



Mobile information behavior of Warner Pacific University students

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ABSTRACT

The mobile information behavior of Warner Pacific University students was studied using survey questionnaires, in-depth interviews, and group-based exercises through the lens of several common information theories and models. As ownership of connected devices became nearly ubiquitous, students used the Internet more than the library. Students built digital networks to connect with friends or classmates. The Internet was the students' primary information source, since using Google was a daily lifestyle habit while the library was totally new and unfamiliar territory. Comparison of the students' information search processes (ISPs) with Kuhlthau's ISP diagram revealed that the students searching was idiosyncratic and unpredictable, and they only adopted systematic search protocols when these were imposed on them. Chatman's theory of information poverty was useful as it revealed that the students' perception of information deprivation cut across all socio-economic groups.

1. Introduction

Since the 1970's various researchers in healthcare, cultural anthropology, mass communication, and sociology have studied mobile technology use (Bell, 2005; Muer, 2015; O'Keefe & Sulanowski, 1995; Taylor & Harper, 2003; Wurtzel & Turner, 1977). Mobile technology refers to connected devices like PCs, smartphones, tablets, and wearables. With falling prices and wireless-Internet access proliferation, laptops, smartphones, and similar connected devices became affordable for university students as essential appurtenances for learning and research. College and university students' connected device use in the USA was high in 2017. At the end of the 3rd Quarter of the year, 92% of the country's students currently enrolled in two-year, four-year, or graduate schools owned smartphones, 72% owned laptops, and 23% owned tablet computers (Kelly, 2017). The proliferation of connected devices in college and university campuses made it important to understand Warner Pacific University (WPU) students' library usage models and mobile information behavior, which includes the emotional, communication, networking, and pedagogical activities performed by connected device users.

WPU is a Christ-centered, urban, liberal arts university founded in 1937. Accredited by the Northwest Commission on Colleges and Universities (NCCU), WPU is a private institution, affiliated with the Church of God (Indiana). WPU's urban campus is located on Mount Tabor with three other campuses at Center 205, Longville, Washington, and King's Way Christian, Vancouver, Washington. At the time of this study, WPU was in the throes of change. The institution was transitioning from a teaching college to university while concurrently introducing new programs. The new offerings were in various subject

areas including masters' degree programs in Business Administration, Management & Organizational Leadership (online or on campus), and Nursing (RN to BSN). Amid these changes was leadership transformation at the university library. Two new librarians were hired. Almost immediately, the new librarians and the Circulation Supervisor, launched new library-marketing campaigns, organizing various relatively well-attended public events/lectures including "Everyone's Constitution: Citizen or Not!", "Why Read Banned Books", and "Hispanic Heritage: Beyond Murals & Fiestas". Total enrollment at the time of the study was 907.

2. Problem statement

Despite the successes, there were no hard numbers to inform future program planning to boost student and faculty participation. Furthermore, local technology diffusion was unknown, and it was uncertain how many WPU students owned connected devices with which they could access new programs and events promotion on social media. Online library usage models of traditional and non-traditional students were non-existent. It was unclear what specific challenges hindered students and faculty from visiting the library website more often and how many students had Wi-Fi at home to fully benefit from the renewal of existing subscriptions and the licensing of new online databases. A clearer understanding of these issues and of how students' behavior was explained in various models like Kuhlthau's Information Search Process (ISP) would benefit information literacy, library instruction, in-house research products development, and academic success. Yet until now, there was no systematic analysis of the mobile information behavior of WPU students.

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The study explored the following research questions:

1. What is the Technology Diffusion (TD) among WPU students?
2. How do WPU students use online library resources?
3. What are the main influences on the mobile behaviors of traditional and non-traditional students?
4. Are the mobile behaviors of WPU students explained by common models and theories?
5. How do the mobile behaviors of WPU students map to Kuhlthau's ISP model?

3. Literature review

3.1. Common theories

This section reviewed four common theories related to this study. The first was Zipf's (1949) principle of least effort, which explains that human beings typically prefer the path of least resistance. Every "individual's entire behavior is governed by the Principle of Least Effort [PLE]" (p.6), or by "the expenditure of the probably least average of his work (by definition, *least effort*)" (p.543). Though the low-hanging fruit might not be the juiciest, Bronstein and Baruchson-Arbib (2008) concurred with the theory, arguing that when seeking information, the seeker would choose the most easily accessible physical or digital channel (p.4). Digital channel involved a communication infrastructure like the Internet that influenced mobile behavior.

The second theory was Kuhlthau (1983) who developed the original model of ISP. In the model, she divided information behavior into six key stages: Initiation (Stage 1), Selection (Stage 2), Exploration (Stage 3), Formulation (Stage 4), Collection (Stage 5), and Search closure/Presentation (Stage 6). Kuhlthau's ISP was extensively applied in information behavior research. For example, Hyldegård (2006, p.298) argued that Kuhlthau's study of elementary and secondary school students did not consider emotional factors and group dynamics that influenced the outcomes of individual ISPs. Other studies like Bowler's (2010) applied Kuhlthau's ISP to adolescents, finding that conversation and social interaction were important in adolescents' information behavior; they "trusted family and friends, than...the class teacher or college librarian" (p.1). This study tried to understand whether WPU librarians were in the last category. Wiley and Williams (2015) found after applying Kuhlthau's ISP to novice researchers and undecided students that "Not all students who seek research assistance function at the same ISP stage" (p.16). Moreover, none of these applications involved how traditional and non-traditional students drew ISP diagrams based on their mobile ISP in a group-setting.

The third was Dresang's radical change theory which explained children's works with digital technology attributes such as interactivity, connectivity, and access; the same attributes involved in the mobile social networks of the respondents in the present study. Prior to that, Dresang and McClelland (1999), Dresang (1999, 2005a,b & 2008), and Dresang and Koh (2009) applied the theory to youth information behavior and the innovative ways that young people interacted, connected, and accessed the Internet. In one of these studies, Dresang (2005a, 2005b) lauded the strength of the radical change theory and its applicability to "contemporary information behavior and resources" (p. 301); predicting the use of connected devices for searching personal and academic information.

The fourth was Chatman's small worlds theory (Chatman, 1991; Chatman, 1992; Chatman, 1996; Chatman, 1999). After studying the information behavior of female inmates, janitors, low-income civil servants, minorities, older people, retirees at the Garden Towers, and single mothers, she developed the theories of life in the round, normative behaviors, small worlds, and information poverty. She argued that social exclusion exacerbated by "deception", "mistrust" [of outsiders], "secrecy", "self-protecting mechanisms", and insider/outsider syndrome, prevented people from obtaining needed information (1996,

p.197). Mistrust also created a sense of information poverty in the respondents in the present study. Britz (2004) concurred with the theories, postulating that lack of "requisite skills", accessibility, literacy, and digital infrastructure engendered information poverty (p.194). Though infrastructure and accessibility were not challenges to the respondents in the present study, low information literacy skills apparently limited their awareness of the WPU library's online databases. Similarly, Wheeler, Dillahunt, and Rieh (2017) reported that poor search-query formulation skills, inability to use Internet search engines, and "limited social networks" were symptoms of information starvation (p.2225).

3.2. Information tools

Murphy (2010) described connected devices as "information tools" loaded with news apps such as Google, Facebook, and Twitter (p.1). Analyzing various usage models impacting information behavior, he isolated text messaging as a popular usage model. Some of these tools included eBooks, PCs, and smartphones, while additional usage models were school-related. Dresselhaus and Shrode (2012) discovered that out of 25,000 graduate and undergraduate students of Utah State University (USU), 50% of the former and 54% of the latter used connected devices for academic work. A similar study identified smartphones as a popular gateway for information searching. Emanuel (2013) found that 68% of 403 undergraduates surveyed at a public university in the American Southeast, were heavily engaged in social networking with 73% of the respondents using their phones "to get information they need right away" (p.12). As reported by Deodhar (2013), most users including university students, preferred "searching information using mobile apps" (p.52), universally available free or paid, from Internet service providers like Google and Apple, publishers like Springer/Nature Publishing Group, and library product vendors like ProQuest and EbscoHost, the most popular online database provider in the WPU Library. Hofstra University students used the same platforms on tools like iPads, laptops, and smartphones to access library resources (Caniano & Catalano, 2014). The Hofstra University study was a mixed gender analysis but Mills, Knezek, and Khaddage (2014) found that 62% of women enrolled in pre-teacher classroom technology courses enjoyed learning and sharing information with mobile devices while Lee and Song (2015) reported that undergraduate business majors were also familiar with smartphone-based information access. In a comparative study of the mobile behavior of students of the University of Illinois at Urbana-Champaign (UIUC), USA, and Kyungshung University (KU-South Korea), the authors' found that "whereas the majority of KU students had used library services via their smartphones in the last 12 months" of the study, "UIUC students had never accessed library services in this way" (p.157). Similarly, Krubu, Zinn, and Hart (2017) adopted Kuhlthau's ISP model to explain the mobile behavior of petroleum engineering students during a group assignment. Analyzing the WhatsApp journals of 77 students, the authors concluded that the ISP was of limited applicability though the procedure did not require students to draw their individual ISPs. Sampling a larger, more diverse student groups like those in the present study, Tang and Oh (2017) examined the mobile news information behavior of undergraduate and graduate students made up of 40% White/Caucasians, 34% Asians, 14% Hispanics/Latinos, and 14% African Americans from 30 different universities in 17 states across the USA. Analyzing 50 responses to an online survey, the authors found that the respondents heavily depended on social media apps for sharing (68%), finding (52%), reading (50%), and receiving news stories (42)%. Some of these sharing platforms were eBook apps; a rapidly growing collection in the WPU library. After analyzing the results of 820 STEM (Science, Technology, Engineering, & Mathematics) and 1091 non-STEM respondents, Carroll, Corlett-Rivera, Hackman, and Zou (2016) found that undergraduates (38.6%) were the most frequent daily/weekly users of eBooks for academic work compared to graduate students (37.2%), faculty (16.2%) and staff (14.2%).

Of the type of devices used for accessing eBooks, laptops or desktops (37.9%) were the most popular, followed by tablets (37.9%), mobile phones (36.7%), and eBook readers (34.8%). [Lipsman and Lella \(2017\)](#) reported high diffusion of information tools in the USA. During this year, smartphone apps influenced the mobile behavior not just of the 18-24-year-olds reported by the authors, but people from all generations. For academic library consumer mobile behavior, college and university students used the apps of various publishers and libraries, including Physics World app, ACS Mobile app, Library of Congress app, National Library of Medicine app, or their local library apps.

4. Methodology

4.1. Surveys

Questionnaire survey was the main instrument for data collection (see survey questions in Appendix A). The survey explored research questions 1, 2 and 3: (1) What is the Technology Diffusion (TD) among Warner Pacific University students? (2) How do WPU students use online library resources? (3) What are the main influences on the mobile behaviors of traditional and non-traditional students? Using semi-structured paper and digital questionnaires, the authors gathered disparate information about the mobile behavior of WPU students. As outlined by [Neuman \(2006\)](#), questionnaires were a cost-effective way of collecting various types of biographical and related information from homogenous and heterogeneous populations. The survey created with [Google Forms](#) included questions on networking platforms and technology diffusion. To make the questions easy to understand by the survey population, five students volunteered to construct the questions after the authors discussed the purpose of the study with them. The questions were then tested on 12 other volunteer students who identified various terminological ambiguities. For example, terms like “cell-phone” and “laptop” confused reviewers who did not identify the former as a “smartphone” and the latter as a mobile device. Such incomprehensible or ambiguous terms were replaced with familiar ones. To achieve a good response rate, the questionnaires were distributed in the paper form to students recruited in either the cafeteria or through direct distribution by program directors on each of the four campuses of WPU. The authors also visited four non-traditional students' classrooms to distribute more questionnaires. Concurrently, the questionnaire was made available on WPU students' dashboard online. A total of 293 respondents completed surveys, yielding a response rate of 31%.

4.2. Interviews

This study also conducted in-depth follow-up interviews of interviewees randomly recruited from the survey respondents. Interview questions confirmed biographical information and the ways in which friends, colleagues, and followers of similar interests built and strengthened mobile social networks for communication, learning, study, and research. The interviews used open-ended questions proposed by [Cobbledick \(1996, p. 347\)](#), for collecting “detailed information” and by [Boyce and Neale \(2006, p.3\)](#), to achieve a holistic understanding of the respondent's viewpoint.

4.3. Group-based exercises

This study gathered additional information during group-based exercises. For these exercises, 22 participants were randomly recruited from the second author's information literacy classes. Of these, 15 participants were from her English 200 level class and seven students from her master's degree Human Services information literacy class. Each of the 50 min classes provided the opportunity to test and compare the participants' mobile ISPs with Kuhlthau's model using task-centered instructional strategies recommended by [Merrill \(2007, p.7\)](#).

After distributing printed diagrams and explaining the specific steps

in Kuhlthau's ISP process, the second author tasked participants to draw new diagrams based on their personal information seeking behavior or mobile ISPs following Kuhlthau's ISP. In addition, the participants were asked to provide brief narratives of their diagrammatic experience or representation.

4.4. Analysis

Microsoft Excel was used to code questionnaire survey results. The raw data was then imported from a comma-separated value (CSV) file into Python version 3.6 for analysis using the Pandas Library (version 0.23.3). After sorting the data column-wise, Python calculated the descriptive statistics for categorical and numerical variables or yes/no questions by means of their mode and respective frequencies. Segmentation plots were generated with Python Seaborn Library (version 0.8.1). The cut off for statistical significance in segmentation analysis was $p\text{-value} < 0.05$ while Google Slides aided visual representation.

5. Results

This section reports the demographics of connected device ownership, mapping survey results to the research questions (RQs). Of the total number of 268 respondents to the demographic question, 31% ($n = 83$) were in the Professional Graduate Studies (PGS) Program while 69% ($n = 185$) were Traditional Students. The average age of the respondents was 25.4 with Hispanic and Pacific Islander students being the youngest. In terms of diversity, the number of White respondents was 40.7% ($n = 109$) followed by Hispanics (24.6%, $n = 66$) in second place, African Americans (13%, $n = 35$) in third place, and Asian Americans (9%, $n = 24$) in fourth place. See [Fig. 1](#).

5.1. Research question 1

The survey questions (SQs) mapped to the RQs as follows. RQ1: What is the Technology Diffusion (TD) among WPU students? TD referred to the spread of connected device ownership. This RQ was to determine the number of students who owned mobile hardware and software capable of receiving online library instruction and course delivery. The results were to inform new library service planning and the expansion of online course offerings. The answers to the SQ about technology ownership showed widespread diffusion of various connected device hardware and software (99.7%, $n = 674$). The specific technologies reported were multitouch devices like smartphones (42.2%, $n = 285$), laptops (38.1%, $n = 257$), tablets (15.7%, $n = 106$), and eBook Readers (3.6%, $n = 24$). iPhone smartphone ownership was 65.5% ($n = 199$), Android at 28.9% ($n = 88$), and Windows at 3.3% ($n = 10$). In terms of web browser technologies, Google Chrome was the most popular (57%, $n = 244$), followed by Safari (20.7%, $n = 89$), and Microsoft Edge (14.7%, $n = 63$), while home broadband Internet use was 97.3% ($n = 283$).

5.2. Research question 2

How do WPU students use online resources? As the WPU library's offline resource usage numbers showed that students were not finding the information they needed, this RQ was to measure students' awareness of online databases and to identify the databases that were popular with students. The results were to inform the enhancement of information search tips and online search strategy formulation. The answers to the SQ about database usage models showed that many respondents searched online resources once a week (42.3%, $n = 119$), while far fewer (11%, $n = 31$) searched them daily. Sixty-four percent ($n = 177$) of the respondents searched articles on their connected devices, while 26% ($n = 74$) read eBooks. EBSCOhost surfaced in follow-up interviews as the most popular database.

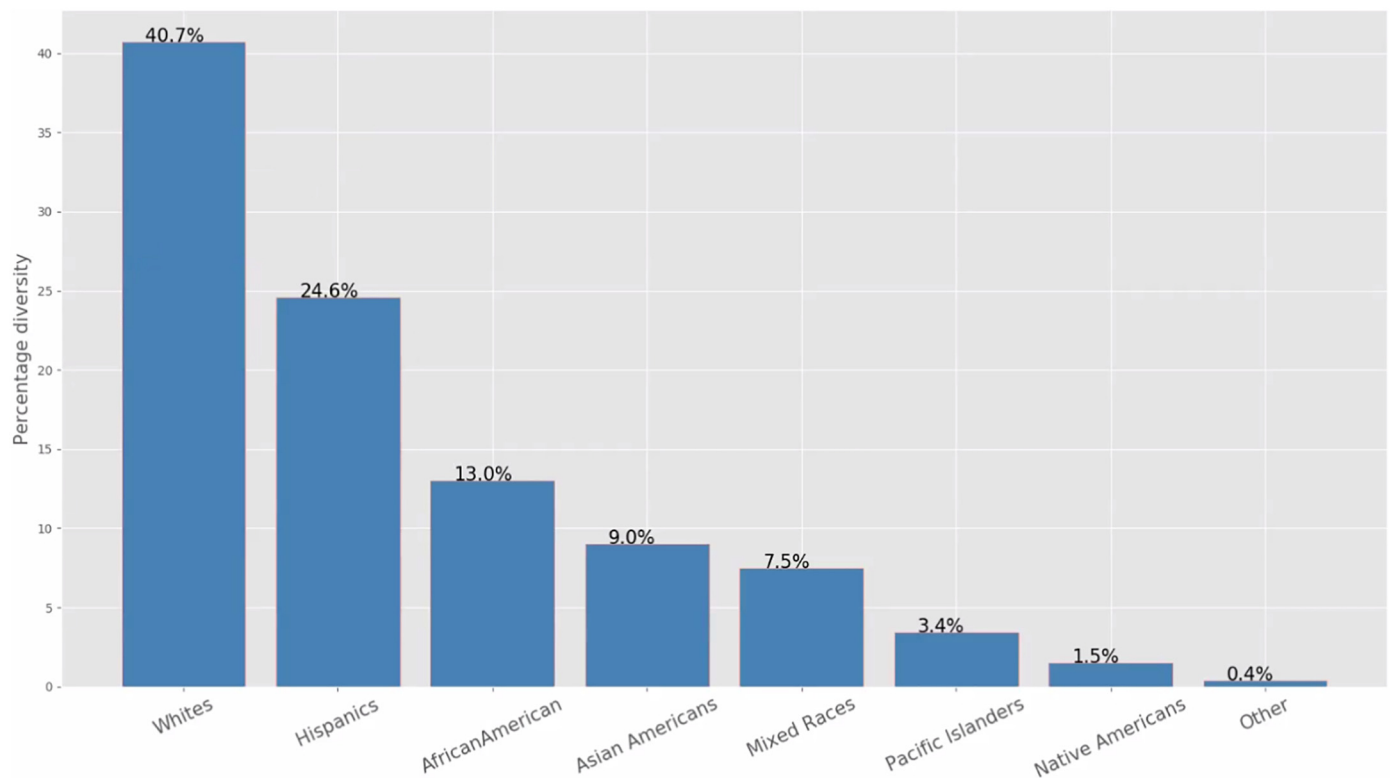


Fig. 1. Population demographics.

5.3. Research question 3

What are the main influences on the mobile behaviors of traditional and non-traditional students? At the time of the study, WPU enrolled both traditional and non-traditional student cohorts. Traditional referred to full time students typically living in campus residential facilities. According to the National Center for Education Statistics (NCES), non-traditional referred to students who attended university only part-time and typically had family responsibilities. At WPU, these students worked full time and were enrolled in the evening programs offered by the PGS Division. The answers to the SQ subsumed under this RQ about myWPclasses (OpenLMS Blackboard) showed that connected devices offered convenience for traditional student respondents (TSRs) (69.4%, $n = 245$) and PGS student respondents (30.6%, $n = 75$). As to whether library resources helped school work completion, TSRs (72%, $n = 132$) and PGS (28%, $n = 51$) answered in the affirmative. Reading eBooks and digital periodicals was popular across the board: TSRs (70%, $n = 121$) and PGS (30.1%, $n = 52$). The answers to the SQ about assignment submission with connected devices lent themselves to statistical analysis. A computation using a two-sample t -test at 95% confidence level, showed that there was a significant statistical difference between the number of respondents, who submitted assignments electronically and those who did so via print media (p -value = 2.2×10^{-16}). Similarly, there was a significant statistical difference between the number of male and female students who submitted assignments via print media (p -value = 0.0459); more male respondents favored print media than females. There was also a significant statistical difference between the respondents who were traditional students and those who were non-traditional (p -value = 0.000); the former favored electronic assignment submission than the latter.

5.4. Research question 4

Are the mobile behaviors of WPU students explained by common

models and theories? This RQ was to explain students' connected device usage models and how they built digital communities for learning. This RQ was also to identify students' communication platforms of choice and information source preferences. In addition, this RQ sought to explain students' perception of the local information resources available to them for study and research. One of the SQs subsumed under this RQ asked respondents to rank the importance of their connected devices for schoolwork. See Table 1.

Despite the personal computer industry's claim that the laptop or notebooks "are a dying breed" (Chauhan, 2018), the respondents ranked them as very important (68.4%, $n = 203$). The answers to another SQ showed that the following were the top platforms for building digital networks and communities for learning: Snapchat (18.3%, $n = 124$) came in the first place, followed by Instagram (16.3%, $n = 110$) in the second place, Facebook (14.2%, $n = 96$) in the third place, Twitter (5%, $n = 34$) in the fourth place, and YouTube (3.3%, $n = 22$) in the fifth place. Follow-up interviews confirmed that social media was the primary vehicle for connecting, communicating, collaborating, and sharing all types of information including personal information, class project ideas, articles, and school related events.

The answers to the SQ on the use of connected devices for schoolwork varied. See Fig. 2.

Reading emails was the most common school-related usage (19.2%, $n = 235$), followed by OpenLMS Blackboard Access (16.6%, $n = 203$), Article Reading (15.3%, $n = 187$), and Music Listening (14.4%,

Table 1
Connected devices' pedagogical importance.

Device name	Very important	Important	Moderately important	Slightly important	Not important
Laptop	68.4%	57.7%	43%	26.6%	6.6%
Smartphone	24.2%	32.3%	5.7%	4.8%	3.7%
Tablet	5.7%	5.1%	17.1%	39.5%	48.3%
eReader	1.7%	7%	34.2%	29%	41.3%

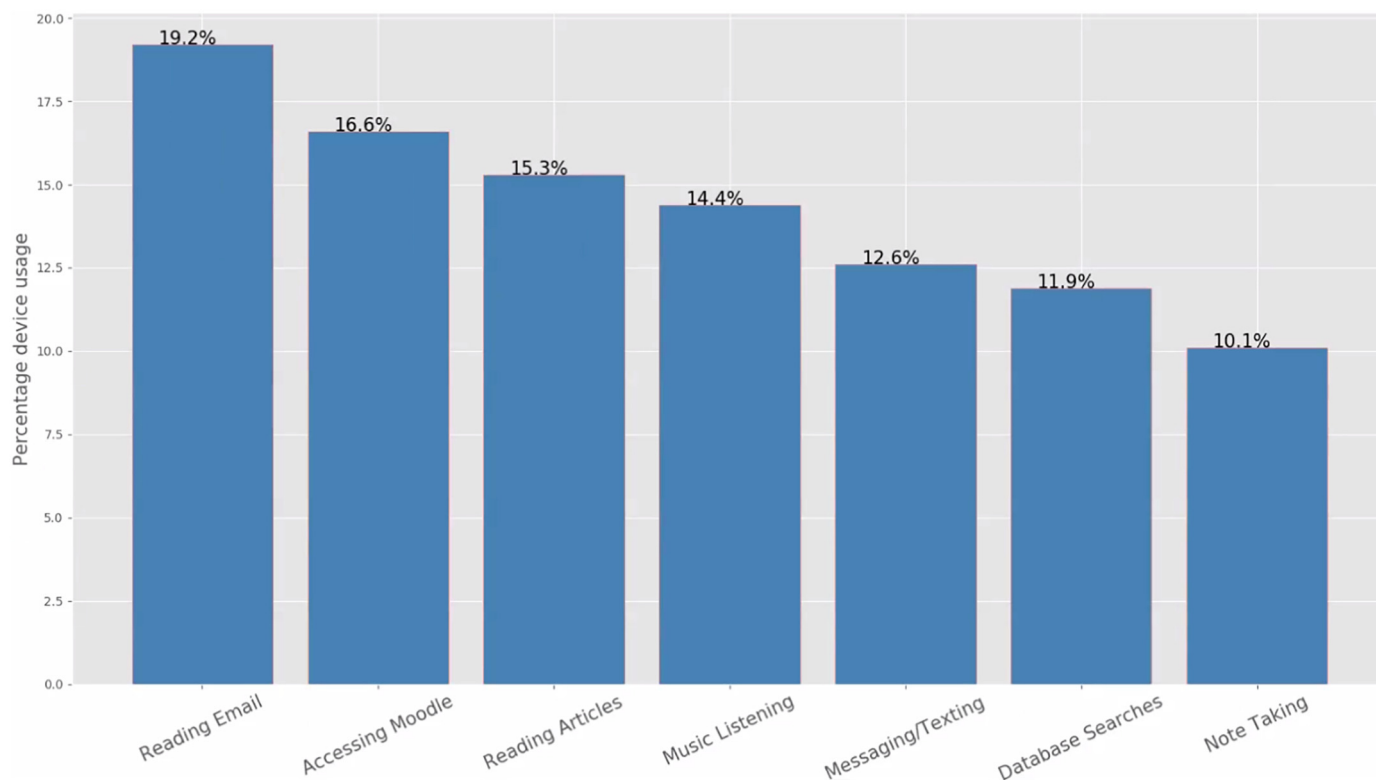


Fig. 2. Pedagogical usage models.

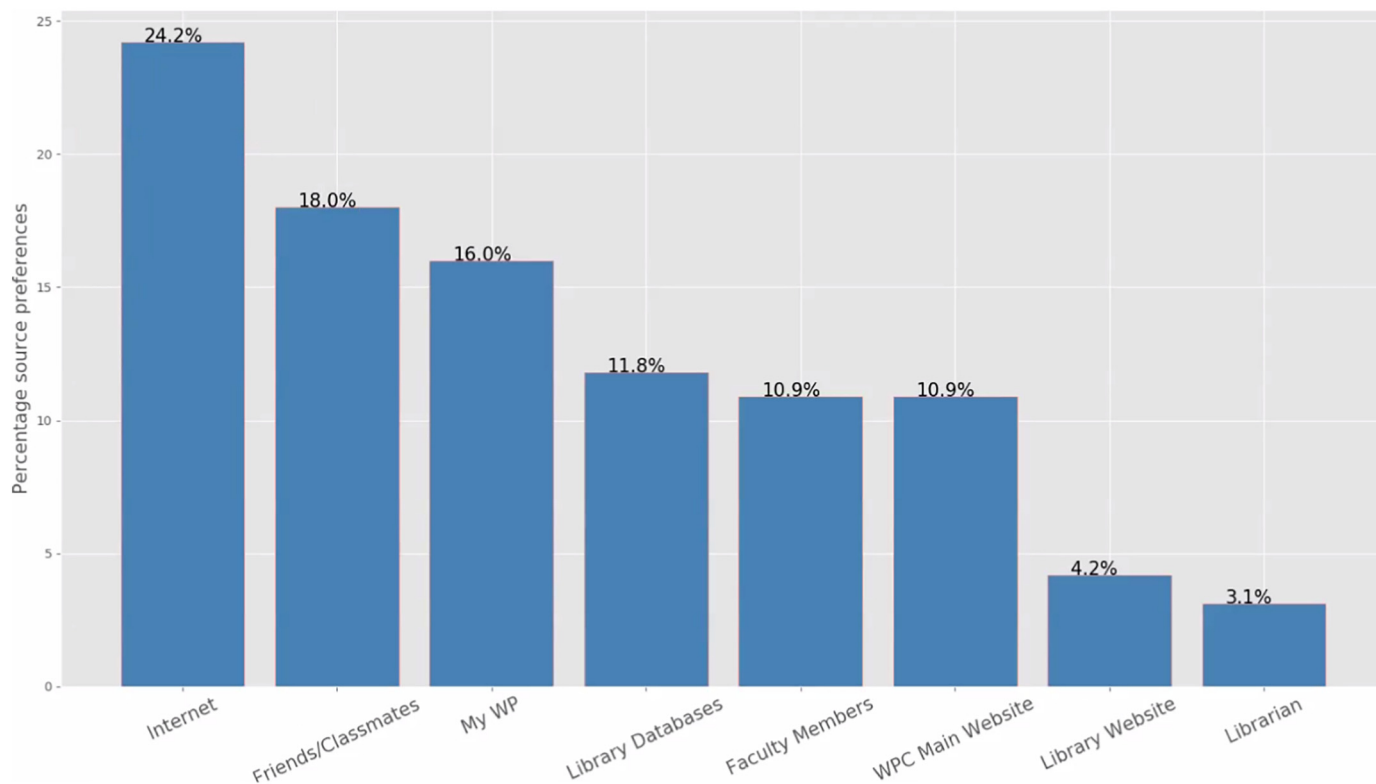


Fig. 3. Information source preferences.

n = 176). The answers to SQ on information source selection showed preference for what Zipf (1949, p.543) called the principle of “least amount of effort”. Refer to Fig. 3.

The respondents ranked the Internet in the first place as their top

information source (24.2%, n = 225), followed by Friends/Classmates (18%, n = 167) in the second place, My WP-the student information portal (16%, n = 149) in the third place, and Library Databases (11.8%, n = 110) in the fourth place. Some interviewees remarked that WPU's

small size created perceptions of information poverty. They doubted the availability of “top of the line” online research resources, while other interviewees expressed concerns about “old library facilities” whose mass of physical shelves were not visible at a glance.

5.5. Research question 5

How do the mobile behaviors of WPU students map to Kuhlthau's ISP model? As the WPU Electronic Services and Instruction Librarian started instructing her information literacy students to look up research information on their smartphones, this RQ was to determine the individual processes of implementing searches in practice. Altogether, the 22 participants (including both traditional and non-traditional students) followed a diagrammatic representation of Kuhlthau's ISP model of “task initiation, topic selection, prefocus exploration, focus formulation, information collection”, results presentation, and assessment (Hallis, 2014). The participants who completed the exercise confirmed that a trigger, typically in the form of a classroom project, caused them to start searching for a new information. For eleven participants, the trigger started at the task initiation stage. For four out of this number, a new information search progressed linearly from task initiation to the topic selection stage. One participant reported a cyclical search protocol while another participant's ISP was anti-clockwise. The eight ISPs reported here were the only ones that provided fully meaningful and complete illustrations with quotable quotes. The colors symbolized the different ISP stages; the circle sizes were aesthetic. The shape and thickness of the arrow heads were of no significance though each arrow head pointed the direction of the activities performed by the participant.

Participant #1 said, “I move back and forth between selection, exploration, and selection. I gather information at the exploration stage, refine it, and build confidence. Formulation means information/data analysis and more information collection [to fill gaps]”. See Fig. 4.

Participant #2 reported that he came “to the research class with a formulated opinion/perspective in mind...and already collected information whose validity I confirm with my instructor resulting in back and forth movement between the stage of collection and exploration. Finally, I will put my project together and present it”. See Fig. 5.

Participant #3 noted, “I think I go selection, exploration, initiation. I battle back and forth between exploration and formulation”. See Fig. 6.

Participant #4 remarked, “I think the only difference from my way of beginning is that the exploration and initiation switch up. First, I

explore and gather materials and information needed for the research paper, then do ‘Initiation’ by organizing the new information to complete the assignment. Selection—now I decide what topic or book to begin with. Formulation—this is where I find formula, ways of writing the paper, then Evaluate”. See Fig. 7.

Participant #5 revealed, “I start with initiation but skip to exploration and formulation at the same time. Then I go back to selecting materials that I will actually use. Exploration and formulation are critical steps because I tend to plan as I am looking at everything. After that it was collection time, argumentation and presentation”. See Fig. 8.

Participant #6's ISP strategy was anti-clockwise. He reported, “I select articles as I explore the topic moving back and forth between the stages of selection and exploration...I collect more information, formulate, and write down my thoughts and assess my work for presentation”. Refer to Fig. 9.

Participant #7 said, “I pick a general topic to research (collection)... I skim for articles that interest me (exploration)...I form an opinion about the topic (formulation)...I start to select articles that would support my opinion (selection), start or initiate an outline of the paper, have peers look over my work to check for mistakes (assessment)... present my findings (presentation). See Fig. 10.

For Participant #8, her “Steps were more cyclical in nature”, encompassing all of Kuhlthau's seven ISP stages. See Fig. 11.

6. Discussion

The main issues addressed in this study were technology diffusion among WPU students, social networks, technology usage models, information-source preferences, and ISP. Though the study did not find any direct relationship between technology diffusion among the respondents and what they used those devices for, the results confirmed the prevalence of technology ownership across all demographic groups. With 99.7% ownership, technology diffusion was highest among Hispanics and Pacific Islander students, who were also the youngest of the respondents. This number would characterize this group of respondents as “early adopters” (Rogers, 2003, p.288). Mostly born from 1996 onwards, many TRS and PGS were respectively borderline Millennials/Gen Z, studying in a world of dedicated Google Scholar and consumer electronics.

The respondents used a total of 676 apps on their connected devices including Snapchat, Instagram, and Facebook to build extensive digital networks and communities or dense networks. These were “tight-knit and interconnected binds that human beings with shared social capital

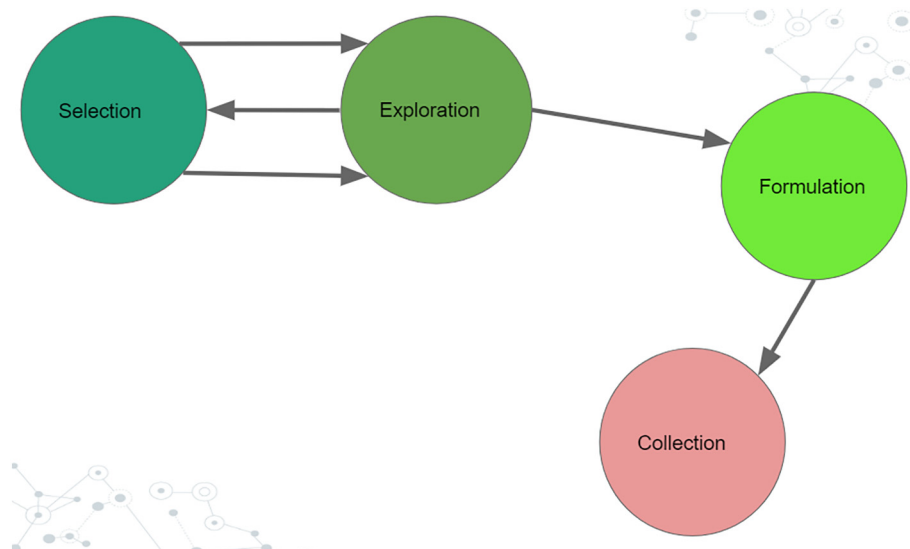


Fig. 4. Participant #1's Tracked Back and Forth.

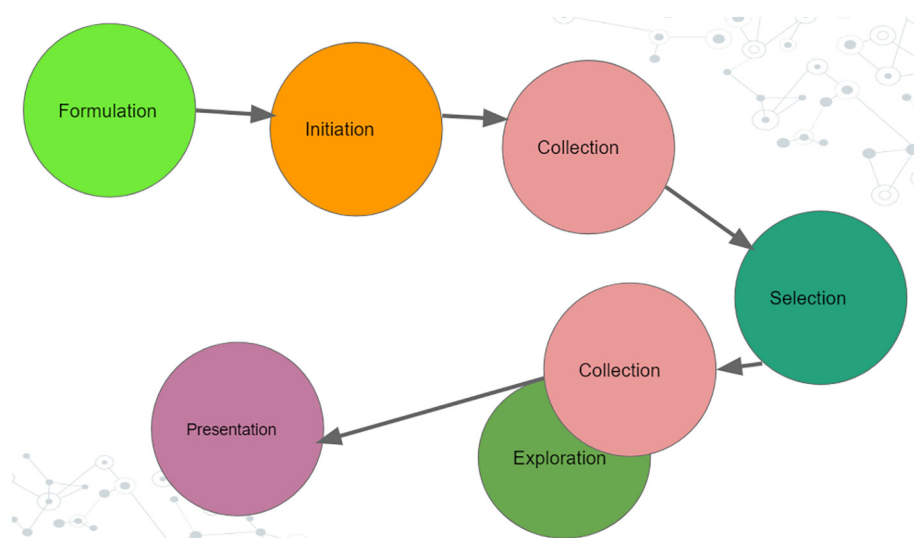


Fig. 5. Participant #2's ISP Strategy Was Self-Directed.

have to each other” (Emdin, 2016, p.131). Applying Dresang's radical change theory based on the principles of accessibility, connectivity, and interactivity, the authors found that the respondents built networks from everywhere in real time using the aforementioned platforms. With these platforms, the respondents forged dense networks both inside and outside the university campus to share all types of information including personal perspectives, class project ideas, articles, and school-related events.

This study found that the respondents used their connected devices mostly for schoolwork. This finding challenged Anderson's (2016) assertion that “Listening to music and shopping on the go are especially popular among smartphone owners ages 18 to 29”. The 18- to 29-year-olds in the present study harnessed their smartphones primarily for communication, studying, and learning. Laptops were the most heavily used connected devices for pedagogical activities; the respondents described them as “very important”, followed by smartphones. As for specific learning activities, Reading Emails (19.2%, $n = 235$) topped the mobile activities that the respondents reported executing on their connected devices, followed by accessing OpenLMS Blackboard (16.6%, $n = 203$) and reading articles (15.3%, $n = 187$).

In terms of information source preferences, the Internet was most popular (24.2%, $n = 225$), because, as one respondent said, it was “easily accessible”; followed by Friends/Classmates (18%, $n = 167$).

Each respondent apparently adopted a course of action that involved “the expenditure of the *probably least average of his work* (by definition, *least effort*)”, (Zipf, 1949, p. 543). Having grown up with smartphones and Wi-Fi hotspots, it was natural for the respondents to turn first to the information sources easily accessible to them on the Internet or sources requiring the least physical or cognitive resistance. In other words, accessibility was the main information-source-selection influencer for the respondents. As Prabha, Connaway, Olszewski, and Jenkins (2007) reported, “the consequences of putting time and effort into finding optimal [information] solutions can be costly” (p. 78). Concurring with this perspective, another respondent, whose first choice for new school-assignment information was Google Scholar, said, “the Internet is quicker, easier...it is in my hand, on my phone.”

The authors investigated the perception that the respondents' mobile behavior was limited because they were cocooned in an information-poor environment. The authors found that WPU's small size of < 5000 students was a factor. The WPU Library's relatively small number of electronic resources and limited visibility of a print collection of < 100,000 volumes, contributed to a general perception of information poverty. In-depth interviews revealed that this perception cut across respondents in all socio-economic groups. The respondents found it difficult to articulate their information needs and they often did not know when their needs were met. Some respondents did not want to use

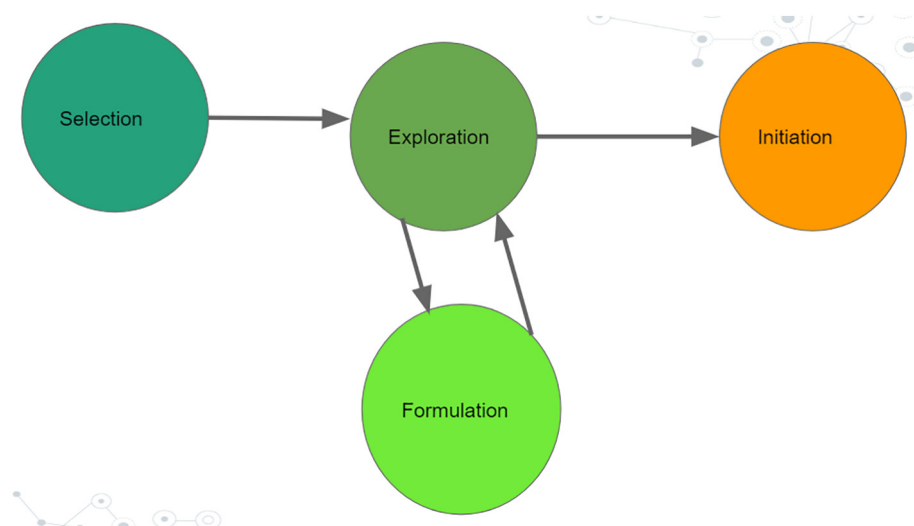


Fig. 6. Participant #3's Battled Back & Forth.

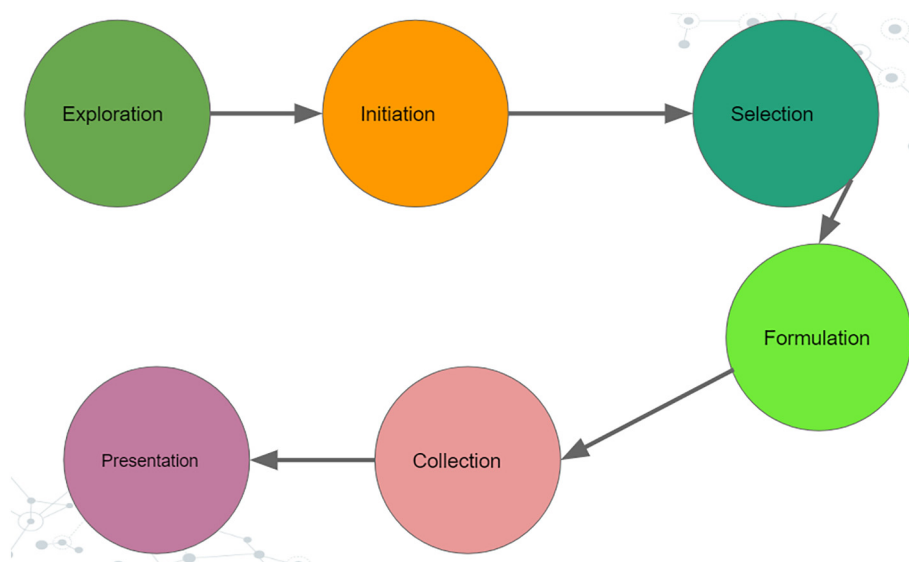


Fig. 7. Participant #4's ISP Strategy was Linear.

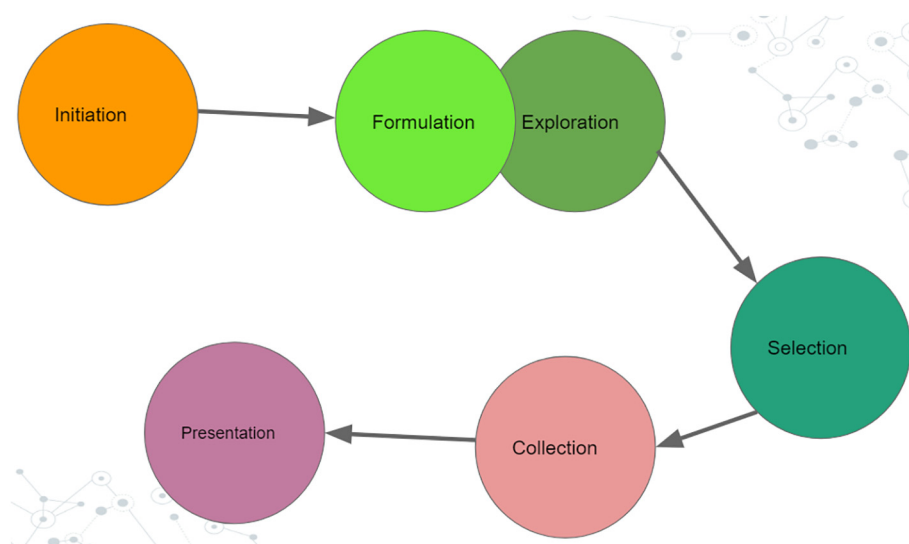


Fig. 8. Participant #5's ISP was "Skip & Hop".

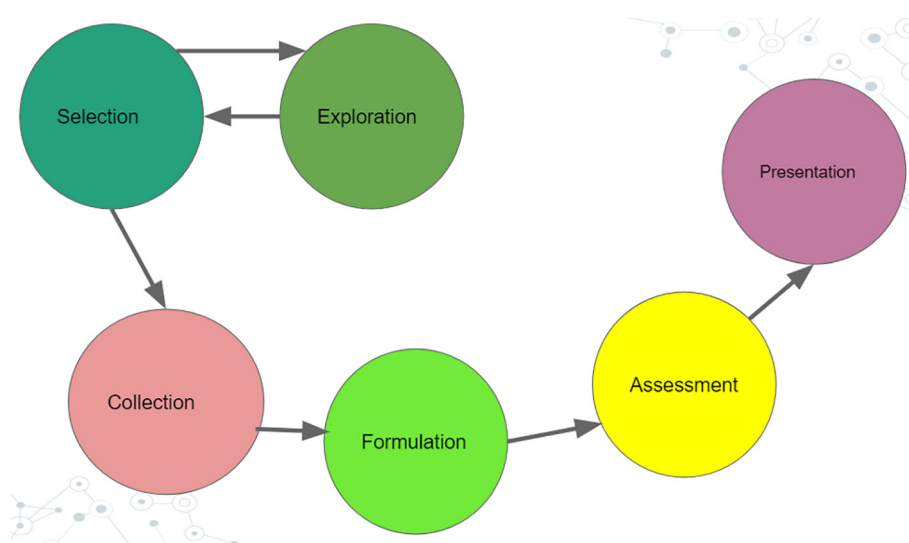


Fig. 9. Participant #6's ISP Was Anti-Clockwise.

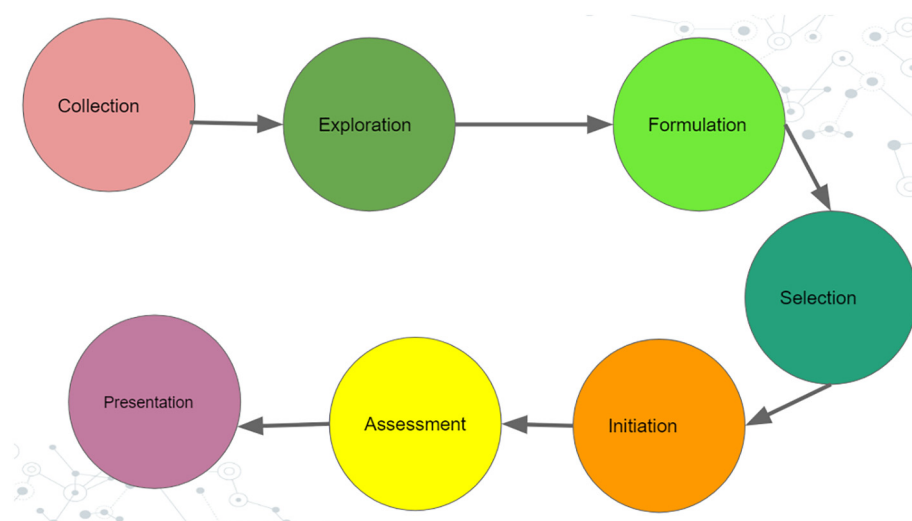


Fig. 10. Participant #1's ISP Strategy Was "Skim & Choose".

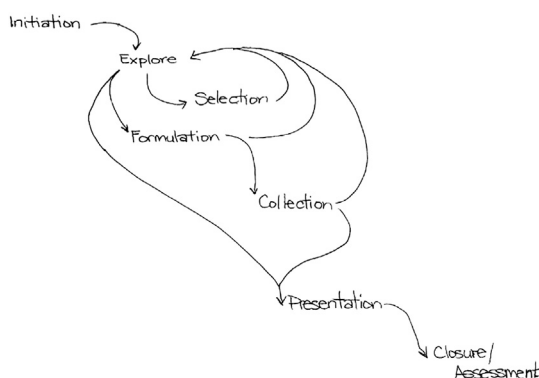


Fig. 11. Participant #8's ISP was Cyclical.

the library or talk to the librarians for fear of being called dumb or weak. Similarly, instead of asking the librarian for advice or instruction, some of the respondents secretly purchased freely accessible journal articles in order not to be seen as financially incapable by their cohorts. As they were too timid to ask for assistance and library promotion was previously limited, most respondents were unaware that the WPU Library provided access to > 31 million information items through its membership of the Orbis Cascade Alliance of 38 participating libraries (Bostrom, 2018).

The group-based ISP exercises were instructive. In constructing their individual ISPs based on their mobile information seeking activities, both traditional and non-traditional participants skimmed and chose, while others skipped and hopped in idiosyncratic and unpredictable manner. The adoption of systematic search protocols was influenced by the scenarios and methodology imposed upon the participants by the

second author. Future initiatives should include systematic analysis of the mobile information behavior of both faculty and staff.

7. Limitations

This study had limitations. Though it was designed as a census survey, logistical issues meant that the authors were unable to reach the entire survey population. Also, while some respondents provided legible contact information others did not, making it difficult to scientifically select interviewees from the list of respondents. Similarly, many participants' ISP diagrams were either incomplete or lacked quotable narratives. Consequently, only 36.3%, $n = 22$ of participants' illustrations were reported in this study.

8. Conclusion

This study provided insightful results. Using the theories of Dresang, Zipf, Kuhlthau, and Chatman to explain the mobile information behavior of WPU students was revealing. Comparison of the students' ISPs with Kuhlthau's ISP diagram showed that the respondents formulated and executed information searches in an idiosyncratic manner. Given this result, faculty and information literacy practitioners should encourage context awareness and creative information search among students without imposing specific protocols.

The results also showed that the respondents leveraged mobile technology for school-related work and relationship building through social networking. The technology was a necessity, implying that ignoring its transformative impact could hinder academic success. In fact, university management should fully integrate mobile technology into all aspects of teaching and learning experiences to make education more flexible, convenient and accessible.

Appendix A

Mobile Information Behavior of Warner Pacific University Students: Questionnaire Survey

Purpose of Survey

The Otto F Linn Library is trying to identify future digital products and services.

Please complete this brief survey to help us align the new services to your research, study and learning needs.

Device Ownership

1. Select the mobile devices that you currently own. Circle all that apply.
 - a. Smartphone
 - b. Laptop
 - c. Tablet

- d. eBook Reader
 - e. None
 - f. Other please specify _____
2. What type of smartphone do you currently own? Circle all that apply
- a. Android
 - b. iPhone
 - c. Windows
 - d. None
 - e. Other, please specify _____
3. What type of tablet do you currently own? Circle all that apply.
- a. Android
 - b. iPad
 - c. Surface (Windows)
 - d. None
 - e. Other, please specify _____
4. What type of laptop do you currently use? Circle all that apply.
- a. Mac
 - b. Windows
 - c. Chrome
 - d. Linux
 - e. None
 - f. Other, please specify _____
5. Do you have Internet access at home?
- a. Yes
 - b. No
6. Do you consider your laptop a mobile device?
Yes or No

Device Features

7. Which Internet Browser do you use most frequently? Circle all that apply.
- a. Mozilla Firefox
 - b. Internet Explorer/Microsoft Edge
 - c. Google Chrome
 - d. Safari
 - e. Other, please specify _____
8. Explain why you selected the Browser(s) of your choice. Circle all that apply.
- a. Quicker
 - b. Has extensions
 - c. Works better with your device
 - d. Other, please specify _____
9. What are your three most commonly used Apps on your smartphone?

_____, _____, _____.

(Flip page to continue survey)

Device Used For School Work

10. Rank each of the following devices in reference to its importance for your school work:
1 = Very Important; 2 = Important; 3 = Moderately Important; 4 = Slightly Important; 5 = Not Important

Smartphone
Laptop
e-Reader
Tablet

11. How often do you use your first/top ranked device?
- a. Hourly
 - b. Three times a Day
 - c. Daily
 - d. Once a Week
 - e. Other, please specify _____
12. What do you mostly use your device of choice for? Circle all that apply.
- a. Notetaking
 - b. Online classes
 - c. Reading e-books

- d. Reading articles
 - e. Reading email
 - f. Accessing Moodle
 - g. Listening to Music
 - h. Recording or editing videos
 - i. Database Searches
 - j. Messaging/Texting
 - k. Other, please specific _____
13. What percentage of your course assignments are submitted in:

Paper/Print	%
Electronic Format	%

Library Services (Please answer with your first/top ranked device in mind)

14. Where do you typically seek school-related information? Circle all that apply.
- a. Friends/Classmates
 - b. Faculty Members
 - c. Library Databases (EBSCOhost)
 - d. WPC Main Website
 - e. My WP
 - f. Internet
 - g. Librarian
 - h. Library website
 - i. Other, please specify _____
15. How often do you use your device to search Library databases (like EBSCOhost)?
- a. Hourly
 - b. Three times a Day
 - c. Daily
 - d. Once a week
 - e. Other, please specify _____
16. Have you read articles from Library databases on your device?
Yes or No
17. Have you read Library e-books on your device?
Yes or No
18. Which Library databases do you most commonly use? _____
19. Has using Library resources helped you complete your school work in a timely manner?
Yes or No
20. Do you use your device to access MyWP Classes/Moodle?
Yes or No

Your Demographic Information Fill in or circle response.

- a. Age _____
- b. Gender _____
- c. Race/Ethnicity _____
- d. Traditional student or Adult Degree student
- e. 2-year program or 4-year program
- f. Freshmen or Sophomore or Junior or Senior
- g. Undergraduate Major _____
- h. Full time or Part time
- i. Undergraduate or Graduate
- j. If Graduate, which program _____

NAME: _____
EMAIL: _____

References

- Anderson, M. (2016). *More Americans using smartphones for getting directions, streaming TV*. Washington, DC: Pew Research Center. Retrieved from <http://www.pewresearch.org/fact-tank/2016/01/29/us-smartphone-use/>.
- Bell, G. (2005). The age of the thumb: A cultural reading of mobile technologies from Asia. In P. Glotz, & S. Bertsch (Eds.). *Thumb culture: The meaning of Mobile phones for society* (pp. 67–88). Bielefeld: Transcript Verlag. Retrieved from <http://sing.stanford.edu/cs303-sp11/papers/bell.asia.pdf>.
- Bostrom, D. (2018). *Orbis cascade alliance accreditation support*. Personal Communication1.
- Boyce, C., & Neale, Peta A. (2006). *Conducting In-depth interviews: A Guide for Designing and Conducting In-depth interviews for Evaluation Input*. Watertown, MA: Pathfinder International. http://www2.pathfinder.org/site/DocServer/m_e_tool_series_indepth_interviews.pdf.

- Bowler, L. (2010). Talk as a metacognitive strategy during the information search process of adolescents. *IR Information Research*, 15(4), 1–10. Retrieved from <http://www.informationr.net/ir/15-4/paper449.html>.
- Britz, J. J. (2004). To know or not to know: A moral reflection on information poverty. *Journal of Information Science*, 30(3), 192–204. <https://doi.org/10.1177/0165551504044666>.
- Bronstein, J., & Baruchson-Arbib, S. (2008). The application of cost-benefit and least effort theories in studies of information seeking behavior of humanities scholars: The case of Jewish studies scholars in Israel. *Journal of Information Science*, 34(2), 131–144. <https://doi.org/10.1177/0165551507079733>.
- Caniano, W. T., & Catalano, A. (2014). Academic libraries and mobile devices: User and reader preferences. *The Reference Librarian*, 54, 298–317. <https://doi.org/10.1080/02763877.2014.929910>.
- Carroll, A. J., Corlett-Rivera, K., Hackman, T., & Zou, J. (2016). E-book perceptions and use in STEM and non-STEM disciplines: A comparative follow-up study. *Libraries and the Academy*, 16(1), 131–162. Retrieved from <https://muse.jhu.edu/article/609814>.
- Chatman, E. A. (1991). Life in a small world: Applicability of gratification theory to information-seeking behavior. *Journal of the American Society for Information Science*, 42(6), 438–449. [https://doi.org/10.1002/\(SICI\)1097-4571\(199107\)42:6<438::AID-AS16>3.0.CO;2-B](https://doi.org/10.1002/(SICI)1097-4571(199107)42:6<438::AID-AS16>3.0.CO;2-B).
- Chatman, E. A. (1992). *The information world of retired women*. New York: Greenwood Press.
- Chatman, E. A. (1996). The impoverished life-world of outsiders. *Journal of the American Society for Information Science*, 47(3), 193–206. [https://doi.org/10.1002/\(SICI\)1097-4571\(199603\)47:3<193::AID-AS13>3.0.CO;2-T](https://doi.org/10.1002/(SICI)1097-4571(199603)47:3<193::AID-AS13>3.0.CO;2-T).
- Chatman, E. A. (1999). A theory of life in the round. *Journal of the American Society for Information Science*, 50(3), 207–217. [https://doi.org/10.1002/\(SICI\)1097-4571\(1999\)50:3<207::AID-AS13>3.0.CO;2-8](https://doi.org/10.1002/(SICI)1097-4571(1999)50:3<207::AID-AS13>3.0.CO;2-8).
- Chauhan, S. (2018). The best laptops of 2018: Top laptops ranked. Techradar, 1. Retrieved from <https://www.techradar.com/news/the-best-laptops-of-2018-top-laptops-ranked>.
- Cobbedick, S. (1996). Information-seeking behavior of artists: Exploratory interviews. *The library quarterly: Information, community, policy*. Vol. 66. *The library quarterly: Information, community, policy* (pp. 343–372). <https://doi.org/10.1086/602909>.
- Deodhar, M. (2013). Using mobile apps for research: An emerging trend in LIS profession. *International Journal of Innovative Research & Development*, 2(12), 52–59. Retrieved from <http://www.ijird.com/index.php/ijird/article/view/42213/33713>.
- Dresang, E. T. (1999). *Radical change revisited: Dynamic digital age books for youth*. Hackensack NJ: H.W. Wilson.
- Dresang, E. T. (2005a). Radical change. In K. E. Fisher, S. Erdelez, & L. McKechnie (Eds.). *Theories of information behavior* (pp. 298–302). Medford, NJ: Published for the American Society for Information Science and Technology by Information Today.
- Dresang, E. T. (2005b). The information-seeking behavior of youth in the digital environment. *Library Trends*, 54, 178–196. Retrieved from <https://www.ideals.illinois.edu/handle/2142/3475>.
- Dresang, E. T. (2008). Radical change revisited: Dynamic digital age books for youth. *Contemporary Issues in Technology and Teacher Education Journal*, 8(3), 294–304. Retrieved from <https://www.citejournal.org/volume-8/issue-3-08/seminal-articles/article2-html-2>.
- Dresang, E. T., & Koh, K. (2009). Radical change theory, youth information behavior, and school libraries. *Library Trends*, 58, 26–50. <https://doi.org/10.1353/lib.0.0070>.
- Dresang, E. T., & McClelland, K. (1999). Radical change: Digital age literature and learning. *Theory Into Practice*, 38(3), 160–167. Retrieved from https://www.jstor.org/stable/1477307?seq=1#page_scan_tab_contents.
- Dresselhaus, A. L., & Shrode, F. (2012). Mobile technologies & academics: Do students use mobile technology in their academic lives and are librarians ready to meet this new challenge? *Mansfield Library Faculty Publications*. 31(2), 82–101. <https://doi.org/10.6017/ital.v31i2.2166>.
- Emanuel, R. C. (2013). The American college student cell phone survey. *College Student Journal*, 47(1), 75–81. Retrieved from <https://eric.ed.gov/?id=EJ1022071>.
- Emdin, C. (2016). *For white folks who teach in the hood... And the rest of y'all too: Reality pedagogy and urban education*. Boston, MA: Beacon Press.
- Hallis, B. (2014). *Think critically! [Evaluate that information]*. PowerPoint Presentation-SIDLIT. 1–38. Retrieved from https://scholarspace.jccc.edu/cgi/viewcontent.cgi?article=1108&context=c2c_sidlit.
- Hyldegård, J. (2006). Collaborative information behaviour—Exploring Kuhlthau's information search process model in a group-based educational setting. *Information Processing and Management*, 42, 276–298. <https://doi.org/10.1016/j.ipm.2004.06.013>.
- Kelly, R. (2017, September 28). Survey: Most students say technology boosts academic success. Retrieved from [Campustechnology.com https://campustechnology.com/articles/2017/09/28/survey-most-students-say-technology-boosts-academic-success.aspx](https://campustechnology.com/articles/2017/09/28/survey-most-students-say-technology-boosts-academic-success.aspx).
- Krubu, D. E., Zinn, S., & Hart, G. C. (2017). Making sense of the information seeking process of undergraduates in a specialised university: Revelations from dialogue journaling on WhatsApp Messenger. *Interdisciplinary Journal of e-Skills and Lifelong Learning*, 13, 19–36. <https://doi.org/10.28945/3640>.
- Kuhlthau, C. C. (1983). *The library research process: Case studies and interventions with high school seniors in advanced placement english classes using Kelly's theory of constructs*. New Brunswick, NJ: Rutgers.
- Lee, J.-M., & Song, Y.-S. (2015). Mobile information-seeking behavior: A comparative study. *IFLA Journal*, 41(2), 153–161. <https://doi.org/10.1177/0340035215583501>.
- Lipsman, A., & Lella, A. (2017). *The 2017 U.S. mobile app report*. Reston, VA: comScore, Inc. Retrieved from <https://www.comscore.com/Insights/Presentations-and-Whitepapers/2017/The-2017-US-Mobile-App-Report>.
- Merrill, M. D. (2007). A task-centered instructional strategy. *Journal of Research on Technology in Education*, 40(1), 5–22. Retrieved from <https://files.eric.ed.gov/fulltext/EJ826059.pdf>.
- Mills, L. A., Knezek, G., & Khaddage, F. (2014). Information seeking, information sharing, and going mobile: Three bridges to informal learning. *Computers in Human Behavior*, 32, 324–334. <https://doi.org/10.1016/j.chb.2013.08.008>.
- Muer, S. (2015). Mobile technology use and developmental/intellectual disabilities. Master of Social Work Thesis, St. Catherine University and the University of St. Thomas, St. Paul, MN. Retrieved from https://sophia.stkate.edu/cgi/viewcontent.cgi?article=1497&context=msw_papers.
- Murphy, J. (2010). Using mobile devices FOR research smartphones, databases, and libraries. *Online*, 34(3), 14–18. Retrieved from https://www.researchgate.net/publication/297219883_Using_Mobile_Devices_FOR_Research_Smartphones_Databases_and_Libraries.
- Neuman, W. L. (2006). Fifteen analysis of qualitative data. *Social research methods: Qualitative and quantitative approaches* (pp. 457–489). (6th ed.). Boston, MA: Allyn & Bacon. Retrieved from <https://www.pearson.com/us/higher-education/product/Neuman-Social-Research-Methods-Qualitative-and-Quantitative-Approaches-6th-Edition/9780205457939.html?tab=contents>.
- O'Keefe, G. J., & Sulanowski, B. K. (1995). More than just talk: Uses, gratifications, and the telephone. *Journalism & Mass Communication Quarterly*, 72, 922–933. <https://doi.org/10.1177/107769909507200415>.
- Prabha, C., Connaway, L. S., Olszewski, L., & Jenkins, L. R. (2007). What is enough? Satisficing information needs. *Journal of Documentation*, 63, 74–89. <https://doi.org/10.1108/00220410710723894>.
- Rogers, E. M. (2003). *Diffusion innovations* (5th ed.). New York: Free Press 288.
- Tang, R., & Oh, K. E. (2017). Mobile news information behavior of undergraduate and graduate students in the US: An exploratory study. *iConference 2017 proceedings* (pp. 340–347). Wuhan, China: iSchools. Retrieved from <https://www.ideals.illinois.edu/handle/2142/97230>.
- Taylor, A. S., & Harper, R. (2003). The gift of the gab: A design oriented sociology of young people's use of mobiles. *Computer Supported Cooperative Work (CSCW)*, 12, 267–296. <https://doi.org/10.1023/A:1025091532662>.
- Wheeler, E., Dillahunt, T., & Rieh, S. Y. (2017). Opportunities to address information poverty with social search. *2017 CHI conference extended abstracts on human factors in computing systems, Denver, CO USA, May 6–11* (pp. 2224–2231). ACM. Retrieved from <https://dl.acm.org/citation.cfm?doid=3027063.3053167>.
- Wiley, C., & Williams, J. (2015). Librarian as advisor: Information search process of undecided students and novice researchers. *NACADA Journal*, 35(1), 13–21. <https://doi.org/10.12930/NACADA-14-008>.
- Wurtzel, A. H., & Turner, C. (1977). What missing the telephone means. *Journal of Communication*, 27(2), 48–57. <https://doi.org/10.1111/j.1460-2466.1977.tb01826.x>.
- Zipf, G. K. (1949). *Human behavior and the principle of least effort: An introduction to human ecology*. Cambridge, MA: Addison-Wesley.

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