Navigating the Role of Mobile Technologies in Shaping Information Behavior: A Meta-synthesis

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ABSTRACT

Mobile technology, primarily via smartphones, has become increasingly ubiquitous in the modern world, and this change is impacting information behavior in important ways. As LIS educators, we must study this new phenomenon and incorporate it in our teaching in order to stay current in the information science field. With this goal in mind, we used the relatively new meta-synthesis methodology to collect qualitative studies that examined the intersection of mobile technology and information behavior, systematically evaluating them for patterns and trends that provide insight into technology-driven change in behavior we are witnessing. Through this process we identified four primary ways mobile technology is affecting information behavior, and these will be incorporated into a graduate level Information Behavior course.

TOPICS

mobile systems; information seeking; information use; curriculum

INTRODUCTION

Mobile devices are a significant technology trend affecting the information profession (Abram, 2015). As ownership and use of Internet-connected mobile devices have increased in recent years, the mobile technology trend has dramatically affected information behavior. According to the Pew Research Center (2018), 95% of Americans own cell phones, 77% of which are smartphones, while about half of the American public have portable tablet computers. The popularity of smartphones is not surprising because unlike tablets, smartphones offer various ways of communication, changing how people interact with others and accomplish tasks. The reason for the widespread adoption of the smartphone is that people want online access while on the go, not merely from home, work, or school desktops. Based on eMarketer's report, users spend more time interacting with smartphones and apps than tablets and the mobile web; apps

account for more than 90% of time on smartphones (Wurmser, 2018). The increasing number of smartphone users and their significant use of apps is partially responsible for the observable change in information behavior. This trend is seen across a wide range of demographic groups, with one in five people using smartphones as their primary internet access at home (Pew Research Center, 2018). All of this taken together represents a dramatic shift in information behavior, which should be reflected in LIS education if the field is to remain current and inclusive of new and evolving mobile technology trends. This is particularly true in courses like Information Behavior, so we conducted research to inform the development of a mobile information behavior module in this course. We began by asking how mobile technologies are influencing information needs, search, seeking, and use, then reviewed recent literature on this phenomenon. We used the meta-synthesis methodology to gather concrete information from this previous scholarly work which can be then incorporated into our course.

RELATED WORK: HUMAN-MOBILE COMPUTER INTERACTION AS CONTEXT

A context reflects an information horizon in which a user can seek information through various information resources, such as a person's physical/online social network, printed documents, information search systems, and observations (Sonnenwald, 1999). The Context of Use in Human-Mobile Computer Interaction (Jumisko-Pyykkö & Vainio, 2010) model examines the distinct contexts where a user interacts with a mobile information system. The model serves as a good guiding framework explaining the different ways a user interacts with mobile technology to fulfill his or her information needs. As shown in Figure 1, there are five contexts of use in human-mobile computer interaction (HMCI), including physical, temporal, task, social, and technical and information context. Related properties of context involve the level of magnitude, dynamism, pattern and typical combinations.
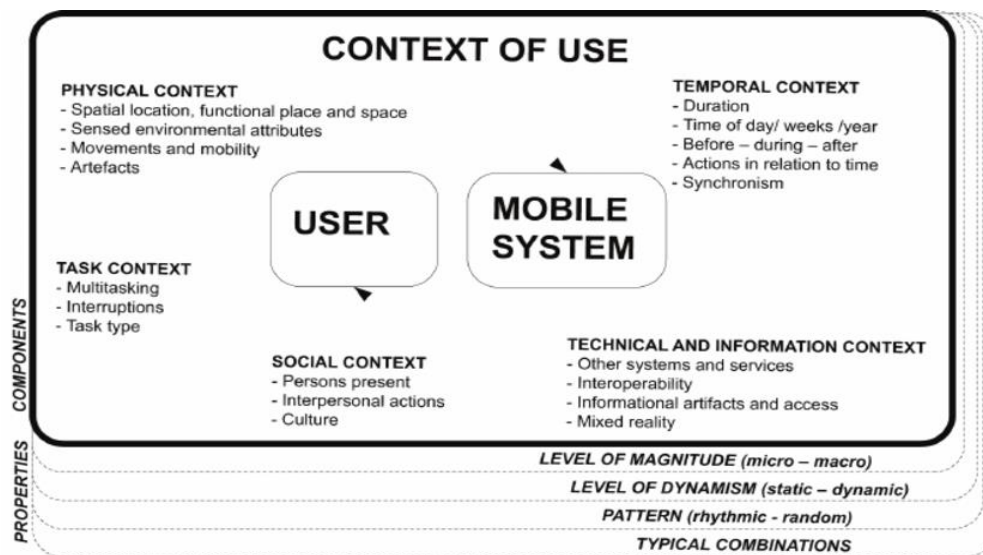

Figure 1. Context of Use in Human-Mobile Computer Interaction

Absar, O'Brien, and Webster (2014) suggested future research comparing information seeking behavior on different types of mobile devices. This study adopts this context of use in HMCI model as the guiding framework to conduct a meta-synthesis and focuses on two contexts, task context as well as technical and information context (Figure 1), in the initial analysis for identifying attributes of user interactions with different mobile technologies. It reveals a mobile information behavior trend that can be studied more specifically as mobile technologies evolve.

RESEARCH METHODOLOGY: META-SYNTHESIS

To the best of our knowledge, no study to date has systematically reviewed and analyzed the relevant literature on the nexus between mobile technologies and information behavior. This is the first attempt to examine the role of mobile technologies in shaping information behavior through analyzing qualitative work. We chose qualitative studies as the starting point because qualitative research focuses on "how" and "why" questions in depth.

Meta-synthesis is the process of collecting existing qualitative research on a specific topic and systematically analyzing it to gain understanding (Urquhart, 2010). This methodology provides a systematic way of reviewing large amounts of data and discerning information from it. We chose to use a meta-synthesis for this project in order to learn as much as possible about current research on the emerging phenomenon of mobile information behavior. Two researchers got involved in the research processes. Figure 2 demonstrates the step-by-step procedure we used for performing the meta-synthesis.
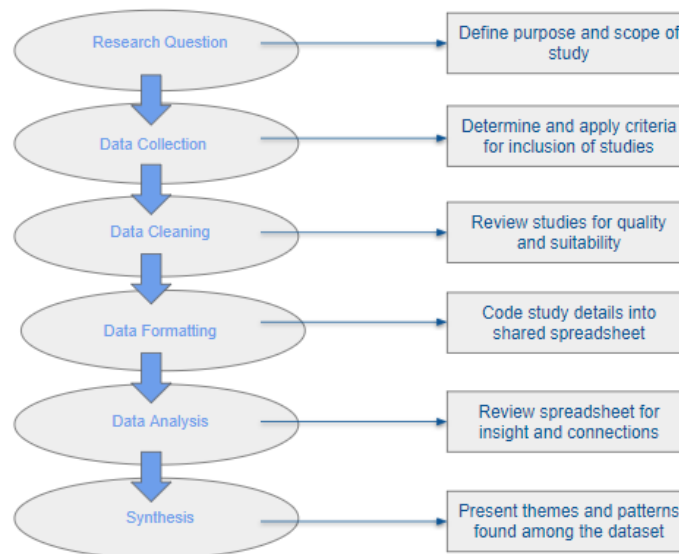

Figure. 2: Meta-synthesis Procedure

Key databases within the LIS field were selected for use in data collection, including Academic Search Complete, ACM Digital Library, De Gruyter Online, Emerald Journals, Library & Information Science Source, Library Science Database, Project MUSE, ScienceDirect Journals, and Taylor & Francis Online. Figure 3 illustrates the data collection process. The search for applicable articles began by using various combinations of keywords and phrases found to be linked with mobile technologies and information behavior. Iterative searches were performed using all possible pairings of the phrases mobile technology, mobile communication, mobile device, or smartphone with information behavior, information seeking, information search, or information use. Each of these searches was performed for "subject terms" and then within the "abstract." This search yielded 61 articles.
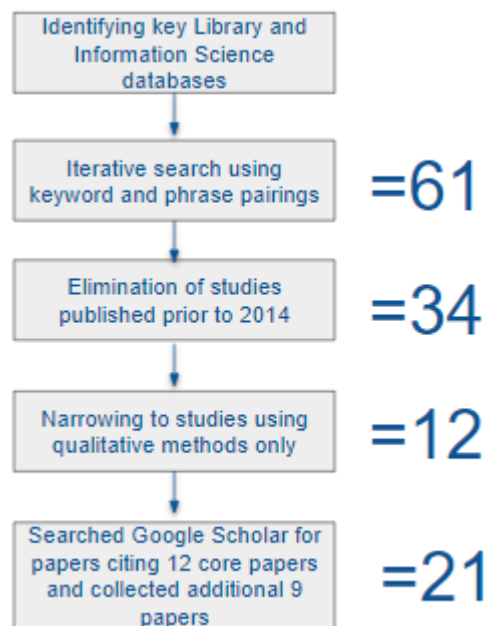
Figure 3. Data Collection Process

The next step was narrowing down the articles based on the publication year. All results published prior to 2014 were excluded, as we wanted to focus on current technology and developments in information behavior, which have evolved significantly in recent years. This narrowing left 34 articles in the dataset. At this point, the articles were reviewed for suitability to the methodology of meta-synthesis. Because meta-synthesis by definition gathers findings from qualitative studies, all studies that used quantitative methods were excluded. This reduced the field of suitable articles to 12. As a final step in data collection, we searched Google Scholar for new qualitative studies citing any of our 12 core papers, and this yielded an additional 9 articles. We then coded attributes of these 21 articles in order to gain better insight into their focuses, methodologies and findings.

For each article, seven key elements were identified and coded for meta-synthesis by two researchers: user group, focus of information behavior, type of mobile technologies studied,

methodology, participants, findings, and impact on learning. In the meta-synthesis, the intercoder reliability is 0.88, measured by Krippendorff's Alpha (Krippendorff, 2011). This indicates that agreement level between two researchers (coders) meets the reliability ($\alpha \geq 0.800$).

DATA ANALYSIS AND RESULTS

The complete meta-synthesis table containing the detailed coding scheme and information is presented in the Appendix. The focus of the information behavior studied in each of these articles varied. While eight studies examined information behavior as a larger phenomenon, others chose to highlight more specific aspects. For example, eight articles focused on information seeking, seven on information use, three on information search, and one on information sharing. Many of the articles had more than one focus.

The main focus of all the articles seems to center on information seeking and use behaviors of different participant groups. Groups studied included students (general, law, and medical), teens, low socioeconomic status people (Hispanics and Chinese), law librarians, physicians, mothers, people with psychosis, and early career PhD researchers. While most of these involved tasks at work or schools, other information tasks included personal health, tourism, social activities, entertainment, and basic daily needs such as transportation, location finding, and answering questions quickly on-site. Of the twenty-one articles reviewed, two focused exclusively on smartphones, two on iPad Minis, one on iPod touch and the rest on comparing multiple types of mobile devices, such as smartphones, tablets and laptops. Structured and semi-structured interviews were the primary data collection method used, but diaries, journals, open-ended questionnaires, usage observations, and focus groups were used as well.

Several overall themes emerged from the conclusions drawn in these articles. First, people rely on mobile technology throughout their day-to-day lives for information seeking and use. Perceived usefulness, personal experience, and job-related characteristics are significant indicators of smartphone use, with younger people even considering these devices extensions of themselves. Second, speed and convenience seem to drive decisions regarding which device is most useful to meet a given information need. For example, the small screens of smartphones are considered adequate for quick access to brief information, while tablets are preferred for reading denser information, such as pdf documents. Third, accessing social media with social apps is one of the most frequent uses for smartphones. Apps such a Facebook, Twitter, WhatsApp, and even ResearchGate are used to build and maintain social connections, access information, and collaborate with others. Fourth, smartphone use does not guarantee access to all necessary information. For example, smartphone users accessing library resources do not generally have successful search experiences. More importantly, access to smartphones alone does not reduce the digital gap for a population; they must also have access to reliable Wi-Fi, quality content in their language, and some degree of smartphone literacy.

IMPLICATIONS FOR LEARNING AND TEACHING

An overwhelming theme in this meta-synthesis is that across different demographics, mobile technology use is increasing and is clearly affecting learning and teaching scenarios. For young people who have grown up using mobile technologies, school and everyday life blends together as they use social media and smartphones throughout their days (Absar, O'Brien, & Webster, 2014). In this way, social and mobile technologies are influencing learning, teaching, and the greater education landscape. Schools of all types should be aware of these changes and actively incorporate mobile technologies into learning, taking advantage of the fact that learning is not confined to specific times or locations. However, teachers, professors, and administrators must also remember that training may be needed for students to effectively and securely use mobile Internet or apps and that reliable, open Internet access is required to support these activities. Creating a wider range of information resources using responsive design, for example, would increase usability of library resources by students working from smartphones with smaller screens (Twiss-Brooks et al., 2017).

Beyond schools, mobile technologies can be effective tools for ongoing education in the workplace. In the medical field, mobile learning has become ubiquitous and is changing how patients view healthcare and the role of their physicians. Mobile devices are greatly used in medical education as well as clinics, with use of trustworthy Internet sources of professional knowledge often considered a better option than consulting a colleague. Whereas the appropriateness of using mobile devices with patients was previously questioned by medical students and professionals, it is now widely accepted as a standard tool. In this same way, users of smartphones are constantly observing and learning socially constructed "right" and "wrong" public uses of their devices, prompting them to surreptitiously use or even keep them hidden. Rather than ignoring mobile devices or punishing those who use them, educators need to design learning activities that make productive use of this technology because smartphones and tablets are essentially personal learning tools that provide countless applications and opportunities for learning.

CONCLUSION

As LIS educators, it is crucial for us to monitor social and cultural changes that affect our field. The dramatic increase in mobile technology and resulting changes in information behavior are a prime example of this type of societal change. We identified instruction addressing the role of mobile technologies as a gap in our information behavior course and sought to fill that gap using a meta-synthesis of current qualitative studies to inform the instruction design. Using an iterative search process, we collected recent articles that studied the nexus between mobile technologies and information behavior. We were able to identify four key themes that emerged from the literature which we can now use to educate students about how people are using mobile devices as tools to meet their information needs and facilitate their learning efforts. We will incorporate these findings into a new module that will be included in our syllabus and course materials going forward and updated as new research becomes available.

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Appendix: Meta-Synthesis Table

Author(s)/ Pub. Year	User Group	Focus of Information Behavior	Type of Mobile Technology	Methodology	Participants	Findings	Impact on Learning
Abbas, MacFarlane, & Robinson, (2017)	Law librarians and law students	Information behavior	Smartphones, laptops, tablets	Interview (face-to-face or by phone); qualitative questionnaire	13 law librarians and 36 law students in UK	Smartphones most dominant mobile technology. Due to small screens, smartphones only used for short information searches; laptops or desktop PCs still preferred for studying and information creation activities.	Students' use of mobile devices is changing how learning and teaching take place.
Absar, O'Brien, & Webster (2014)	Students and non-students in university community	Information search and information use	Smartphones	Interview and diary study	19 mobile users, age 19-37, US students and non-students in university community	Social IB is defined both in terms of users' behaviors and motivations. Specific social activities included co-located mobile searching, searching on behalf of others, and sharing search results. Participants motivated to perform mobile information activities to connect with others as well as to avoid social interactions. There are many similarities between social and non-social IB, in terms of satisfaction and motivation. However, there were some differences in location, showing that non-social information activities often take place at home or on transit, when compared to social searches; social searches, on the other hand, often took place in vehicles with co-located others, where participants were prompted to either search on behalf of others, or share search results with them.	na
Aref-Adib, et al. (2016)	People with psychosis	Information seeking	Smartphones	Semi-structured interviews	22 persons, ages 18-65, living near London with psychosis	Learning about medications and their side-effects was the most common topic of online inquiry. Google and Wikipedia are used to help participants make sense of their symptoms and mental health organizations. Those who searched the internet for mental health information do so because it provides current and in-depth information which is more accessible than other sources,	na

Author(s)/ Pub. Year	User Group	Focus of Information Behavior	Type of Mobile Technology	Methodology	Participants	Findings	Impact on Learning
						including clinicians. Expense of smartphone and data present barriers to some. Participants' experiences of finding and understanding information on the internet varied. Patients experienced anxiety and fear after accessing mental health information online; however, those who discussed information and collaborated with clinicians felt more empowerment and control, whereas those who did not share information with their clinicians felt more isolated.	
Bowler, Julien, & Haddon, (2018).	Teens	Information seeking	Smartphones and tablets	Secondary analysis of qualitative data	34 teens, ages 9-16, in the UK	Young people are adept at information search via mobile devices. Teens consider trustworthiness of the container of the information (digital infrastructure that holds the information) rather than the value of the informational content alone; quick "look up" search is predominant with little time spent evaluating information; fairly adept at information searching using mobile devices even with very little to no training; use of social media for information more common than Google search; young people blend task, purpose, and tools rather than separating and contextualizing online behavior.	For young people, school and everyday life are blending together through use of social media and mobile technologies.
Chase, Julius, et al (2018)	Medical students	Information use	iPad mini	Longitudinal survey with closed-ended and open-ended questionnaires	18 cohorts of medical students (275 in total) in London over three academic years	Medical students embrace mobile learning devices in the clinical setting and whilst it remains unclear if the total length of time spent on study increases, the devices had a positive effect on the perceived efficiency of students' work. Initial concerns about possible disadvantages of devices in clinical settings were largely unfounded, notably the perceived	Mobile learning is becoming a ubiquitous component of learning for medical students. Schools should be proactive in incorporating This aspect of learning, while keeping in mind the need for training and that universal

Author(s)/ Pub. Year	User Group	Focus of Information Behavior	Type of Mobile Technology	Methodology	Participants	Findings	Impact on Learning
						reaction by clinicians, patients or their relatives. WiFi availability, particularly in clinical areas, proved essential but limited, which needs to be addressed by medical schools in conjunction with placement providers.	internet access is integral to success.
Demmans Epp et al. (2016)	Students	Information behavior	Smartphones and iPod Touch devices	Teacher interviews and logging detailed usage of the app by each student.	23 students ages 12 to 21 using the MyVoice application on an iOS device while attending special education classes in Toronto, CA	Students engaged in atypical and unintended practices when using the app because they encountered challenges with information processing and with the interface. Abandoning activities was a strategic choice and unanticipated information practice associated with the application's integration into lessons. Students may have been confused by how information was presented in the device and chose to take photos when an instrumental task was absent.	When integrating apps into lessons, students may not understand how to use them as intended and may require guided practice.
Feng & Agosto (2017)	Students	Information behavior	Smartphones	Interview and contextual inquiry	9 adult students who are smartphone users in the eastern US	Mobile information tasks are closely related to the experience of mobile information overload. Mobile information overload is a prevalent phenomenon among smartphone users. Mitigating interventions for mobile information overload should aim at designing for personal boundaries and removing technological constraints.	na
Griesbaum (2017)	na	Information behavior	not specified	Literature review	na	Learners are empowered with choices but need to be focused and set limits on use. Technology offers some advantages in course offerings but MOOCs and apps should not replace face-to-face learning. Technology is also bringing more for-profit educators into the market.	Social and mobile technologies are influencing learning, teaching, and the education market overall. Mobile devices are personal learning tools with countless applications. Learning is no longer constrained by time and location. Ubiquitous computing

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							and the sensor web are predicted to be the next steps.
Guerra-Reyes et al. (2016)	Mothers	Information behavior	Smartphones	Interviews	10 low-income mothers in Indiana (US) with children 48 months and under	Low-income postpartum women rely on their smartphones to find online infant care and self-care health information. Websites replace pregnancy-related mobile applications and complement face-to-face information. Changes in searching behavior and multitasking mean information must be easily accessible and readily understood. Knowledge of page-rank systems and use of current and emergent social media will allow health-related organizations to better engage with low-income mothers online and promote evidence-based information.	na
Hayman, R. (2017)	Researchers	Information behavior	Smartphones	Structured interviews	116 early career researchers, age 35 or younger from United Kingdom, United States of America, China, France, Malaysia, Poland, and Spain; from various disciplines and held or previously held a research position and held or pursuing a doctorate	Limited use of smartphones for information seeking. About half reported use of smartphone for discovering scholarly sources; less likely to download or read full-text articles via smartphone; social media used to keep track of research trends, opinions, and new works. ResearchGate widely used. Rate of smartphone adoption for accessing scholarly materials varies by country.	na
Ho et al (2016)	Smartphone users	Information search	Smartphones	On-site observation and semi-structured interviews	21 smartphone users, ages 21 to 60 in Taiwan	Results suggest the pre-trip TIS appears in a diversity of search patterns with the usage of multiple information sources. The analysis revealed 10 activities characteristic of tourism information search (TIS) behavior: internal searches, mobiles searches, saving information in the smartphone,	na

Author(s)/ Pub. Year	User Group	Focus of Information Behavior	Type of Mobile Technology	Methodology	Participants	Findings	Impact on Learning
						preliminary collaborative TIS, barriers to TIS, bringing mobile search to an end, summarizing information, PC Internet search, advanced collaborative TIS, and searches via editorial communications.	
Hult, H. V. (2016)	Physicians	Information seeking, information sharing	Smartphones and tablets	Qualitative semi-structured interviews	15 Swedish resident physicians	Physicians use smartphones for collaboration as well as for work related discussions outside of work; use tablets for visualizing anatomy or sending images for direct expert opinion; some physicians co-searched information with patients, talking and learning together.	Health related information and communication technology is changing the healthcare and the role of the physician. Information and communication technology could be a useful tool for supporting workplace learning if fully utilized, which today it is not.
Johnson, E. M., & Howard, C. (2019)	Medical students	Information seeking, information search, information use	iPad Mini 3s	Mixed Methods (survey and structured learning journals)	9 third-year US medical students doing 7-month rural rotations	Mobile device deployments offer great opportunities for innovative medical education. Apps used at varying degrees of success. Increased use with patients over time.	Medical students immersed in a rural environment use tablets to enhance learning and serve patients.
Kim, H., & Zhang, Y. (2015)	Low socio-economic status Hispanics	Information use, information seeking	Smartphones	Semi-structured interview	20 participants earning less than $30,000/yr and with no college degree in the US	Functionality/computing power, easy of use, ubiquity, privacy, and being economical are the five main characteristics that promote smartphone use for seeking health information within this population. Smartphones used to search a wide range of health topics via the web. Barriers encountered were small screens and difficulty opening and comparing information on multiple tabs/sites, as well as users' lack of smartphone skills, lack of understanding of search engines and search strategies, and perceptions of information overload.	na

Author(s)/ Pub. Year	User Group	Focus of Information Behavior	Type of Mobile Technology	Methodology	Participants	Findings	Impact on Learning
Kumah, Beheshti, & Bartlett, (2017)	Undergraduate students	Information behavior	Smartphones	Semi-structured interview	18 Canadian undergraduate students (12 female, 6 male), ages 18-24	Millennials use mobile devices extensively in support of well-being, searching for text and multimedia information, establishing and maintaining social connections, setting and pursuing fitness goals, and tracking nutrition and sleep routines. Searching on mobile devices was mostly done immediately, as soon as a need for information arose. Various apps used to support physical, psychological, and social well-being. Social media apps were used to stay connected to one's social network or to acquire and disseminate information.	na
Ma, Du, Cen, & Wu (2016)	Socioeconomically disadvantaged Chinese	Information behavior	Smartphones	Open-ended questionnaire and semi-structured interviews	32 socioeconomically disadvantaged people living in Nanjing, China, who either had not obtained bachelor's degrees, had a low annual income or were over 50 years old and who also play the lottery	Accessing information and services in places and times previously inaccessible was a primary smartphone-related characteristic that enabled disadvantaged people to adopt mobile technologies. Affordability is a vital consideration for socioeconomically disadvantaged people, as is encouragement from family, friends, and colleagues. Additional factors such as fashionableness and privacy were important factors affecting users' adoption. The limited amount of data available in participants' mobile packages and participants' limited access to Wi-Fi presented a barrier to use of mobile internet services, as did fear of new technology and lack of online help.	na
Shankar, O'Brien, & Absar, (2018)	Smartphone users	Information seeking, information use	Smartphones	Diary study with pre- and post-diary interviews	19 smartphone users in British Columbia, ages 19-37	Smartphones used to communicate via social media several times each day (most popular behavior); other behaviors included browsing online news, looking up directions, verifying information, and consulting product reviews. Smartphones are perceived as	Considering their smartphones as a "third hand," many people use them almost constantly throughout the day. When they receive the message that public use of the

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						extensions of the mind and body, embedded in bodily rhythms and routines; smartphones are a "third hand," both enabling and constraining individuals' activities.	device is not appropriate, they often use it surreptitiously or hide it without turning it off.
Tahamtan, I., Pajouhanfar, S., Sedghi, S., Azad, M., & Roudbari, M. (2017)	Medical residents and interns	Information seeking	Smartphones	Semi-structured interviews	21 medical residents and interns in Iran	Eight factors were identified in the qualitative phase of the study including (1) perceived usefulness, (2) perceived ease of use, (3) training, (4) internal environment, (5) personal experience, (6) social impacts, (7) observability and (8) job related characteristics. Perceived usefulness had the strongest impact on attitude toward using a smartphone.	na
Tidal, J. (2017)	Students	Information use	Tablet, smartphone	Cognitive walkthrough	20 students at City of Technology (City Tech), NYC	Lack of a unified experience of website between tablet, smartphone, and desktop users, despite; smartphone users at a disadvantage in utilizing library resources. Not only do smartphone users have a smaller screen size and a touchscreen interface, but they also encounter specific problems with responsive design including its grid system, form functionality, and navigation.	na
Twiss-Brooks, A. B., Andrade, J., Ricardo, Bass, M. B., Kern, B., Peterson, J., & Werner, D. A. (2017)	Medical students	Information seeking, information use	Smartphones, handheld tablets, and laptops	Semi-structured interviews	68 third-year medical students in US	Participants choose technology for a particular information task by considering speed and convenience factors; resources that use responsive design or are configured for easy use on small screens were preferred for smartphones and tablets; easy of reading pdf documents on tablet mentioned; appropriateness of smartphones in clinical setting was unclear and made some students uncomfortable; smartphones frequently used for time management.	Responsive design for library resources would enhance usability on handheld devices. More licensed learning and information resources should be made accessible via handheld devices.