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Undergraduates' personal academic information management and the consideration of time and task-urgency

ABSTRACT

Young undergraduate college students are often described as "digital natives," presumed to prefer living and working in completely digital information environments. In reality, their world is part-paper/part-digital, in constant transition among successive forms of digital storage and communication devices. Studying for a degree is the daily work of these young people, and effective management of paper and digital academic materials and resources contributes crucially to their success in life. Students must also constantly manage their work against deadlines to meet their course and university requirements. This study, following the "Personal Information Management" (PIM) paradigm, examines student academic information management under these various constraints and pressures. A total of 41 18- to 22-year-old students were interviewed and observed regarding the content, structure, and uses of their immediate working environment within their dormitory rooms. Students exhibited remarkable creativity and variety in the mixture of automated and manual resources and devices used to support their academic work. The demands of a year-long procession of assignments, papers, projects, and examinations increase the importance of time management activities and influence much of their behavior. Results provide insights on student use of various kinds of information technology and their overall planning and management of information associated with their studies.

Introduction

In an age of extraordinarily rapid turnover in information technologies, university students are on the front lines in mastering and using these new technologies while carrying on with more familiar information management habits and techniques. Understanding how students approach their complex academic information worlds is of primary importance today as academic libraries and educational institutions face the challenge of pioneering new and relevant services in a variety of virtual and print formats under increasing budget constraints.

This article discusses findings from a study of the personal academic information management behaviors of typical undergraduates, ages 18 to 22. This demographic group of students is often described as "digital natives," those individuals who have grown up in a digital, high-tech world. Using ethnographic methods, the study looks at how extensively these students actually integrate digital tools and information into their academic information worlds, their preferences in tools and organizational schemes, and how and under what circumstances they choose to use high- or low-tech tools. The fundamental research question addressed was this: How do undergraduate students manage their academic information ecologies in their dormitory rooms? Findings demonstrate a complexity of behaviors driven by individual personalities and affections as well as by time pressures and constraints, allowing a much richer understanding of our college students than the generic stereotype of the always online and plugged-in technophile.

Historically, information behavior was considered largely in terms of the mental world of the individual—what influenced the choices and actions of the individual person seeking information. Increasingly, however, we are coming to recognize the importance of personally created external structures to our effective utilization of information. The information environment created by an individual is essentially a scaffold, simplifying work with information-intensive tasks by providing external reminders and by physically structuring the information in a way that supports internal mental manipulation and use of it in work or study.

In short, in information-intensive tasks, the individual works within his or her own personally created *information ecology*. Understanding that ecology is essential to a full understanding of information seeking and use. To use another analogy, which is not as far fetched as it may at first appear, spiders live by capturing and eating insects. They do so by spinning a web that ensnares and stores the insects. It would be unimaginable to try to understand spiders as a species without also studying the creation and use of webs by these spiders. Biologists describe the spider-plus-web as the

"extended phenotype," that is, the animal combined with the structures it creates in its environment to support living (Dawkins, 1999). To speak of the student's "information ecology" is not merely to use a metaphor. The student working among his or her academic information resources is, in truth, working in an ecology he or she created. Failing to design that ecology well may even be associated with academic failure. The student-plus-academic information ecology is a *combined package that must be understood as a whole*, just as the spider cannot fully be understood without seeing it in relation to the webs it spins.

The study described herein represents a distinctive convergence of theoretical paradigm, study subjects, and research design. The study builds on the paradigm known as "Personal Information Management" or PIM (Jones, 2008). This literature concerns the study of the ways in which people collect, organize, and use the information they need in their immediate work or study environments. The vast literature of information seeking and use addresses many aspects of information behavior, but the most immediately and highly used context of information use—one's desk and local environment—is one of the least explored in the research literature.

Although there is a growing body of PIM literature, most of that literature addresses business and other work environments. We are unaware of any study that addresses this core personal information management behavior of college students. Studying students at this historical moment is of particular interest also because of the rapidly shifting forms of information and communication technologies (ICT) available to them. Implications of this research are of interest to many communities—researchers in information science, PIM, information technology development, education, student counseling, and the world of new technology startups among others.

The study employs ethnographic/naturalistic methods. Ethnographic methods are characterized by fieldwork or observations of phenomena in their natural environments, an approach known as *naturalism* as opposed to designed experiments and laboratory studies. These methods are used to produce detailed and accurate descriptions of a society, culture, or phenomenon. They are particularly well suited to studying students in their work environments, for instance, in their dormitory rooms. Writing specifically about using naturalistic approaches for the study of Personal Information Management, Naumer and Fisher (2007) state: "Naturalistic inquiry techniques can be a powerful means for better understanding contextual factors that affect an individual's PIM style" (p. 77).

In sum, this study investigates how undergraduate students manage their personal academic information ecologies in their dormitory rooms: the content, structure, and organization of those environments, how

students apply and use information tools therein, and whether distinct models of information behavior can be discerned. Much is learned about the variety of techniques and tools, both paper and digital, that students use for PIM as well as about their methods of organization and archiving patterns. Among the findings from this study are the importance of time and task-urgency in the students' organization and management systems and how they are primary factors in the flow of their information work. This observation appears to be unique within the relevant literature and has immediate implications for information work flow models.

Review of related work

Literatures relevant to this study include Personal Information Management, both in the management literature and in the information science literature, time in information management, student information seeking, and student "millennials" in relation to information technology.

Personal information management (PIM)

In Malone's (1983) groundbreaking study of the organization of people's desks and offices at their place of employment, he states: "I use the term *desk organization* loosely to include not only the desks, but also the tables, shelves, file cabinets, and other information repositories in people's offices" (p. 100). Participants gave Malone a tour of their office during which they explained "what information was where and why it was there" (p. 100). Two major units of desk organization are identified as "files" and "piles." Both "are ways of collecting groups of elements into larger units . . . files are units where the elements are explicitly titled and arranged in some systematic order . . . piles . . . are the individual elements that are not necessarily titled, and they are not, in general, arranged in any particular order" (pp. 105–106). Malone also describes the two most important functions of desk organization uncovered in his study—a way to find things, and a way to remind the owner of tasks that need to be done, which he calls finding and reminding functions.

Studies in numerous other disciplines outside of information science have followed up on Malone's approach including environmental psychology (Lansdale, Parker, Austin et al., 2011), industrial ergonomics (Lottridge, Chignell, & Straus, 2011), human-computer interaction (Song & Ling, 2011), and design (Wodehouse & Ion, 2010).

Jones is the most active proponent of PIM (2006, 2008). He states that PIM "refers to both the practice and study of the activities a person performs to acquire or create, store, organize, maintain, retrieve, use, and distribute the information needed to compete tasks . . . and fulfill various roles and responsibilities" (Jones, 2006, p. 453).

Lansdale (1988) considers the psychological processes involved in the management of personal information, specifically classification and memory. In stressing his point that many of the issues involved in the automation of information management are essentially psychological in nature—particularly recall, recognition and categorization—he creates a theoretical framework for developing user-oriented information management systems.

A parallel line of research can be found in information science that studies the individual's office information organization and management. It began with Soper (1976) and continued with Case (1986, 1991) and Kwasnik (1989). Hartel continued this work with an examination of the arrangement of informational materials in the home by cooking hobbyists (Hartel, 2007). These authors addressed information organizational behaviors, behaviors of specific populations, and how people make classificatory choices when organizing their information. Despite these earlier studies, examining the information world created by individuals is still a relatively underdeveloped part of information behavior research.

Time in information management

"Time is one of the main contextual factors of information seeking" according to Savolainen (2006, p. 110) addressing the question of temporal context as conceptualized in information seeking studies. He notes that "[E]ven though the research abounds in expressions implying temporal contexts . . . the temporal factors have rarely been discussed in information studies" (p. 111).

Time as a factor in information management was identified by Kwasnik (1989) in her study of how people organize documents in their own offices. She noted how people distinguished the placing of materials in their offices by the frequency ("very seldom used") or urgency ("must deal with immediately") (p. 208) of their use. In a later publication she stresses that these classificatory decisions are based less on a document's attributes than on the context in which the person finds himself when making this decision—his or her goals, purposes, knowledge, history, etc. (Kwasnik, 1991).

Balter (1997) studied e-mail organization strategies and recognizes that "anti-organization" behaviors, that is, failure to organize, compete

with organization behaviors in the same individual when that person is feeling the effects of information overload (i.e., amount of incoming e-mail to process) and time pressure. Undergraduates demonstrate this type of behavior in waves throughout their academic term as assignments and deadlines press upon them. But the general PIM literature does not treat the time factor or its effects with such emphasis or centrality. In the PIM literature, time is considered an element that can be managed through effective personal information behaviors and systems. Time management is an element of task management—scheduling and calendaring tasks in a project, but it is not discussed as a key factor guiding or interfering with an individual's information organization and management. This article draws attention to the time element in a way not typically seen in the PIM literature.

College student information seeking

College students are the subjects of numerous studies of information-seeking behavior (e.g., Gabridge, Gaskell, & Stout, 2008; Kuhlthau, 1991; Weiler, 2005; Whitmire, 2004), Internet-use behavior (e.g., Agosto, 2002; McMillan & Morrison, 2006), library behavior (e.g., Keefer, 1993; Mellon, 1986), research behavior (e.g., Kracker, 2002; Kracker & Wang, 2002; Valentine, 1993; Walters, 2009), information literacy (e.g., Head, 2008; Seamans, 2002), and behavior with technology (e.g., McMillan & Morrison, 2006; Mennecke, Valacich, & Wheeler, 2000; Pena-Shaff, Martin, & Gay, 2001; Weisskirch & Milburn, 2003). For all that has been studied and written about them, however, it is a population whose behaviors within their own academic information worlds have yet to be explored. This section reviews a few papers illustrative of the findings on student information seeking.

Holliday and Li (2004) discuss several studies that explore students' attitudes towards the general research process. They cite a study by Valentine that found that there was often a gap between what their instructors thought of as good academic resources, and the students' ability and lackadaisical efforts to find them. Valentine's study also points to students' chaotic manner of finding information, their heavy reliance on the sources most familiar to them—usually the web, and their preference for convenience and speed (Valentine, 2001, as cited by Holliday & Li, 2004). Other studies indicate students' use of ineffective search strategies generated by their inability to think of and employ a number of alternative terms, synonyms, broader and narrower terms while searching, resulting in poor quality information retrievals. Holliday and Li point out that while a great deal is known regarding students' attitudes and search habits, very few studies

attempt to explore their "deeper cognitive and affective behavior in the more holistic context of their research process" (2004, p. 356).

Lee looked at undergraduate information-seeking behavior and asked a question related to aspects addressed in this study: "Do existing [library and information] structures continue to make sense and help users locate needed information in a timely fashion? In view of technological advances, should we find new ways to structure resources to further facilitate information seeking?" (2008, p. 211). She interviewed fifteen students of diverse backgrounds and asked them to describe their research process. One notation she makes is of particular interest for this study:

> Most participants possessed a small collection of their own information sources, too. Some had a subscription [or regular access] to a magazine or a newspaper . . . that was sometimes used for coursework. From time to time, the students con-sulted the textbooks from current or previous classes and/ or other books they had for personal interests. The students across disciplines reported this personal collection habit. Few, however, had saved article printouts from previous classes. One student labeled herself a pack rat and admitted saving every-thing for later use. Others simply discarded article printouts as soon as they finished the paper or project in hand. (p. 214)

This demonstrates that a personal academic collection culture does exist among undergraduates, although Lee seemed to focus on traditional print items to the exclusion of digital items. This current study uses a broader range of academic information, and looks at the environment and ecologies in which the students interact with it.

Librarians at the University of Rochester in New York hired anthropol-ogist Nancy Fried Foster to lead a study of how students at their institution actually go about writing their research papers (Foster & Gibbons, 2007). Among the many findings from their extensive study, the researchers learned that the physical design of the library and its facilities is not espe-cially compatible with the way students prefer to use their physical study space. The authors also discuss the technologies available to students and what students actually use. They observe, for example, that even though students have laptops, they did not bring them to class. "That is when we discovered how itinerant students were during the day, carrying what they needed for long stretches . . . it was simply not practical for most to include a laptop along with all the other things they brought to classes . . . laptops came out when students planned to be in one place for a while to do their

work." (pp. 46–47). This current study has been informed by the methods used in the Rochester study.

Undergraduates today

Digital Natives, also known as the Millennials, the Net-Generation, Net-Gens, and Generation Y, are usually described as young people born between 1982–2000, the age bracket of most undergraduates today. Several institutions support research into the academic, technological, and general lifestyles of these students. Examples of annual national surveys and other studies can be found at websites such as UCLA's Higher Education Research Institute (HERI) (UCLA Graduate School of Education and Information Studies, 2012), Indiana University's projects at the Survey Research Center (Indiana University Center for Postsecondary Research, 2012), and the University of Michigan's College Student Experiences Questionnaire Assessment Program (University of Michigan, 2012). Most of the authors reviewed below base their findings on national surveys and studies.

In 2002, the Pew Internet and American Life Project released a major report on the use of the Internet by college students and how they have incorporated it into their education and social lifestyles (Jones, 2002). The report covers use of Internet features such as e-mail, instant messaging (IM), recreational online browsing, and downloadable music files. It found that as a group, college students are early adopters of the Internet incorporating new uses of its features before other population groups. Purposes for Internet use among students fell into two broad categories: educational and social. In their academic environments they reported using the Internet to contact professors, conduct research, work on collaborative projects with other students, and receive messages from academically oriented e-mail services. In their social lives they use the Internet for social communications, for entertainment, to stay in touch, and forward messages to friends and family. The study concluded that for college students, the Internet is "integrated into their daily communication habits and has become a technology as ordinary as the telephone or television" (Jones, 2002, p. 2). This report is still cited extensively as a benchmark of students' behaviors with technology in the early 21st century.

In the years since its publication, use of new communication technologies and features has proliferated among college students. In recognition of the speed with which the technological landscape evolves, a second study was undertaken over three academic terms between Fall 2005–Fall 2006 to investigate students' use of the Internet and to compare results to the 2002

study (Jones, Johnson-Yale, Millermaier, & Perez, 2009, p. 1). This report acknowledges the impact of social networking sites, especially Facebook, on the students' Internet use and behaviors, but reports that in many ways, their behaviors changed little since the earlier study. The report discusses the rise of blogging habits among undergraduates, but is too early to detail the impact of the surge of smart-phone usage which allows easy access to the Internet and other online applications.

Oblinger (2003; Oblinger & Hawkins, 2005) not only discusses the characteristics of today's college students, she stresses that these students are markedly different from previous generational groups. Millennials, as Oblinger calls them, tend to be visual learners, preferring to acquire their knowledge from a television or computer screen to text-heavy print materials. Having grown up with Sesame Street and cable music television stations like MTV with their short clips and fast changing action, they seem to have little patience for the slower, more traditional pedagogical methods of higher education. Multitasking is the norm.

They also prefer hands-on methods when learning. Concepts should be introduced at the students' point of need when they perceive the immediate worth or application. Most of their scholarly motivation reflects an academic climate that emphasizes earning good grades (an extrinsic form of motivation) rather than an altruistic pursuit of knowledge for its own pleasure. They are used to a high degree of instant gratification, especially with information on the web, and are very concerned with saving time.

Research design and methods

Within the broad topic of how students manage their academic information ecologies, the following specific questions are addressed in this article:

1. What are the contents of these ecologies?

2. How are these environments structured and organized?

3. How do students apply and use information tools within this ecology?

4. Can distinct patterns of information behavior be discerned?

Academic information is defined in this study as the information collected and generated by students for the purpose of facilitating or fulfilling their needs for coursework, scholarly research, and institutional

requirements. As students collect academic information for their particular needs it becomes their *personal* academic information, which they shape into an actual physical milieu in their dormitory rooms and school backpacks. They create these information environments through their inclusion of physical and digital tools and carriers for actions, such as studying, reading, writing, sorting, piling, reminding, and so on. The dynamic properties within the environment and students' cognitive and physical interactions with the information constitute a personal academic information ecology.

The students sampled were limited to those living in campus dormitories. The relatively uniform conditions found in dormitory facilities should help minimize factors emanating from variations of family, social, economic, spatial circumstances, and commuting conditions that exist among students living in other types of housing. Dorm living is a broadly shared experience among college students throughout the United States, and there is an identifiable dormitory culture as discussed by sociologists, anthropologists, and scholars of higher education (e.g., Blum, 2009; Goffman, 1961; Moffatt, 1989; Nathan, 2005).

Approximately 9,400 undergraduates live in the University of California at Los Angeles (UCLA) campus residence halls out of a total undergraduate population of more than 26,000 during the academic year, defined here as three 10-week quarters (www.orl.ucla.edu). Student dormitories are located in the northwest section of campus, between 0.6 and 1.0 miles from most classrooms on the east side of campus. UCLA authorities are very chary of issuing permission to do research with undergraduate dormitory residents. It is a common request, and few opportunities are provided. The authorities felt that this study was particularly apropos to the students' own needs and so agreed to it. Students were then recruited through advertising within the dorms.

The ethnographic approach, developed by anthropologists and sociologists, has, as a central tenet, the creation of an understanding of a phenomenon as experienced by and through the eyes of its participants. Pollner described how ethnography can be used as a tool to discover "the extraordinary organization of the ordinary" (1987, p. xvii). Because this study sought to uncover the students' organic information systems, that is, the behaviors and systems they develop in their own living spaces, ethnographic methods seemed most appropriate, as they would allow students to describe their physical and digital study worlds as they saw them and interacted with them.

The ethnographic approach concentrates on qualitative depth of interaction with the study subjects, rather than breadth or statistical representativeness of categories. However, all students shared the basic

requirements of living in a UCLA dorm and being between 18 and 22 years old and enrolled in a baccalaureate program at UCLA. Eight students lived in single occupancy rooms, and the rest shared their rooms with one or two roommates. The original intent was to recruit 18 to 24 students, but interest was high, and a total of 41 were studied. The final set consisted of 28 women and 13 men, with a mixed racial/ethnic background reflective of the campus (and the Southern California community) as a whole. The numbers of students in their first through fourth years were 11, 20, 4, and 6, respectively. Twenty-two students were in the sciences, 11 in the social sciences, 7 in the arts/humanities, and one was "don't know."

Using multiple methods to test the same question, sometimes known as triangulation, is known to strengthen the validity of the findings through a cross-examination of answers. Three methods for gathering data were employed: 1) guided tours by the students of their academic environments, supported by video and photographic inventories, 2) semistructured interviews following an interview protocol, and 3) free-write descriptions by the students themselves of their information environment and behaviors.

By sequencing these elements in this manner, the students had maximum freedom to identify elements of importance to them in the environment, and to shape their descriptions as desired, with minimal influence from the investigator. Only after they identified elements of interest would the investigator then pursue further questions. Sample portions of actual tours can be viewed at: http://youtube/ b4sVSMkwvFI ("Lynn"), http://youtube/4z7QkyqGnI4 ("Oscar"), and http://youtu.be/3BViz6Lyumc ("Olivia"). The tour, which was video- and audio-recorded, usually lasted between three to nine minutes during which the student showed the contents and basic organizational structure of her or his environment. The rest of the time with the student was audio-recorded. These interviews generally lasted between 20 and 45 minutes. Specific probing questions arising from the tour and questions on other topics from the interview protocol followed (see the interview protocol at Mizrachi, 2011, pp. 263–267). Photographs were taken of items and areas in the environment that seemed particularly noteworthy based on the student's emphasis on them, or the interviewer's interpretation of their uniqueness or typicality.

After the student and researcher completed the semistructured interview and any other relevant discussions about the environment and student behaviors, the researcher then asked the student to write about "How I organize or manage the information I need for school in my residence hall room," for up to 10 minutes using any means preferred. Most wrote short essays, some used an outline or bullet format, and some preferred to sketch their environments.

Several students commented on how much fun the interview was, how interesting the topic was, or that they had never thought of their behaviors in such a way. In general it appeared that the students enjoyed the opportunity to share and talk about themselves. Student names used in this text are pseudonyms.

Using the qualitative methods of Glaser and Strauss's Grounded Theory approach (Glaser & Strauss, 1967), transcripts of each interview were coded and more than 100 codes listed, some more specific than others depending on the details provided by a particular student. Concept categories included the following: contents of the environment, structure/organization, use/application of tools, information behaviors and flow, evolution/development of the environment, and social/cultural influences. Tables of the concepts and categories were created, enabling efficient visual analysis. Data from each student's experience were thus compared and contrasted through repeated ventures into the data, and general behavioral tendencies and variations were then drawn. It is these behavioral tendencies and patterns that are described in the next section.

Findings

In this section, the nature of the information ecologies created by students in their dormitory rooms is first examined. Here, students store their academic resources and, usually, do their most intensive studying. Then we turn to the dynamic processes of acquiring and transmitting academic information. First we examine the paper and electronic tools and channels used by the students, then turn to the specific means students use to acquire, organize, and manage their information resources. In the subsequent Discussion section, we draw out several major themes that appeared in the analysis of these data.

Academic information environments

As one first-year student stated:

> In order to stay organized for school, I try to keep things in a certain place on my desk or in my drawers all the time so that I will always know where to find it. For example, I keep all my binders and notebook paper in my bottom drawer so whenever I need to restock or find use for it I know where to access it. As for my books for classes, they all sit on my desk. Also on

my desk are pens, pencils, index cards, and [sticky] notes—
essential to being a student [here]. On my laptop, I try to keep
subfolders for different courses I am taking at the time so that
I can easily find documents I've typed for the class. (Debbie)

To open the interviews, students were asked where they keep their
academic "stuff." They always began at their desk area, which they indi-
cated was the focal point for their information environment. Each desk
contains a shallow keyboard tray on the left side, three drawers reaching
to the floor on the right, a chair, and a two-tiered bookshelf, which some
students remove and relocate on the floor nearby. Many students also attach
a desk-extension, like a table-leaf, which increases the depth of their desk
by approximately ten inches. Figure 1 shows typical examples of students'
desk organization.

Students post academic information on their walls (which are lined
with bulletin-board material in some rooms), and side surfaces of dressers,
closets, bookshelves, and doors, especially those furnishings and areas
that are closest to the students' desks. Figure 2 shows multiple calendars
posted on a student's wall.

Shelves and drawers in closets, dressers, and bed frames are used as
storage areas for various types of academic information, and piles of infor-
mation carriers and repositories can usually be found on top of furnishings
with convenient flat surfaces, such as dressers, tables, mini-refrigerators,
televisions, and window sills. Occasionally, piles of academic information
can be found on the floor or bed, especially before major deadlines or
exams. Most students who report using their bed as an additional study
space do so for what they call light study tasks such as reviewing or light
reading, but prefer to sit at their desks for tasks requiring more focus. Many
use space under their beds for storing academic materials. Closets in the
rooms usually extend to the ceiling to maximize space, but it is difficult
for some students to access and the inconvenience becomes a barrier to
fully utilizing this space.

Four types of information were identified in the students' academic
environments: course-related, institutional, extracurricular, and sup-
plementary. This study focuses specifically on the first two types. These
types of information came in both paper and electronic forms. (Because
most of the latter is digital today, the terms *digital* and *electronic* will be
used interchangeably.)

Physical information contents of the rooms include notebooks, binders,
folders, boxes, planners, calendars, books, and course readers, singly and in
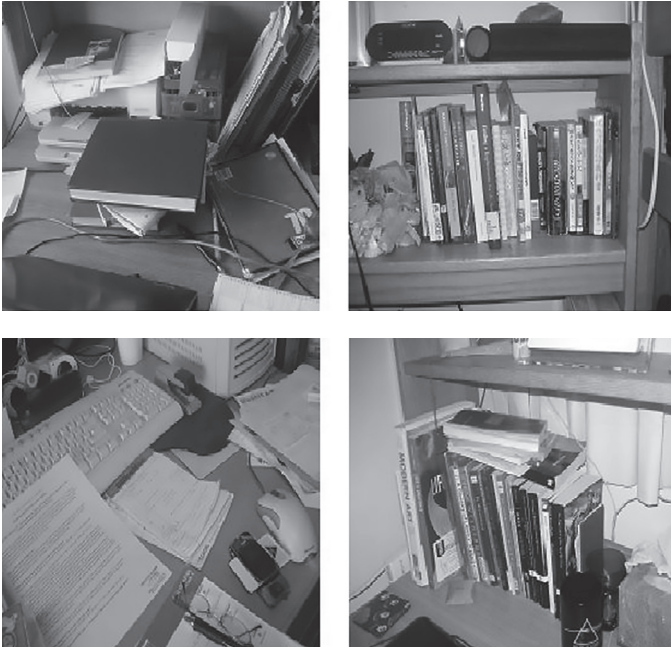files and piles. Externally produced materials include textbooks, personal

FIG. 1. *Photos of desk organization.*

FIG. 2. *Multiple calendars and schedules on wall.*

books, reference books, library books, newspapers, magazines, course readers, handouts distributed in class (power points, readings, syllabi), fliers, announcements, and calendars. Self-produced materials include class notes, assignments (homework, papers, drafts), exams, note-cards, lists, reminders, and print-outs from digital sources.

Digital contents of the students' academic information environments are more numerous, open-ended, and challenging to list than physical contents. Types of digital contents found and used can be divided into seven categories: social networking sites, general communication sites and applications (public e-mail, instant messaging, texting, etc.), academic communication sites (institutional e-mail, student portals, course Web pages, etc.), electronic publications (e-journals and articles, e-zines, etc.), software applications, academic websites (created specifically for academic, educational, or reference purposes such as "dictionary.com," and "sparknotes.com"), and general Internet sites.

Transport tools (backpacks, book bags, etc.), allow students to re-create an academic environment in the library, study lounge, or other space for the same types of tasks they perform in their dorm rooms. These carriers are also used as an organizational tool and for storing some components of the environment such as stationery supplies and materials of immediate or near-immediate use.

From the descriptions of the students' academic information environments above, a visualization can be constructed which shows the different environmental spheres as concentric circles focused around the desk area, room, campus spaces, and off-campus spaces. The transport tools penetrate and move through all of these spheres. Figure 3 (overleaf) illustrates the construction of students' academic information environment.

Use of tools and channels

Students in this study demonstrate a broad variety of behaviors and preferences in the use and application of information tools for their academic tasks. For example, Jackie states "[My laptop is the] basis for everything . . . I do everything on my computer and take it with me everywhere," while Charles always keeps his computer in his room and prefers using traditional paper tools for many of his needs. Ursula uses many of the features in her cell phone: "Much of my academic information is also in my phone. I record a lot of things in my phone. Sometimes I even take notes under the memo pad of my phone," but Nancy rarely uses her supplemental phone functions: "It takes longer to write or text in my phone than write in my paper planner."
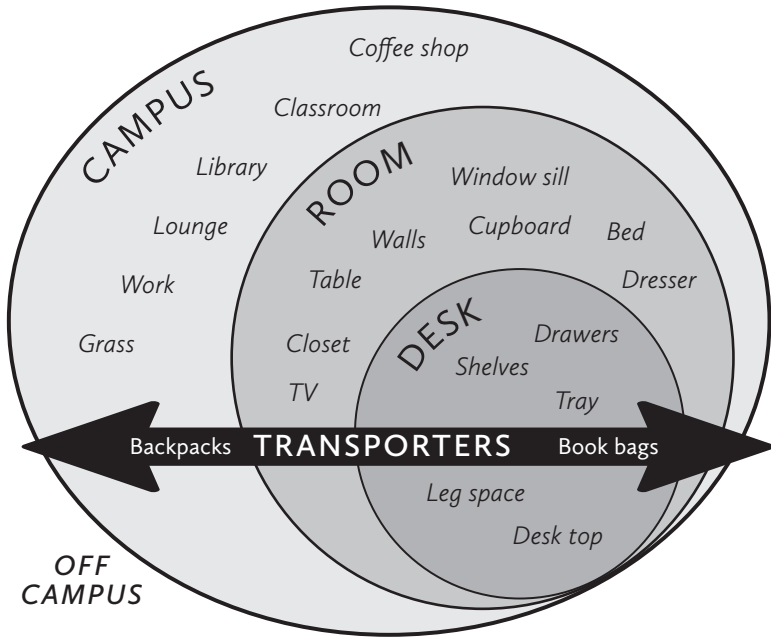
FIG. 3. *Academic information spaces.*

This section describes how students use specific tools within their academic information environment and for their academic tasks. The tools most commonly used by students in this study and discussed below are their computers, including software, Internet and social networking sites, format preferences for reading, and cell phones and their various functions.

Computers   All of the students in this study own a laptop, which they consider the key element in their life as a student: "Like most people my age, my computer is kind of my central device for academic and social networking" (Yolanda). "I would probably say that academic information-wise, all of it centers around my MacBook. I honestly don't know how people in the past were able to go through school without a computer" (Zoey).

Interviews with the students took place in October and November 2009, before the public release of the Apple iPad and other more recent innovations. All of the students at the time of this study own at least one laptop. One student also uses a desktop computer. Almost half of the students reported that they regularly leave their computers in their rooms and do *not* bring them to class. Six reasons were identified for doing so:

1) security concerns (theft or damage to their computer); 2) professors' attitudes against computers in the classroom; 3) technical reasons; 4) the size and bulk of their computers; 5) open computers provide too many distractions to focus properly in class; and 6) individual learning styles and preferences to write notes by hand on paper.

Many students take notes on their computers for certain kinds of classes, especially large lecture classes in the social sciences and humanities fields, but find digital note-taking is not practical for other kinds of classes such as small discussion-based groups, and science and mathematics classes. The latter frequently use formulas, graphs, and other graphic forms of information that cannot be easily represented on a laptop.

Software and Internet   All the students in this study use a word processing program as well as other standard programs in the Microsoft Office suite such as PowerPoint, Excel, or their equivalents. The next most commonly mentioned type of software among participants is a digital Post-it or note-pad feature, which they use for list-making and reminders. Digital clocks, calendars, alarms, and color-coding features are also used. Several students mentioned using iTunes, Adobe Acrobat, Google docs, and different photo applications such as Photoshop.

On the Internet, students overwhelmingly access Google, Wikipedia, and Dictionary.com for quick information needs, beginning their research assignments, and for spelling, thesaurus, and fact checks. Other commonly mentioned sites include those recommended by their instructors and classmates, Google Scholar, the Library webpages (catalogs, databases and e-resources), news sites, and e-mail. For more details about these students' online behaviors, see Mizrachi (2010).

As an example of bookmarked sites typical among the students, Janice, a freshman, has her student portal page (my.ucla.edu, an institutional information site to which students can log on for personalized information pertaining to all aspects of their academic progress and career), Facebook, the Library catalog, "Sparknotes" (a site offering study guides and discussion forums on various academic subjects), a job search site, and her e-mail. Other academically related Web pages commonly found bookmarked include quick reference sites, course websites, and other sites specific to the institution or their future profession.

Course websites and features   Online course websites are an essential tool for all students in this study and are accessed regularly for communication and announcements from their instructors and classmates. Different instructors use various features and integrate different kinds of online

requirements, so the student experience is often conditioned to some degree by faculty expectations. The most commonly mentioned uses by students in this study are for accessing announcements, homework assignments, readings, lecture notes, and PowerPoint slides. Usually the latter two sources are accessed, downloaded, and often printed before the corresponding lecture, and students follow along, or, more commonly, take their class notes on them either electronically or by hand. Ten of the students report participating in online discussion forums through their course website. Some post questions, read classmates' questions, and use the answers and discussions as a review or study guide for their exams.

Several students report accessing audiocasts and podcasts of class lectures through their course Web pages. They use the podcasts as "make-ups" for when they miss a class, and as supplementary sessions. Students usually view or listen to these broadcasts on their laptops, but some listen to the audiocasts on their iPods or MP3 players. Eric explains "I don't [audio] record lectures but lectures are usually podcasted. I can easily download them. . . . I usually just use the standard download utility and then use iTunes to manage my music, and broadcasts, and whatnot. And I usually just put them on my iPod or listen to them straight away on my computer speakers."

Social networking All students in this study have a Facebook account that they use primarily for social purposes. Other sites and social communication tools mentioned by students include Zynga (browser-based games that can be played alone and as an application on social networking websites), Tumblr (a blogging platform), Twitter (a social networking/microblogging system), Skype (a software application that allows users to make voice calls, chats, and video conferencing over the Internet), and ooVoo (an audio/video instant messaging client for Windows).

Most of the students in this study recall using Facebook on at least one occasion for an academic purpose during their undergraduate years. Most common uses are posting or chatting about homework questions with classmate "friends," and organizing study groups: "I create an event then invite people" (Iris). Vivi worked on a group project with her class-mates through Facebook. They gathered together in the same room, each with their own laptop, and posted their working document into a single Facebook thread. "We thought it more efficient for our lab report. Each worked on a different section. This way we could talk about it, share ideas easily, but still work on our own parts. It was easier than e-mail." Elaine often takes pictures of her professor's notes on the classroom whiteboard with her camera and then posts them on Facebook to share with her

classmate "friends." No student reported "friending" a professor, though a couple had become "friends" with TAs, and one became a fan of a UCLA librarian's Facebook page.

Format preferences for reading

> In an ideal world I would prefer to have [my readings in print] because it is definitely easier to have it in front of you because you can highlight it and stuff. But I definitely prefer when [classes] have online readings because you don't have to buy a textbook. And it's more convenient, you can just click on it. Yeah, it saves you money and then also it's nice when you don't have papers all over the place. . . . But I definitely do get more out of [the reading] when it's on paper. (William)

Students in this study show a mixture of habits and preferences when they need to read academic information for an academic task. Most state a definite preference for reading in print rather than online because reading online 1) causes eyestrain, 2) offers too many distractions, 3) print is more portable and easier to use, and, most commonly mentioned, 4) students can interact with the text much better in print than online. Highlighting and taking notes on the print copy is important to them and many state that being physically involved with the reading is how they learn best. In actuality, however, many of the students do most of their reading online because they don't want to waste paper, don't have their own printer, paper and/or ink are expensive, or it is just more convenient.

Studies are beginning to show a relationship between the type of reading format and the cognitive process of information absorption. "There is a close relationship between the media we use to read—books or digital technology—and the way we read and think. . . . Digital technology is often preferable for searching and scanning short snippets . . . slow reading of books is still essential for nurturing literacy and the capacity for extended linear thought" (Miedema 2009, pp. 19–20).

Cell phones All of the students in this study have cell phones, which they keep close at hand and easily accessible at all times. Debbie keeps hers on a chain with her student identification card and room key, which she calls the "three essentials of a UCLA student." It is important to note that while some students own a current smart phone model, many others have older or simpler models that offer only a minimum of features. The five
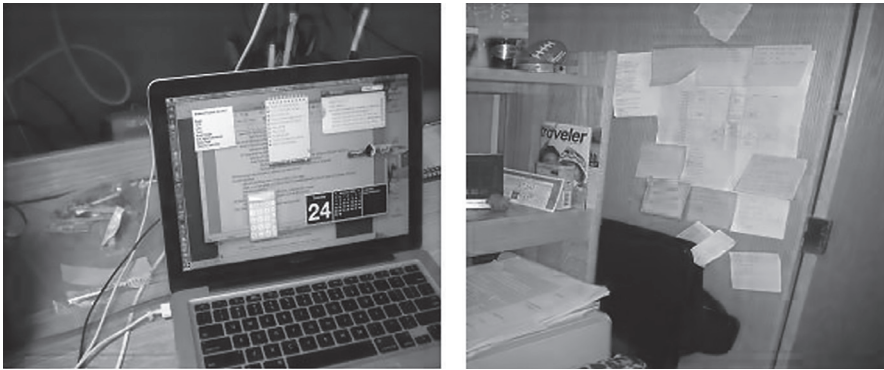
FIG. 4. *Electronic and paper sticky notes.*

most common uses cited by the students are calling, texting, alarm clock/reminder, calendar, and notes/memo.

The great majority of students use texting "a lot!" but some dislike it and limit it or do not use it. Alarm clock and reminder functions are also highly used by the students in this study for both academically related purposes and personal tasks. They are set not just for waking up in the morning, but also to help them remember meetings and other appointments.

Some, like Yolanda and Steve, use their calendar applications as their primary scheduler and planning tool, which they coordinate with their e-mail accounts. Several others however, note that they only use the calendar feature on occasion or rarely, stating they prefer using paper calendars and planners.

Though twenty of the forty-one participants in this study say they use the notepad or memo function on their phone, several of them qualified their use as only sometimes or rarely. For writing quick notes to themselves, there is a wide variety of responses: typing it in a text, writing it in a paper planner or scratch paper, or even, as eight students mentioned, writing it on their hands. See Figures 4 and 5.

*Acquisition, manipulation, organization,
and archiving of academic information*

Acquisition Course material enters the students' domain through multiple actors, and contains multiple elements. Instructors distribute print handouts, use course webpages and email to disseminate PowerPoint slides, readings, assignments, communications and announcements; they
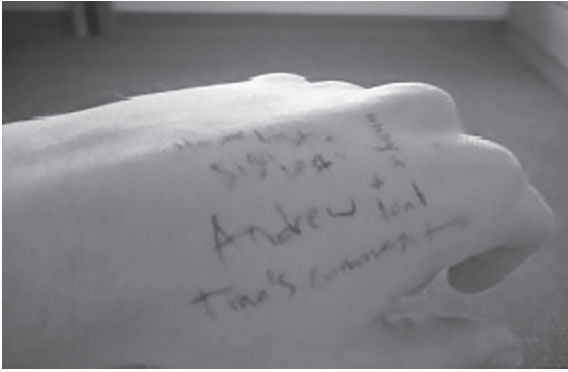
FIG. 5. *Information written on a student's hand.*

assign course readers, lecture supplements, and textbooks, present lectures and lead discussions in class, and provide consultation and guidance in office hours, all of which generates course material information with which the students must engage and interact. Teaching assistants, tutors, classmates and outside consultants such as librarians and knowledgeable acquaintances can also contribute to this corpus through verbal discussions, communications, sharing and recommendations of relevant sources. The students themselves generate course material when they interact with the information to produce notes and study aids, work on their homework and practice exams, conduct research, or find supplementary sources and information which they consult and record to expand upon their understanding of the topic or complete an assignment. Academic information is thus collected and imbibed through both conscious action and passive reception in a multitude of ways and formats.

Jones uses the act of highlighting a passage in a document for further understanding and use as an example of the interwoven nature of information management and information use, one of the main themes in his book on PIM (Jones, 2008, pp. 59–60). From the moment students anticipate an encounter with coursework information, they begin engaging in preliminary management decisions. Even before leaving their rooms for classes on the other side of campus, they must consciously decide how they will record their notes, and bring along the paper or electronic means to do so in their backpacks. If they have printed out slides or lecture notes from the course Web page, should they transport them in a folder containing all information from that course, or just the information relevant to that day, week, or particular unit of study?

Most students in this study use separate spiral notebooks for each class to capture their raw notes when taking them by hand. Others use loose leaf pages or scratch paper. Some later copy their notes into digital form or into another notebook to make them neater and more organized for review or reinforcement later. Lynn says "I'm taking four classes so I have four different notebooks." Hans also has one notebook for each class, but class notes for those sequential courses taken over two or three quarters, such as chemistry and math, are kept chronologically in the same notebook for easy reference.

Many instructors require course readers or lecture supplements for their classes, and it is common for students to take their class notes directly onto these paper-based tools. This was especially common in science classes such as chemistry. Instructors often post PowerPoint slides or lecture notes ahead of time on the course webpage, which students then print out and take their notes on. A few will pull the slides up online in class and take their notes digitally. Students who took notes electronically did so using Microsoft Word, Notebook View, or Google Docs, an Internet-based word processor. Students using minicomputers transfer notes they take in class to their regular laptops by using a Universal Serial Bus (USB or "flash drive") or e-mailing them as attachments.

One implicit theme in student comments is that their choices in recording lecture material is in part stimulated by the way the instructor uses PowerPoint. In some cases, the PowerPoint contains essentially the whole lecture; in other cases the PowerPoint slides just list what are essentially titles of topics covered, with little content, whereas other cases fall in between, where much of the lecture is on the slides, but students add supplementary information that the instructor provides in class. This raises the question of what the optimal design and use of PowerPoint slides might actually be. How can professors best use PowerPoint to help students learn? Despite the very pervasive use of this software in society and in education, and despite hundreds of articles written on it, a search of the *Web of Science* revealed only a smattering of empirical studies to test the best use of PowerPoint, with no dominant research theme (e.g., Griffin, Mitchell, & Thompson, 2009; Savoy, Proctor, & Salvendy, 2009). Much more needs to be learned.

Other forms of course materials in print format include those they acquire through purchase or loan: textbooks, course readers, reserve material from the library, library books, and notes borrowed from friends and acquaintances. Most students in this study seek ways to minimize costs by using strategies such as purchasing used books, purchasing books

through discount online venders, finding materials through the Facebook "Marketplace" application, photocopying whenever possible, or borrowing them from the library or an acquaintance. Course material in digital format with which the students interact include: e-mails, class discussion board postings, online readings from the course webpage, online reserve material, e-books, e-journals, scholarly and public webpages, pod-casts, and audio-casts.

Manipulation and organization Students develop and employ strategies to assist their cognitive absorption and understanding of the information. They must effectively integrate the information with other course material and organize it all in a system that allows easy access for quick reference and referral. Though some actions and strategies can be applied in both print and online formats, students in this study use a greater variety of strategies when they interact with their paper-based material.

After class, in their information environments in their dorms or elsewhere, most students continue to interact with their raw notes in their original notebooks. Some students copy their notes into a second notebook both to reinforce their understanding of the material and to make its appearance neater and more organized, thus making future reference and review easier. Nancy even adds her own references to the textbook or other sources in her copied notes.

Xena uses one spiral notebook for all her classes but upon returning home she tears out the pages, groups them together by class, and places them into a pile on her desk. At a later time she files them into separate class binders in chronological order. Charles and Elaine both prefer to take their raw notes on scratch paper that they have saved over time or found in recycling bins. Elaine files them directly into course binders in her room, but Charles, a fourth year bioengineering student, copies them into a spiral notebook.

Manipulation may involve making alterations to appearance, format or location of the information. Cognitive and physical interactions with academic information include reviewing, reading, writing, copying, sorting, piling, filing, discarding, deleting, archiving, placing (purposefully setting information within the environment for accessibility, visibility, and reminding), shifting (e.g., moving information carriers from one pile, file, or side of the desk to another etc.), and prioritizing (by urgency, or importance). These actions occur throughout the various stages of the student's work flow, not necessarily in a linear manner, and depend upon temporal factors as well as individual personality and habits.

Organizing physical materials Students tend to place the work they intend to do first on top of their desks within comfortable reach of where they sit. Three general behavioral patterns present themselves: keeping coursework and materials in their backpack until ready for immediate use, pulling out all materials at once and piling them in consistent locations on or around the desk until use, or less systematic behaviors that vary in consistency. Contents of the piles are most commonly found in either chronological order (usually the most recent items on top, older items further below) or urgency, with items relevant to the tasks that are most urgent on top. In general, students create a piling or filing system for their course work that enables them to find the physical information they need when they need to interact with it by grouping current information together by course and maintaining those groupings by chronology and urgency. Often a pile will also serve as a reminder or motivator for work yet to be done. Working their way through a pile provides satisfaction and serves as a visual reminder of accomplishment. Highlighting and other uses of color coding are common strategies for interaction, as are creating note cards, and among chemistry students, building physical models of information they need to internalize.

Nonurgent materials Strategies for keeping nonurgent but still relevant materials among the students in this study include: filing material into folders or binders which are kept in the immediate environment; creating separate piles that are organized by course topic and placed in specific locations within the environment such as a bookshelf or drawer; and "stashing" the information in a convenient location. Contents of these stashes are in no particular order and may or may not have further uses.

Archiving/retention/disposal Students in this study show an overall tendency to retain used course material after the completion of the course for various reasons with a variety of thoroughness and sophistication. Some only retain their digital materials, but most students do retain selections of their physical books, readings, notes and projects, and a few claim to keep everything. Reasons given for retention are the following: 1) keep for future reference and referral, 2) share or pass material on to other students, 3) the course material was especially interesting, 4) they were especially proud of achievements in the class, and sometimes 5) just keep for sentimental reasons or habit. It is also not unusual for students to retain course material from high school and even earlier.

Organizing digital materials Most discussions of academic digital material organizational schemes and interactions centered on Word documents

or the equivalent, and the course readings and PowerPoints students had downloaded, but a few also touched on e-mail management. Several digital organizational schemes are present among the students in this study, and a small minority does not systematically organize their digital course material but instead relies on search features. The most common organizational method found was a hierarchical system of folders in the My Documents program (or its equivalent) headed by a folder titled "college" (or its equivalent), year, quarter, and class. Variations of this method are less hierarchical and use fewer folder categories; for example, filing the documents in the appropriate class folder within the appropriate year but not by quarter. A second common method is simply to keep current work on the desktop and upon completion either delete it or file it straight into My Documents (or its equivalent). In their study of students' organizational strategies of personal online academic information, Hardof-Jaffe, Hershkovitz, Abu-Kishk, Bergman, and Nachmias (2009) also found that "[t]he folder hierarchy is the standard mechanism for organizing personal information in digital environments" (p. 3). They found four patterns of folder creation but the design of this study is so different that it is not possible to directly compare their results.

Within the online environment, students create ways to manipulate their academic information to assist them in their learning and studying tasks. Some students execute these manipulations entirely online, and others use a combination of both virtual and physical strategies. Students' discussions of how they study and process their online materials do not reveal as many varieties or as much sophistication as the strategies used when the course material is in print and physical formats. Most strategies appear to be modified transferences of practices developed in print rather than completely novel innovations.

E-mail organization   E-mail is the primary tool for academic communication. All of the students who discussed e-mail behaviors use multiple e-mail accounts. Even though they all receive an official UCLA e-mail account, most prefer to maintain a previous account as their principal site. Many manage their multiple accounts by forwarding incoming messages to a single address, and they often leave their e-mail open whenever they are on their computer or use an online or phone application to notify them of a new message. Of the 70 students who first contacted this researcher in answer to the recruitment fliers, 25 used their UCLA accounts, 23 used Gmail, nine used Yahoo!, five used Hotmail, and one each used sbcglobal, live.com, and a work e-mail. E-mail folders organized by subject matter are often employed as management strategies or students search by key word.

Digital archives   Parallel archival preferences can be found among students for retaining both their physical and digital course materials. Individual personalities appear to drive students' practice of minimal retention, selected retention, or comprehensive retention.

Institutional information

This study reveals only a limited number of organization and management systems specifically for interacting and maintaining institutional information, unlike the wide variety of methods found with course materials. These methods are the same types used for archiving course materials. Most of the students keep the physical documents and materials that they feel important enough to save for further reference or referral in a consistent place so that they know where to find it when it is needed. This may be piled on a designated spot on a desk or closet shelf; piled with similar material in a desk drawer; filed in a vertical file container; or filed in a designated binder, and some types may be posted on a wall or bulletin board. Institutional information received electronically—almost exclusively by e-mail, is usually filed in a "college" or similar folder, in document format, or an e-mail account.

Ancillary strategies and tools

Ancillary strategies in the academic information ecology are those purposeful actions that support a student's information management and organizational goals. They are not the primary outcomes of information organization and management, but an integral and conscious part of the process. Students in this study discussed three strategies that they use to help them manage the information relevant to their tasks and roles as students: planning, noting, and reminding.

Planning is the formulation of a scheme or method to accomplish an academic task. It can include deconstructing a project or goal into smaller components and mini-goals and prioritizing those components. It can also include scheduling component tasks—meshing them into a manageable timeframe by assigning dates and times.

Reminding actions are those whose outcomes cause the student to remember or think of a specific task.

Noting is the recording of "information scraps"—"short, self-contained personal notes that fall outside of traditional filing schemes" (Bernstein, Van Kleek, Karger, & Schraefel, 2008). Though it may result in reminding,

noting differs from a reminding action because its primary outcome is a record for referral or reference.

For each of these strategies, students use enabling actions such as jotting, list-making, outlining, ordering, sorting, color coding, highlighting, posting, and placing. Various tools used for executing these actions include paper planners, paper and electronic calendars, paper and electronic post-its, Word documents, electronic spreadsheets, note-paper, the student's hand, scratch paper, memo and text functions on the phone, alarms, and whiteboards. See examples in Figures 2, 4, and 5. Iris and Kathy discussed how they increased the efficiency of their ancillary strategies after their freshman years by expending more effort on their noting, planning, and reminding behaviors.

Sophistication of organizational systems show a pattern of development as students progress through their academic careers and the number of documents they interact with and maintain grows. This is true with both their physical and digital formats. In part, it may be the natural consequence of a growing and dynamic collection. Obviously the new freshmen are dealing with much less material than the upper classmen, and many appear to be developing their schemes as they go along. Quantities of material may also depend on the characteristics of the students' classes or major. Several examples of second year students making conscious efforts at improving their organizational systems were noted; upper division students have successfully made the transition to college and learned how to balance their independence with their responsibilities. Observing the environments of students in all stages of college and hearing them discuss their organization methods brings this into sharp focus.

Discussion

In this section, three emergent themes arising from the study are discussed: 1) variety of information behaviors and hybrid use of tools, 2) information organization and archival methods, 3) temporal arc of student information management.

Variety of information behaviors and hybrid use of tools

Individuality of behaviors Individuality of adult personal information management behaviors and practices is well documented in the PIM literature. "People vary greatly in their approaches to keeping and organizing

information. Even people in the same work situation show tremendous variation" (Jones, 2008, p. 127). According to Gwizdka and Chignell: ". . . [E]ven people who have quite similar profiles with respect to job and demographics can exhibit huge observable differences in PIM-related behaviors, their choices of strategy, and their preferences in tools. These differences apply both with respect to paper-based information management and to the management of electronic information" (2007, p. 207). Gwizdka and Chignell note there are so many variables affecting individual behaviors, both external to the person and internal, that explaining causality may not be possible at this point in the research. However, they do conclude that "Individual differences are contextually dependent, and they respond to changing situations and task demands dynamically" (p. 217).

This current study of undergraduates' information practices clearly shows that a broad spectrum of individual information behaviors and preferences also exists among students. It is unfortunate then, that this demographic group is so easily stereotyped in popular media as well as by academic institutions. Carlson writes about the "Millennials" in the Chronicle of Higher Education: "They are smart but impatient. They expect results immediately. They carry an arsenal of electronic devices—the more portable the better" (Carlson, 2005). UCLA Magazine published an article in July 2010 titled "R U Talking 2 Me?" that discusses the impact of new technologies on communication, culture and education. The first sentence begins: "In a world where it's obsolete to note that laptops are the new spiralbound notebooks . . ." (Hewitt, 2010).

Findings from among the students in this study show that these sorts of assumptions are overgeneralized and inaccurate for this population. Individuality of behaviors among undergraduates should be as recognized and respected as it is among adults. Laptops have not replaced spiral notebooks for all note-taking purposes, for example, and preference for reading important academic material in print format is still found among most of the students. Although some use their phone features or computer applications for noting important information and dates, many others prefer a paper planner, post-its, or even his or her hand! Furthermore, high-technology behaviors and preferences are not necessarily consistent under varying contexts and circumstances even within individuals. We saw, for example, that Jackie takes her computer everywhere with her, but is highly dependent on her paper planner, and for certain classes takes notes in her spiral notebook.

Learning styles and information styles The recognition of the spectrum of individual behaviors is important for educators and educational institutions

when policies are being considered that try to unify or narrow the students' PIM choices. Barreau (2008) writes: "Past studies suggest PIM behaviors are highly personal, idiosyncratic, and contextual and there is evidence that at least some behaviors persist over time" (p. 2). Administrators and educators are very familiar with theories of learning styles (individual approaches or ways of learning), and the need for varieties of pedagogical methods to address these differences in learning styles so that each individual can best fulfill her or his potential. It becomes apparent that there are individual *information styles* too. These appear to be based in endogenous factors within each individual, and may or may not be tied to learning styles. But to attempt to implement institutional programs based on the assumption that all students need or even want to use the newest technology (e.g., iPads for all students) is inherently unfair to those students whose information styles and preferences may differ.

The students in this study often appear to give great thought to the tools they use for their ancillary strategies as well as other information tasks. Even when they see their peers do similar information tasks differently, they express confidence that they are using the appropriate tool *for them*, and it seems presumptuous to try to convince students otherwise. Students who are pressured or socialized into adopting expected behaviors may never even have the opportunity to discover which methods work best for them, and this in itself may act as a barrier to fulfilling their potential.

Hybridity of tools and styles Beagrie (2005) refers to personal digital collections as extensions of physical artifacts used as external memory and reference aids and recognizes a shift in collection format "from physical to hybrid to digital" (p. 1). Whether or when this shift to a total digital world will materialize is not within the scope of this study. But current behavioral tendencies of the student participants here show a hybrid use of high-tech and traditional formats, tools, and collections rather than a reflexive rush towards total embracement of the newest gadgets and applications. Standard information tools for all students include both physical—books, notebooks, binders, paper and stationery, as well as digital—laptop computers, cell phones, and their respective applications. Students' choice of tools and formats to use for their various tasks and under various circumstances appears to be driven by cognitive styles, learning styles, information styles, and personality traits.

It is possible that digital native students do not even recognize the distinction between the different formats as sharply as older digital immigrants do. Growing up in a digital world allows for an attitude that considers technical gadgets a natural part of life. They are simply part of

a repository of "stuff" students use for many things including academics. Comparatively, the clothes in their closet are "stuff" they wear for different occasions and different circumstances, even though they consist of different "formats," for example, shirts, tank tops, sweaters, and so on. What they choose to wear and when depends primarily on the context or the occasion as well as the students' personalities and tastes. The extent of a student's array of "stuff" may be constrained by outside factors such as socio-economic status or cultural practice, but the variety of behaviors possible within those limitations is still immense and reflects individual personalities, tastes and styles.

Student information organization

Principles of information organization As noted earlier, the student's desk is the focal point of the academic information ecology. Here, students engage in studying, reviewing, reading, writing, sorting, and all the other information management activities. Students need to know where the items or tools are when they need them and be able to access them with the least amount of effort, preferably at a glance.

Time is extremely valuable for these students; besides classes and academic obligations, they fill their days with jobs, volunteer activities, social activities, leisure, and just "chilling." They also feel the pressures of completing both their academics and tasks of everyday life within a physically confining space, which they typically share with one or two roommates. As they arrange their areas, students express consideration of specific attributes of items, such as height, bulk, color, format, use, and convenience.

From this study it is possible to identify four broader principles that guide their organizational schemes beyond item characteristics in a more encompassing manner: accessibility, visibility, urgency, and work flow. Table 1 shows the four principles and the primary conditions of which they are a function.

In the PIM literature, much study is devoted to finding and re-finding strategies. Students in this study place items in their desk area that need to be found and re-found quickly (urgency) and easily (accessibility, visibility). Students tend to place the items of most frequent use and importance in plain view for convenience and reminding purposes. Even those who keep material they use daily in a desk drawer because they like a clear desk area know that the drawer is the item's location and they can see their important material by simply opening the drawer.

TABLE 1. *Information management principles.*

PRINCIPLE	FUNCTION OF:
Accessibility	Time, space, least effort
Visibility	Space, reminding, least effort
Urgency	Time, reminding
Work flow	Time, information load, personality, cognitive style (combine to create an individual system)

The more ephemeral types of information, such as reminders, are placed in close proximity to their desks, as it is important to students to be able to see and/or amend their notes concerning tasks, due dates, and activities in a quick glance from their academic center. See Figures 2, 4, and 5. Materials that are not immediate or urgent are stored further from the ecological center as space and their assigned values allow.

Work flow is a mini-system that students create for engaging in a task within their academic environment. Some students demonstrate consistent preferences for how they like to organize their things while they work, whereas others are more varied in behavior. For some, things to do are kept on the left side of the desk and moved to the right as they are completed, for example. Time influences the work flow significantly—the amount of time engaged in a task, time left until the deadline, time of day (or night) the work is being performed, and so on, as does the information load involved in the task or the load with which the student is coping at that point in general. These factors combine with the individual's personality and cognitive style to influence the student's work flow system, which in turn guides how that student organizes and manages his or her academic information.

Beyond convenience and expediency there is a deeper need that these organizational practices also address: the human need to feel a sense of control and ownership over one's environment. Through the act of creating a working space that will be theirs exclusively for the next 9 months, by filling it with their possessions, arranging and maintaining it to the satisfaction of their tastes and individual personalities, students claim ownership of their environment. During an academic term, especially a 10-week quarter, students often find themselves feeling stressed and even overwhelmed by the sheer volume of information entering their domains over which they are expected to attain a degree of mastery. Effectively interacting with

their academic information through these management processes helps many students relieve this stress and feel a sense of accomplishment. This renewed sense of control then helps the student maintain the confidence to meet further challenges as they arise.

Archival practices Referring to the importance and urgency of the materials held in one's office, the PIM literature labels materials hot, warm, or cold (Sellen & Harper, 2002, pp. 169–170), with the "hot" items being the most current and pressing. This echoes the archival and records management literatures' concept of the document life cycle passing through active, semiactive, and inactive stages (SAA online glossary, accessed July 5, 2012), except that these latter fields more often refer to the institution or department's resources, rather than solely the resources associated with one individual's work flow.

Students' academic information flow is similar to the above in many respects, both in physical and digital formats. Items at the core of their environment include the hot information used that day—class notes, assignments in progress, etc. Warm information may be found in a pile on the desk, in the backpack, or digitally accessible on the laptop. These are the items relevant to a task that the student works on regularly or plans on doing soon. Most students retain at least some course material and institutional information beyond the term or year it was produced or used. Usually it is stored in a box at home or in a less accessible space in their dorm room. This, of course, is their cold information.

The very nature of being an undergraduate student implies a state of temporariness with an identifiable beginning and end. Being an undergraduate is not someone's life's work but rather a phase. The life-cycle of their academic information therefore differs from personal documents in an office or records in an institution. Except perhaps for students aiming for academic or research careers, being an undergraduate is more comparable to working on a major project (with many subprojects) that lasts 4 or 5 years and then ends. Thus, the life-cycle of their academic information in their dormitory rooms is probably best visualized from the perspective of project management.

Temporal arc of student information management

As noted above, time wields a major influence over the principles guiding students' information organization and management behaviors. There are many different aspects to time—time of day, time of year, time remaining

until an event, time passed, timing, timeframes for projects, the multiple components and measurements of time, and so on, and each of these aspects influences students and how they manage their information. This can be seen by the detail and precision with which so many of the students in this study schedule and plan their time (see Figures 2 and 4). It is their way of coping with the challenge of coordinating and managing all of their affairs, including their academics, into four different calendars, and the demands and impositions these sometimes competing calendars place upon the student. The four calendars are society's general annual calendar, the institutional calendar, course calendars, and the individual's calendar.

In the PIM literature and other studies of personal collections, participants are adults who establish their work-space environments with the understanding of a semblance of permanence. A person usually moves into an office area, takes advantage of the facilities provided for information management, perhaps adds a few personal touches, and establishes him or herself for the duration of their employment or relationship with the company or institution. Moves do occur, but usually not on a regular basis. When managing their information, workers may group a set of documents together into a physical folder for example, which they file away in their work space, and theoretically at least, they will be able to re-find it again 4 months or 4 years later.

Students living in residential hall facilities do not share that sense of permanence. They move into their room in fall knowing full well that they are expected to move out completely at the end of the academic year in spring. And then they must re-establish themselves in another room again the following September. Students taking summer quarter classes are assigned entirely different rooms during those 6 to 8 weeks than they occupied in the previous term or can expect to occupy in fall. They create their academic information environments in their rooms with the expectation of impermanence. It is only a matter of time, 9 months at most, until they must break down their environment and move on. This time-related imposition impacts students' information management decisions, especially their retention and archival behaviors, because for the sake of convenience and practicality, they know they must travel light. The students are circumscribed in this manner by the temporal arc of the institutional/academic calendar.

Within the academic year are various impositions of the institutional calendar that affect the students' information management behaviors: The 10-week quarter system, final exam weeks, breaks and holidays, registration deadlines, payment deadlines, deadline for declaring a major, and so on.
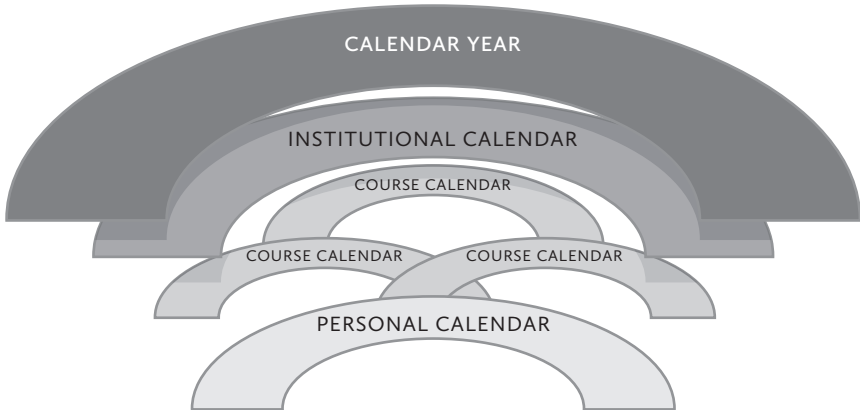
FIG. 6. *Temporal arcs.*

The institutional calendar is imposed upon the student. Other than exercising the choice of enrolling and attending or not, the student has no control over that calendar.

Students are further obliged to meet the demands of the schedules and deadlines of each of their instructors and courses—meeting days and times, assignment due dates, exams, office hours, and so on, all of which must fit into the framework of the institutional calendar. In theory, students have some control over their course schedules in that they choose and schedule their own classes, but, in practice, they must ensure that they are fulfilling their compulsory courses, prerequisites, and general education requirements, which often limits their choices in any given term.

The fourth calendar is that of each individual student, that is, his or her own schedule of classes, activities, study time, work time, meal time, nap time, social gatherings, sleep, and so on, that he or she creates in association with the three imposed temporal arcs. As illustrated earlier, most students work hard at planning and scheduling times for the activities of their academic and extra-curricular obligations. As assignments, projects, exams, or institutional deadlines approach, students' academic information environments reflect the upswing in the amount and intensity of information interaction. Papers and other materials are left around their space more haphazardly as less time is available to maintain systematic management. After tasks, projects and deadlines are met and completed, attempts are then made to "straighten up" the environment through management activities such as sorting, prioritizing, shifting, discarding, deleting, archiving, and re-organizing piles and files to return to or improve

upon the previous sense of order. The model in Figure 6 illustrates the imposition of the annual, institutional, and course calendars upon the students' personal time schedules.

Conclusions

Contrary to the stereotypes of today's college students perpetrated by massive surveys, high-tech companies, the media and even institutions of higher education, students in this study demonstrate an individualistic approach to their information management behaviors. Their organizational schemes are driven by accessibility, visibility, urgency, and work flow factors which vary by context and are impacted by the multiple time factors, deadlines and calendars inherent in academia. Students employ a hybrid of electronic and traditional information tools and develop their own personal information styles just like the professional adults discussed throughout the PIM literature. Bernstein and his co-authors include in their definition of information "scraps" the idea that scraps occur because appropriate management tools are not available or being used (Bernstein, Van Kleek, Karger, & Schraefel, 2008, p. 3). Rather than viewing this as strictly a technological gap, we should also consider personal choice, information styles, and context. Perhaps jotting a note on one's hand, or using a paper calendar *is* the right strategy or tool for that particular student and his or her purposes at that time. Different information styles may be more the result of cognitive and affective differences than a direct reflection of high-tech opportunities or socialization. Further research should explore the possible relationships of technological choices with information and learning styles. Some students stated they remember things better, or they learn better when they write information by hand rather than texting or taking notes electronically. Most students admitted that they absorb information better when they read in print than online. How do the kinesthetic differences in these actions affect their cognitive processes?

What becomes evident upon close study of these students' information ecologies is that they are managing a very complex and high-pressure informational milieu. Further, this study was conducted at a time of rapid turnover in information technology modalities, where the students are juggling and combining old and new forms on a daily basis. But the complexity is not limited to the variety of information and communication technologies used. The students are also under relentless time pressure to produce assignments, prepare for tests, write papers, and conduct all the leadership and other extracurricular activities associated with

their college experience. Much of the apparatus supporting their work as students consists of planning devices, reminders, texts-to-self and a variety of other means to meet these pressures. Instead of working on a single project for weeks or months, as is often the case in the work world, students often conduct several projects a week, if we take into account the quizzes, assignments, lab experiments, and so on that they must routinely complete on a tight schedule.

When we also take into account the fact that students in this age range may be living away from home for the first time, may be exploring relationships and sexuality, are working on developing an adult identity, and may be discovering new and exciting intellectual and career pursuits, it is impressive that they still manage to study and learn at all!

But putting the other elements aside and just considering the students' academic pursuits, this study has demonstrated that *academic information organization and management* is a surprisingly demanding challenge and a nontrivial element of student academic lives. In all the research and writing about the "Freshman experience," about undergraduate learning styles, and about challenges in general for the person seeking to succeed in college, we should certainly add a consciousness of the information collection and management demands of the college experience.

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