ADOLESCENT TASK MANAGEMENT: MULTITASKING AND SOCIAL MEDIA IN THE STUDENT SEARCH PROCESS

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This study examines adolescent students at an American international school and observes student use of social networking programs as well as physical actions in the search process. The study specifically observed multitasking behavior and organizational skills among students, as well as linkages made through social networking sites. Student observations, student interviews, analysis of Facebook entries, and a survey on multitasking yielded rich data.

Students appear to be far more organized than previously suggested in the literature, and in this study, the organization proved to be largely self-taught. Students used their social networks to build a kind of group expertise that compensated for their youthful naivety. Students exhibited self-control within the search to the degree that they could focus on what they wanted to find, and they used heuristics—mental shortcuts—to achieve what they needed. Searches also suggest creativity in that students were flexible in their search methods and used a number of tools to gather information. Students could balance the needs of the academic or imposed search with their own online lives, meaning that they made compensations for social media and media multitasking when it was deemed necessary.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This dissertation seeks to highlight and explain ways in which adolescents maximize online search behavior in light of ubiquitous multitasking. The study draws upon assumptions made in Bates (1989) Berrypicking model as well as Kuhlthau's (1991) information seeking process in terms of the information search process, and recognizes the importance of Dresang's (1999) radical change theory in understanding contemporary adolescent online information seeking. Multitasking is not a new concept, yet media multitasking is relatively new and an understanding of the impact of multitasking upon adolescents is both necessary and as yet misunderstood.

1.2 Statement of the Problem

Multitasking is a common behavior among all ages. This study focuses on the generation known as Millenials or Generation Y, meaning that they were born around the year 2000. For this generation, multitasking is commonplace and is viewed as a normal procedure. School curriculum often does not address management of tasks, yet adolescents remain active multitaskers and may even excel at it. Students manage multitasking while conducting a search and this may lead to greater self-satisfaction upon completion of a task.

For the purposes of this study, multitasking is considered to be either cognitive or physical. Cognitive multitasking has been recognized as early as 1935 by Jacobsen

and refers to switching from one thought process to another. This is best seen as task switching. Research has also recently included the role of media multitasking, which is when a person attempts to pay attention to multiple modes of media at the same time (Xu, 2008). Physical multitasking refers to performing multiple things simultaneously. This study focuses on cognitive multitasking.

Cognitive multitasking occurs in the prefrontal cortex (Burgess, Veitch, Costello & Shallice 2000); it is a cognitive process and dependent upon developmental stages. Burgess (2000) notes that three constructs support multitasking: retrospective memory, prospective memory, and planning. These constructs become increasingly important for adolescents where the prefrontal cortex has not yet fully developed. As such, the role of memory, expertise, and organization become critical. Regarding the cognitive process, Klingberg and Roland (1997) observed increased brain activity during multitasking and showed that when two tasks activate overlapping parts of the cortex, significant interference and increased reaction time results.

1.3 Definitions

As with any study, understanding terminology is critical for overall clarity. The subject of this study is the adolescent student. Subjects are adolescents, aged 15 to 18 and in the process of mental and physical development. Subjects are also students, meaning that the study took place in an educational situation inside of an educational context. While some questions in the interview process related to non-academic matters, the overall view is from an academic setting. These students are also Millenials, meaning that they were born at or around the year 2000. For clarity, student is the most common word used in this study.

1.3.1 Expertise

The study relies on an assumption that expertise and memory play a role in building knowledge. Expertise refers to a person with extensive knowledge and ability in a particular domain. Sternberg (2003) defines expertise as "superior skills or achievement reflecting a well-developed and well-organized knowledge base" (p. 389-390). It could be that the collaborative nature of media and the Internet allow for what I am terming as shared expertise among students. Studies on chess masters, doctors and nurses, air traffic controllers, and college students also provide a wealth of understanding regarding expertise (Eva, Norman, Neville, Wood, & Brooks, 2002; Salden, Paas, Broers, & Van Merrienboer, 2004; Camp, Paas Rikers, & Van Merrienboer, 2001). Experts possess large amounts of domain knowledge built into developed schemas and these schemas are well organized and interconnected. Heuristics is what is meant by these schemas; a sort of knowing based on previous experience. Experts spend more time developing a plan and dissecting the problem and they possess more procedural (system) knowledge. When faced with time constraints, experts rapidly solve a problem and tend to have higher accuracy and flexibility in approaching unique problems (Eva et al). Expertise is also related to communities of practice, as it is within these communities that the domain of the expert is defined. Expertise is generally attained after approximately 10 years of practice (Gladwell, 2008).

1.3.2 Memory

Expertise has traditionally focused on how the brain stores and recalls information in adults. This is closely linked to memory. Information is built from the

acquisition of information and the storage of memory (Sternberg, 2003). A receiver (learner) encodes information in three ways: semantically, visually, and/or acoustically. Once the information is encoded, it is stored in short and long term memory. Memory plays a critical role in expertise and links between strong memory and expertise would appear obvious, particularly in the sense of recalling domain knowledge. Finally, information is retrieved from its' storage place. Within this storage place information organization plays a critical role and how well a person organizes information helps with the success or failure of the recall process (Sternberg).

1.3.3 Multitasking

Multitasking is central to this study. Multitasking is when multiple actions are attempted simultaneously, either physical or cognitive. This is different from task switching, when a person engages in one task, stops, and then switches to another task. This study is mostly concerned with the impact of cognitive multitasking. This study does not measure cognitive multitasking, but it is vital to understand the impact of cognitive multitasking on the task performance. Multitasking is also known as polychronicity (Nimon, Bonner & Lin, 2012) as is evidenced in the multitasking tool used for this study.

The prevailing theories on cognitive multitasking concern whether the cognitive process follows a parallel or serial process. Main theories include Meyer and Kieras's (1997) executive-process interactive control (EPIC) theory, Pashler's (1994) response-selection bottleneck (RSB) or central bottleneck (CB) theory, and Anderson's (1993) adaptive control of thought, or ACT-R.

- EPIC states that an executive controller sets priorities of tasks and manages the flow of information; when a task is considered primary, other tasks are delayed so as to reduce or eliminate demands on cognitive resources.
- ACT-R is similar to EPIC, except that processes in EPIC can be parallel while in ACT-R the processes are serial. ACT-R also states that as the cognitive stages develop, the stages form into a single process, something like the parts becoming the whole. The whole then becomes the entire process after repetition.
- Central bottleneck is different. According to CB, if a response to a stimulus has been selected, then a different response to a different stimulus cannot proceed until the first process has ended. In all cases, it is assumed that parallel processing requires considerable cognitive load.

Cognitive stress is thus an outcome of multitasking. Expertise, heuristics, creativity, and organization, or compartmentalizing small parts into a whole, do compensate for the detrimental effects of cognitive multitasking. It is highly likely that adolescents go through the same process in developing expertise, but developmental stages as proposed by Piaget (1952) and Vigotsky (1962) would suggest that adolescents gather information differently, depending upon their age and development.

1.3.4 Collective Creativity

Collective, interlinked knowledge, as is found in social media sites like Facebook and wikis, offer a broad platform for the individual information search process. There is an ever increasing push to include online environments in formal education (Guo & Stevens, 2011), which augments the informal nature of personal social media. Whereas formal collaboration means, “social processes by which a small group of students work together to complete an academic problem solving task designed to promote learning,” (Alavi, 1994, p. 161), students exhibit behavior ranging from gift queries to planned discussions, all informal and outside of any external motivator. The creative process performed in a group setting, typically online, is referred to as collective creativity.

1.3.5 Collaboration

Collaboration is when two or more students work together on the same goal, but in a formal setting meaning it is planned. Collaboration is normally seen as providing a better answer, as in the old adage of two heads are better than one. Group size matters; groups facilitate expertise and performance (Littlepage & Silbiger, 1992). Diverse expertise also leads to more creative and productive solutions, (Roberts & Nason, 2011). These factors would suggest that a large, diverse, online group would provide expertise and even offer levels of shared heuristics that would allow students to manage their multitasking behavior. Within the social network would be schema allowing for students to make shortcuts with their tasks, leading to greater individual organization. In many cases, students do not truly collaborate as it is much more of an informal process.

1.3.6 Digital Expertise

Marc Prensky (2001) coined the term *digital native*, meaning someone that was born in a digital world. The suggestion was that younger generations are more adept at technological literacy as they were born into it. This remains a debatable topic. Other differences include gender, income levels (the digital divide) and age. For the purposes of this study, it is important to bear in mind that the multitasking student faces stress from multiple modes of media.

1.3.7 Imposed Queries

Within education, most assignments are imposed queries. Gross (1995) defines an imposed query as, “thought up by one person then given to someone else to resolve” (p. 100). Within the research process, when answers or help are offered informally, and

between students, it is termed a gift query (Gross). Students often exhibit satisficing actions, meaning that a threshold is reached where the student is content with their response, all the while knowing that it may not be the best answer. This is closely related to satisfaction and self-satisfaction. Within this study, most information will have been imposed and thus more likely to meet a satisficing end.

1.3.8 Community of Practice

A classroom, including its' online presence, represents a community of practice. A community of practice is "formed by people who engage in a process of collective learning in a shared domain of human endeavor,"(Wenger, 2006) and this extends to online communities. As such, it is closely related to a social network, which traditionally referred to a social structure in which different actors related to one another and different actors held specific roles, as in the case of an information gatekeeper. In a classroom setting, social networks certainly exist, and for this study the online social network will be highly significant. It is within this community of practice that collective creativity emerges.

1.3.9 Creativity

As much of education involves imposed, or directed, queries, creativity is often lacking. Creativity refers to the ability to generate a unique concept or idea. Greenes (1996) points to the need to present "curiosity provoking situations, problems, and questions that are intriguing and captivate students' interest and attention" (p. 37). There are links between group effort and communities of practice and creativity, as well as expertise and creativity.

Kuhlthau's (1991) Information Search Process (ISP) is significant for this study as the model focused on adolescents. ISP refers to the six affective stages that the adolescent searcher passes through while in the information search. Berrypicking (Bates, 1989) is also highly relevant and means that information is gathered a *bit-at-a-time*. This is directly relevant to the online environment. Dresang's Radical Change Theory (1999) is also critical for understanding within this study. Radical Change Theory offers a view of information science which includes, "three digital age principles of interactivity, connectivity, and access" (p. 27). These three works provide a strong theoretical base for this study.

1.4 Purpose of the Study

The purpose of this research is to understand the ways in which an adolescent manages online tasks. Based on the aforementioned definitions of expertise and creativity, as well as understanding what is entailed in a community, it is both unique and valuable to investigate how students multitask. Adolescents multitask, yet also exhibit behaviors that suggest greater expertise or creativity in managing multiple tasks. This may be due to creativity, or to a higher level of technological self-efficacy. A greater understanding of adolescent online behavior benefits an understanding of the adolescent academic, social, and behavioral condition.

1.5 Research Questions

The research questions and purpose are closely related:

1. To what degree, and in what ways, do adolescents manage multiple online tasks?
2. Does this task management grow from collective expertise?

3. Do students exhibit heuristics indicating expertise and creativity in managing the task?

4. What role does technological self-efficacy have in this process?

1.6 Research Setting

All investigation took place at a large international school located in Lima, Peru. The school uses the International Baccalaureate (IB) program for curriculum delivery. IB is popular world-wide and is considered the standard for international schools. A review of the International Baccalaureate (IB) program is in order as understanding the educational setting is critical to understanding this study. There are four programs within the IB and these programs are based on the age levels of the learner. The Primary Years Program (PYP) addresses students aged 3-10, the Middle Years Program (MYP) covers ages 11-16, the flagship Diploma Program (DP) corresponds to the final two years of a North American education, meaning ages 16-19, and the newly introduced IB Career-related Certificate which also covers ages 16-19. This study relies upon an understanding of the MYP and DP programs.

The PYP, MYP, and DP programs are connected through the IB Learner Profile as well as the use of inquiry-based instruction in each of the programs. The IB learner profile, “is the IB mission statement translated into a set of learning outcomes for the 21st century…The learner profile provides a long-term vision of education. It is a set of ideals that can inspire, motivate and focus the work of schools and teachers, uniting them in a common purpose” ("IB Learner Profile," n.d.). The Learner Profile is a guiding document and does not play into direct instruction. Still, it is perhaps the most

critical, and most referred to, document within the IB publication manual. The Learner Profile is listed in Appendix D.

The MYP is a flexible program designed for students 11-16, roughly corresponding to the US grades 6-10. Within the IB, the grades are referred to as MYP 1-5. Broadly, the MYP is meant to be flexible enough to fit into a number of national curriculums and asks students "to become creative, critical and reflective thinkers… to make connections between their studies in traditional subjects and to the real world"("IB Middle Years Programme," n.d.).

The MYP program is complex as there are 8 subject groups, and these are connected through 5 interactive areas. The eight subject groups include two languages, humanities, sciences, mathematics, arts, physical education and technology. There is flexibility in defining these programs. At Colegio Roosevelt, the two languages include English and Spanish, the humanities and science units are largely based on South American topics, and technology is defined as design technology, which is similar to industrial design ("IB Middle Years Programme," n.d.).

Beyond the 8 subject areas, the 5 interactive areas include Approaches to Learning (AoI), Community and Service, Human Ingenuity, Environments, and Health and Social Education ("IB Middle Years Programme Areas of Interaction," n.d.). These 5 areas form the basis for interdisciplinary education, sort of like a web that ties the different subject groups together. The subject groups, along with the AoI, aims to make a robust, inquiry based program that is flexible for the international community.

Assessment adds another level of complexity to the MYP program. MYP uses a criterion-based rubric for evaluation. According to the IB, "MYP assessment model is

criterion-related. Teachers structure varied and valid assessment tasks so that students can demonstrate achievement according to objectives defined by the IB. Tasks are assessed against established criteria, not against the work of other students"("IB Middle Years Programme," n.d.). Thus, evaluation is based against a published set of standards in the hope of objectivity. Each subject has different criteria, and different numbers of criteria. For the purposes of this study, it is critical to understand that the IB is based on an integrated philosophy that includes pastoral care issues, the AtL in the MYP, and looks to integrate the AoI in MYP.

Regarding the DP program, assessment is narrower. While inquiry based, students in the DP program follow a curriculum that is the same as other schools around the world. There are a number of exceptions based on teacher preference, geography, resources, and ability, but ultimately, the DP program follows the same curriculum based on the northern or southern hemisphere calendar. Requirements for the IB Diploma are consistent throughout and all schools are certified and regularly monitored. Assessment takes place either in November or May, depending upon the hemisphere. The IB may seem confusing, and when initially introduced to the program, it probably is. The study site has had the IB in place for 12 years and this experience has led to successful implementation. The IB charts included in the appendix will offer greater clarity on the program.

Within this study, several key points emerge. First, organization is taught within Approaches to Learning. However, this is not mandated and relies upon the teacher to implement. With 5 years of MYP, approximately 6 units per year, and 8 subject areas, it is fair to assume that organization is taught to all students. However, it is not

standardized and the AtL is not the main purpose of a unit. Teachers focus on content over delivery. Second, Design Technology may use computers, but equally may use scissors, sewing machines, or construction tools. Computer skills are not taught officially within the MYP curriculum at the study sight.

Another point worth noting concerning the IB is the ambiguity in the role of the librarian. The IB does require that schools have a library, a librarian, and research databases, but there is no defined role for the librarian as there is for other teachers and administrators within the IB. This means that the librarian is often under-utilized and given the opportunity to define their own role within the context of each individual school. The librarian should be the person to deliver information literacy, which could include organization. However, no official class is arranged for this and it happens at best in a haphazard manner.

1.7 Research Design

In order to gain evidence, the study employed both qualitative and quantitative measures. Six individual interviews offered suggestions into meta-cognitive insights regarding online tasks. Analysis of posted messages taken from two quasi-formal student Facebook pages indicated how a community of practice uses online communication. Approximately 50 students completed a survey tool measuring multitasking behavior and offering insight on self-perceptions of multitasking. Finally, four planned observations of students revealed rich detail in the search process, how a community affects this process, and hidden or subtle behaviors of the student. The research design directly grew from the research questions. The research design is elaborated in Chapter 3.

1.8 Significance of Study

This study will be significant on several levels and applicable to distinct disciplines. Understanding another level of cognition among adolescents aids the field of Information Science, as well as educational research and psychology. Adding to the growing, yet nascent, body of research which covers online social media will also help Information Science as well as education, technology, and even commerce.

1.9 Assumptions, Limitations, and Scope (Delimitations)

The study holds several assumptions. First, it is assumed that adolescents are avid multitaskers and assumed that their observations of adults would indicate that multitasking is a common element in the professional lives of adults. Within the curriculum of the International Baccalaureate, adolescent students are rarely and haphazardly taught to organize online tasks. In spite of this, adolescents exhibit tools to manage the online task in terms of organization and successful termination. Expertise lends itself to heuristics, and expertise typically emerges after about 10 years of practice, making the adolescent a novice in terms of the formal definition of expertise. This study hopes to show that adolescents use self-taught tools, reminiscent of heuristic shortcuts, to manage their online life effectively. Additionally, online groups bring collective, interlinked knowledge which compensates for a lack of expertise. All of this is affected by self perceptions during the task, and by the technological self-efficacy of the adolescent.

This study rests largely on the assumption that students work together on assignments, both officially as a part of the requirement, and unofficially as a matter of choice. When students work together, I suggest that this is not cooperation, nor is it

collaboration. Cooperation is when students offer help to each other on different assignments, and is typically voluntary. Collaboration is formal and is the product of an assignment whereby the teacher mandates that students work together. What this study observes is communal expertise. Communal expertise is cooperative in that help given to others in the class is voluntary, and it is collaborative, in that the teacher often expects assessment to be group based, but much of the work is independent. But more than this, communal expertise includes the online and face-to-face social environment whereby students take advantage of group knowledge via online networks to aid in their own underdeveloped expertise. Students provide gift queries, support, levity, and overall increased knowledge on searching and content knowledge.

The socio-economic status of the subject group is a limitation, as is the international nature of the group. The school is well resourced with open access to information meaning multiple databases and no Internet filtering. Student search behavior is likely affected as students come from wealthy homes and are also expected to enter university. At the same time, the IB program is an asset. The study is likely replicable as the population at international schools is very similar and the use of a standard curriculum makes the subject group very similar across space.

Another limitation is the level of digital access given to the subjects in this study. All students have an online class platform to support face-to-face learning. The school uses Moodle, an open source platform for classroom management. Moodle is functional in that teachers post assignments and students submit work through the portal, and this is the primary means of assignment delivery. However, Moodle is not easy to use, nor particularly attractive, and students do not use Moodle for cooperation

on assignments or for communication. Second, the school does not filter Internet content, apart from sites that carry malware. This means that the students have open access to information and thus have few restrictions when searching online.

The scope of this study covers adolescents in education, information and cognitive science, and online social media. Information science and educational research has long covered adolescent learning and this study looks to add meaningfully to previous research. Understanding social media is still new, but highly significant at the present and very likely to continue to be significant for some time. Multitasking or task switching overloads the cognitive process, but through heuristics, or mental shortcuts, adolescents manage their online tasks. While not experts, their *collective creativity* stemming from a community of practice allows for a managed search process.

1.10 Summary

Multitasking is an age-old phenomenon, but with the introduction of so many different modes of media, multitasking has become highly significant in terms of understanding the search strategy of the adolescent. Adolescent searchers are novices and this has been well documented (Lucas & Topi, 2002; Dinet, Favart, & Passerault, 2004). Social networks are popular with adolescents and provide a community of practice wherein information is passed in a new, rapid, and often satisfactory manner. This community of practice may account for greater levels of success within the adolescent information search, perhaps suggesting a precocious sort of expertise.

CHAPTER 2

LITERATURE REVIEW

A review of the literature for this study necessarily includes previous research on expertise, memory, multitasking, information gathering among adolescents, communities of practice, collective knowledge, and task management. A thorough review of each area leads to a foundation from which the multitasking adolescent can be better understood. With certain topics, research has long been established and is rich in breadth, while in other topics less research has been done. Further, studies often focus on adults and while the cognitive levels of adults and adolescents are obviously different, the studies are included as results are revealing.

The following review is organized by general topic, though there are times when a review could have been located in several areas at once. Related research questions are included in each introduction in order to provide fluency between the review and the research question.

2.1 Expertise

Studies looking at non-students offer an idea of how adults in general gather and organize information and then become experts. This relates specifically to question 3 of this study, do students exhibit heuristics indicating expertise and creativity in managing the task? Eva, Norman, Neville, Wood and Brooks (2002) studied medical students and found that novices are more detailed in their analysis of a problem. Experts pulled summary information and stored that knowledge in an abbreviated form. Experts were thus able to draw from schema built over time; memory and experience led to rapid and accurate, albeit brief, conclusions (p. 261). The study drew attention to the intermediate

effect, whereby intermediates recall more than experts when there is no constraint on time. However, the study supports the characteristics of an expert as having a larger schema for domain knowledge. Experts gave quicker, more accurate diagnosis and this was based on experience.

Air traffic controllers served as the basis for two major studies on expertise. Salden, Paas, Broers, and Ven Merrienboer (2004) and Camp, Paas, Ricers, and Van Merrienboer (2001) showed that dynamic problem solving, where participants were given flexibility in choice of solution, lead to more efficacy in decision making. Dynamic task selection and problem solving led to greater success as it caters to the cognitive state of the learner. The cognitive load, defined as, "the mental load imposed on the cognitive system of the learner by a certain task," (Camp, et al., p. 576) became more manageable through dynamic problem solving and led to greater success. Novices experience greater cognitive load and experts less due mainly to schema organization. Thus, dynamic problem solving offers a model for helping novices perform and would offer directions for approaching how novices search for information.

Lucas and Topi (2002) investigated the different between experts and novices in search term use using the World Wide Web. Differences included the number of search terms used (experts used more), the percentage of matching terms between those searches, and the use of incorrect operators, where novices were more likely to make errors (p. 103). Regardless of expertise, most users reject using search tips and the study found that search term selection and use was more important than operator selection and use (p. 104). Not surprisingly, the complexity of the information request

led to greater or lesser use of operators and terms in query formulation. Finally, increasing query complexity had little effect on query results (p. 105).

Studies that look at student users of the Internet are consistent with studies of the general public. One area of distinction concerns domain (content) knowledge and system knowledge. It is difficult to expect young learners to have a large storage of domain knowledge due to lack of experience. For older students, domain knowledge does become significant. McCauley, Murphy, Westerbrook, Haller, Zander, Fossum, Sanders, Morrison, Richards, and Anderson (2005) showed that the most successful computer students in university were well organized and integrated programming knowledge (thus, domain knowledge) into their wider understanding of computer science (p. 152). Students performed as experts: they developed advanced schema and organized information better.

Dinet, Favart, and Passerault (2004) identified a number of characteristics of expert and novice searchers. Given equal pre-training, experts used Boolean searching significantly more than other groups, which would support the notion of adding to an advanced schema. Applying Mann's principle of least effort (1993), Dinet et al. (p. 339) showed that students selected easily available resources. Their searches terminated as soon as the searcher felt the need had been met (an obvious notion that any teacher can tell you does not need to have a principle established about it). Experts produced more queries and used more specific terms than novices, which supports Marchionini (1993) and other studies. Query terms again averaged about 2 terms per search and were rarely modified. Dinet et al. did find that the number of queries was the same regardless of the level of search expertise (p. 343) and that

experts had more system knowledge, as shown in greater use of Boolean operators. It would seem, then, that people search about the same amount but do so in a hasty manner. Searchers stop easily. Finally, given the chance, expertise in system knowledge can be established through repetition.

Brennan (2001) investigated students searching for a university course and many findings support characteristics for expertise. Experts search when they know what they are looking for and are therefore able to minimize the amount of time spent on a search. Experts, "may see information which they perceive to be relevant but which the institution may not be willing to provide (p. 219)" which suggests creativity. Experts are individualistic and less likely to seek interpersonal sources of information. Finally, student self perceptions suggest that students felt they possessed more expertise than they actually demonstrated (p. 221). Overall, students felt that they possessed more expertise than they actually did (pp. 221-222). This makes establishing a benchmark for expert/novice difficult.

Fidel, Davies, Douglass, Holder, Hopkins, Kushner, Miyagashima and Toney (1999) observed students performing imposed query searches. Students proved to be resilient, persistent, and clever, but also became easily frustrated (p. 31). Students preferred use of the Internet to the library due to perceived speed of search. Successful results emerged when the searcher knew what they were looking for (p. 32). Finally, students were better at skimming and scanning pages while looking for results (p. 34).

Watson (1998) also looked at student searchers and offers characteristics of an expert. Watson studied a group of grade 8 students and found that searchers gained confidence from past trial and error, they were adept at independent browsing, and

found they needed to identify a search topic before beginning a search. Expert searchers, identified as successful students, exhibited basic search skills including flexibility, organization, and modification of the search (p. 1034). Overall, students felt that they possessed more expertise than they actually did (pp. 221-222). This makes establishing a benchmark for expert/novice difficult.

Pennanen and Vakkari (2003) note the difficulty users have in establishing an understanding of the topic and in formulating a search query. While this is not expressed as a study of expertise, the findings are highly relevant as the authors do investigate habits of the novice searcher. The searcher's *Anomalous State of Knowledge* (Belkin, 1980) improves with strong domain knowledge but their study showed that searchers went through a process where the topic became increasingly specific. Searches become more focused, a vocabulary of search terms is constructed, and knowledge is chunked and stored for later retrieval (Pennanen & Vakkari, pp. 764-65). The study reconfirmed that searchers are not familiar with Boolean logic, thus the search term selection is critical. As the search progressed, the searcher displayed increasingly better skills, thus expertise.

Kalyuga and Sweller (2005) offer suggestions on developing expertise in evaluating learner expertise. They note that working memory in novices is quickly overloaded and that expertise evolves through repetition of skills. After time, schemas develop and then occur naturally. These schema change as the learner gains more information. The only aid for the novice is instruction (p. 92). Kalyuga (2006) again refers to instruction and suggests that cognitive load must be reduced as novices are easily overwhelmed. The level of expertise of the individual does have an effect upon

cognitive load and while the author discusses necessary changes to educational formats, the main point is that novices are not cognitive experts (p. 341).

Van Gog, Ericcson, Rikers and Paas (2005) define expertise as, “consistently superior performance on a specified set of representative tasks for a domain” (p. 75). Expertise was shown to be linked to time on task, and creativity critical to the search process. Experts as well develop mechanisms that “mediate their superior performance and allow them to circumvent the processing limits that constrain novices”(p. 79). The authors note a phenomenon known as expert reversal effect, wherein experts perform worse on mundane tasks designed for novices. Within domain specific tasks, however, experts continually show greater results (p. 75).

2.2 Memory

A review of literature regarding memory is highly relevant for this study. Questions 1 and 3 specifically rely upon an understanding of how memory affects learning and understanding. Question 1 asks, “To what degree and in what ways, do adolescents manage multiple online tasks?” Memory and the ability to hold multiple thoughts in a cognitive space simultaneously, is a variable affecting task management. Question 3 asks if students exhibit heuristics indicating expertise and creativity in task management. Memory is linked to heuristics as memory allows for schema to develop.

Conklin, Luciana, Hooper, and Yarger (2007) note that prefrontal development continues into the third decade of life, and this prompted the study as they looked at prefrontal development and working memory. The study specifically observed typically developing children and their working memory. The study showed that working memory did improve as the subjects entered adolescence (Conklin et al., p. 117). The authors

note the importance of multitasking, as this is largely based on working memory (p. 104). As frontal lobes develop, working memory increases, meaning greater likelihood of multitasking success.

Foerde, Knowlton, and Poldrack, (2006) add to the body of research attesting to the lack of successful multitasking. This study observed the competition between declarative memory and task (habit) learning, using neuroimaging to map cognitive activity. The highly significant study shows that, "declarative memory and habit learning compete to mediate task performance" (p. 11778). When subjects were given dual tasks, accuracy did not diminish but declarative memory did, consistent with other studies. In other words, the task can be completed, but flexibility and acquisition of new knowledge decreases. The study refers to flexible knowledge, which "can be applied in a novel situation outside the training context" (p. 11778). The study also suggests that memory permits greater multitasking ability.

Law, Logie, and Pearson (2005) used a virtual errands test, which measures executive dysfunction in a dual task setting. The results showed a drop on performance with the dual task activity, and this drop increased when the dual task was a random task rather than a repetitive task. This suggests that declarative memory does aid in the multitasking environment, but multitasking still led to a drop in performance (p. 27). The researchers also note that participants protected performance of the first task to the detriment of the second, apparently protecting performance on the first task at the expense of the second (p. 38). The authors say that the drop in performance was not as great as expected, noting that scores were acceptable (p. 41).

2.3 Cognitive Multitasking

Cognitive multitasking deals with the cognitive process which ensues when multitasking. Generally, subjects experience cognitive overload. The way in which this happens is under discussion, but researchers agree that multiple cognitive processes impede understanding and knowledge in that declarative memory is interrupted. This is most closely related to question 3, though it is not a direct relationship. It is vital to include a review of cognitive multitasking as it shows the difficulty experienced in successful multitasking and how shortcuts emerge in order to manage multiple tasks. Further, it relates to the significance of the study as increased understanding in student behavior aids in understanding the cognitive process.

Arrington (2008) focused on the effect of stimulus availability on task choice. Findings showed that there is an influence of stimulus activity on task choice (p. 995). When subjects had longer to prepare for the task, the external stimulus had less effect which suggests that declarative memory has a role in reducing external stimuli. The author explains this to be simple heuristics—the subjects will go with what they know (p. 996). This is significant as resorting to heuristics indicates expertise. Finally, stimulus availability affects task choice (p. 996), so what we want also affects our choice.

Borst and Taatgen (2007) studied cognitive development and processes. If there is no central executive managing a task, then individual processes must share resources in cognitive processes. There are times when tasks share resources, as in peripheral and declarative memory. However, when both tasks need a problem representation then there is extra interference. In other words, we can talk and chew gum but we cannot read and watch TV effectively. “Threaded cognition can therefore

account for the flexible way humans combine previously unrelated tasks, and for the fact that many tasks can be learned in isolation first and performed together later" (p. 133).

Multitasking has an effect upon cognitive load. Dongyuan, Proctor and Pick (2009) note, "how people adjust to payoff changes for one task of several, and how that priority shift influences the performance of the remaining tasks, are the topics of concern in the present study" (p. 705). People can vary the amount of attention given to a particular task so that the reward is greater for that task—this is referred to as executive control processes. The authors mention that plenty of studies have shown how this happens in the natural world (cell phones and driving). In the lab setting, the results are similar; people switch attention based on what reward they need to gain (p. 706). Put another way, if people sense more significance in a given task, then the attention to that task needs to increase (p. 714). The caveat is that people are trained to do multiple tasks, as in the case of air traffic controllers.

Dux, Ivanoff, Asplund and Marois (2006) offer support for the bottleneck theory, in which cognitive processes are bunched up at some point in the neural network of the frontal lobe area. The study used fMRI to map cognitive activity and results were consistent with findings by others. Cognitively, dual task performance is not possible (p. 1114). The study enlightens the understanding of the information process as the authors note that parallel processing might be happening at the motor stages of processing, but not at the central processing point. This is a critical point; while it is possible to do multiple things at once, it is impossible to process at once. Further, the study strongly suggests that the prefrontal cortex is at the center of multitasking abilities

(p. 1115), which supports previous studies linking the cognitive area of multitasking to developmental stages of the subject.

Foerde, Knowlton and Poldrack (2006) used a catscan to measure brain activity, noting that, “declarative memory relies on a medial temporal lobe system, whereas habit learning relies on the stratium” (p. 11778). Their results show that “the presence of a demanding secondary task during learning modulates the degree to which subjects solve a problem using either declarative memory or habit learning. Dual-task conditions did not reduce accuracy but reduced the amount of declarative learning about the task” (p. 11778). Further, “declarative and habit learning compete to mediate task performance and they suggest that the presence of distraction can bias this competition” (p. 11778). Declarative memory encoding relies upon working memory.

Halford, Wilson and Phillips (1998) note that cognitive processing depends upon the difficulty of the task. Thus, “information processing capacity limits in humans and higher animals should be defined not in terms of the number of items but in terms of the complexity of relations that can be processed in parallel” (p. 803). Strategy affects this processing; strategy may account for improved search behavior.

Konig, Buhner and Murling (2005) began with the assumption that attention and working (declarative) memory would influence multitasking performance. Fluid intelligence, polychronicity (defined as a preference for multitasking and a belief that MT works), and extraversion were also considered as influential variables. The results showed that working memory was most important, followed by attention and fluid intelligence (p. 260). Other variables were not found to be significant. This is an interesting and important study as it brings up expertise and memory as well as the

concepts of polychromic and extraversion. Extraversion is highly unique in studies; people who are Type A personalities might have greater MT abilities, but this study did not find this to be true (p. 261).

Xu (2008) looked at instant messaging and Skype when combined with other activities. Findings are consistent with other studies; dual tasks led to lessened performance. Interestingly, the study had a subject and a partner, and the subject's self-appraisal was higher than what the partner awarded, supporting other studies which show self-perceived successes with multi-tasking (p. 70). Finally, the study was consistent with other studies in suggesting that the addition of another task slows down the completion of the primary task (p. 67).

Luciana, Conklin, Hooper and Yarger (2005) present an in-depth study on adolescents and multitasking. The study finds that teens are not fully developed so working memory is also not fully functioning. This has repercussions on multitasking performance. The executive processor continues to develop into adolescence and beyond, independent of general intellect. The authors reaffirm previous studies and support the notion that memory has a large role in the cognitive multitasking process.

Salvucci and Taatgen (2008) propose a blended concept of mental multitasking. "Threaded cognition posits that streams of thought can be represented as threads of processing coordinated by a serial procedural resource and executed across other available resources (e.g., perceptual and motor resources). The theory specifies a parsimonious mechanism that allows for concurrent execution, resource acquisition, and resolution of resource conflicts, without the need for specialized executive processes" (p. 101). This would be similar to parallel processing, combining parallel

processing with a central executive. Salvucci, Taatgen and Borst (2009) again attempt to unify the theory on cognitive multitasking. The authors incorporate threaded cognition, ACT-R cognitive architecture, and memory-for-goals theory and suggest that each theory is correct, and contributes to the multitasking process. It is important to note that cognitive multitasking studies are often theoretical as it is difficult to show exactly what happens in the cognitive process.

Speier, Valacich and Vessey (1999) reaffirm previous studies in that, "Interruptions were found to improve decision-making performance on simple tasks and to lower performance on complex paths" (p. 337). The cognitive information system is highly interruptive and interruptions are external, random, and discrete. The authors apply Distraction/Conflict Theory which states that distractions facilitate performance on simple tasks and inhibit performance on complex tasks. The reason for the first is that distractions focus the person on the few tasks and they complete them faster. One interesting finding: "interruptions containing information dissimilar from the primary task took longer to complete than those with similar information. However, they were completed with equivalent accuracy" (p. 350).

2.4 The Millennial Adolescent Learner

Understanding the subject is critical to any study. Much has been written on the millennial, Generation Y group, but most writing has been anecdotal and not fully researched based. A survey of the current literature on Millenials provides a set of consistent traits and characteristics that are critical to a study on this group. In this sense, a review of relevant literature applies to all research questions.

Abram and Luther (2004) consolidate previous research and offer 9 characteristics of the next-gen/screenagers/Gen Y/Millenials. First, this group is format agnostic, meaning that they do not care about the format of the media tool; TV, print, online is all the same, resulting in information being delivered in a combined manner. Second, they are nomadic; they get their information when and where they want to and multitasking is a core behavior. Third, Millenials are experiential--they want content rich information rather than table-of-contents. Millenials are also collaborative and prefer communicative tools like Instant Messaging over static tools like email. They are integrated and blur the lines between private/public and educational/entertainment. The group is principled, possessing a well-defined value system. Related, they are adaptive and expect considerations for ADD, ADHD, disabled, and such. Finally, they are direct and will ask for what they need, getting upset if the need is not met. Again, this stems from anecdotal observations in libraries and from a review of literature. The information is certainly valid, regardless.

Abram (2006) adds to the previously observed characteristics, noting that Millenials are smart, as demonstrated in the rise of IQ scores over the past years. The author also notes that eye pattern scanning for Millenials is more rapid and not uniform. Further, they delay choice until the last second and expect more choice. Thanks to social media, Gen Y students have more friends. They are avid gamers and see positive aspects of gaming. They respect diversity to a greater degree, in fact, they demand it. They seek balance and are politically non-aligned. They are optimistic with high expectations. They are civic minded and good readers. Finally, they know they have diverse learning styles and they expect those styles to be met by educators. This

may be specific to the subject group which was North American students. Barnes, Marateo and Ferris (2007) reiterate the characteristics of Gen Y students as a way to enlighten educators to know better the students they teach. The authors do not offer a study, but rather, a review of multiple studies, all suggesting agreement with Abram. Finally, Jones (2008) characterizes millenials as confident, optimistic, but impatient (pp. 66-67).

Rowlands, Nicholas, Williams, Huntington, and Fieldhouse (2008) offer a critical study on previous research on how the newest generations are searching the net. The British library conducted the study and focused primarily on what the paper calls the Google Generation. To be sure, the role of the library has changed from the point of view of the Google Generation, and libraries must find ways to respond. Whereas Google Generation uses the Internet for information, libraries are still associated with books (despite online collections), and the Google Generation is mostly satisfied with their research results (p. 7). The findings are important for research and for application. As the researchers point out, young people are not better at searching, in fact, they may be worse. They use keyword and do not understand the organization of the internet. They do not read critically nor do they analyze information. Their ISB is no different than other generations, but the mode of that ISB (Internet) is. They seem to skim for information, what Bates calls berrypicking (Rowlands et al., p. 8-10). The study lists probabilities related to ISB and some ideas for future improvement (p. 23). Basic library skills are linked to higher test scores and if it is not taught in the young grades, the student will never get the information. This instruction must take place in the earlier years; at university, Google is the preferred method to gather information.

The study offers an outlook of the future, attempting to predict what information will look like in 2017, suggesting that ebooks will rise, ubiquitous access will rise, and more content will be available (p. 26-27).

Cooper, Moore and Wells (2008) addressed student opinions toward roving librarians and mobile devices as service points in an academic library. Peripherally, the study offers characteristics of the millennial: they have great expectations, they expect customization, they are tech veterans, and they utilize new communication modes. All of this supports the notion that multitasking is prevalent (p. 76). The researchers interviewed students in an academic library and found that they preferred face-to-face contact and customization consistent with characteristics for Millenials. Further, Millenials are diverse and have high expectations. The like customization and communication and being mobile, especially in terms of hand-held devices. One interesting, and perhaps unique finding, is that students want a quiet place to study, in addition to access to evolving technologies.

Alvermann (2004) presents a cultural studies perspective on the debate surrounding youth literacy. The author sees new definitions as necessary when approaching youth and literacy. Hypermedia is interpreted, even becomes part of reading and writing, and this is the emerging paradigm. Whereas the classic view saw audiences being coerced by powerful media initiatives, the youth of today is much more savvy and creative. In a sense, the study relates to Lessig (2009) and Dresang (1999). The author concludes with how this new literacy will affect the classroom, basically stating that old models of textbooks need to be reevaluated in favor of more inclusion of multimedia.

Though Prensky does not offer research, his coining of the term *digital native* and the resulting popularity of the term makes it impossible to dismiss his writing. Prensky's (2001) initial argument suggested that technology had helped create two distinct groups: digital natives who were born into the digital generation, and digital immigrants, born prior to the digital era. Prensky suggests that natives are more adept at all things digital, including the way in which digital devices are used (multitasking), going so far to suggest that natives are even hardwired differently. Prensky (2008) incorporates the term *Continuous Partial Attention* as the way in which a digital native operates. CPA derives from consumerism, and refers to the way in which multiple modes of media target the consumer, which is standard business procedure. Prensky suggests that CPA is different from multitasking which is about efficiency.

Taking direct issue with the *digital native* debate is Bennett, Maton and Kervin (2008). The authors present an excellent critical review of the digital native discussion. Research to date shows that much of the language used by the 'digital native' crowd is hyperbole and meant to scare the field of education. The authors find no evidence to support Tapscott's and Prensky's notion of a digital native. Technology skills are very different within the digital native population and are more often due to social and economic factors (p. 778). Borzekowski (2006) has also indicated how socio-economic factors influence Internet use in terms of health research. Further, multitasking is not a new phenomenon (p. 779). Developmental stages based on the work of Piaget are the key to understanding as the user needs the reasoning abilities. Information tends to be gathered haphazardly (p. 781), much like Bates' Berrypicking model. The authors call

the Digital Native discussion a *Moral Panic*. The change is evolutionary (p. 783) and all are adapting.

Selwyn (2009) offers an even greater rebuttal to the digital native discussion. The author notes that children are not innate users of technology and they are not born as experts. Adolescents are not too good at gathering information and thus, their answers are often not very good. Selwyn mentions that some problems might be arising in terms of getting adolescents to think about what they are doing, in other words, metacognition. There is a developmental issue in this notion, of course. Selwyn points out that much of what has been written regarding the *digital native* is in fact anecdotal. Selwyn references that any changes that are observable among adolescents are due to, "young people's abilities to access digital technologies remain patterned strongly along lines of socio-economic status and social class, as well as gender, geography and the many other entrenched 'social fault lines' which remain prominent in early twenty-first century society" (p. 372). In Selwyn (2007), Web 2.0 learning is shown to be a powerful tool in education, including social media, gaming, and applications.

The Kaiser Foundation study is perhaps the most cited study on multitasking. It examines the prevalence of media multitasking, the nature of media multitasking (i.e. which media are adolescents pairing?) as well as predictors of media multitasking, or who multitasks. A majority of youth spend some time multitasking. The computer serves as the main station but television is a large part of their media multitasking world. The difference is that youth will have the TV on as a secondary media, but when it is the primary media, it is often alone. There is evidence on who multitasks the most: "Young

people who are exposed to the most media, those who have a computer and can see a television from it, those who are sensation seekers, those living in highly TV oriented households, and girls are more likely to media multitask" (p. 23).

Carrier, Cheever, Rosen, Benitez and Chang (2009) studied the at-home multitasking behaviors of three generations: Net Generation (Millenials), Gen X, and Baby Boomers. Results showed that younger people multitasked more. Studies are not consistent when it comes to generational multitasking behaviors. The methodology of the present study appears very robust and the findings are perhaps more credible than other studies, but overall, studies on generational differences are limited. The findings also showed that Net Gens found multitasking easier (p. 488), and that all generations agreed upon which combinations of activities were hard and which were easy, meaning that metacognition was present. What is most interesting about this study is that younger people have less developed brains (Conklin, 2007; Luciana, 2005). This discrepancy might be due to a potential limitation of the study, one which the authors mention: this measures perceptions of multitasking ability rather than actual ability (Carrier et al., p. 488).

Boese (2008) sets out to examine the perceived notion that bilingualism enhances a person's ability to multitask. Three groups of subjects, English only, English/Spanish, and English/sign language, were given a computerized test and measured against the findings. Bilingualism affects the frontal lobe area of the brain, which is the same area as multitasking. The author suggests that continued bilingual use through life does in fact allow for greater multitasking ability. Also interesting is the suggestion that multiple languages may increase flexibility or creativity as the user has

a greater means of expression (p. 37). Older participants also showed greater multitasking abilities, which is consistent with other research (p. 69). Finally, a link between language ability and working memory was suggested (p. 70), which could very well be connected to greater multitasking success.

Agosto and Abbas (2010) investigated adolescent use of media and perceptions toward social network and information and communication technology (ICT). The authors found that adolescents did not use technology just for the sake of using it; rather, technology use was purposeful. Second, online relationships matter a great deal to adolescents, both in terms of who is contacted and how they are contacted. As an example, adolescents select appropriate tools depending upon the contact group, meaning that email is used for contact with adults, but social networking is preferred with peers.

Fidel, Davies, Douglass, Holder, Hopkins, Kushner, Miyagashima and Toney (1999) studied student searches in a focused setting. Students performing a directed search showed themselves to be resilient, persistent, and clever, but became frustrated early. Students indicated that they preferred the internet to the library due to speed of search. The study showed that results are more likely when the searcher knows what is being sought. The example was an imposed or directed search and subjects were not allowed to wander on the search independently. Rather, they were focused because they knew what they were looking for from the beginning. Spelling was an issue, consistent with other research. Expert searchers showed skimming and scanning pages while looking for results.

Bilal (2000) observed the children's cognitive, physical, and affective behavior. Children seem to have a metacognitive understanding of the search process, or the search task, term relationship, concept selection, search formulation, and subject hierarchies (p. 655). Bilal offers observations concerning successful searches. Namely, successful children avoided natural language and instead chose single or multiple concepts and, although they made fewer moves, successful children scrolled more, navigated more hyperlinks, and examined more homepages (p. 656). The search process and the design of Yahooligans! was shown to affect the physical and cognitive aspects of the search. Concerning affective behavior, Bilal suggests that children were mostly concerned with topicality and experienced confusion in task definition (p. 658). Children did show motivation in using the internet and exhibited persistence and patience in the search process.

Hirsh (1997) combined a hierarchical browsing search method with a keyword search. Findings support those of previous studies; children with higher domain knowledge searched better and success depended upon the complexity of the search. Keyword searching proved most successful while browsing only and combined searches were moderately successful. Hirsh's study suggests that browsing is a system centered approach while keyword searching is much more user centered. Hirsch (1999) examined relevance criteria of 10 fifth grade students as they completed an assignment. Hirsh found that children actively engaged others for help: teachers and librarians helped formulate queries and fellow students offered gift queries (p. 1270). Students proved to be sophisticated in the search process and varied search strategies based on the electronic resource, but frustration did set in at various stages

(pp. 1270-1271). The findings show that when children examine search results, they employ different techniques to determine the usefulness of the information object (p. 1272). Book cover, book title, table of contents and the book index all aid the decision making process. Relevance of an information object was most often based on topicality, or the degree to which the information object would meet the project requirements (p. 1273). Accuracy or authority was much less important; children tended to accept what was on the Internet as valid (pp. 1273-1274). Other criteria included convenience, interest, language, novelty, peer interest, quality, recency, and completeness (p. 1275). Concerning all relevance criteria, Hirsh showed that students became better evaluators of each criteria as the project progressed and the students became more focused (p. 1275). Relevance criteria did change through the research process and as students reached the end of the project, topicality became the central criteria (p. 1280).

Laverty (2002) observed children in a resource-based activity. Laverty studied two classes of 5th grade students as they collected information on the Mayan civilization. In the observation, Laverty taped interviews with students and teachers, observed students in the search process, and held discussions with students in small groups (p. 226). Group work was shown to spark more creativity in formulating the queries. Children used one search term in the card catalog, and if unsuccessful, they commented that the information was not part of the collection. In other words, a failed search did not lead to alternative ways of searching. Children also had difficulty in finding information on the shelves and often preferred to scan for relevant books. When information was located, children proved to be poor evaluators of relevant information

and often needed assistance in focusing on information and in selecting information. One indicator signaling importance in information was the number of documents recovered; the more documents, the more success to the student (pp. 226-227).

In one of the only studies that compare different cultures, Lei, Zhou and Wang (2009) compared Internet use at home and at school between students in China and the United States. Researchers found significant differences in behavior at school, but not at home. American and Chinese students behaved similarly in terms of tasks: searching for information, communication, and entertainment/gaming (p. 160). As a result, both groups multitasked. Also, home-school use was more different for US kids than for Chinese, which the authors attributed to different pedagogical styles (p. 160). Overall, the study provides some interesting comparative insights but is mostly consistent with other multitasking studies.

Branch (2002) studied 12 middle school students in the process of individually answering questions posed for the research project. Students received basic knowledge of the online system. Branch notes that students performed three processes: students entered a search word into the search box, they skimmed results to find relevant articles. Then, students skimmed the article to find the answer. Branch compares this process to Bates (1989) berrypicking process (Branch, p. 16). Branch mentions that certain factors affected the success of this process, finding the right keyword, broadening or narrowing a search at the right point, and patience and persistence all affected the search (p. 16). The study is consistent with Bilal (2000), Borgman (1995), and others in terms of establishing a process for online information searching by the adolescent.

Bowman , Levine, Waite and Gendron (2010) measured the effect of a distraction (instant messaging) upon reading comprehension. Findings were consistent with other multitasking studies, namely, students take longer to read and achieve comprehension when they multitask. Performance did not suffer, but multitasking impacted the time needed to complete the task (p. 930). The study did measure three interruptions: IMing prior to reading, during reading, and no IMing, and an unanticipated finding was that those who IMed before reading had the shortest reading time (p. 930).

Also looking at instant messaging is Lee and Perry (2004). In this study, the researchers found that subjects could not self-regulate when using IM. Other socialization tools lost out and IM took up a substantial amount of time. The authors' state that IM does not deliver content, but rather, only the message (p. 400). The authors also list IM as an addiction and offer the affect of that addiction (pp. 400-401). This is a powerful suggestion, indeed. The authors go on, "synchronous communication supports deep relationships (p. 402)," so IM use is not considered completely negative. Finally, sleep deprivation was linked to IM use (p. 414) as in Calamaro, Mason & Ratcliffe (2009).

A third study on IM comes from Levine, Waite and Bowman (2007). The authors studied college students and looked at the impact of instant messaging and reading upon distractibility. The study is straightforward and the findings are consistent with other studies of this nature. The amount of time spent IMing led to more distraction in academic reading while reading did not (pp. 564-565). IMing interfered in three ways: reduction of study time, direct interference, and a cognitive style of short and shifting attention (p. 565). This last observation is perhaps the most significant as it suggests

that IMing is partly responsible for a reduced ability for in-depth focus among students. The authors also question the positive effects of multitasking and IMing.

Lin, Robertson and Lee (2009) studied college students in a multiple media situation. The authors measure the affect of multitasking upon task performance and how a subject's expertise would affect multitasking success (p. 173). Subjects were separated into three groups and different levels of multitasking variables were introduced. Findings showed that both novices and experts did best with background distraction (p. 182) which contradicts Levine, Waite, and Bowman, though a number of variables are of course distinct. Experts did perform better than novices with background disruptions, but with no disruptions, the results between expert and novice were very similar (p. 182).

Judd and Kennedy (2011) define multitasking as parallel processes while task switching is procedural (p. 625), and based on this definition, sought to differentiate between multitaskers and task-switchers. The study measured online use among graduate students. Results showed that Gen Y users did multitask and task switch, but less than is commonly believed (p. 629). Further, men and international students multitasked more, which does counter previous studies suggesting that women are greater multitaskers. Finally, graduate students directly out of school multitasked more often than did returning students (p. 630), which also contradicts some studies showing greater multitasking among older users.

Kubey, Lavin and Barrows (2001) offer a frequently cited study that looked at collegiate academic performance in relation to Internet use. The authors note that, "heavier recreational internet use was shown to be correlated highly with impaired

academic performance. Loneliness, staying up late, tiredness, and missing class were also correlated (p. 366)." There is a suggestion of self-efficacy in terms of higher grades resulting from Internet use (p. 366). The study defines what too much Internet use is, which is certainly dated following the Kaiser Family study (2009). The authors show loneliness as a key link to high Internet use, due in part to synchronous communication that internet affords. In the end, the addiction that students show is not deemed to be solely from the internet. Addiction is dependent upon the personality of the individual, not necessarily the stimulus item.

2.5 Information Gathering and Seeking

Bates (1989) suggests a model of information gathering termed berrypicking. Berrypicking represents a process of information seeking that takes information "a bit-at-a-time" (p. 410). Berrypicking is a circular process; the information seeker progressively gains information during the search. Adding new information affects the understanding of the original query and the process strays from a linear seek-find-answer format. Each information piece adds to an evolving search whereby the search terms are changed and perhaps even a partial or entire change in the search objective takes place (pp. 410-411). Bates suggests that searchers use a variety of search techniques and switch back and forth between techniques (p. 413). Finally, berrypicking lends itself to browsing, or physically scanning the search environment in a random manner (p. 420). The berrypicking model makes a great deal of sense in the current atmosphere of online searching, especially with adolescent searching.

Bates remains significant given the nature of online searching. Dresang and Koh (2009) elaborate upon Dresang (1999) with a new approach to information gathering in

the 21st century. Radical Change Theory was first applied to the new format and layout of books for children (p. 27), and is based on, "the digital age principals of interactivity, connectivity, and access"(p. 27). Dresang refers to interactivity as "dynamic, nonlinear, and nonsequential learning," with more control in the hands of the learner (p. 27). This is immediately applicable to the multitasking student of today. Second, connectivity refers, "to a sense of community or construction of social world that emerge from changing perspectives and expanded associations" (p. 27). The social network of the current learner fits this model. Finally, access refers to the "breaking of longstanding information barriers, bringing entrée to a wide diversity of formerly inaccessible opinion" (p. 27). Radical change theory is thus in line with information seeking behavior of today, and fits any understanding of the adolescent search process. The approach builds upon traditional information seeking behavior, but responds to the different paradigms of today.

Belkin's (1980) anomalous state of knowledge (ASK) pertains both to student/ adolescent information searching and to online searching. The ambiguity that adolescents often feel when undergoing an online information search is at the core of ASK. Belkin's model includes first the recognition of a need for information, then the person presents a query to an information retrieval system, and finally, the person evaluates the information, determining if their need has been met. Unless an assignment is an imposed query, whereby the adolescent is asked to find a specific answer for a specific question, the searcher will encounter Belkin's model. ASK predates online social networks, but in the sense of ASK, a social network could

perform as the second stage of ASK, meaning that the social network could be the information retrieval system.

Kuhlthau's (1991) information seeking behavior adds a holistic interpretation of the search process. Kuhlthau suggests six stages of development in the information seeking process affecting the affective, cognitive, and physical realms common to each level of the search process. The six stages include initiation, selection, exploration, formulation, collection, and presentation. The stages of exploration and formulation are particularly significant when considering the online multitasking student; students are often given an assignment to investigate and inevitably multitask through the first three stages. Stage four sees online gift queries, creativity, and experience result in self-efficacy. This is perhaps the key study in adolescent search behavior, and although it is on the affective side of the search, it is simply critical in any research on adolescents and searching.

Gross (1999) offers a model that is suited particularly well for student information seeking behavior. Gross's imposed query model suggests that information seeking is either self-motivated or imposed (p. 501). Such a model is well suited for the classroom. Gross notes that in the early years of education, prior to 3rd or 4th grade, students begin asking self-generated queries. By the 5th or 6th grade, students are compelled to seek information for imposed queries (p. 502). This imposed query model remains the main model from that point on. Six steps comprise the imposed query model. The first stage, initiated, refers to the question the imposer is asking to have answered (p. 504). This is followed by the second stage, transferred, when a level of mutual understanding is reached between imposer and agent (p. 504). The third stage,

interpreted, sees the agent expressing the query as the agent understands it. With a query understood, the agent proceeds to seek information, a step which involves a third party. This fourth stage, negotiated, is where the agent expresses the information need to an intermediary. The processed stage follows, when the agent understands the query based on the previous stages. The information would have thus been obtained at this point. Finally, in the evaluated stage, the query is returned to the imposer. I think that this model, when taken with Kuhlthau and Bates, makes for a modern search behavior model.

Significant for a study on multitasking is Spink and Park (2004). Their paper proposes that interactive information retrieval multitasks on two levels: the interactive search task (the actual search that is part of multiple activities) and multitasking information behaviors (switching between searches online). While multitasking is typically seen as counterproductive, the authors suggest that "effective interactive IR is coordinating switching between related tasks" (p. 16). The authors then offer a model of the task switch and multitasking experience. The model is direct and makes sense and includes seven variables that can affect the experience.

Pitts (1995) focused on information related problems of teenagers and offers a grounded theory on how students make decisions in the seeking and use of information. Pitts suggests that students use four intertwined strands in their cognitive domain for a particular assignment. The four strands include understandings from subject matter, information seeking and use, life skills, and video production, or system knowledge (p. 178). Pitts found that when a student encountered a problem with one of the strands, the student applied skills from a different strand to compensate. The change of strand

reflects sense-making and topicality, or the desire to complete the information task. Pitts research is a significant study that offers additional insight to the cognitive process involved in the information search. It also offers some links as to a multitasking search, if one sees the strands as different tasks.

2.6 Collective Expertise

Many agree with the age-old adage that more input and collaboration brings about increased diversity and creativity as well as improved results. Two heads are better than one, as it is said. This research study defines collective expertise as being the process by which novices use a social network, either online or in person, to expand upon limited knowledge bases and create knowledge at the expert level. There is a nascent body of research that supports the idea that novices, when working together, can create results that account for heuristics and thus, expertise.

Guo and Stevens (2011) observed the usefulness of wikis in a collaborative learning environment. A wiki is a, "freely expandable collection of interlinked Web pages, a hypertext system for storing and modifying information – a database where each page is easily editable by any user (p. 221)." In other words, a wiki is a platform that encourages collaborative, online work. In this sense, a wiki is part of the world of social networking, often understood as Web 2.0. The authors found that subjects with greater experience on social network sites such as Facebook found wikis to be of less help (p. 230). The authors note that collaboration has become key to both education and business, whereby, "a small group of students work together to complete an academic problem" (p. 222). Findings showed that experts, or those most familiar with

wikis, used the tool to a greater degree than did novices (p. 237). An interesting question would be to know if the students used popular social media to answer queries.

Littlepage and Silbiger (1992) measured expertise within different sizes of groups in collaborative activities. Larger groups proved more effective for success with intellective tasks (p. 352) consistent with a large previous body of scholarship. The authors found that group size did affect success; larger groups found greater success, especially when the group was able to identify expertise (p. 352). Both recognition of expertise and possession of expertise increased with group size, suggesting that collaboration in social networking situations does lead to greater success and self-efficacy. The study does not indicate if a group can become too large, only that greater numbers mean greater participation, success, and identification of expertise.

Karamuftuoglu (1998) lays the groundwork for an approach to Information Retrieval that builds upon several interconnected users. The author posits that knowledge creation is dependent upon multiple participants within a particular domain. The online community allows for interconnectivity to be observed, and Karamuftuoglu notes that collaborative IR takes place voluntarily, with increased ideas and creativity as a result.

Ellis, Oldridge and Vasconcelos (2004) address the recent phenomenon of online communities. The authors note that virtual communities provide, “much more knowledge, wisdom, experience, and a place to thrash things out and come to new solutions”, (p. 153) which suggests that online communities are ripe spaces for creativity. An online community is also a community of practice, where like-minded individuals gather to share and build information. This community can also be a gift

community where information is the gift (p. 147). Finally, collaboration relies upon, "an appropriate organizational culture…and information sharing culture" (p. 165). Thus, an online class would bind students to a community of practice and foster creative collaboration.

Any notion of collaborative knowledge or expertise has Social Network Analysis at the core. Haythornthwaite (1996) defines Social Network Analysis as focusing on, "patterns of relationships between actors and examines the availability of resources and the exchange of resources between these actors" (p. 323). While Social Network Analysis did not first address online communities, the connections are obvious today. Both content and the pattern of the relationship reveal how resources move between actors, including the direction and strength of the flow of information. The network moves from star to isolate, where the star represents an actor who receives and gives information at a high level and an isolate maintains few connections (p. 334). In terms of Facebook, the star is the actor with many connections and activity while the isolate is the lurking, passive user. In the traditional sense, strong, close connections lead to greater information sharing (p. 336). This may no longer be true in the sense of social media as the online platform allows for information to be shared at times distinct from the closeness of the connection.

2.7 Adolescent Learning Behavior

A brief understanding of current theories on cognitive development is in order. Piaget (1955) offers a four stage developmental process. The first stage, sensorimotor, pertains to building reflexive actions and repeating interesting sensations, leading to object permanence. This stage lasts from birth to age two. The second stage,

preoperational, is from age 2 until 6 or 7. In preoperational, language and conceptual development take place, with experimentation and planning helping the child to establish a foundation for logical thought. Stage 3, concrete-operational, is from age 6-7 until age 12, and is marked by concrete operations, particularly mental manipulations. Key to this stage is conservation of quantity, when a child is able to keep a particular concept in mind in spite of the change of the object. The final stage, formal operations, brings abstract thought and logical reasoning. It is in this stage that the brain is reaching full development, though Blakemore and Choudhury (2006) have suggested that the pre-frontal cortex may still develop in men as late as 30 years of age. To Piaget, cognitive development takes place internally and the stages are observable.

Lev Vygotsky (1962) represents the second major approach to cognitive development. Unlike Piaget, Vygotsky explained cognitive development through internalization, meaning that knowledge derives from context. Vygotsky's Zone of Proximal Development places learning in three stages: what the child has mastered, what the child is learning and can perform with help, and what the child cannot achieve under current capabilities. It is between stages two and three that ZPD takes place. This is critical as most educators are only concerned with what a student knows rather than what the student can know.

In a thorough review of the literature, Vakkari defines a task as, "an activity to be performed in order to accomplish a goal" (p. 416). It is critical to bear in mind that the information search is a task and may include sub-tasks. This research study does not propose to conduct Hierarchical Task Analysis, but noting the significance of the formal task is necessary. Understanding the characteristics of a task allow for a better

understanding of the information search process, precisely because a task has a goal of finding information. By observing tasks, the study aims to, “identify those factors in users that cause systematic variation in search process and outcome that are systematically connected to searching” (p. 423).

CHAPTER 3

RESEARCH DESIGN AND METHOD

3.1 Objectives of the Study

Based on the review presented in the previous chapter, it is assumed that adolescents will multitask while working online, that they will be novices in their search strategies, and that multitasking will hurt their performance. Due to physiological factors in line with adolescence, and due to external factors that enable social and multiple media multitasking to be so prevalent, adolescent searchers will enter the search process as a novice. It is also assumed that in a classroom (physical and virtual) setting, students will belong to a social network, and to a large degree this is a community of practice, and that within this group there will be exchanges of information, gift queries, and specific roles for participants.

The objective of this study is to observe and measure adolescent students while they engage in online multitasking, which invariably includes social networking. The primary hypothesis is that students manage their multitasking abilities efficiently, demonstrating creativity in task management. Second, students' exhibit heuristics gained from group expertise that enables them to overcome their lack of expertise in the search. A related exploratory issue asks what role technological self-efficacy has in the entire process.

3.2 Participants

As this study focused on adolescents in a classroom setting, students were recruited from an American high school located in Lima, Peru. One observation entailed classroom Facebook conversations drawn from two student activity groups.

This totalled approximately 200 students from Grade 10 and Grade 11 (ages 15-17). A second observation recruited Grade 11 and Grade 12 Economics students, as a class and while in session. The observation was in line with normal search practices within the course curriculum. Students from the economics class, as well as Grade 11 psychology students, completed a multitasking survey tool. The third set of participants was drawn from the student observations. Short, 20 minute interviews were conducted with six students. A total of approximately 200 students took part in the study. Exact demographics are detailed in Chapter 4.

3.3 Measures and Instruments

Students were asked basic demographic information as part of the Observer Impression multi-class observation. Gender, ethnicity, and age were gathered. No demographic information was gathered on the discourse analysis portion of the Facebook communication as part of student anonymity and because participants could use avatar names. After reading instructions for the experiment and listening to a brief introduction of the study, participants completed a self assessment of multitasking (polychronic) abilities using the Inventory of Polychronic Values (IPV).

In addition to the self-assessment on multitasking ability, observer impression was used to gain insight to multitasking behavior, shared information within a collaborative group, and collective expertise. Classes were observed and a student observation checklist was used to record participant activity. WEFT software was used to code and analyze the data. A list of free codes and tree codes emerged from an exploratory study of the same student group. These codes were shared with

colleagues, both within information science and within the study site, to assure validity (Appendix A).

From the observed classes, six volunteer participants were recruited for short, twenty minute interviews. The subjects recruited for interviews were purposefully selected to ensure a broad base of experience. The interview was a more in-depth analysis of the observer impression observations. The same free codes and tree codes were used, and again analyzed with WEFT software. The questions asked to each participant were recorded and transcribed. The interview questions are listed in Appendix C.

Discourse analysis was used to make sense of the observation and interview data. Discourse analysis is common in the field of Information Science and when used in conjunction with classification, discourse analysis aids in revealing subtle meanings in text and speech. Discourse analysis makes assumptions explicit, teasing out the subtext in a statement. Frohmann (1992) discusses the effective use of discourse analysis in the field of Information Science. Frohmann (1994) gives practical instruction on how to use discourse analysis in Information Science and these guided this study; it is a valid means of gathering data.

This study employed three different means of communication. First, the self-evaluation offered quantitative data on self-perceptions on multitasking and was completed individually with paper and pencil. Second, observer impression and interviews employed quiet observation of participants, including body language, as well as think-aloud approaches and questioning participants based on their actions, so as to

gain greater understanding. Finally, all Facebook messaging was in written and informal manner.

3.4 Experiment Design

The experiment employs both qualitative and quantitative measures. The primary investigator made observations and conducted interviews, as well as analyzed all data gathered. Procedure was consistent between the different classes under observation and with the interview subjects, and participation was completely voluntary.

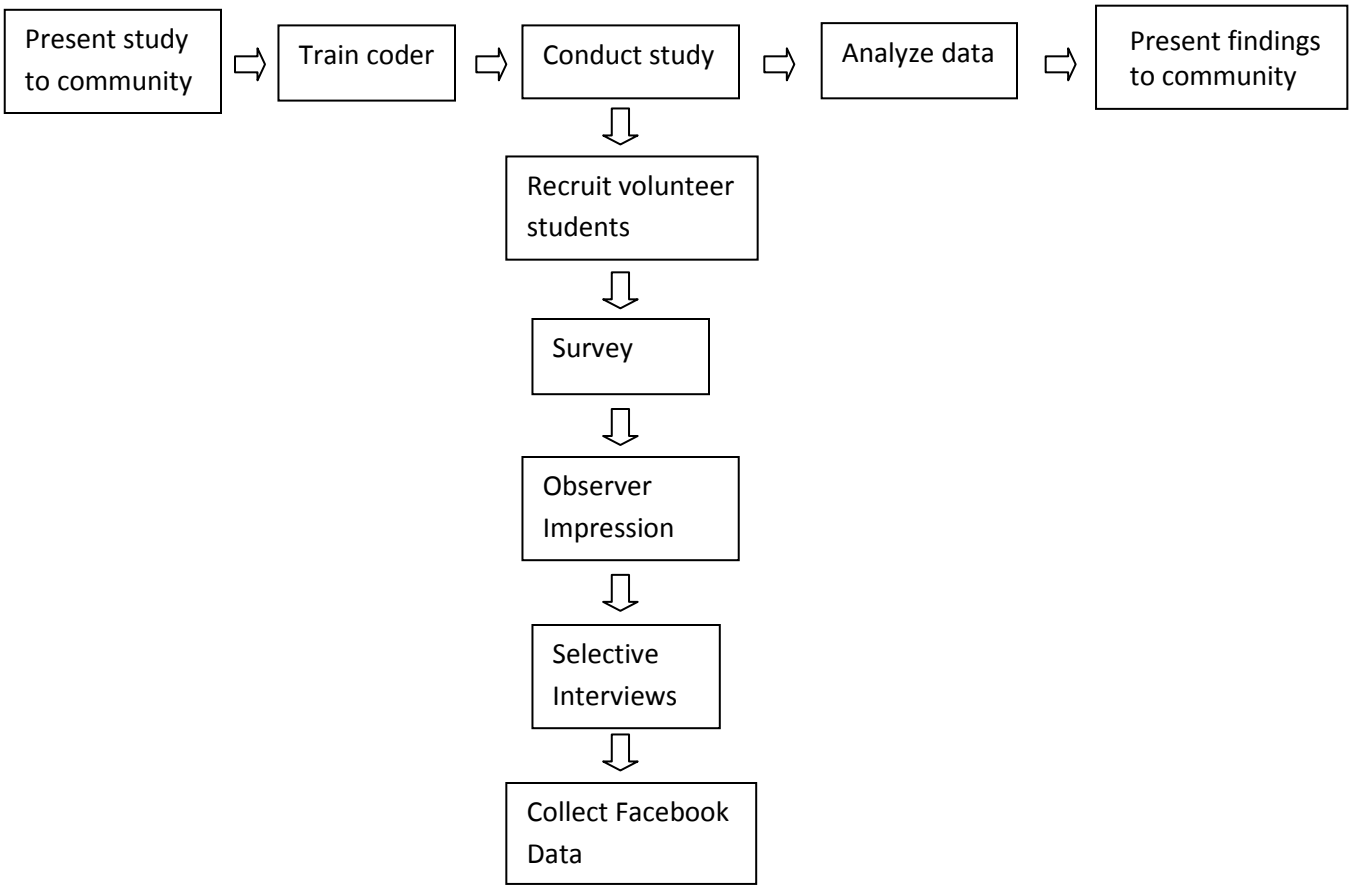
Following an initial approval for study from the school leadership team and an oral presentation of the study to the school's Board of Director's, volunteers were sought through bulletin announcements with a description of the study in the student daily circular for one week. Classroom visits and parental meetings further explained the purpose of the study. Once volunteer classrooms and individuals had been identified and all appropriate forms signed, the experiment began.

3.5 Procedure

Each class under direct observation was presented with the multitasking self-assessment tool. This tool measures perceived success with multitasking, demographic characteristics, and the level of multitasking for each student. Next, Grade 11 and 12 economics courses were observed for a class period each (90 minutes) while the students were engaged in research for a class based assignment. In this sense, the design of the study did not interfere with the purpose of the class and it is believed that the impact of any external variable was reduced. Four classes in total were observed, consisting of 45 students.

From the observed classes, invitations were offered to purposefully selected students for short interviews. Six students participated in 20 minute interviews. All interviews were recorded, transcribed, and analyzed using discourse analysis. Following the interviews, each classroom was visited for a description of initial findings, which included a debriefing of the process.

In addition to the survey, observation, and interview processes, communication between and among students using classroom Facebook pages provided rich data. The Un Techo para Mi Pais club and a class site belonging to Environmental Systems and Societies, use Facebook as a secondary or tertiary means of communication. Much of this communication suggests gift queries and patterns of information flow. The public discussions on Facebook were gathered and analyzed with the same process as the observed and recorded information using WEFT software.



This chapter has outlined the process by which data was gathered regarding student multitasking within a community of practice, as well as self-perceptions of multitasking abilities and success. Analyses of written data via informal Facebook postings offered real-time communication regarding the task. Observations of adolescents in the process of researching an information query as well as interviews with volunteers from this group provided insight into the way in which information was passed and how students managed information. Finally, data from a survey of self-perceived abilities in multitasking supported evidence of student multitasking behavior.

3.6 Validity and Reliability

An issue for any qualitative study concerns reliability. The design of this study followed qualitative methods laid out in Patton (2002). A serious attempt has been made to ensure validity and reliability; the study employs triangulation of both qualitative approaches and incorporation of quantitative methods. The four approaches used to seek data intersect so as to add objectivity and reliability. Interviews, observations, analysis of written comments, and a survey yielded rich data and meet concerns about reliability.

Interviews with subjects yielded rich data. According to Patton, “interviews add depth, detail, and meaning at a very personal level of experience” (p. 17). Interviews allowed for the researcher to enter into the perspective of the subject. Open-ended questions were formulated, and then shared with colleagues to ensure reliability. Again, Patton notes that “the truly open-ended question permits those being interviewed to take whatever direction and use whatever words they want to express what they have to say” (p. 354).

Interviewees were purposefully selected, what Patton refers to as maximum variation. "When using a maximum variation sampling method the researcher selects a small number of units or cases that maximize the diversity relevant to the research question" (p. 242). Information-rich cases were selected which lead to "high-quality, detailed descriptions of each case, which are useful for documenting uniqueness, and important shared patterns that cut across cases" (Patton, 2002, p. 169-172). Through maximum variation, data were thus richer and more broadly based.

Direct observation allows for first-hand analysis and description. "To understand fully the complexities of many situations, direct participation in and observation of the phenomenon of interest may be the best research method" (Patton, p. 21). Both interview transcripts and observations were coded using a coding scheme that was the product of multiple points of view. Coding yielded patterns in observed behavior. While it would be obtuse to suggest that everything was observed, objectivity was approached through the use of dual coders and multiple settings with different participants.

The paper survey that was administered, the Inventory of Polychronic Values (IPV), was tested multiple times. Bluedorn, Kallaith, Strube and Martin (1999) first tested reliability during test development and IPV scores "demonstrated good reliability" (Nimon, Bonner & Lin, 2012). Regarding validity, Bluedorn et. al. employed a Q-method approach and later, a known-groups test, with both showing validity.

Overall, the study seeks to provide validity through cross-validation of data via multiple coders and interpreters of data, as well as a manageable organizational system for data. Using multiple coders not only allowed for more validity as data were checked by more than one person, but multiple coders allows for more data to be observed; what

one person might miss can be observed by another person. Triangulation of the data is found in the different approaches; three qualitative means of gathering data and one quantitative approach ensure reliability. As Patton (2002) notes, “areas of convergence increase confidence in findings” (p. 559). This is the case for this study. Codes and interview questions grew from a pre-study and had input from multiple perspectives ranging from anthropology to information science to education. Data was analyzed using tested programs and data was shared with colleagues to ensure maximum objectivity. Collaboration helped ensure reliability. Finally, the site was known first-hand and that enabled the researcher to move into deeper levels of research as a result.

Discourse analysis will not provide absolute answers to a specific problem, but enable us to understand the conditions behind a specific "problem" and make us realize that the essence of that "problem", and its resolution, lie in its assumptions…the very assumptions that enable the existence of that "problem." It is postmodern and therefore open to full analysis.

CHAPTER 4

RESULTS AND FINDINGS

In the following chapter, the data gathering process is detailed. The quantitative method included a survey where subjects offered self impressions and basic information regarding multitasking. Qualitative methods included the results of four 1.5 hour observations of a Grade 11 and Grade 12 economics class, six individual interviews with students, and an analysis of discussion from two Facebook groups for students. Each of the four data collection processes are presented in individual sections with a brief analysis. A summary of findings follows in Chapter 5.

4.1 Demographics

Forty-seven students completed the measurement tool; 24 boys with a median age of 16.9 and 23 girls with a median age of 16.5. Nine classified themselves as Asian, 21 as White, and 17 as Hispanic. The four observations consisted of 45 students, 34 boys and 11 girls who classified themselves as 10 Asian, 27 Hispanic, eight White, and one African-American. Interviews included six students, four boys and two girls. Of these, two classified themselves as Asian, three as Hispanic, and one as White. The Facebook page observations did not include demographics, and the total number of students fluctuated. An approximation of the group would include approximately 200 students based on the number of views of postings, and about 100 students who actively posted.

4.2 Survey Measurement Tool

Seventy-one surveys were distributed to students in Grades 11 and 12. Of those submitted, 49 were returned and 47 were complete. Two surveys were discarded as they

were incomplete. 24 respondents were male and 23 female. Descriptive statistics for ethnicity show that 21 students identified as White, 17 as Hispanic, and nine as Asian. Ages included 15 (one student), 16 (19 students), 17 (21 students), and 18 (six students).

The survey tool measured polychronicity, more commonly known as multitasking. The IPV asks ten questions, with answers measured on a seven-point Likert scale. The questions are coded with four being favorable to multitasking and six as unfavorable. The IPV was designed for adults, but is relevant for adolescents. Nimon et. al. found minimal differences between mother and adolescent mean scores (2012). The survey tool directly corresponds to research question 4, "What role does technological self-efficacy have in this process?" and question 1, "To what degree, and in what ways, do adolescents manage multiple online tasks?"

Student answers suggest that students feel multitasking is detrimental to performance. Overall mean scores suggest that a preference for multitasking falls between "moderately disagree" and "neither disagree nor disagree."

Table 4.1

Preference for Multitasking

	Mean
I like to juggle several activities at the same time	4.8936
I believe people should try to do many things at once	3.7234
I believe people do their best work when they have many tasks to complete	3.1489
I believe it is best for people to be given several tasks and assignments to perform	2.8085

Table 4.2

Preference for Non-Multitasking

	Mean
I would rather complete an entire project every day than complete parts of several projects	5.3191
When I work by myself, I usually work on one project at a time	5.0213
I prefer to do one thing at a time	4.6383
I believe it is best to complete one task before beginning another	4.9787
I seldom like to work on more than a single task or assignment at the same time	4.1702
I would rather complete parts of several projects every day than complete an entire project	3.4894

On the other hand, when asked questions that support doing one thing at a time and avoiding multitasking, answers vary between “Neither Agree nor Disagree” and “Slightly Agree.” The overall Mean scores indicate a preference for non-multitasking, with 3.6436 preference for multitasking versus 4.603 for non multitasking behavior. To compare the mean scores, Welch’s T-Test which allows for variance between frequencies of the two data sets was used. Results indicated that the difference in Mean scores is significant (.013). Students have enough metacognition to apply self-control when multitasking and they are aware of the impact of multitasking.

4.3 Observations of Diploma Program Economics Classes

Four classes of junior and senior students (ages 16-18) were observed on March 5 and 6, 2013. All students completed consent forms as stipulated by University of North Texas regulations. The student investigator also held an explanatory meeting for parents as well as sending home a letter explaining the purposes of the study. Students understood that they could opt out at any time. Apart from students who were absent

from school, the observations had full attendance. This Observer Impression directly relates to research question 1, “To what degree, and in what ways, do adolescents manage multiple online tasks?” and question 3, “Do students exhibit heuristics indicating expertise and creativity in managing the task?” Following the observations, research question 2, “Does this task management grow from collective expertise?” emerged as highly relevant.

The class under observation was International Baccalaureate Diploma Program (IBDP) Economics. The student investigator worked with the instructor so as to create an optimal environment to gather information but also reduce interruptions during course time. The specific assignment was research for the IBDP Internal Assessment (IA). The IA is a regular assignment (once per semester) where students are required to find an economics article that they can then analyze. It is a difficult assignment in that many of the articles available online are already analyzed. Further, it is not an imposed query; the student must instead generate the topic to be searched, including search terms. The student investigator and the instructor felt that it would be a good opportunity to observe different levels of expertise in an assignment which the students are already familiar with. Thus, one junior class and three senior classes were selected.

Each class met in the Borges computer lab within the school media center. The students are familiar with the area and it is semi-secluded so as to offer a controlled environment. The lab is U shaped and has 24 networked computers. In the center of the lab is a large oval table and as the lab is also wireless, students are able to use personal laptops. The area is open, yet enclosed enough to minimize interruptions. A map of the Borges Lab is included in Appendix B.

Code selection grew out of a pre-study conducted as part of an anthropology course. The codes initially emerged through observation and feedback from peers and the course instructor. From this initial setting, and as the study became more defined, code terms were shared with colleagues in Information Science and within the academic setting of the data gathering site. In particular, a peer group of fellow doctoral students reviewed the code terms as a supportive, collaborative effort. Two instructors of the IBDP also reviewed the terms based on their experience with the population.

Both the course instructor and the investigator coded the data. Meetings were held with the course instructor two times formally, and multiple times informally, regarding the design of data gathering and particularly the coded terms. A portion of these meetings included training in how to gather observation notes.

Each coder moved through the room and observed students as they researched. Each coder had a map of the room which allowed for subjects to be numbered anonymously. Written notes as well as coded terms for particular observed behaviors provided rich data. Following each observation, the principal investigator and secondary coder met and compared notes for approximately 45 minutes. Notes on the observations were recorded and these were in turn shared with the secondary coder to assure validity.

4.3.1 General Observations

Students fell into two groups, seniors who had done the exercise three times, and juniors who were doing the exercise for the first time. This allowed for some obvious differences in search behavior, though this was not the key purpose of the study. Generally speaking, the senior group showed signs of expertise: they went

directly into sites that they knew would help, they had a higher level of subject specific vocabulary, and they searched in their mother tongue to understand concepts before returning to an English language search. Seniors also used Facebook more often, while juniors proved to be more focused, meaning purposefully eliminating other distractions. Seniors preferred to print an article and use a highlighter while juniors read online and tended to skim the article, using seek and search tools. Also, seniors held conversations that were much more general while juniors talked mostly of the assignment. Most of these differences could be due to the previous search experience of the senior group.

Searchers used textbooks, wikis, and Google to clarify search terms. Students also offered gift queries in which successful search terms were openly shared. This was common, but not the norm as most students worked alone. Most students also opened multiple tabs open at once, but all or most were topically based. Side bars, advertisements, and pop-ups were ignored for the first hour, but in the final 30 minutes, students did begin to wander during the search process.

While Google and Bing were the default search engines, both groups did use subscription databases (Proquest and NewsBank), and knew how to search with the use of keywords (non-natural language) and advanced search techniques. Using subscription databases is perhaps not common for most student researchers. This behavior is most likely attributable to availability and experience as the students knew they could rely upon research databases, and due to teacher and librarian support. From grades six to 11, students receive instruction on database use and research, though this happens haphazardly. Databases are prominently displayed on the school

webpage, which is the default homepage of all school computers, thus access is straightforward. All in all, students are well aware of the effectiveness of subscription databases and there is little difficulty in accessing these databases.

Following the study, the economics classrooms containing the students who participated in the observations and interviews was revisited. Member Validation proved valuable as it assured me of the findings. The students were a bit surprised to learn that they were more organized than they first thought, and this applied to their appreciation of personal metacognition. During the discussion, however, students began to see how they did organize and reflect. Students also confirmed their own high level of online activity, going beyond the findings in terms of how the online environment is critical to their social world. Regarding communal expertise, students commented that this was such common practice that they did not even consider it until it was highlighted.

4.3.2 Observation 1: March 5, 11:40 am

The observation consisted of 13 students, ten male and three female, all of which were in Grade 12. The students were 17 or 18 years old and the group consisted of two Asian, 11 Hispanic, and one Caucasian student.

The teacher began the lesson with a general introduction. The assignment is personal and students had previously completed a similar assignment. In the center table sat six students, nearly half of the class, and this group spoke in Spanish, offering gift queries in Spanish and helping each other to expand upon definitions of subject terms. A number of students at the center table began a search in Spanish and then took successful searches and translated these into English searches in Google. Much

of the conversation centered on daily activities, homework, upcoming exams, and social life.

Several students listened to music while searching. Student 4 listened from a personal computer, student 10 used an iPad for music while searching on a desktop computer, student 11 played music via YouTube and did so from the computer being used to research.

Students all used Google or Bing for information. Several students used the school webpage as a portal to subscription databases (Proquest & Newsbank). Additionally, Moodle was open to the class page in order to gain access to search terms. Moodle is the online platform that the school uses for digital coursework, it is similar to Blackboard. Several students also went directly to sites that had proven successful in the past. These included the New York Times and British Broadcasting Corporation (BBC). To expand search term vocabulary, students accessed Prezi presentations via the Moodle site as well as using the textbook while searching. Generally, the student would select a region of the world (ex. China) and then match the region with a micro or macroeconomic term (ex. price ceiling).

Students were organized online. While multiple tabs were open, they generally focused on the same topic. Student 8 had nine tabs open, eight for searching and one email tab related to the assignment. Student 3 had four tabs open, but did include Facebook. Student 4 had seventeen tabs open but they were all topically based. It would appear that a method to search, and to build a search vocabulary, is to open a series of tabs and skim the material until a knowledge base is attained. Use of

Facebook was quite low. While all students did check Facebook, they left it off while searching.

4.3.3 Observation 2: 5 March, 1:40 pm

The observation consisted of eight students, seven male and one female, all of which were in Grade 11. The students were 16 or 17 years old and the group consisted of two Asian, four Hispanic, and two Caucasian students.

The teacher had previously given an introduction to the assignment as this was the first time this group had searched for Internal Assessment articles. Additionally, as per standard practice, the librarian had given tips on smart search strategies. Four students used personal laptops from the center oval table and four used desktops. The teacher rotated around the room answering questions, but not guiding the search process.

Students used multiple devices at one time; student 4 listened to music from an iPod and several students used phones for calling and for listening to music. Student 8 used an iPad along with a desktop, both used for the assigned research, and student 6 used a laptop and desktop for the same purpose. Students primarily used Google as the search engine, but Students 2 and 5 used the subscription database Proquest and Student 7 used the New York Times directly. Students opened multiple tabs but kept the tabs open on the same topic; Student 2 had eight tabs open, all focused on the assignment. The group was quite focused (though novices in the subject area).

Students used their text for term clarification (Student 1, 3, 5, 7), but natural language searching was most common. While the group seemed focused, they also appeared to be a bit naïve about searching for this assignment. This appears to be a

lack of domain knowledge rather than search knowledge. Student 7 asked for search terms from Student 8 upon completion of a successful search. Still, very little expertise was shown; it was a lot of hunting: specification was requested from the teacher and from successful colleagues and limited gift queries were used such as, “What site did you use?” (Student 7) and “what term did you use to search?” (Student 3).

4.3.4 Observation 3: 6 March, 8:15 am

The observation consisted of 12 students, eight male and four female, all of which were in Grade 12. The students were 17 or 18 years old and the group consisted of four Asian, four Hispanic, and four Caucasian students.

The teacher began the lesson with a general introduction, which is sufficient as the assignment is personal and the students had done similar assignment previously. Students appeared comfortable with the assignment as several began before the teacher had finished with explanations. Students sat in two areas, the main, oval center table and others at desktop computers around the U shaped wall.

Most students began with Google searches in spite of instructions to use the subscription databases. Search terms were natural language and not successful at first. Students seemed to pick up information from different sites until they had clarity in what they wanted. As in other classes, students used the textbook to build search terms. Several students asked the teacher and colleagues for search term clarification; Student 5 asked Student 8 for search terms and Student 4 offered unsolicited help.

As in other observations, students had multiple tabs open, a case of multitasking, but work was focused on the search query. Student 11 had three tabs open, all on the assignment. Student 3 opened four tabs and Student 4 opened three tabs, all of which

were topical. Student 8 opened eight tabs, seven relating to the assignment and one being Facebook. Student 9 also had Facebook open, along with eight other tabs, all topical.

Conversations centered on the assignment, but did vary. The central oval table discussed college applications while searching, and then moved on to do math homework collaboratively, all the while searching for their assignment.

Several students built searches from mother tongue and then transferred to English. Student 1 searched in Korean, Student 6 in Spanish, and Student 7 in Japanese. The students would find search terms in mother tongue, and then use these translated terms to search in English.

4.3.5 Observation 4: 6 March, 10:15 am

The observation consisted of 12 students, nine male and three female, all of which were in Grade 12. The students were 17 or 18 years old and the group consisted of two Asian, eight Hispanic, one African American and one Caucasian student.

The teacher began the lesson with a general introduction, which is sufficient as the assignment is personal and the students had done similar assignment previously. Students sat in two areas, the main, oval center table and others at desktop computers around the U shaped wall.

The group appeared relaxed and several group discussions took place, apparently based on friendship ties. The group also appeared to be the least on-task of all observation groups. Student 2 listened to music on iTunes through the desktop computer, Student 10 played music on the cell phone, and Student 7 used a laptop for music. The group was the most active with Facebook; the pod of students (3, 4, 5) all

used Facebook and checked updates about every ten minutes. This pod also used video for search term clarification, and casual video while waiting for web pages to load. The pod also used class Prezi presentations for search term building. Finally, this pod used BlackBerry Messenger extensively.

The groups spoke in their mother tongue and offered each other assistance. The student 3, 4, 5 pod spoke in Spanish and offered gift queries on search terms. The center oval table saw two students helping each other in Korean.

Students transferred web pages either through Google Drive (Cloud based) or cut and paste into Microsoft Word. Many students printed the article and highlighted on paper. This organizational system allowed the students to keep a record of their files. Students using the cloud expressed that it was a self-taught process.

Search term selection showed little creativity. Most searches were natural language. “I can only find articles on China,” reported Student 2, as the student had not changed the search term. Student 6 used, “Want Yen to weaken,” without specifying economic terms. This group proved to be the most off task which could be due to the group dynamics or it could have been timing as this was prior to a four day holiday and many seniors were leaving on a group trip that evening.

4.4 Interviews

Employing standardized, open-ended questions yields rich data. Question design was the result of multiple perspectives and emerged with the research questions in mind. Questions were not designed with one specific research question in mind, but rather the design was broad and was meant to allow flexibility in answers so that all questions would be addressed. The first research question, “To what degree, and in

what ways, do adolescents manage multiple online tasks?" emerges through self-perceptions of social media (interview question 1), as well as understanding the way in which an online task progresses (interview question 2). The second research question, "Does this task management grow from collective expertise?" is evidenced in interview questions 4 and 1. The third research question, "do students exhibit heuristics indicating expertise and creativity in managing the task?" appears in interview questions 2 and 3. Research question 4, "what role does technological self-efficacy have in this process?" is really about the survey instrument, but is revealed in interview questions 3 and 4.

A number of students from the observed classes volunteered to participate in the interview process. Six students were purposefully selected to add the greatest level of diversity possible, what Patton (2002) refers to as Maximum Variation. Four male and two female students participated, all either 17 or 18 years old. Students represented high and low tech abilities, academic and non-academic aspirations, and different socio-economic backgrounds. The interview questions are found in Appendix C. All students completed consent forms as stipulated by school regulations. The investigator also held an explanatory meeting for parents as well as sending home a letter explaining the purposes of the study. Students understood that they could opt out at any time. The interviews were transcribed and then analyzed proving to be rich in data. Similar themes appeared, in part due to the nature of the questions, and in part due to the similarity in student behavior. Student responses were gathered into five categories, and these offered a much greater opportunity to make sense of a large amount of data. The five categories include: Organization and Managing Multiple Online Tasks,

Collaboration, Expertise, Online Behavior, Self-perceptions and Opinions about online life.

Managing multiple online tasks requires organization. Interviews indicate that students believe themselves to be poorly organized, but in fact, are highly organized in terms of their on-line lives. This is particularly evidenced on the desktop. One student noted, “My desktop is kind of messy, but every week, I organize it, so I uh have folders for links I found, there’s a folder for applications, for games, for homework, I organize all of my pictures into corresponding topics, music…music genre, uh, movies shows, all that, I organize them like once every week.” Another student said, “My computer is very organized, I got like everything in one folder.” A third student commented, “I have not a single icon. All of my folders are arranged into groups.” Desktop and online organization was ubiquitous among all interviewees. Observations of different students suggest that this is the trend as students had very neat desktops and opened limited numbers of differently themed tabs.

Organization is perhaps something that is taught indirectly, starting with children picking their toys up or compartmentalizing food on a plate. Certain curriculums do allow for organization to be taught, and this is the case for all students observed or interviewed. The Middle Years Program of the International Baccalaureate includes a mandatory set of skills for each unit, the Approaches to Learning, mentioned previously and located in Appendix E. While not all academic teaching units include organization, students should see several purposefully designed activities in the five years of the MYP program.

With this in mind, it is interesting that all of the interviewees stated that their organizational skills were self-taught. One student commented, “I’m not sure who taught me or if I taught myself. I’ve just, I don’t know, I kind of just do it.” Another student noted some of the organizational skills learned at school, but overall, it was self-learned, “Who taught you?..Myself. Well, the school also, like the school guided me to be more organized, like they introduced the use of binders and stuff like that, folders, and put each corresponding paper in the folder, so from that um, I created my own organizational skills.” Perhaps the greatest example regarded daily organization for school, also self-taught, “I use these notecards, index cards that are individual ones, and every day I make myself a schedule from 4:00 to 4:30, do this, and 5 minutes of rest, and then do that.”

Students also proved to be very savvy in the choice of online tools, including when they operated multiple devices. One student mentioned the use of the cellphone, “For school, I mainly use it for the Dropbox function. I have Dropbox on every single one of my computers and when I want to make sure I have it saved or stored, I just open my cellphone and I check it out.” The use of Dropbox and the cloud appeared in several interviews and observed behaviors. “Not everything is in the Dropbox. In the Dropbox I have schoolwork because I think that it is like five or six GB, and I have my entire computer in a redundancy in a hard drive.” One student had even downloaded copies of all textbooks in pdf form and was able to access the books at any time.

How do the students manage multiple online activities? First, students take a lot of breaks. The most commonly mentioned time period was 20 minutes. Students felt that this allowed them to do “leisure work” and while the practice was seen as moving

from disruptive to procrastination, students had come to convince themselves of the validity of numerous breaks. One student put it best, “Because whatever, even, like, at school, it’s nice to get your mind off of whatever you’re working and just to be able to get in touch with everyone and talk for a little while. And it isn’t a game, so it isn’t like you are gonna be staying long periods playing it, you eventually get bored 30 minutes afterward, so I think it is really good to have it around because it helps me personally be able to get better quality of work.”

Collaboration is closely linked to creativity and even productivity. Guo and Stevens (2011) noted that collaboration has become central to education. Littlepage and Silbiger (1992) found group size affected success; larger groups found greater success. In speaking with students, it is apparent that students have increased assignments that include collaboration and also that they prefer collaboration and easily carry on from face-to-face situations into online situations. Online collaboration, however, tended to amplify the amount of multitasking going on, as students often used Facebook Chat or Skype to hold multiple conversations and while online, pursue multiple activities.

Students felt that the online environment offered support in terms of a back-up when the student had not been present or did not understand the assignment. Students commented that Facebook was the default place to gain information if they had been absent, as well as to share schedules. While it may seem insignificant, this is critical information for students, “if you were not at school cause you were sick or you were doing something else, you can just ask your friends for the homework and uh, tell them what you studied that day and stuff like that.” Even greater is when students did not

understand an assignment. This was universally mentioned in the interview process. Said the students, “if I don’t know how to do a question on math, and I don’t know what term for that exact question is, I just ask my friend, Hey, what…um…how’s question 2 do that method,” and “Yeah, either like just asking people, ehm, for help on some homework, or asking what the homework was usually, like math homework.”

Gift queries tended to be very common in Facebook. “We have the class website where we share information, schedules, everything you need to know for certain classes, what is included in the tests, even study sheets, so pretty much it has all the functions that we need in our day to day life.” Another student mentioned, “I know of one of my friends who posted a study sheet for like the last seven exams that we took.” And again, “Like for example, the ESS students, they, when they have tests, they post up like um the vocabulary questions up, they just put them up and people study from those. For example, a guy in my biology class, he always puts up like review sheets with like everything really detailed that he does for his own review, but he shares it.” Students even brought out that this bordered on too great of a level of sharing, “We always do vocab quizzes for Environmental Science and then there is sequence for every single person. So, one person does, this is bad, oh my God, one person posts the answer and everyone gets help from that answer.”

Collaborative berrypicking was quite the norm. Students used Skype, Skype Chat, Facebook, Facebook Video, and Google Documents to carry on work that had begun at school. Students were well aware of the strength of the tools, “some things really need to be worked on at school, in person, I’ll stay after school like an hour and a half like to work on it, but if its, per se, a presentation, that can be worked on in

GoogleDocs, I can just go there and from the house, go like, hey, friend, go on and help me work on this presentation, and we can just work on it." Online collaboration also cut down the distance between people, "if I can't go a friend's house to do projects, we Skype and do the project online." One of the most interesting examples included a student who noted that when he worked together with friends, they worked independently, but offered verbal suggestions to each other while working. When one student hit upon a successful search, all of the students would adopt that search.

Students noted that student created pages in Facebook were very helpful. Some had been created for subject specific courses, and other pages were group pages for the entire class. Students then exploited these pages when preparing for exams, completing homework, and generally sending messages for assistance. Students did not use email, unless it was to send to a teacher. A dialogue between the student researcher and interviewee noted, "Would you email a colleague? No. Never. You would Facebook them? Yes." This was the case for each student interviewed and during observations, very little use of email was seen, unless it was in connection to a question to the teacher.

Expertise and metacognition are related in that the ability to understand your own mental processes allows for the building of schema, of heuristics. Sticking to a narrow definition of expertise would mean that less than ten years in a particular topic would be defined as novice. The initial assumption was that all students would be novices due to their age, but their own metacognition, and their own beliefs, challenge this assumption. As one student put it, "Because, we have been doing it like, forever," in reference to online multitasking. It is perhaps too much to consider students to be experts, but there

is plenty of data to suggest that they possess a high level of metacognition and apply mental shortcuts to accomplish tasks, both factors which determine expertise.

What does expertise mean? Eva et al. (2002) suggest that experts apply memory in pulling relevant information to make a judgment (heuristics). The expert would experience less of a cognitive load as a result of higher domain knowledge. Experts also learn from mistakes more quickly and are able to make decisions from scanning material. Using these criteria to define expertise, both the interview and observation suggest that students perform as experts. It remains to be seen if this is due to the collective knowledge of the group, but based on the collaborative nature of student behavior, one could make this assumption.

Students demonstrated metacognition and expertise in the proper selection of online tools. From experience, students knew which tool to use, and when. Facebook is the preferred educational tool, “I couldn’t do homework without it because I, I’ve become, it’s become a kind of necessity to send files and talk to people and ask things.” Moodle, the online management tool that the school uses, is used only when students have a specific need. Said one student, “Yes, because for example this week, I was sick and I missed my class, my math class, and it was on vectors, so what I did at the point was access Moodle, Ms. Heykoop had posted the classwork for the day in Moodle so I just opened it and I read it and I can…like it was very helpful for me and I do it for all the classes.” Other students relied on Moodle for specific reasons, “the deadlines are always up there so you can find them, you just turn your homework in there and it is much easier deadlines are not like until 3:30 but until 11:59, so it helps,” and “I use Facebook more for recreational/educational and Moodle more for the turning in and the

receiving the instructions part." All students commented in similar fashion, "Submit assignments through Turn-it-in in Moodle, and download things that teachers and other students have posted."

Students also commented on self-taught tricks learned through trial and error. These tricks allow for quicker scanning of information. Several students mentioned shortcuts, "Cause sometimes articles, they are like a huge wall of text and you just want to find a small excerpt that you want so Ctrl-f actually works a lot," and "I search my textbook, Ctrl-f same thing. I usually find what I need." And how were these shortcuts learned? "I just, if I want to learn something I do it by myself, I discover it. I learn how to use it by myself. Um…trial and error, mostly." Finally, students stick to the grading rubric and base their search success on how well their results match up. While this is really a matter of creativity and education, it still suggests savvy expertise in searching for information.

The aforementioned organizational abilities using online folders hold greater impact when discussed in detail. Students did not use hierarchical folder organization. Students blended organization with heuristics. They organized data into one of several general folders, and when they needed to retrieve information, they would open the folder and use a shortcut to search the folder for a particular file.

Perhaps most impressive was that every student mentioned ways in which they controlled their multitasking. This indicates a high level of metacognition as students knew when to turn off Facebook, the television, or music based on their own perceptions of how difficult a task was. First, students displayed beliefs that they were able to multitask. "I think it is really good to (multitask) because it helps me personally

be able to get better quality of work," and "I figured out that the more I calm down and work at my own pace, the better quality work I can create." It was this approach to doing multiple tasks over a longer period of time that one student called, "constant leisure homework time." A third student commented, "Because it's (multitasking) something I've been doing for years now so I've learned how to work around it and make sure that it doesn't allow for like, for procrastination."

Plenty of research would suggest that these students are mistaken in thinking that they can effectively multitask. The truth is that in each case, students expressed a metacognition that suggests they know when to concentrate. Regarding Facebook, several students commented that they willingly turn off Facebook, or at least the chat feature, when they needed to concentrate, "I know when I am on Facebook like when I am doing work at night, and I know like when to stop using it and get off," and "I started like doing my math homework with Facebook open and I found like, I didn't really concentrate on it so much, so I think it is better when I have it closed and just focus on one thing." Students also felt they knew when to control other disruptions, "I don't like to do work with like, music on, cause when I play music, I concentrate on the music so I prefer not to have music on when I am working." Or with the selection of music, "With lyrics, I would probably not concentrate because I would listen to the words, and I would be like…I just like the constant noise, like that doesn't bother me at all, it helps me I think." A final example suggests personal knowledge of abilities, "I actually don't multitask when I am doing English, for example, we have to critique poetry and the only reason I would even have my computer open is to look up, like other examples of poetry analysis, like would have everything off, no music, no other textbooks, just my poetry.

Like I have to focus more. Math is just like, you know the formula, you know how to do it, all you have to do is just like technical problems that you already know how to solve cause you already learned them, so I have more like, freedom to listen to music."

Considering the online search, surely much of the search process did not change with the introduction of social media and increased collaboration. Based on interviews and observation, Bates' (1989) berrypicking model is more relevant than ever. Students do search "a bit-at-a-time" (p. 410) and they do proceed in a circular process, often adding new information until a satisfactory answer is reached. Students do not show themselves to be expert searchers in terms of search selection, but they are resilient and have developed their own process to evaluate a good search. The searches tend to move from broad to narrow and rely upon Google and PageRank to help determine the answer. Students also seem to display knowledge of knowing when enough is enough based on the criterion for the assignment. Finally, group search happens and often provides better results.

First, berrrypicking. Students do move about, picking up information in bits. One student commented,

> Well, I guess I would open Google, and then search what I want to do, but, what I always do is like I search it and then I keep going through cause there are pages underneath, like how many, it has like, endless pages of information. I go through at least like 20 pages, but I just keep opening new tabs and go to the next page, just keep the tabs open at the top and just keep going through the research and when I find a useful link I open a new tab, and then if I go through, like 10 pages, I start to go over what I have opened and I just close whatever is not useful and I keep what is useful and then I go over it again if I don't have enough resources, but I think that most of the time I have enough resources.

Another student added, "I usually open 3 or 4 links, so I just skim through all of them, and uh, I first read the first one, and then the next one, I skim through it and not

read the whole thing as that takes too much time, so I try to find information that the other site doesn't have so it like, adds up to it."

And the search is neither direct nor straightforward. One student commented on how they sort of ramble through information, "Well, I, first, I would open Google, and I would put in a general block term from, depends on what I'm searching for actually, but generally, I just like look for a term and once I have a few ideas of what exactly I am trying to look for, then I go specifying more and I start using the quotation marks, so what comes out is more specific." Another student added, "Ok, so like uh, first, I like uh start by going to Google. And um, I first type out the exact words I find, uh, for what I want to find out about. And if that doesn't work, I start using the more advanced search, like uh, most relevant."

Students rely upon the search engine to define their search, most commonly with Google PageRank. This also often means moving from broad to narrow in search terms as the students are building a vocabulary of terms. "If I'm not sure what I am looking for example anytime I don't know what I am looking for, like an IA article, I look for broad things and then once I have a more clear idea, I start specifying and using other databases." Two other students said, "When I look for something online, I just go into Google and I just search for the broadest part regarding my topic and then if that doesn't work, I just start searching for very specific things," and "What I do is I open most of the links I get on the first page of Google, and I know it is the proper information when it is not only related to the topic but it appears more than once on the website. When I see it repeating two-three websites, I know that it has to be good information because otherwise it would not be appearing in all of them." Finally, "I search my

textbook, Ctrl-f same thing. I usually find what I need. If not, I have two physical textbooks that I reference. And, if it's not there, which is not very likely, I just Google search it, and I try to look, especially for chemistry and those scientific-mathematic classes, at better sites, more reliable ones." In observations, students also used textbooks to clarify word choice, but the result seems to be that students use the internet and textbooks to define better their search term.

This process is not solitary; there were many suggestions of group search effort. One student commented about study sessions outside of school, "Everyone is texting or searching for something while talking about the subject, so it is, it is really weird, like the way we manage to learn stuff, we manage to study." In observations, students readily offered search term help. As mentioned previously, collaboration is a key to online search strategies.

And when do students know they have enough? Several students mentioned that they get a feeling after having seen certain key words enough times, as in a search threshold. "It's just the idea, since I've been reading the ideas get stuck in my head and if I go across the same idea, I notice," and "I just, for when I am done, I just, I don't know, I feel like I am done when I have enough information, then I would just keep on working on the assignment, and if I feel the need, that I am missing something, some part of the analysis is missing something, then I go back and do more research, it's just a feeling that I usually have."

All in all, the student online search process looks a lot like berrypicking, but really more of a communal berrypicking. They do not overextend their search and instead

base their results on what is expected of them as defined by the rubric. While this may not be expertise, it is certainly communal and savvy.

And what do students think of their own search habits? This is surely important as it gauges the level to which they will work. Students recognize that Facebook and social media waste time, but also that there is merit. Students do regard themselves as efficient multitaskers, though they can rarely provide examples of this efficiency beyond comparisons with parents and teachers. There is widespread belief that younger people are more efficient media multitaskers.

"I am almost 100% sure that without Facebook or anything, I would be way more focused and doing better at school, I think, without Facebook." This feeling came up often. "When I am studying for exams, I want to like, shut my Facebook down, but like I can't really, the only reason is if I need help or something it is so easy to ask a friend for it, and that's like the only reason I don't shut down Facebook, cause it is, it can be really distracting during exams. I'd say it is helpful, but it is very distracting." Note that the student saw both positive and negative effects. Other students more readily defended Facebook and offered some examples on its usefulness. "I think that many teachers don't know that…like when teachers go around and see Facebook on our laptops, yes, there are some times when it is not school related, but most of the time, it kind of is so I think that a lot of teachers should take that in mind because Facebook and other websites that appear not to be school related, most of the time, you do use them," and "It's really helpful, especially now when you are studying for exams, you can see the review sheets, everything on there, you have everything on your computer, it is really simple."

Based on the measurement tool, observation, and interviews, it is clear that students use multiple objects consecutively, and that they feel they are able to do this successfully. One student commented, “I think that the younger generation is developing a sense for multitasking, so yeah, I think the younger generation is more prone to multitasking than older generations…Because, we have been doing it like, forever. “ Another student said, “I think that multitasking has always been there, it is just that now its focused on different, before, I’m pretty sure that people had radios on while they were writing on their paper and stuff like that, but now you just have different websites open at the same time and stuff like that, and you keep switching back and forth.” And again, the superiority of youth in multitasking, “I guess younger people now have more experience with it cause now it is tied with social media so they are, like, they have done it when they were kids, and now when they are growing up they already have an experience of it…I would say that younger people would multitask better than older people.”

As noted, the transcripts were loaded into the WEFT software tool and then coded. Individual codes based on a word tree gave a general understanding of the importance of certain words over others. Note that questioning targeted all of the words listed below, so frequency can be considered as relevant to the student answer and not something that was targeted.

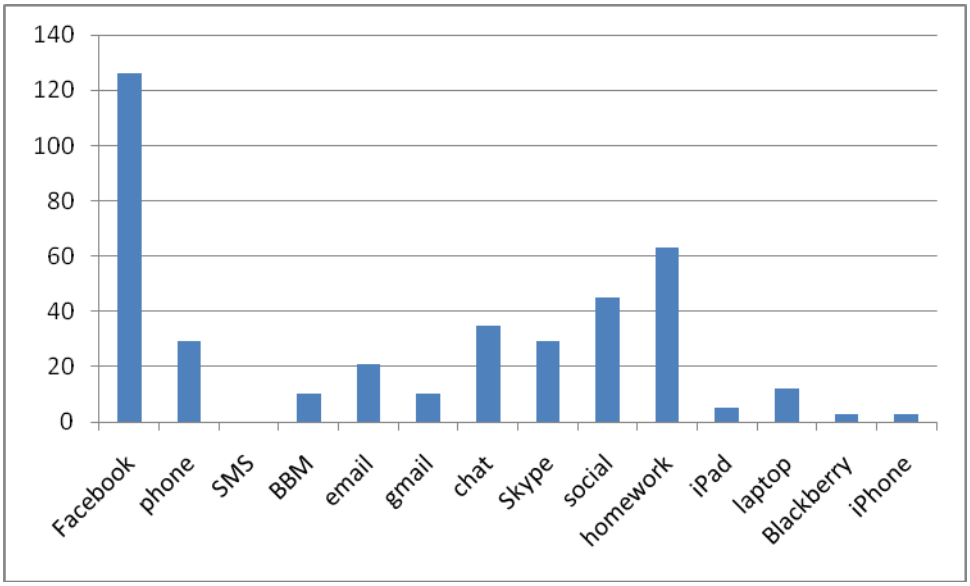


Figure 4.1. Frequency of word tree terms from interviews.

It is clear that Facebook is very popular. It is tempting to suggest that there is a relationship between Facebook, homework, and social activities, but simply presenting raw numbers cannot do more than to suggest the notion.

4.5 Facebook Page Observations

The first Facebook page analyzed was a class support page for Environmental Systems and Societies, an IB course for junior and senior students. The course instructor is very active and involved, as well as technologically oriented. This makes the class a good place to gather data. The second page belongs to the *Un Techo para Mi Pais* club at this private international school in Peru. This group is affiliated with a non-governmental organization that builds houses for people in impoverished areas, in some ways similar to Habitat for Humanity. The group has over 200 student members and is very active, making it a good place to gather data for this research.

Private class pages have been excluded. Students hinted that much of the information was private and it would have been a breach of ethics to include these

pages. Instead, multiple interviews gave a sense at how the private pages are used. The Facebook page observations mostly answer research question 2, “Does this task management grow from collective expertise?” though the way in which students manage tasks is also observable.

4.5.1 Students, Ms. Rumble Rocks You

The course instructor manages this classroom Facebook site and uses the site as a duplicate for the class Moodle page. As such, most of the information is teacher driven. However, it is easy to note that students use Facebook as their first option for class information. The course instructor noted that Facebook was the first place where information was posted, followed by Moodle. The following student comments suggest extended learning rather than in-class support:

> “Ms, there are no detergents with nitrogen or phosphorus; they were all made out of sodium sulfate. Should I just buy artificial fertilizers?”
>
> “Ms! I remember you talking about how toothpaste packaging is inefficient, here’s a solution: (video clip). Comments: rosquete, tu te lavas con chele maricon, you go antonio!, Nice pintonio, This goes here http://bogobrush.com/

Several students posted articles related to class assignments that would be considered gift queries. One student posted a general article on CO2 reduction. Another student posted a YouTube video on a teen scientist that had developed a way to purify water. A third student posted an explanatory article about Greenpeace.

The page does not see a lot of activity; it is mainly supplemental for face-to-face and Moodle instruction. As noted in one of the interviews, “Also, Ms. Rumble, our Environmental Science teacher, she also has a page where she posts interesting stuff. She doesn’t really use to communicate class material, but more as a means of posting interesting articles related to the course that we should read, but that isn’t mandatory,

but TOK is, sort of mandatory." The same student opened up on how private use of student-created pages helps, "We always do vocab quizzes for Environmental Science and then there is sequence for every single person. So, one person does, this is bad, oh my God, one person posts the answer and everyone gets help from that answer."

4.5.2 Students and Teacher: Un Techo Para Mi País Page

The Techo page is managed by the club president, but the club sponsor posts often. Student response is high with a median of 201 views for each posting. This number drops to 154 during break, but student comments continue. Students offer teen banter, but also offer suggestions, answers, questions, and support. It is clearly a very well connected social environment and according to the sponsor, it is the first place students look for answers, schedules, and information.

Postings are arranged as informational, questions, answers, and support/encouragement. Analyzing the comments from November 2012 results in 119 posts revealing the following:

Table 4.3

Facebook Group Posting Types

Posting type	***Total posts***	***Percentage***
Informational (Including gift queries)	*51 (14)*	*42.8 (27)*
Questions	*28*	*24*
Answers	*21*	*17.6*
Support/encouragement	*19*	*16*

The sponsor posted, but infrequently. Information posts tended to be schedules, Gift queries included postings such as, "Let me know who needs cake/cupcake mix because I have some," and "Ok. If you need help making, tell me please." Informational postings that offer unsolicited information are included as gift queries as they are novel

informational pieces. These would include, “don't put the posters up yet tomorrow. We need Mr. Akin's permission before we are allowed,” and “awsomeee! two things though! we're not doing the bean bag, just the dodge ball, and techo uniform day is techo twin day, using techo's colors.”

Question and answer posts were direct and open. Most answers came from students, though the advisor had to answer some specific questions. The questions and answers support the sponsor’s claim that Facebook was the first place students went for information. Finally, support and encouragement postings were the least used and included comments on pictures, postings, and general community support. Taken together, the Facebook page for Techo fits the model of a community of practice. Within this community, when expertise is lacking, the community compensates and students support each other to find best answers.

4.6 Summary

The three qualitative approaches support answers from the measurement tool regarding online multitasking behavior. Descriptive analysis throughout this chapter offer glimpses into the online live of students. These analyses, when supported with word counts and pen and paper survey questions on habits and self-perceptions, offer a robust understanding of the online lives of students.

CHAPTER 5

SUMMARY AND CONCLUSIONS

5.1 Summary

To what degree did the investigation answer the research questions? There are clearly observable trends as well as unexpected findings. The first research question asked, “To what degree, and in what ways, do adolescents manage multiple online tasks?” Students managed online tasks with a variety of tools, mostly self-taught. Students tended to feel that they were unorganized in life, but demonstrated that they were highly organized online. This meant minimal folders but also a lack of hierarchy within the folders, and multiplicity of browser tabs, but centered on one or two tasks. Students tended to bounce around, collecting information a “bit at a time” and found usefulness in looking for keywords, blocked text, and building a vocabulary for research. This last bit is interesting as the students used a number of sources to derive the terms that they would find as most successful. This method of searching is consistent with Bates (1989). I would term the search process to be multi-tabbing.

The second research question was, “Does this task management grow from collective expertise?” Collective expertise was certainly observable, but it was not as direct as expected. Students did not truly collaborate nor did they cooperate. Instead, collective expertise emerged where students helped out at times with gift queries and assistance. Students did manage and search as experts, and the social nature of the search process is too large of a variable to ignore, but it does not appear to be the sole reason for signs of expertise.

The third research question asked, “Do students exhibit heuristics indicating expertise and creativity in managing the task?” This did prove to be the case. Students combined self-taught organizational skills (question 1) with shortcuts, or heuristics, to enhance their searching abilities. Actions included Ctrl-f to do a search with the find function, deciding to print certain information rather than reading online, selecting to focus by turning off other media, multi-tabbing, and selectively working with others to enhance creativity. These heuristics are self-taught as well. Combined, it appears that students search as experts given familiarity with the research objective.

The final research question asked, “What role does technological self-efficacy have in this process?” The best answer for this question resides in the high level of metacognition among students. They knew when to focus and when it was possible to do multiple things. They were all very comfortable with technology and truly live online, and this supports their self-efficacy and metacognition, perhaps leading to displays of expertise in the search process.

Regarding the search process, several findings are of interest. Students tended to feel that they were unorganized in life, but demonstrated that they were highly organized online. This meant minimal folders but also a lack of hierarchy within the folders, and multiplicity of browser tabs, but centered on one or two tasks. Students tended to bounce around, collecting information a “bit at a time” and found usefulness in looking for keywords, blocked text, and building a vocabulary for research. This last finding is interesting as the students used a number of sources to derive the terms that they would find as most successful. This method of searching is consistent with Bates (1989).

All methods of data gathering show that students do multiple things while online. The interviews suggest that students know when to focus, and when they can do more leisure work. Observations suggest that when presented with one stimulus (music) the students still kept the computer open to no more than two different topics. Lin, Robertson and Lee (2009) found that experts and novices performed equally with background disruption. This study suggests that students selected background interruptions based on the difficulty of the task, perhaps a sign of expertise.

These methods do seem to grow from self-instruction though there seems to be a pattern among students. When students find one subject difficult, they will focus on that subject. Lee and Perry (2004) found that students could not self-regulate with Instant Messaging. This study suggests that students are able to self-regulate, depending upon the self-perceived difficulty of a task. Obviously, the subject changes between students, but the management tool remains. Some tricks are learned from the group, but the idea of a collective expertise remains unanswered. Collaboration is very common and there were instances in all qualitative measures where students used a collaborative group to answer questions, often unsolicited gift queries. This does aid in creativity of the search.

Students did exhibit heuristics in the search process. They knew which tool to use for a particular task, and this included a physical device as in phone versus laptop, and more commonly, online. Use of shortcuts was commonly observed and the method of searching suggests a comfort and adaptability with finding information due in part to heuristics. Todd (2003) noted that multiple studies indicated students "inability to manage and reduce large amounts of information" (p. 38), but in this study, students

were able to define what they needed through a number of tools, and then extract that information through a search.

Students act as experts, though it is hard to say that they are experts. As noted in Chapter 4, when comparing senior to junior classes in observation, the senior group showed more signs of expertise: they went directly into sites that they knew would help, they had a higher level of subject specific vocabulary, and they searched in their mother tongue to understand concepts before going back to an English search domain knowledge. This is consistent with Watson (1998) who identified student expertise as including flexibility, organization, and modification of a search. Lucas and Topi (2002) found expert student searchers included more search terms, and this bore out with the creation of a vocabulary of terms during the observed settings of this study. Students used multiple tricks to help in the search, indicating expertise and creativity. They searched online and noted key terms, they searched textbooks, and they asked each other and the teacher. While students did not write down the terms, they were in effect building specific domain knowledge for the search. This growth of knowledge compares to findings in Pennanen and Vakkari (2003). In the end, the study suggests that students are highly creative, in part due to the collaborative nature of their online lives, but are still not yet experts as one can see the knowledge base being built.

Students felt incredibly comfortable online. This was evident in the measurement tool, and also in each of the qualitative measurements. Students felt they were experts online due to the number of years they had been online and they offered numerous examples of how they were more efficient online than older persons. Self-efficacy did have a role in the search process; students live online and are comfortable there.

Two recent publications define the range of student online life. At one end is Daniel Pink (2005) who defines our current age as the conceptual age. Students collaborate and produce mash-ups that are more about creation than discovery. Rapidly produced videos, Web 2.0 products, and new forms of presentation emerge as a result of collaboration and a life that is spent largely online. On the other end is Jaron Lanier (2010), who suggests that this hasty process reduces the human factor in creation and that the self is co-opted to the larger community. It would appear that students live closer to the Pink side of the spectrum, and Lanier's admonition should be heeded.

From the student perspective, consider the visual and organizational model that is presented online. Icons include representations of items that are often unknown to students, as in the 3.5 floppy disc image for *save* or in the *folder* image for the classic manila folder. Students have developed their own way of managing online organization.

5.2 Conclusions

Findings from this study link directly to three previous theories on adolescent information practice. First, Kuhlthau's (1991) Information Search Process is still highly relevant. While this study did not focus on the affective process, the steps to finding an answer remain consistent. One addition would be the large increase in collaboration within the search process as collaboration aids in creativity and likely reduces stress that a student might feel.

Second, Bates' (1989) berrypicking model for finding information proved very popular in both individual searches and in collaborative searching. Students to gather information "a bit at a time" and this often happens within a group setting, often online.

The students gathered information in chunks and slowly built a vocabulary to improve their search, and they shared the information chunks with each other.

Finally, Dresang's (1995) radical change theory proves relevant in understanding the online life of students. While no comparison with different generations was undertaken in this study, it would seem that students manage a very different life, one that is online and organized; one that makes sense to them. Dresang noted three Digital Age Principles (1999) and these are all highly relevant for the adolescent searcher. Interactivity, particularly increased sense of control by the end-user, Connectivity and the construction of social worlds, and Access, where previous barriers to information have been broken, all are exhibited regularly in the student search process. These three models and theories allow for a better explanation of why students act the way they do.

Alvermann (2004) discussed hypermedia and an emerging new literacy, a concept much in line with Dresang. It would appear that consistent scanning for information, as well as numerous tricks designed to seek an answer while avoiding in-depth analysis, has created a new, or at least different, type of literacy among students.

The results of this study suggest that students are active collaborators, they are clever searchers, and they are more organized than supposed. Students are distracted, but focus when it is necessary to do so. Students have a high level of metacognition regarding their own abilities and this helps to shape their search and their behavior. Finally, adolescents consider themselves to be experts at multitasking.

A proposed model on creativity emerges from the study, though this was not the initial purpose of investigation. It would appear that collaboration leads to an influx of

ideas for the community and individual. Next, students use mostly self-taught organizational skills to manage this collaborative group think. Finally, creativity emerges as the multiple ideas from the group are organized and then acted upon.

Possible causes for students' high levels of metacognition start with an ever present online life and the nature of social media as collaborative and voyeuristic. Causes also include a possible increase in the amount of collaborative work students are expected to do, and of course the simple increase in the number of devices available.

Consequences of this study apply directly to educators of adolescents, and also to the field of information science. A better understanding of the difference of adolescent online searching and the importance of social media would lead to different approaches in the information delivery. An example is in simple message delivery. Teachers use email while students use Facebook.

The study has several limitations. First, while the sample size was large, it only addressed students at one school. While these students did offer a diverse background, their socio-economic standing meant that they had greater access to information and to the devices for this information. Borzekowski (2006) and Selwyn (2009) suggest that multitasking abilities are linked to socio-economic status, so this population should be better at managing multiple tasks. Closely related is the international setting of the subject population. Students at international schools are often from the highest economic standing of the domestic population or they are children of diplomats and NGO officers. This means that families typically value education, students have access to information with multiple personal computer

devices, the schools are well resourced including multiple databases, and students are international with a broad perspective on life. Third, the study observed students in semi-controlled situations. It would be very revealing to see how students use Facebook when they are not in school, though this would perhaps be invasive. Finally, any study is a construct, and there are limitations to observed data and what the data mean.

5.3 Recommendations

For educators, recommendations from this study would be to take a more active role in online social communities of students. Collaborative lessons should be encouraged, but a new approach would be for the educational leader to be a part of the collaborative community. Finally, the use of rubrics provides students with an immediate map for what the task should include, and the role of rubrics should be considered as it may well reduce creativity in the search.

For researchers, further investigation would be revealing. First, what generational differences appear in the use of social media? Second, is expertise possible for adolescents? Is a new approach to what expertise means in order? More research into group or communal expertise would be revealing.

APPENDIX A

STUDENT OBSERVATION CHECKLIST

Observations and interviews will employ Observer Impression, and code data using the following terms:

Free codes

Academic drive
Activities
Automatic
Screen image
Focus
Time spent online
Concentration
Study Space
Programs
Distraction
Procrastination
Food/eating
Sports/gym/swim
Search process
Technology
Subscribe
Internet

Tree Codes

Online/non-online

FUN

- Facebook
- YouTube/video
- Music
- Entertainment/motion empire
- ` Gaming/MMA
- Breaks
- Phone
- iTunes
- relax
- WORK
- Organization (checklists, calendars)
- Group Work
- Screen
- Homework
- Habits
- Subject
- Moodle
- amersol
- share

Opinion

Definition

Generational

Drive

Priority

MAC/PC

Preference

Communication

Facebook

phone

SMS

BBM

email

- gmail
- hotmail
- school

chat

Skype

Devices

iPod

Laptop

desktop

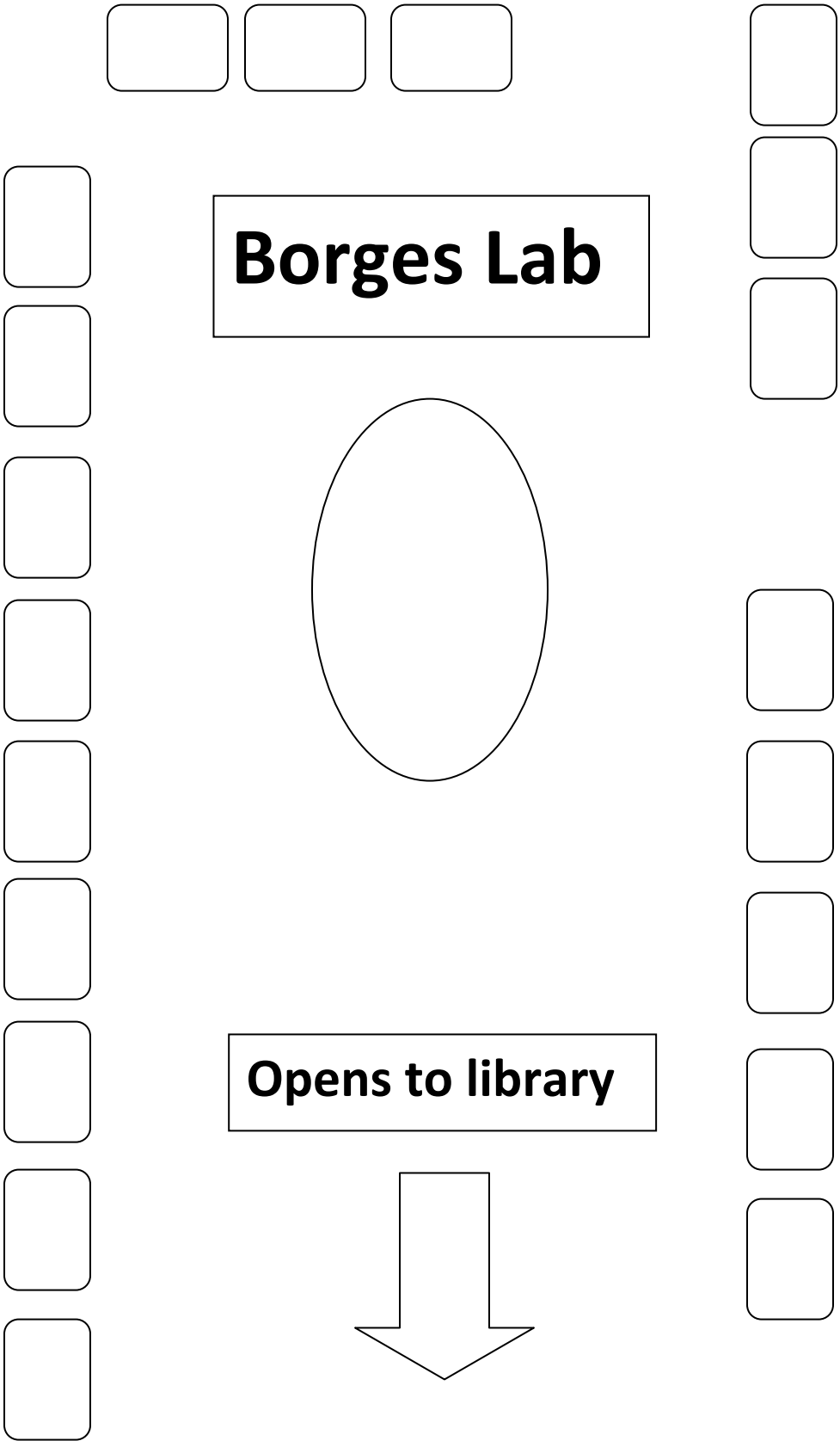
cell phone

- Blackberry
- iPhone

television

APPENDIX B

THE BORGES LAB


Borges Lab
Opens to library

APPENDIX C

INTERVIEW QUESTIONS

1. Tell me about how you use Facebook?
a. Moodle, other social network sites (web 2.0)
b. Do you find online classes helpful?
c. Is social media helpful for coursework?
2. What is the typical process when you look for something online?
a. Class, personal
b. Top webpages that you visit
c. How often do you take breaks?
3. Do you find multitasking easy?
a. Are younger people better at multitasking?
b. Do you consider yourself as organized?
4. Who else multitasks in your life: friends? Your parents?
a. What do you think of their multitasking abilities?
b. Do you offer/receive online help from classmates?

APPENDIX D

THE INTERNATIONAL BACCALAUREATE LEARNER PROFILE

IB learners strive to be:

- inquirers
- knowledgeable
- thinkers
- communicators
- principled
- open-minded
- caring
- risk-takers
- balanced
- reflective.

APPENDIX E

THE IB MIDDLE YEARS PROGRAMME APPROACHES TO LEARNING

Approaches to learning

- organizational skills and attitudes towards work
- collaborative skills
- communication
- information literacy
- reflection
- problem-solving and thinking skills
- subject-specific and interdisciplinary conceptual understanding.

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