technology and any other tools at our disposal to make learning enjoyable and less like work, but they do not necessarily demand constant entertainment.

Complex Relationship Between Technology Use, Digital Characteristics and Productive Learning Habits

Research Question 4 asked: Do students' patterns of technology use correlate with their characteristics from the popular profile of the digital learner? This question was addressed through correlation analysis at several levels, with extreme group t-tests to further illuminate the patterns suggested by the correlations.

Small to moderate correlations were found between many types of technology use and digital characteristics. Correlation analysis indicated that participants who reported higher frequencies of use of Rapid Communication Technology, Gaming, Microblogging, Active Web Reading and Writing, Multimedia Creation, and Collaborative Web Tool Use tended to have higher average scores on the Average Digital Characteristics scale, while those who reported higher frequency of Book Reading tended to have lower scores on the Average Digital Characteristics scale. The strongest relationship was seen with Rapid Communication Technology Use, ($r_s[335] = .29$, $p < .001$).

There were also some relationships between technology use and Average Productive Learning Habits scores. Participants with higher scores on Rapid Communication Technology use, Microblogging, and Multimedia Creation tended to have lower Average Productive Learning Habits scores. Those with higher Book Reading scores had higher Productive Learning Habits scores ($r_s[347] = .22$, $p < .001$). Gamers are perhaps the group of technology users most frequently discussed in the popular press discussions of digital native learners, but there was no significant correlation between Gaming and Average Productive Learning Habits score in this study. This could be due to the fact that there were so few frequent gamers represented in the data set, but it nevertheless highlights the caution needed when interpreting popular press claims that this generation of learners is "the games generation" (Prensky, 2001a).

In summary, digital technology use was associated with higher Average Digital Characteristics scores while reading printed books was associated with lower Average Digital Characteristics scores. Some digital technology categories were also associated with lower Average Productive Learning Habits scores, while reading printed books was associated with higher Average Productive Learning Habits scores. These associations followed the direction

predicted by the more pessimistic popular press assessments of the digital native generation, but the relationships were not as strong or as clear as the popular press writings often suggest.

Relationships between technology use, Digital Characteristics and Productive Learning Habits Differ by Frequency of Technology Use

Analysis of extreme groups indicates that the frequency of use of these technologies may affect the interaction between technology use, digital characteristics and Productive Learning Habits. T-tests indicated that high-frequency users of Rapid Communication Technology, Active Web Reading and Writing, Microblogging, Multimedia Creation, and Collaborative Web Tool Use had significantly higher Average Digital Characteristics scores, while frequent Book Readers had significantly lower Average Digital Characteristics scores than infrequent Book Readers. This reinforces the findings from the correlation analysis suggesting that high levels of digital technology use appear to have some association with the characteristics popularly claimed for the digital natives, while reading printed text is associated with lower levels of these characteristics. The effect sizes on this extreme group analysis were all small to moderate and the analysis done here does not provide a basis for determining a causal link.

The extreme group analysis of the Productive Learning Habits score showed that Book Reading was the only category in which high-frequency users had significantly higher Average Productive Learning Habits scores. High-frequency users of Rapid Communication Technology, Microblogging, Multimedia Creation and Collaborative Web Tools had significantly lower mean Productive Learning Habits scores than low-frequency users. More research is needed to determine why these technology groups are associated with lower levels of Productive Learning Habits. Neither Microblogging nor Rapid Communication Technology Use requires sustained attention, and Multimedia Development involves constant activity and rich sensory input, so it

makes some intuitive sense that students who prefer these activities might also rate themselves lower on the Productive Learning Habits scale items which emphasized sustained attention and deep processing. It is more difficult to imagine why Collaborative Web Tool use would be associated with lower Average Productive Learning Habits scores. More research will be needed before specific conclusions can be drawn.

While the correlations and comparisons of means lend some support for the relationships between technology use, Digital Characteristics and Productive Learning Habits found in the popular press claims, the small to moderate relationships and effect sizes indicate that technology use patterns explain only a small percentage of the variation in participants' Digital Characteristics and Productive Learning Habits scores. In addition, the variability seen in these scales challenges the popular press assumption that the digital natives are a homogeneous group of learners. These findings add data to support the argument posed by Selwyn (2009) that technology is not the deterministic force that the popular press discussions of digital natives claim. Rather than viewing digital natives as passive subjects whose brains are being molded by technology, he emphasizes how "young peoples' use of technologies [is] subjected continually to a series of complex interactions and negotiations with the social, economic, political, and cultural contexts into which they emerge" (p. 371). Technology use may very well be an influence in the development of the digital natives and their approaches to learning, but it is an influence that interacts with many other influences in their lives.

When discussing the various factors that affect students' approaches to learning, personality differences must also be considered. For example, variation in a personality factor commonly referred to as *conscientiousness* has been shown to affect learning. De Raad and Schouwenburg (1996) define conscientiousness as "the drive to accomplish something" and state

that it encompasses characteristics such as "being organized, systematic, efficient, practical, and steady" (p. 325). It is possible that some of the variation seen in the current study is attributable to differences in personality factors of this type. At the same time, immersion in digital technology could very well interact with personality factors. For example, someone who is organized, practical and efficient may be less susceptible to the distracting aspects of Rapid Communication Technology than someone with a tendency to be disorganized and inefficient in his or her work. The potential interaction between personality and technology immersion is an area in need of more research.

Nevertheless, frequent use of Rapid Communication Technology (i.e., texting, Facebook and instant messaging) in particular does appear to have some association with less productive learning behaviors, including a difficulty in controlling multitasking. The data from this study do not provide any basis for assessing a causal relationship, so it would not be appropriate to assume that frequent use of Rapid Communication Technology causes nonproductive approaches to learning. It could easily be the case that students with less adaptive study habits use Rapid Communication Technology as a convenient vehicle for procrastination, or that some third factor is causing both the nonproductive learning behavior and the high level of Rapid Communication Technology use. The relationship itself, however, can provide teachers with some insight into which of their students might be more likely to need scaffolding to support better learning habits. Students who are frequently caught texting or updating Facebook during class may need intervention to improve their study skills more urgently than they need to be punished for their impolite classroom behavior. The types of strategies articulated by the interview participants in this study may serve as a basis for developing such an intervention. Future research is needed to explore this possibility.

Digital Natives Express an Awareness of Technology and the Need to Manage its Use

Research Question 5 asked: How do learners with different configurations of PPDL characteristics describe their own technology use and approaches to learning? This question was addressed through semi-structured interviews with eight participants. In contrast to the popular press claims that technology is "like the air" (Tapscott, 2009, p. 18) and so much a part of the landscape that digital natives only notice its absence, the eight students interviewed in this study expressed an awareness of the influence of technology in their lives and their learning, and articulated specific strategies to manage their technology use in order to meet their goals.

Though only one of the eight interview participants had ever heard the term *digital native* before I defined it for them, all of them were able to articulate, when asked, a nuanced view of how technology had influenced their daily life and their learning. They readily acknowledged its benefits for learning and for daily life, usually in terms of convenience but also sometimes with respect to its specific affordances. At the same time they recognized the potential pitfalls of constant technology use and a need to take some control over it to make sure it supported rather than impeded their learning.

One of the most interesting themes related to the place of technology in daily life was the concern for the next generation expressed by several participants in this study. Given how the digital natives are often described as having not only an innate comfort with technology but an inability to imagine life without it, it is interesting that some participants in this study said they were worried about how technology immersion from a younger age will affect the next generation. When they saw preschool children using technology that they did not use until they were school age, or heard about technology playing an increasingly large role in early grade education, they expressed concern that this very early immersion was "not a good thing for

them." One eighteen year old woman even stated that she was worried about the children she might have in the future because she saw the encroachment of technology on childhood as an escalating force that was affecting "younger and younger" children. Rather than taking technology for granted or being unaware of its existence, these participants were capable of thinking critically about the effects of technology on society.

In addition to their thoughtful awareness of the influence of technology at a societal level, they were able to articulate very specific ways in which technology affected their study habits, and to describe specific strategies they used to manage technology in their daily lives. For example, they were able to explain when, why and how they control their multitasking and the distractions of technology, and they recognized when technology was helping them and when it was not. They also emphasized their ability to take a long-term view and put forth focused effort despite being accustomed to the speed and instant results that technology often provides.

Some of the specific strategies the participants in this study described, separating themselves from distracting technology or relegating it to a carefully-timed study break, duplicated the findings of Jones and Healing (Jones & Healing, 2010) in their study of university students in England. These authors also emphasized the deliberate and thoughtful aspect of students' technology use.

> Distraction can be seen as a feature or negative affordance of the communication technologies available to students. They are not passive in response to this feature and their coping strategies illustrate the ways in which university tasks requiring concentration interplay with the social desire to stay connected. Students dynamically manage their activity with communication technologies in order to meet the requirements of being a student (p. 345).

Some of the more optimistic views of the digital natives expressed in the popular press literature take a similar view of the digital natives' ability to manage distraction. For example, both Rosen (2010) and Tapscott (2009) downplay the potential risks posed by multitasking by claiming that the digital natives are capable of controlling their multitasking when needed, multitasking in situations where they have excess cognitive capacity (Rosen, 2010) but focusing on a single task when the task is demanding. Several of the interview participants made this same claim about their own study habits. Some of them said they liked to multitask when studying subjects that came easier for them but to focus on a single task when studying subjects they found more challenging. Others described a routine where they put in a full day of classes and focused study in the library, but took a more relaxed approach, which included more multitasking, in the evenings. The important difference between the popular press claims and the views articulated by the participants in this study (as well as those described by Jones and Healing, 2009), however, is that the popular press authors often imply that the digital natives have a natural ability to manage the distractions of technology without thought or effort. The participants in this study viewed control of multitasking, as well as the other distractions of technology, not as something they did naturally as digital natives but rather as something to be consciously managed. They allowed themselves to multitask at the end of a productive day or in low-stakes circumstances (e.g., when the subject was easy for them or when there were no exams in the near future), but took deliberate steps to restrict it (e.g., physically separating themselves from their phones or Internet access, installing blocking software on their computers, etc.) in more demanding situations.

In general the participants in this study seemed to agree with many of the popular press claims regarding their outward behaviors (particularly multitasking and maintaining connectivity

to friends) but disagree with the popular press claims regarding the internal processes behind these behaviors. While the popular press claims that digital natives manage their technology use automatically, the participants in this study described a deliberate strategic process. This might partly explain why, when asked to react to specific quotations from popular press books describing their generation, the participants in this study expressed conflicting views. Participants often agreed that the claims were "pretty accurate" but then went on to describe exceptions, or to explain that although the claim was true of their friends it was not true for them. Many of them also found the claims insulting ("they're not giving us enough credit for wanting to learn") or they found them to be true but unfortunate or embarrassing ("It is kind of embarrassing that I come from a generation that can't read a book"). While the popular press describes the digital natives as passive subjects being acted on by the force of technology, the digital natives interviewed in this study appeared to see themselves (at least at an intuitive if not a conscious level) as being active agents making decisions about how to respond to the sometimes competing demands of technology, their social world, and their university coursework.

Contributions of this Study

The primary contribution of this study is that it provides some empirical evidence that can help educators evaluate the claims being made about the digital native generation and how they learn. While many of the claims, and the recommendations that follow from those claims, are based on untested theory and anecdotal evidence, this study provides data on the digital natives' patterns of technology use, their perceptions of how well their own approaches to learning match the claims being made about them, and the relationships between technology use and the presence or absence of the behaviors, habits, and attitudes attributed to their generation. While educators receive urgent messages from the popular press about how they should change

their teaching to meet the needs and "demands" of the digital native learners, this study provides evidence that can help educators evaluate these claims and recommendations critically. This critical evaluation is necessary in order to resist making wasteful or unproductive decisions based on media hype and overgeneralizations about an entire generation. As Jones and Healing (2010) explain it:

> In popular use, such overgeneralizations are largely benign, but when they become an accepted and an even received wisdom, they hold dangers. Policy-makers make use of generational metaphors to describe future intakes of students and to frame plans for the development of educational infrastructures. Teachers begin to design their courses for a presumed audience of Net Generation students (p. 354).

This study provides evidence that the digital native generation, like all generations before it, is a diverse collection of individuals, and no single prescription for "how to teach the digital natives" is going to serve all students well.

In addition to providing information for educators and educational administrators about the complex nature of the digital natives, this study provides a basis for future research on the unique challenges and opportunities that technology does present for this generation of learners. While previous research has explored the technology use patterns of the digital natives, few if any studies have addressed the claims made about the way this generation approaches learning. The Digital Characteristics scale and the Productive Learning Habits scale developed for this study, while still in need of some refinement, provide a starting place to continue testing the claims made about the digital natives, with a goal of separating any elements of truth from the popular press overgeneralizations. While the findings from this study were more modest than the popular claims, there still may be relationships between technology immersion and

approaches to learning, particularly with respect to the frequent use of Rapid Communication Technology. This study highlights areas most in need of further research and provides some tools to assist with that research.

Finally, the rich data from the semi-structured interviews in this study provide examples of how some of the digital natives manage their technology use and balance the demands of their digital culture with the demands of university coursework. The strategies and attitudes that they describe could be the basis for developing interventions that could help students who are less successful in navigating these competing demands. While the strategies these students discussed were not unique to the digital age, hearing these strategies described in the voice of a digital native using contemporary examples (e.g., a student describing how she uses blocking software to stay off of Facebook during finals week) could provide an effective way of teaching classic time management strategies to students who have resisted them in the past. Interventions such as this would need to be tested empirically, but the current study provides an empirically-grounded starting place for future research in this area.

Tangential Findings for Future Follow-up

In addition to the findings already presented and discussed, an additional preliminary area of analysis (not presented in detail here because it was tangential to the research questions addressed in this study) suggests potentially interesting findings in need of future confirmation and follow-up. An analysis of correlations between individual Digital Characteristics scale items and individual Productive Learning Habits scale items was performed for different levels of technology use, and the strength of correlations between these different frequency groups was compared using a Fisher's Z statistic. This preliminary analysis revealed complex interactions that cannot be further explained using the current data set. As an example, there was a

correlation of -.316 ($p \leq .01$) between multitasking while learning and ability to control multitasking. Participants who reported higher tendency to multitask reported lower ability to control their multitasking when needed. When this correlation was examined for high and low-frequency users of all digital technologies, however, the relationship held only for low-frequency digital technology users ($r = -.698$, $p \leq .01$), while the correlation for high-frequency digital technology users was non-significant. The reason for this difference is not clear. It could be that high technology use helps people learn how to control their multitasking, or that frequent technology users think they have better control of their multitasking than they actually do, leading to higher scores for that item on this self-report survey. Other explanations are also possible. While preliminary findings like this one are outside the scope of the current study and the current data set does not provide a basis for exploring them further, it is an important area for future research, provided that the findings from this preliminary analysis can be confirmed.

Limitations

While this study adds to our understanding of the technology use patterns and digital native characteristics of freshmen university students, there are limitations inherent in the methods chosen for this study. First, both the survey instrument and the interviews rely on self-report, and the participants may not answer honestly, or may not have good insights on their own habitual practices and thus may not answer accurately. Pace (1985) found that college students were relatively accurate at reporting their progress toward their academic goals, and as described in Chapter 3, the eight point Likert-type scale with no mid-point helps mitigate the effects of social desirability bias. Nevertheless the self-report nature of the questionnaire remains a limitation.

In addition, because the survey was delivered over the Internet it is possible that students who are comfortable with or interested in technology were more likely to respond than those who are not. The use of university-assigned email addresses to send the invitations means that all members of the freshmen class, regardless of their comfort level with technology, had an equal chance of receiving an invitation to participate in the survey, but there still may be non-response bias because responding to the survey is voluntary and those who chose to not respond may be systematically different than those who did respond.

The population used in this study was the freshman class at a large Midwestern land grant university. The findings here may not generalize to younger students, especially those who are not college-bound, or to university students at different types of institutions. Students at the sophomore level and beyond, who have completed specialized coursework in their chosen majors, may also have different characteristics than the first-semester freshmen who participated in this study.

The correlational analysis done in this study provided insight into the relationships between patterns of technology use, Digital Characteristics, and Productive Learning Habits, but this correlational data does not prove that technology immersion causes the development of Digital Characteristics or that it enhances or impedes Productive Learning Habits. It is possible that students who have these digital learner characteristics are more likely to use a wide variety of technologies. This study does not demonstrate causation, but highlights interesting relationships that merit further study.

While the interviews provided rich descriptive data about how participants with different patterns of digital learner characteristics describe their own learning and technology use, the

findings from this small purposefully chosen sample of participants might not be typical of all learners and cannot be generalized.

Future research to build on this study

The findings from this study suggest several avenues for future research. One of the more important areas needing additional study is the possible connection between Rapid Communication Technology use (i.e., texting, Facebook, and instant messaging) and less adaptive learning behaviors. While the correlations and effect sizes between Rapid Communication Technology use and lower Average Productive Learning Habits scores found in this study were at the small to medium level, this category of technology use did show a stronger negative association with Productive Learning Habits than any other technology use category. Research is needed to explore this finding and attempt to find the causal relationship. It is possible that frequent use of Rapid Communication Technology encourages the development of maladaptive reading and study habits, as suggested by Carr (2010). It is also possible that some other factor is causing both the preference for Rapid Communication Technology and less adaptive reading and studying behaviors. While an experimental study to establish a causal link may not be feasible in this situation, a study that included more information on the history of participants' technology use and the development of their approaches to learning might, through causal-comparative analysis, provide more information on a possible causal link.

An additional area of future research is to duplicate this study with different age groups to explore whether learners from different generations are different in their technology use patterns, Digital Characteristics, and Productive Learning Habits. The popular press claims attribute certain characteristics to the digital natives based on the time they were born and the amount of technology they grew up with, but there is no clear evidence that these digital learner

characteristics are more prevalent in the digital native generation than they are in older people. In fact, Carr (2010) claims that extensive technology use encourages maladaptive reading habits in technology users of all ages. Duplicating the current study with different age groups would provide evidence about whether exposure to digital technology at a younger age affected approaches to learning differently from technology use later in life.

Finally, it would be valuable to explore the level of awareness students have of their own behaviors and approaches to learning, and whether their actual behaviors when studying match their self-reports. Because the current study was based on a self-report survey, it does not show to what extent students who claim an ability to control their multitasking when studying or control their socializing when studying with friends, for example, actually *do* control those less adaptive behaviors. A study that included an observation of students in a somewhat natural setting could help address this question. As an example, if students think they are reducing their multitasking during difficult or high-stakes tasks (as the interview participants in the current study claimed) but in reality are still multitasking heavily, this would indicate an area where the digital natives need assistance managing their technology use. Observational studies would highlight any areas of disconnect between students' actual behavior and their perceptions of their own strategies, and would indicate areas where interventions needed to be developed. An intervention that increased student self-awareness would help not only the current generation of digital natives but also future generations who will need to manage their learning in the midst of rapidly-evolving technology that is both intrusive and seductive.

Concluding Remarks

This study investigated the claims made in the popular press about the "digital native" learners by exploring their patterns of technology use, their approaches to learning, and the

complex relationships between them. The findings indicate that students may be using a narrower range of technology tools than the popular press authors claim, and they may not be exploiting the full benefits of these technology tools when using them in a learning context. Findings from this study also suggest that the influence of technology on the digital natives' approaches to learning is varied and complex rather than deterministic, and that digital natives may be more thoughtful and strategic in their technology use than many popular press authors claim.

While the claims about the digital natives often imply that students would be self-sufficient learners if they were simply "turned loose" with the right technology, findings from this study highlight several areas where teachers can play a critical role in preparing students for success in the digital world. Digital native students may need scaffolding from teachers before they will go beyond the rapid communication technology they are most comfortable with and learn the wide variety of technology tools that are important for productivity in school and the workplace. For example, teachers can help students develop skills in using a search engine effectively to exploit the full potential of the Web, or help them develop strategies for managing the distractions of technology that is sometimes intrusive on study time. Most importantly, this study suggests that technology is not a deterministic force that usurps the role of the teacher while molding students' brains according to its own ends, as much of the popular press literature seems to imply. Technology is an important influence in students' lives, but it is one influence among many, and teachers still have an opportunity to help their digital native students navigate successfully through the promises and pitfalls of learning in the digital world.

APPENDICES

Appendix A

Survey Questionnaire

Traditional Versus Digital Scale

1) How would you describe your typical reading style when reading something from a book or printed page that you are very interested in?

Slow and deliberate							Rapid Scanning
☐	☐	☐	☐	☐	☐	☐	☐

2) How would you describe your typical reading style when reading something on the Web that you are very interested in?

Slow and deliberate							Rapid Scanning
☐	☐	☐	☐	☐	☐	☐	☐

3) When using the web to learn about something that really interests you, how do you typically manage your search (e.g., using Google or some other search engine)?

slow and iterative (repeating search with slightly different terms)							fast and efficient (getting what I need on the first attempt)
☐	☐	☐	☐	☐	☐	☐	☐

4) While reading or learning something that really interests you, how much do you typically "multitask" (e.g., watch TV or text friends while reading, etc.)?

Focus on one thing at a time							multitask constantly
☐	☐	☐	☐	☐	☐	☐	☐

5) When reading something you find interesting that contains both text and graphics, how do you balance your attention?

Focus more on text than on graphics							Focus more on graphics than on text
☐	☐	☐	☐	☐	☐	☐	☐

6) When reading a very interesting web page that contains a lot of hyperlinks, how do you proceed?

read the page straight through before clicking any links							click on all the links as soon as I get to them
☐	☐	☐	☐	☐	☐	☐	☐

7) If you think of a question while reading something that interests you, what do you typically do?

make a note of my question so I can look for the answer later							find the answer immediately
☐	☐	☐	☐	☐	☐	☐	☐

8) When explaining something that interests you, how do you typically express your thoughts?

start at the beginning and explain in a step-by-step way							explain thoughts and ideas in the order they occur to me
☐	☐	☐	☐	☐	☐	☐	☐

9) While reading or learning something that interests you, how much contact do you maintain with your friends, including all forms of contact such as face-to-face, online, calling, or texting?

no contact							constant contact
☐	☐	☐	☐	☐	☐	☐	☐

10) When learning something that interests you, do you prefer to study and learn alone or with friends?

studying and learning alone							studying and learning with friends
☐	☐	☐	☐	☐	☐	☐	☐

11) When learning something that interests you, do you prefer to have information provided for you (e.g., as a lecture or something to read) or to find the information yourself (e.g., web search or research project)?

to have information provided							to find information myself
☐	☐	☐	☐	☐	☐	☐	☐

12) When learning something that interests you, how would you describe the relationship between "work" (including studying or learning) and "play"?

clearly separate parts of my life							completely mixed together
☐	☐	☐	☐	☐	☐	☐	☐

13) When learning something that interests you, how would you describe your attitude about short-term boredom when you know the reward will come much later?

a normal part of learning that I accept							intolerable - I really need a timely reward for my effort.
☐	☐	☐	☐	☐	☐	☐	☐

14) When learning something that interests you, how do you feel about lessons presented in game-like fantasy settings?

unnecessary							necessary to keep me interested
☐	☐	☐	☐	☐	☐	☐	☐

15) When learning something that interests you, how important is technology for helping you learn?

an unnecessary add-on							so much a part of my life that I'm distracte when it's not there
☐	☐	☐	☐	☐	☐	☐	☐

Productive Learning Habits Scale

16) How would you describe your process when reading something that interests you?

gather a lot of information quickly without thinking about it much							take the time to reflect on what I read even if it means I read slower
☐	☐	☐	☐	☐	☐	☐	☐

17) When learning something that interests you, how would you describe your balance between keeping your focus and finding new ideas or perspectives?

focus too narrowly and miss important conflicting or new ideas							always be open to new perspectives even when my attention is very focused
☐	☐	☐	☐	☐	☐	☐	☐

18) How would you describe your typical style of multitasking while learning something that interests you?

multitask unrelated things, like watching an entertaining TV show while writing a paper, etc							multitask related things, like watching a related documentary on the same topic I'm writing a paper on, etc.	N/A - I don't multitask
☐	☐	☐	☐	☐	☐	☐	☐	☐

19) How would you describe your ability to control or manage your multitasking when doing an interesting task that needs focused attention?

I can never stop mutli-tasking							I can always focus on one thing at a time when I need to	N/A – I don't multitask
☐	☐	☐	☐	☐	☐	☐	☐	☐

20) How would you describe the way you distribute your attention when reading something that interests you and has both text and graphics?

focus on the mode (either text or graphics) where I'm most comfortable and ignore the other							always make sure I understand how the text and graphics fit together
☐	☐	☐	☐	☐	☐	☐	☐

21) What do you do when exploring and learning about a very complex topic that interests you?

look for one really good source that gives me what I need							Seek out as many conflicting views on the subject as I can find
☐	☐	☐	☐	☐	☐	☐	☐

22) When studying or learning a topic that interests you with your friends, what kind of balance do you usually have between learning and socializing?

spend most of our time socializing							spend most of our time working on the task	N/A – I don't study with my friends
☐	☐	☐	☐	☐	☐	☐	☐	☐

23) How would you describe your typical experience listening to a lecture on a topic that interests you?

bored, restless, or daydreaming through the whole thing							attentive and mentally engaged
☐	☐	☐	☐	☐	☐	☐	☐

24) How would you describe your typical experience learning from working on a hands-on project (e.g., making a video or podcast, etc.) on a topic that interests you?

focus so much on the activity that I don't have time to think about what I should be learning							use the activity as a way to reflect on what I should be learning
☐	☐	☐	☐	☐	☐	☐	☐

25) What is your opinion about the responsibility of teachers to make learning enjoyable?

teachers should make learning fun so it never feels like work							it is the student's responsibility, not the teacher's, to make learning enjoyable
☐	☐	☐	☐	☐	☐	☐	☐

26) Do you think learning is generally enjoyable?

no, it is never enjoyable							yes, it is always enjoyable
☐	☐	☐	☐	☐	☐	☐	☐

27) When learning something that interests you, how would you describe your strategy for coping with short-term boredom when you know the reward will come much later?

I usually quit if I don't get a quick reward							I create my own rewards along the way OR I just push through
☐	☐	☐	☐	☐	☐	☐	☐

28) When learning something that interests you, do you use your imagination (e.g., making a game out of the work, daydreaming, etc.) to enhance your work or to escape from it?

escape from my work							enhance my work	N/A – I don't use my imagination when I'm learning
☐	☐	☐	☐	☐	☐	☐	☐	☐

29) What is your typical experience when learning a new subject that interests you using unfamiliar technology?

think more about the technology than the subject I'm learning							focus on the subject without letting the technology get in my way
☐	☐	☐	☐	☐	☐	☐	☐

Technology Use scale

30) Please estimate how often, on average, you do the following (using the scale below):

Never	A few times a year	About once a month	A few times a month	About once a week	A few times a week	About once a day	A few times a day
☐	☐	☐	☐	☐	☐	☐	☐

a. Work on a word processing document (e.g., Microsoft Word, Google Docs, Apple Pages, etc.)
b. Work on a spreadsheet (e.g., Microsoft Excel, Google Spreadsheet, etc.)
c. Work on a database (e.g., Microsoft Access)
d. Work on a slide presentation (e.g., PowerPoint, Keynote, etc.)
e. Watch a video online or on a computer
f. Listen to music online or on a computer
g. Create or edit video (e.g. using iMovie or MovieMaker, etc.)
h. Create or edit an audio file (e.g., using Audacity, GarageBand, etc.)
i. Create or edit a digital image using software (e.g., PhotoShop, iPhoto, etc.)
j. Upload a video you created to a video sharing site (e.g., YouTube) or social networking site (e.g., Facebook)
k. Upload a digital image you created to a photo sharing site (e.g., Flickr) or a social networking site (e.g., Facebook)
l. Create or maintain a website
m. Read a blog
n. Read an entertainment related website (e.g., Rolling Stone online)
o. Use the web to look up a fact or answer a specific question
p. Use the web to explore a topic in depth
q. Use social bookmarking (e.g., delicious) to share something interesting you've found
r. Use an online annotation tool (e.g., diigo) to mark up a web page
s. Read a long and detailed web page
t. Read a book to learn something
u. Read a book for enjoyment

v. Write a blog entry
w. Comment on a blog entry, online discussion forum, or listserve
x. Contribute to a wiki
y. Contribute to a collaborative writing project (e.g., a shared Google Doc, etc.)
z. Comment on a video, photo, or other item on a multimedie sharing site (e.g, YouTube, Flickr, etc.)
aa. Play an action or skill game (e.g., Doom) by yourself (with the computer as your opponent)
bb. Play an action or skill game (e.g., Battlefield 1942) against other players
cc. Play a strategy or roleplaying game (e.g., World of Warcraft)
dd. Play a puzzle or card game (e.g., Solitaire, Tetris) on the computer

31) Please estimate how often, on average, you do the following (using the scale below):

Never	Up to once month	Up to about once a week	A few times a week	About once a day	Several times a day	About once an hour	more than once an hour
☐	☐	☐	☐	☐	☐	☐	☐

a. Send a text message on a cell phone
b. Answer a text message on a cell phone
c. Use a cell phone to make or receive a voice call
d. Use a computer for live chat or instant messaging
e. Check for updates on a social networking site (e.g., Facebook, MySpace)
f. Comment on a friend's post on a social networking site (e.g., Facebook, MySpace)
g. Update your own profile on a social networking site (e.g., Facebook, MySpace)
h. Play social games (e.g., Farmville, etc.) on a social networking site (e.g., Facebook, MySpace)
i. Check for updates on a micro-blogging site (e.g., Twitter)
j. Update a microblogging site (e.g., Twitter)
k. Use two or more technologies (other than listening to music) at the same time (e.g., text friends or watch TV while working on the computer, etc.)?

32) If there are any technologies not listed above that you use frequently, please list the technologies and how often you use them.

Demographic and Miscellaneous Information

33) If someone asked you to write a paragraph answering the question "What is learning?" what kinds of ideas would you include in your answer? Don't write the paragraph here, but just list a few key words or phrases that you would be likely to include. (with text box for open-ended answer)

34) How well do you think your current learning strategies meet your learning goals?

My strategies are not working for me							My strategies almost always work well for me
☐	☐	☐	☐	☐	☐	☐	☐

35) How old are you

- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- over 25

36) What is your gender (Note: This question was intended to be part of the survey but was accidentally deleted from the online version actually used, so these responses were not collected.)

- male
- female
- other gender

37) Which college or program are you currently enrolled in?

- Agriculture and Natural Resources
- Arts and Letters
- Business
- Communication Arts and Sciences
- Education
- Engineering
- James Madison College
- Lyman Briggs College
- Music
- Natural Science
- Nursing
- Residential College of Arts and Humanities
- Social Science
- Veterinary Medicine
- Other (please specify)

38) Are you an international student?

38a. If yes, what is your country of origin?

39) Is there anything else you would like to say about your use of technology, how you learn, or how technology use influences your learning.

41) What is your email address? (Your email address will be used for two purposes. First, it will be entered in a raffle for one of 15 gift certificates, in the amount of $40, for either iTunes Amazon.com. Second, I will invite a few people who respond to this survey to participate in an interview, for which you would be paid $20 for approximately 30 minutes of your time. Providing your information here does not guarantee that you will be invited, and if you are invited you will be free to accept or decline the invitation. Once participants are selected for interviews and the gift certificates are distributed we will remove all email addresses from our data.

Appendix B

Interview Questions

While the interviews will be semi-structured and flexible to gather more detail on the specific topics discussed by the participants, the following are the initial questions to be asked:

1. Have you ever heard the term "digital native"? If you have, what does that team mean to you?

2. There isn't one single definition of the "digital native," but essentially in means that people your age, who have grown up surrounded by a lot of digital technology and access to the internet, think and learn differently than those of us who grew up relying more on printed text. Do you think the technology you grew up with has influenced the way you learn, both in school and out of school? Explain.

3. The following four quotes are taken from some popular press books about the digital natives. I'm going to show you each quote and read it out loud to you, and then ask you for your reaction. As you listen and read, think about whether this quote describes you or your friends, and how you feel about it.

Quote 1: "Digital Natives are used to receiving information really fast. They like to parallel process and multitask. They prefer their graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to “serious” work." (from Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5), p. 3-4)

- Does this sound like a good description of you? Why or why not?
- Does this sound like a good description of any of your friends? Why or why not?

- How do you feel hearing someone in the press talk about your generation in this way?

Quote 2: "This generation multitasks more than any other and does so seamlessly, often without missing anything from any information source. They can listen to music, watch television, text message, and do their homework all at the same time." (from Rosen, L. (2010). Rewired: Understanding the iGeneration and the way they learn. *The Eduction Digest*, May 2010, p. 20)

- Does this sound like a good description of you? Why or why not?
- Does this sound like a good description of any of your friends? Why or why not?
- How do you feel hearing someone in the press talk about your generation in this way?

Quote 3: "Young Americans prefer to learn about one another…The Web offers wondrous information and images, but why would a [student] download them when he can read what his classmates say about what happened over the weekend?" (from Bauerlein, M. (2008). *The dumbest generation: How the digital age stupefies young Americans and jeopardizes our future*. New York: Penguin Group. p. 135)

- Does this sound like a good description of you? Why or why not?
- Does this sound like a good description of any of your friends? Why or why not?
- How do you feel hearing someone in the press talk about your generation in this way?

Quote 4: "Young people today spend much less time reading for leisure…Why spend time staring at a dull and stagnant string of words when they could be entertained and informed with fast-paced visual and auditory computer images instead? Some Digital Natives also complain that books make them feel isolated – they want to stay connected with their friends online instead of holing up along with a book" (from Small, G., & Vorgan, G. (2008). *iBrain: Surviving the technological alteration of the modern mind*. New York: Harper. p. 25)

- Does this sound like a good description of you? Why or why not?
- Does this sound like a good description of any of your friends? Why or why not?
- How do you feel hearing someone in the press talk about your generation in this way?

4. Is there anything else that I haven't asked regarding your technology use, your learning, or these quotes I've read to you, that you would like to tell me?

Appendix C

Glossary

Active Web Reading and Writing - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes reading, writing, and commenting on blog entries, creating or maintaining a website, reading long detailed web pages, and reading entertainment web pages.

Productive Learning Habits Scale - an eight-point measurement scale created for this study that asks respondents to rate the degree to which they practice habits conducive to learning, such as focused attention, deep processing, and persistence. A higher score suggests more adaptive learning and study habits while a lower score suggests less adaptive habits.

Book Reading - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes reading books for enjoyment or for learning.

Collaborative Web Tool Use - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes annotating a web page (e.g., using diigo), using a social bookmarking site (e.g., delicious), using a shared document on the web (e.g., Google docs), and contributing to a wiki.

Digital Characteristics Scale – an eight-point measurement scale created for this study that asks respondents to rate the degree to which they feel they have the characteristics associated with the digital native generation in the popular press literature. A higher score indicates higher levels of the characteristics claimed for the digital natives, while a lower score indicates more traditional characteristics (based on the popular press claims).

Gaming - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes playing strategy games on computer, playing action games alone or with others, and playing puzzle games (e.g., Tetris) on the computer.

Microblogging - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes updating or reading a microblogging site such as Twitter.

Multimedia Creation - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes creating a digital image, uploading a digital image to a file sharing site, creating or editing a video, uploading a video to a file sharing site, and creating an audio file.

Popular Profile of the Digital Learner (PPDL) – a construct defined for this study as a synthesis of the characteristics claimed for the digital native generation. This includes the degree to which a learner displays the digital characteristics claimed for the digital native generation (see Digital Characteristics Scale) and their overall level of Productive Learning Habits (see Productive Learning Habits Scale).

Productivity Tool Use - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes use of word processors, spreadsheets, databases, and presentation tools.

Rapid Communication Technology Use - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes text messaging on a cell phone, checking, updating, or commenting on Facebook, making a voice call on a cell phone , and chatting in real-time on a computer. Use of several technologies at one time also loaded in this factor.

Web Resource Use - a technology use category determined from a factor analysis of the technology use portion of the survey. It includes using the web to explore a topic in depth, using web to look up a fact, watching a video online, and listening to music online.

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