OCLC RESEARCH REPORT

The Many Faces of Digital Visitors & Residents:

Facets of Online Engagement

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OCLC

The Many Faces of Digital Visitors & Residents: Facets of Online Engagement

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We also would like to thank our OCLC colleagues, Erin M. Schadt for her hard work and patience during the writing and production of this report, and Brittany Brannon for her constructive feedback.

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OVERVIEW

What are the needs of our students and library users in a changing landscape of digital technologies? Researchers and practitioners in the fields of education, technology, library and information science, and others have been trying to answer this question for decades. Understanding how users engage with digital technologies will help institutions meet these changing needs and improve learning and service outcomes.

In 2001 education consultant Mark Prensky wrote the influential article, “Digital Natives, Digital Immigrants,” which divided people into these two groups. According to Prensky, digital natives are younger generations, who grew up with digital technologies and exhibit fluency when using them. Digital immigrants aren’t introduced to digital technologies until later in life, and using these technologies can feel foreign to them.[1]

While Prensky’s metaphors were very influential, some people questioned them. If digital natives represent individuals fluent in using digital technologies, wouldn’t those who created and developed these technologies be considered natives, even if they were born before the digital age? Is someone without the means to access digital technologies considered a digital native, just because they were born into a world where these technologies exist? These are just two examples of how the digital native and immigrant dichotomy falls short of explaining technological engagement. Prensky’s metaphors also have been challenged because he based them on assumptions, not on empirical, or research-based, evidence.

We propose the Digital Visitors and Residents (V&R) framework as an alternate way to understand how individuals engage with technology. This framework is based on empirical evidence across several different studies in multiple countries, which strengthens the applicability and replicability of our data collection and analysis tools and findings. This report will demonstrate what we did, what we found, and how you can use our findings to make changes in your classrooms and libraries.

HOW TO USE THIS REPORT

This report is aimed at practitioners, students, and researchers in education, technology, library and information science, and related fields. Here are a few things to keep in mind when reading the report:

- The intent of this report isn’t to duplicate information about V&R projects that are already published, but to provide a compilation that includes the history, activities, and findings of our work using the V&R framework.
- *Chapter 2. Data Collection and Analysis* focuses on a variety of methods, used with a diverse set of groups, to capture information on individual engagement with digital technologies. The chapter includes several different study designs that can be replicated in various contexts and disciplines. Developers who are interested in image normalization and shape analysis can find detailed information about the V&R Mapping Sessions included in appendix E.

- *Chapter 3. Findings*, and *Chapter 4. Conclusions and Recommendations,* are excellent resources for practitioners, including educators and librarians, interested in how individuals engage with digital technologies.

- We use certain terms frequently. These terms are defined in appendix F.

- The quotes used throughout this report are verbatim to preserve the voice of the participants. In some cases, they have been translated from Spanish.

INTRODUCING THE V&R FRAMEWORK

In 2008, David White, manager of an e-learning research and development group, wrote a blog post that critiqued Prensky's digital native and immigrant metaphors from the perspective of distance learning. White argued that the way distance learning students engage with technology isn't related to skill level or when they were born, as Prensky theorized, but is based "on if they saw the web as a 'place to live' or as a collection of useful tools." In other words, White argued that context beyond one's age matters when describing an individual's engagement with digital technologies.

At OCLC, we embrace context when determining how we can improve service to individuals. A key tenet of our philosophy is meeting individuals where they visit, live, work, learn, and play, rather than imposing specific solutions on them.[2] For this reason, White's blog post inspired us to further investigate where individuals are in the context of their engagement with digital technologies.

We established a trans-Atlantic partnership, which included collaborations with White, to explore this engagement. With funding from Jisc, Oxford University, and OCLC, in partnership with the University of North Carolina, Charlotte, we worked together to:

- Identify the factors that shape how novice and experienced researchers choose to engage with information

- Determine if individuals develop personal engagement strategies that evolve for specific needs and goals, or if their educational contexts are the primary influence on their engagement strategies

- Determine if modes of engagement shift over time, influenced by emergent web culture and the availability of new ways to engage, or if the underlying trends and motivations are relatively static within particular education stages

EDUCATIONAL STAGES

Since one of our research goals was to determine how people engage with digital technologies within an institutional context, we first identified four educational stages:

1. *Emerging*: students in the last year of high school/secondary school and the first year of undergraduate study

2. *Establishing*: upper-level undergraduate students

3. *Embedding*: graduate/postgraduate students (students seeking master's degrees or doctorates)

4. *Experiencing*: faculty, researchers, and scholars

Based on previous work, we hypothesized that these educational stages would better describe individuals' engagement with digital technologies than age or generation.[3] While age and educational stage do positively correlate, they do not determine one another. After all, not all undergraduates are 24 years old or younger, and not all university faculty are 40 years old or older. We will revisit these four educational stages later in the report.

DATA COLLECTION TOOLS

To collect information on engagement with technology, we used the following data collection tools:

- semi-structured individual interviews
- monthly individual diaries kept by participants or semi-structured interviews with the participants
- mapping of engagement with digital technologies
- an online survey

In this trans-Atlantic partnership, data were collected in several different countries, including the US, UK, Spain, Italy, and China. One institution that collected data, the Universitat Oberta de Catalunya (UOC) in Barcelona, is an online-only university, meaning that we could compare the faculty and students of UOC to other institutions that offer face-to-face or blended teaching and learning environments (for more information on how UOC compares to other institutions, see chapter 3, "Non-recognition of Library Sources," page 37). Data were collected from our four educational stages by interviewing some participants, surveying others, and asking others to draw maps that showed their engagement with technology. In total, we collected semi-structured interview data from 164 individuals, online survey responses from 150 individuals, and technology engagement maps from 151 individuals.

> "HKU Libraries had two main motivations for participating in this project: it was an opportunity for us to learn about our users and to respond to their needs and behaviors accordingly, and there was an exciting opportunity to collect data for analysis and comparison with data from UCLA. In order to formulate an effective strategy for leveraging social media in our libraries, we need a fuller understanding of the behaviors and needs of our users."
>
> **V&R project team members**
> HKU (University of Hong Kong)

VISITORS AND RESIDENTS

Based on our findings from this research, we developed two typologies to describe people's engagement with technology: Visitors and Residents. We have defined this in previous writings as:

"...the Visitors see the web as a series of tools. They decide what they want to achieve, chose an appropriate online tool to do the job, then log-off. They leave no social trace of themselves online. The Residents live a proportion of their lives online. They see the web as a place where they can express themselves and spend time with people. Residents will have a profile on a social networking platform and aspects of their persona, or digital identity, maintaining a presence even when they are not online. The premise of this project is that V&R is a continuum in which the way participants interacted with the digital and non-digital world were more Visitor or Resident depending on their personal motivations and the context and situation at the time."[4]

Unlike Prensky's digital native and immigrant metaphors, which exist in a dichotomy, the V&R framework represents a continuum. People land in different places within this continuum because of their general preferences and also because of specific contextual factors and information needs. Therefore, V&R status isn't totalizing. An individual can exhibit Visitor behavior when completing one task and Resident behavior when completing another. Further, the behaviors they exhibit when completing the same task may change over time.

"The main motivation to replicate the study in UC3M was to analyze how our students study and learn and which technologies they use and they are engaged with. The semi-structured interview, fundamentally face to face, made it possible to contact, speak, and gather first-hand information from the various participants who participated freely in providing their opinions. Being able to have a conversation that listed what they wanted allowed the interviewees to share opinions, confidences and experiences that, otherwise, would not be possible to collect."

V&R project team members
UC3M (Universidad Carlos III de Madrid)

By applying these two typologies, we found that so many contextual and situational factors shape a person's engagement with technology that it becomes difficult to parse out a definitive list of all variables that influence engagement (see chapter 3, "Participant Mappings"). In other words, it is not as easy to describe a person's engagement with technology based solely on age, as Prensky argued. Instead, factors like convenience, familiarity with the technology or source, and the importance of the need to know or find something, all influence how individuals engage with technology and the sources they use. How individuals engage with technology and use sources depends on the context and situation, so most individuals cannot be described as either a Visitor or Resident, but can be mapped onto a continuum of the two.

> "As faculty members of the Universitat Oberta de Catalunya (UOC), an online university based in Barcelona, we can observe every day how important the interaction patterns of our students with their information environment is for their learning process. Indeed, for an online student whose main—and often only—interface with her university teachers and peers is mediated by technology, the way in which they engage with technology is extremely important."
>
> **V&R project team members**
> UOC (Universitat Oberta de Catalunya)

We continue to collect data for V&R. In fact, individuals around the world are sending us maps that indicate their place on the V&R continuum. As a result, we created a map application that allows individuals to easily create maps digitally and submit them to OCLC for analysis. The more maps we collect and analyze, the better the portrait we can obtain of how individuals get information and engage with technology. (You can find more details on this aspect of our research in chapter 2, "Mapping")

We hope you enjoy reading about how people engage with the digital environment and get their information. We encourage you to send us feedback through our project page at http://www.oclc.org/research/themes/user-studies/vandr.html and, more important, to use the information included in this compilation to try something new.

Chapter 2. Data Collection and Analysis: What Did We Do?

Empirical testing provides support for a proposed framework, like V&R. A framework becomes stronger as it is tested in a variety of contexts, and using a variety of approaches. We tested the V&R framework in several contexts by collecting data across different countries and from participants at a variety of educational stages. Sampling from outside the US allowed us to examine the influence, if any, of geographic and cultural factors on individual modes of engagement.[5]

We also tested the V&R framework using various methods of data collection and analysis, a technique referred to as a mixed methods approach.[6] Use of mixed methods allows for rich results that are stronger than any one method alone. We used different methods of data collection and analysis to enhance the explanations provided by the V&R framework.

We will briefly overview each of the data collection and analysis methods, but more information is included in appendices A, B, C, and D, for those who wish to replicate our methods.

DATA COLLECTION

We collected data from four sources: semi-structured interviews, diaries, an online survey, and participant mappings. Each source was collected sequentially, and we used findings from the analysis of each source to inform the next round of data collection and analysis. Since one of our research goals was to determine how people engage with digital technologies within an institutional context, participants for data collection included students in their final year of secondary school, undergraduate and graduate students, faculty, and librarians.

Semi-Structured Individual Interviews

We began with semi-structured interviews, where researchers were given a list of questions, but were allowed to ask additional clarifying questions to enrich the interview data based on what the participant said. We based the semi-structured interview questions on the literature and goals of the research project, then submitted the questions and our research design to the Institutional Review Board at the University of North Carolina, Charlotte, where the questions and research design were approved (See appendix A for the semi-structured research questions). Multiple institutions in the US, UK, Spain (Barcelona, Madrid), and Italy (Milan) conducted the interviews with 164 people, allowing us to compare our findings across countries and cultures.

These interviews were a good way to start data collection, since they allowed us to collect information from participants that we may not have received when asking closed questions, such as in a survey. By asking open questions we could gather data about what might be important to participants that was not captured by initial iterations of the V&R framework. These interviews were individual, meaning that we spoke to one person at a time.

Table 1. Demographics from semi-structured interviews (N=164)

Location	Time Period	Emerging*	Establishing	Embedding	Experiencing
United States (US)	3/2011 to 1/2012 and 3/2013 to 4/2013	22	5	5	5
United Kingdom (UK)	3/2011 to 1/2012 and 2/2013	21	5	5	5
Madrid, Spain (UC3M)	10/2014 to 7/2016	8	10	10	10
Barcelona, Spain (UOC)	11/2015 to 6/2016	6	7	7	13
Milan, Italy (Unicatt)	11/2015 to 12/2016	3	6	6	5
Total (n)		**60**	**33**	**33**	**38**

**Includes first and second round Emerging interviews.*

We recruited participants for the interviews using several sampling, or selection, methods. We used purposive sampling, where we had an idea of who we wanted to interview, reached out to and recruited them using high school, college, and university listservs, as well as posted notices on campuses. We also used convenience sampling, which means that we asked people to participate who were most convenient to us. Specifically, we asked faculty and librarians from our personal networks to refer us to people we could interview. Finally, we used the snowballing sampling technique, in which we asked interviewees to connect us with other possible participants. (For more information on different types of sampling, see Connaway and Radford 2017.)[7]

> "I personally would have thought that the library staff was quite uninterested in doing this project. By contrast people feel curious and work with satisfaction and closely with the project team."
>
> **V&R Project Team Member**
> Unicatt (Università Cattolica del Sacro Cuore)

Since we wanted as variable a sample as possible, all interested participants completed a pre-screening questionnaire that included demographic information (view the full questionnaire in appendix C). We then reviewed the responses to the screening and, through purposive sampling, selected participants that represented demographic diversity. Individuals who were chosen for the semi-structured interviews in the US or UK were awarded gift cards in the amount of $20.00/£15.00 upon completion of the interview. The interviewees from Unicatt, UOC, and UC3M were not offered incentives.

Use of all three sampling methods (purposive, convenience, snowballing) indicates that sampling was not random and, therefore, generalizations of findings to other individuals must be made with caution. An online survey was conducted using a random sample to counter this lack of generalizability (see chapter 2, “Online Survey” for more information about the online survey).

One member of the research team led the interview, while other members took notes and interjected with additional clarifying questions. Notes were used to identify key issues, or themes, which informed data analysis. Interviews lasted between 45 and 90 minutes, and all interviews were audio-recorded and transcribed for coding and analysis. Most interviews were audio-recorded in duplicates, in case a recorder didn’t work or picked up poor quality audio.

The data we collected from the US and UK occurred during two time periods: the first began in 2011, with semi-structured interviews of 31 individuals (16 in the US and 15 in the UK), then, in 2013, we interviewed another group of 12 (six in the US and six in the UK) first-year undergraduate students (part of the Emerging educational stage). Sampling from two different time periods helped us identify whether individuals adopted new technologies, or used the same technologies their counterparts used two years earlier. This information would help support or refute the digital native and digital immigrant framework.

> “Before approaching this project, I was assuming that the metaphor of the ‘digital natives’ was really useful in describing our society. Without giving it much thought, I believed that that divide between digital natives and immigrants based mainly on age was real. When I started to get into the literature review for the project that assumption was certainly called into question, and after conducting and analyzing the interviews it is clear to me that the visitors and residents metaphor describes much better our information society.”
>
> **Agustí Canals**
> UOC (Universitat Oberta de Catalunya)

Diaries and Follow-up Semi-Structured Interviews

Semi-structured interviews provided us with rich data regarding individuals’ engagement with technology, but we wanted more information to determine the role of time, context, and situation on modes of engagement. For this reason we asked US and UK participants to submit monthly diaries about their engagement with technology, and how they got information for both personal and institutional situations. Participants provided their diaries to the team using the format and communication medium of their choice. Most diaries were in written form; however, some participants kept video diaries.

Even with reminders and incentives offered for submissions, the diaries were not as numerous or as detailed as we had hoped. As a result, we began conducting follow-up interviews on the participants’ modes of engagement via Skype and telephone, in order to gain more detailed information about their monthly activities to determine the role of time, context, and situation. (The interview questions and protocol for the follow-up semi-structured interviews can be found in appendix B.) This information helped

us determine if participants' engagement with technology evolved to meet specific needs and goals, or if their educational stage primarily influenced their engagement strategies. Similar to our longitudinal sample (collection of data within two different time periods) of participants from the US and UK discussed above, the information also enabled us to determine if current websites and apps influenced modes of engagement, or if the underlying trends and motivations for engagement were relatively static.

A total of 22 of the 73 US/UK initial interviewees participated in the diaries and semi-structured follow-up interviews, which is 30% of those who participated in the semi-structured interviews.

Table 2. Demographics from diarists and follow-up interview participants

EDUCATIONAL STAGE*	US	UK
Emerging	9	8
Establishing	2	1
Embedding	1	0
Experiencing	1	0
Total	**13**	**9**

**Educational stage the participant started at.*

Online Survey

The data collected from the semi-structured interviews and diaries were not from a representative sample of our desired participants—individuals in academic institutions between their final year of secondary school and undergraduate and graduate students and faculty in colleges and universities. Specifically, the number of emerging US and UK participants was much higher than the number of participants sampled from the other three educational stages. In order to determine how well these findings could be generalized to a more representative sample of 150 participants, we distributed an anonymous online survey using the quota sampling method to select participants at each educational stage from the US and the UK. For the quota sampling method, a certain number of individuals are selected from each demographic group of interest (e.g., educational stage, age, gender) through a demographic screening questionnaire, then a set number of individuals are invited to participate. The intent is to provide a representative sample as compared to the overall population. For instance, if a researcher wanted a representative sample related to gender in a social group comprised of 80% men and 20% women, the researcher would recruit this same proportion for their study (for the demographic categories that informed our quota sample, see appendix C).

While we attempted to recruit 50 participants (25 from the US and 25 from the UK) from each of the four educational stages, we did not reach the quota. However, when we began to review the incoming results of the online survey, we noticed that we received the same information from each of the respondents. This observation is referred to as theoretical saturation.[8] It is recommended that data collection end once such saturation is achieved, therefore, we capped participation at 150 individuals. This online survey was distributed by various academic institutions in the US and UK to their faculty and students. If the

individuals were chosen for the online survey and participated, they were awarded gift cards in the amount of $20.00/£15.00 upon completion. The survey, which primarily consisted of open-ended questions, was created and administered using Google Forms and took an estimated 45 minutes to complete. (See appendix D for the full survey.)

Since there were no online survey respondents from the other geographical regions (Barcelona, Madrid, or Milan), direct comparisons only can be made between online survey findings and findings from the semi-structured interviews conducted in the US and the UK. However, the online survey findings do support findings from the semi-structured interviews conducted at Universitat Oberta de Catalunya (UOC), Universidad Carlos III de Madrid (UC3M), and Università Cattolica del Sacro Cuore (Unicatt) (see chapter 3).

Table 3. Demographics from online survey (November 2013 to July 2014)

Educational Stage	US	UK
Emerging	17	25
Establishing	25	17
Embedding	25	17
Experiencing	23	1
Total	**90**	**60**

Mapping

Since the data collected were predominantly text-based, we supplemented them with another type of data: maps. Mapping sessions were built to visualize the behaviors discussed in the interviews, diaries, and surveys. Mapping sessions provide a fun and less complicated data collection method for library administrators and staff to identify how their communities engage with technology in both their personal and institutional lives.

A V&R map is a picture of a participant's engagement with technology, and helps participants tell their stories about their relationships with digital tools. The activities that appear in an individual's map, and how the individual arranges those activities, allow us to better understand their interactions and relationships with technology.

The analysis of the semi-structured interviews, diaries and interviews, and online survey indicated that most individuals were on a continuum between exhibiting Visitor and Resident behavior, within Personal and Institutional contexts. Our analysis demonstrated that we could not predict the individuals' location on the continuum, so we created the maps as an interactive visual representation for individuals to report their own behaviors within a specific time, situation, and context. We asked participants to draw their use of digital tools (i.e., technologies such as computers, phones, tablets, or software) using the map. Figure 1 displays this continuum.

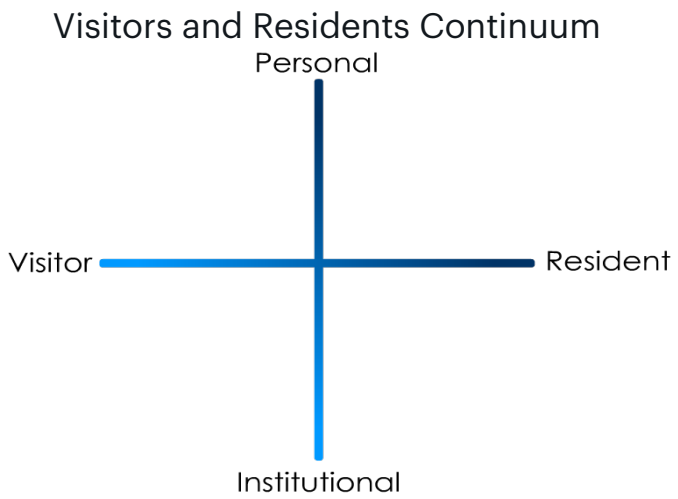


FIGURE 1. The visitors and residents (V&R) continuum.

Mapping sessions were in person, with one team member acting as the leader and asking questions about the participants' maps, and another team member cataloging the maps through photos and text for further analysis. Following the mapping sessions, we asked participants to share their thoughts, as well as answer follow-up questions based on team members' preliminary visual analyses of their maps.

Much like the other project phases, our sampling of participants to draw these maps was a mixture of purposive, convenience, and snowball. The individuals who participated in the initial mapping sessions were from the Hong Kong University (HKU), the University of California at Los Angeles (UCLA), Pittsburgh University (Pitt), and Carnegie Mellon University (CMU). HKU and UCLA were selected as mapping session sites because both universities have a diverse and global academic population. Pitt and CMU were interested in learning how librarians engaged with technology to guide their strategic planning.

We recruited individuals from each of the four institutions to participate in the mapping sessions by email, as well as by hanging posters in the library, placing banners on the library website, and posting to the libraries' Facebook pages. We asked interested participants from HKU and UCLA to complete a pre-screening questionnaire, and then chose people from different countries of origin, disciplines, age groups, and genders to participate in the study. We did not disseminate pre-screening questionnaires to Pitt and CMU librarians since their participation in the mapping sessions was part of a discussion about staff reorganizations and strategic planning.

Make Your Map Online with the Digital Visitors and Residents Mapping App

V&R mapping sessions can be an enjoyable exercise for participants, and the resulting maps are often artistically inspired and full of interesting findings. During the mapping sessions, some participants suggested an app for doing the mapping exercise, which would remove the need for many resources, planning, and analysis. Based on these requests and the fact that digital maps would facilitate and expedite analysis, we developed a mapping app, ensuring that the design process of the Digital Visitors and Residents Mapping App centered on participants' experience and satisfaction by conducting usability testing. Usability testing is a collection of procedures and techniques designed to assess and evaluate a product by observing participants as they interact with it.

The OCLC Usability Lab conducts detailed usability tests related to OCLC products and services, and collaborates with OCLC researchers in usability studies related to research projects. They provided extensive support, guidance, and usability testing sessions that were integral in creating the look, feel, and design of the app. Allowing our participants to try the software during development ensured that our software hit the mark and that it provided the best participant experience possible.

The Digital Visitors and Residents Mapping App works with most touchscreen devices such as tablets, phones, and most web browsers. To get started with the app, visit http://oc.lc/VRmap and view the three-minute instructional video or the instructional comic book for comprehensive directions. Figure 2 shows the basic app interface and its "stretchy shapes" that allow you to interact with your V&R map as if it were a digital scrapbook.

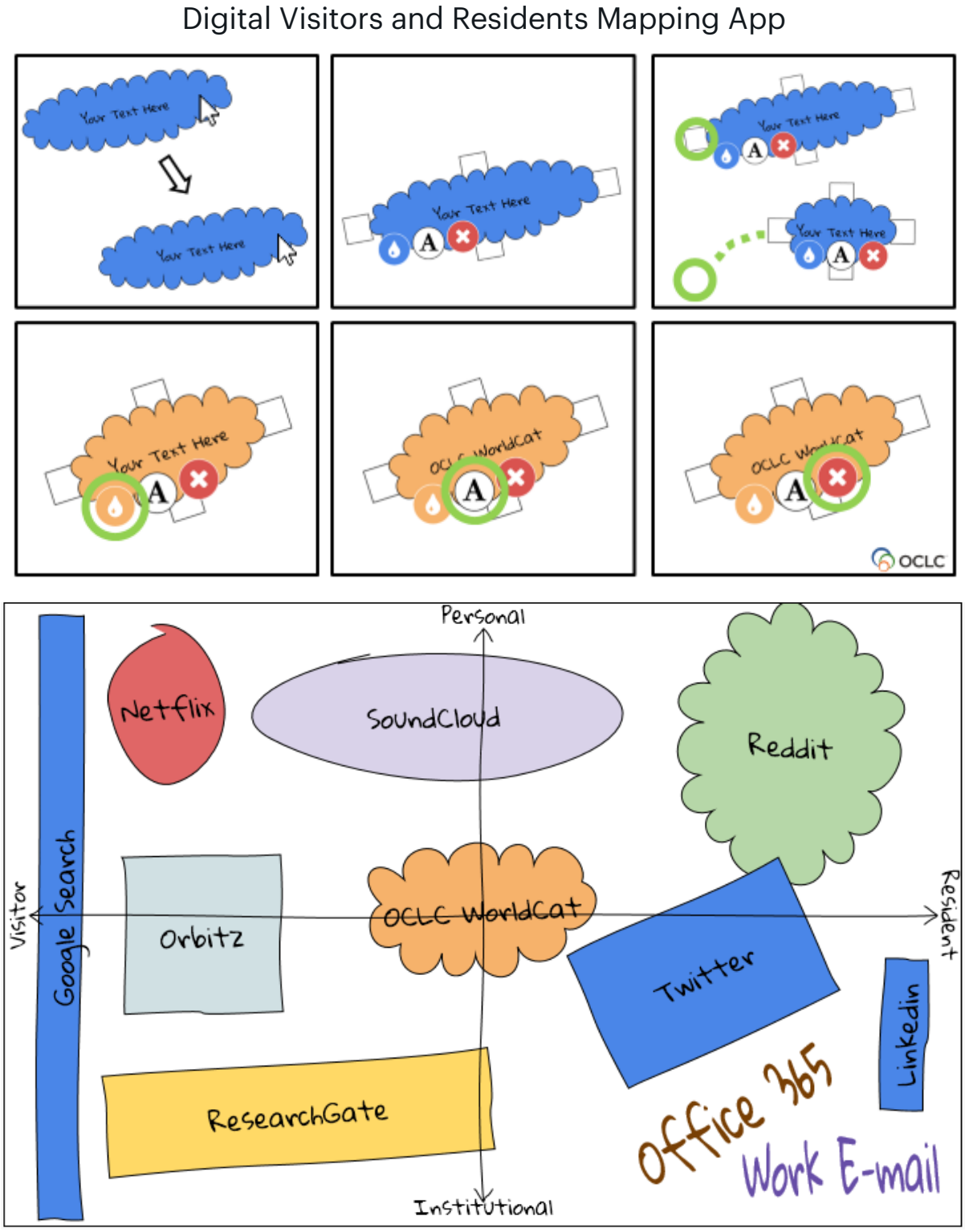


FIGURE 2. (top): Interacting with the Digital Visitors and Residents Mapping app is a fun way to create your map using a touch-enabled mobile device or computer. (bottom): An example of a V&R map created using the app.

Thirty-nine students and librarians participated in the mapping sessions at UCLA, chosen from the 93 pre-study screening respondents, and received $30 Amazon.com gift cards as incentives. Of the 527 pre-study screening respondents from HKU, 74 people participated and received grocery store vouchers in appreciation for their participation. Mapping sessions were conducted with 38 librarians at Pitt and CMU, who did not complete pre-screening questionnaires nor were they compensated for their participation. A total of 151 individuals participated in the mapping sessions at UCLA, HKU, Pitt, and CMU. Table 4 displays demographic information for participants from each mapping session.

Table 4. Demographics from mapping sessions (UCLA, HKU, Pitt, CMU) (N=151)

Location	Time Period	Emerging	Establishing	Embedding	Experiencing	Not Provided	Total
University of California, Los Angeles (UCLA)	2/2016	2	17	8	9	3	39
University of Hong Kong (HKU)	9/2016	16	18	21	9	0	74
Pittsburgh University (Pitt)/ Carnegie Mellon University (CMU)	3/2016	0	0	0	0	38	38

DATA ANALYSIS

The online survey results and diaries already were in text form, and we sent the semi-structured interviews and follow-up interviews to a transcription service. We then assigned an anonymous identifier to each of these data sources and uploaded them to the qualitative research software program, NVivo. We used NVivo to assign codes, or themes, to sections of text and met to discuss the themes.[9] These themes provided the basis for a V&R codebook, developed by the US and UK research team. A codebook provides a standardized way for different researchers to refer to the data, based on the goals and objectives of the research. For more information on coding and how to develop a codebook, see Connaway and Radford 2017.[10] You can see the V&R codebook at http://www.oclc.org/content/dam/research/activities/vandr/resources/vandr-interview-diary-codebook.pdf.

To determine whether team members were on the same page when coding, we compared our coding of the same data with one another to calculate inter-coder reliability (ICR) scores. These scores, measured by kappa value and percent agreement, are used by researchers to determine how well the individual coders agreed with one another (table 5). While there is no single, universally accepted scale to determine appropriate levels of agreement, the literature shows that these ICR values indicate good to substantial agreement, meaning that team members were, for the most part, on the same page. After calculating ICR we discussed cases of disagreement, before coding the remainder of the data.

Table 5. Inter-coder reliability scores

Location	Kappa Value	Agreement	Method Type
United States (US) and United Kingdom (UK)	Between 0.63 and 0.64	98%	Semi-structured interviews
United States (US) and United Kingdom (UK)	Between 0.63 and 0.65	98% and 99%	Follow-up interviews and diaries
Madrid, Spain (UC3M)	0.61	97%	Semi-structured interviews
Barcelona, Spain (UOC)*	---	---	Semi-structured interviews
Milan, Italy (Unicatt)	0.75	100%±	Semi-structured interviews
United States (US) and United Kingdom (UK)	0.84	96%	Online survey

**UOC ICR was unable to be conducted.*

±The agreement between ICR coders for Milan, Italy was 99.7%.

Once codes were assigned, we used descriptive and inferential statistics to analyze the codes. Descriptive statistics describe the data, such as providing a percentage breakdown, or the average number of people who reported the use of a technology. Inferential statistics make inferences about the data, such as using age and gender to predict use of a given tool. Inferential statistics can also be used to compare coding categories, such as if Emerging scholars are more likely to exhibit Visitor behaviors than Establishing ones.

> "One of the most surprising things for me was to realize that young students have a great spirit of cooperation among them instead of competition."
>
> **Eva M. Méndez Rodríguez**
> UC3M (Universidad Carlos III de Madrid)

A key aspect of inferential statistics is whether they are significant. How confident are we that what we are observing is due to our proposed explanation? How likely is it that an alternate explanation exists for what we are observing? Researchers require a significance level, or yardstick for significance, which tells them how confident they can be in their explanation for what they are observing. In this report, we use a significance level of $p < 0.05$, which is standard for the social sciences (For more on statistical significance, see Connaway and Radford 2017.)[11] By analyzing the statistical breakdown of the codes, we could identify patterns in the data describing how the participants got their information and engaged with technology.

Mapping Analysis

The mapping analysis stage of the project offers us the best way to locate participants' behavior on the V&R continuum. Trends and patterns emerge from the maps, showing the dynamics of individuals' engagement with technology over time. Since many of the techniques involved in the mapping analysis

are advanced—including programming and mathematics—those curious about the advanced techniques used can refer to appendix E. The other techniques discussed in this section are easier to implement and are helpful for analyzing and using the data generated from the mapping sessions.

> "I had hoped to learn how patrons feel about library platforms like our catalog, discovery layer and library accounts. HKU Libraries is introducing a new library management system and revamped discovery layer this summer. I hoped to learn how our patrons made use of these platforms in order to design the best and most intuitive service for them."

Melissa Man
HKU (University of Hong Kong)

Word Frequency Analysis

A simple way to extract interesting information from maps is to temporarily set aside the shapes themselves and only consider their labels. This is straightforward to do with vectorized maps (i.e., maps that have been rendered readable to the computer), but can also be done with raw map images by creating a computer-readable table, or spreadsheet, that lists the labels that are shown within each map. When participants draw maps, they make a shape and then label this shape with a specific technology (e.g., Google) and/or activity (e.g., email). With such representation, we lose information about the geometry of the shapes and their precise locations on the maps, but it still preserves other, useful information.

This processing helps us get a sense of the variety of activities occurring within a group of maps, and how different groups of maps are similar, or vary. Additionally, it can be interesting to keep track of activities that tend to appear in more than one shape on a map. We call these multiple modes of engagement. Figure 3 shows a V&R map in which several activities were drawn using multiple shapes, indicating multiple modes of engagement among those activities.

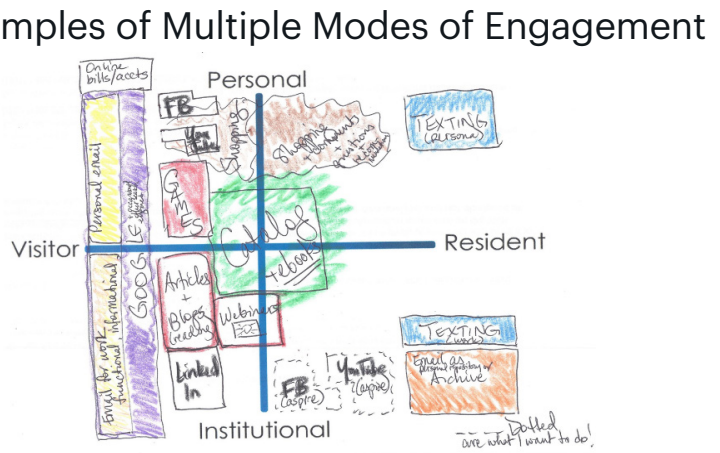


FIGURE 3. A map with several examples of multiple modes of engagement. Texting, Facebook, YouTube, and Email appear at multiple locations in the map, indicating multiple modes of engagement for those activities.

Another way to explore the data by word frequency is by creating histograms of the frequencies of reported activities. These histograms can reveal interesting trends. For example, figure 4 shows the top ten activities appearing within maps collected during exercises at UCLA and HKU, along with the occurrences of multiple modes of engagement. But histograms are just one way to get a sense of the salience of activities. Word clouds, such as the ones in figure 5, also helped us get a sense of the different kinds of websites and technologies used at UCLA and HKU.

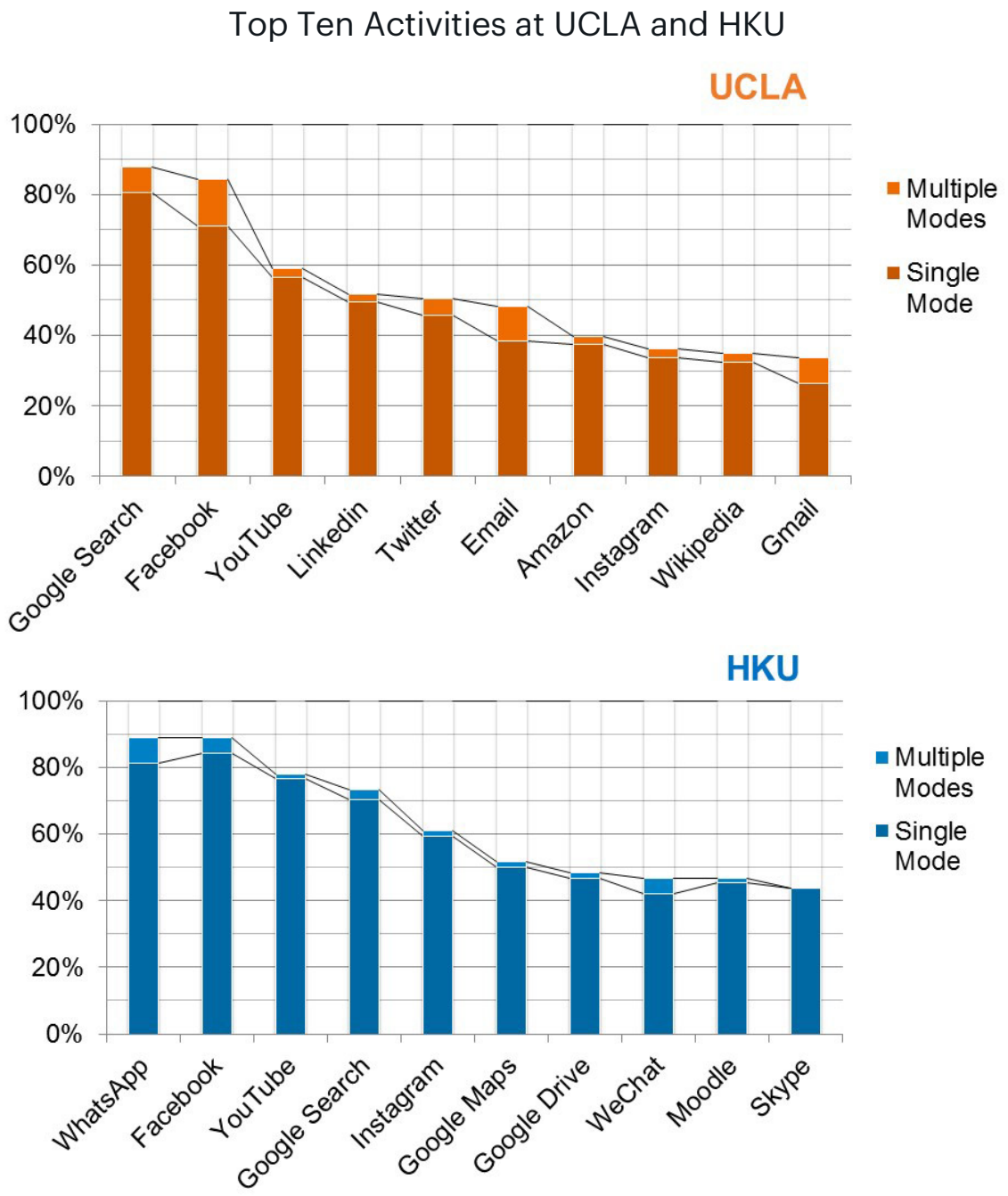


FIGURE 4. Top ten activities reported in maps collected during UCLA and HKU mapping exercises. The height of each bar is the percentage of participants reporting an activity. The caps at the tops of the bars indicate multiple modes of engagement.

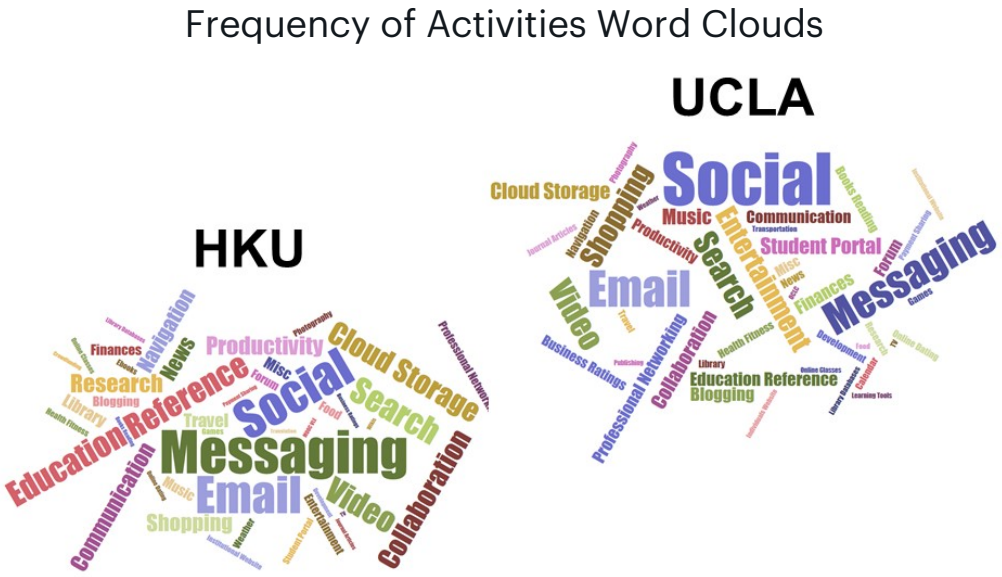


FIGURE 5. Word clouds based on the frequencies of reported activities within V&R maps at UCLA (left) and HKU (right).

Advanced Word Frequency Analysis

The word frequencies of maps also can help to determine how they differ from one another. There are many options available for finding these differences, from statistics (e.g., hypothesis testing) to machine learning (e.g., classifiers).[12] We settled on a technique from machine learning called a support vector machine (SVM). This algorithm assigns comparative weights to the features of different items to indicate how those features differentiate the items, and which item the feature best represents.[13] In other words, the algorithm allows us to determine which words on the map are most effective in distinguishing between various groups. For instance, perhaps the word “Instagram” is used in most UCLA maps, but used very infrequently in HKU maps, demonstrating that UCLA participants indicate using Instagram more than HKU ones.

While the description of the algorithm sounds a bit daunting—and the math certainly can be—there are several SVM implementations available online for free that can help ease the process of experimentation. Two widely used machine learning kits that include SVM algorithms include scikit-learn[14] and Apache Spark MLlib.[15]

To use SVM with our maps, we first transformed each map into a term vector. A term vector simply represents the unique terms used in the maps we want to explore, and the amount of times each term was used. Each amount is indexed with its unique term, based on its position within the term vector. To make sure that terms were unique, such as “Facebook,” “Face Book,” and “Browsing Facebook,” we used two techniques, called term normalization and stemming, to compensate for variations in spelling and phrasing. As a simple example of a term vector, first imagine we have a collection of very simple maps in which users have only drawnshapes containing the normalized terms “facebook,” “google search,” and “instagram.” To create a term vector for one of the maps, we count the number of times each of those normalized terms appears in the map, and store these counts in a list according to the alphabetical order of the normalized terms. For example, a map containing two shapes representing Google search, one

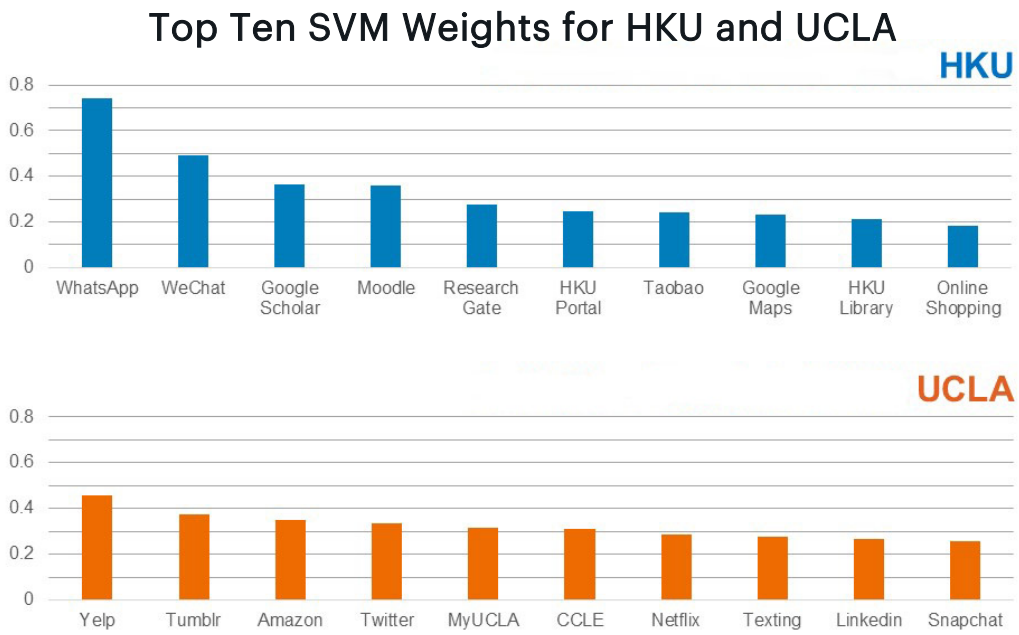


FIGURE 6. Top ten SVM weights, by magnitude, for differentiating between HKU (top) and UCLA (bottom) maps.

shape representing Instagram, and no shapes representing Facebook would be represented as [0, 2, 1]. The zero is because Facebook was not mentioned in the map. Both scikit-learn and Apache Spark MLlib contain APIs for easily transforming text data into term vectors.

We then trained an SVM on these vectors, and inspected the SVM weight calculated for each term (activity) that occurs in our set of maps. The magnitude of a weight (which can be between 0 and 1) indicates how important its corresponding activity is in differentiating between two sets of maps, and the sign of a weight (either positive or negative) indicates which of the two groups the activity better represents. Figure 6 shows the SVM weights of the activities that most distinguish maps drawn by HKU and UCLA participants.

The SVM weight analysis is just one example of how machine learning and statistical tools can be used to explore the differences between two or more sets of maps. As another example, we trained a decision tree classifier to differentiate between maps drawn by a group of 30 students and nine librarians from UCLA, and 44 OCLC Global Council Members.[16] In the context of our work, a decision tree classifier (available in scikit-learn and Apache Spark MLlib) is an algorithm that takes a map as input and guesses whether that map was drawn by a librarian or a student, based on the shape labels that are found in it. The algorithm makes its best guess by answering a cascade of questions that it learns based on training data. Figure 7 below reveals the results.

In this figure, there are a list of labels used by librarians and students that were deemed by the decision tree algorithm as most important in differentiating the maps by whether they were created by one of the two groups. In this way, the decision tree algorithm is like the SVM previously overviewed. However, where the decision tree differs from SVM is that it asks whether the presence of each label on a map is more indicative of that map being drawn by a librarian or a student. Often, the decision tree needs to ask more than one question to decide. As an example, the top of the figure asks if Snapchat is present on the map. The position of Snapchat at the top of the tree means that it is the most important feature. If the

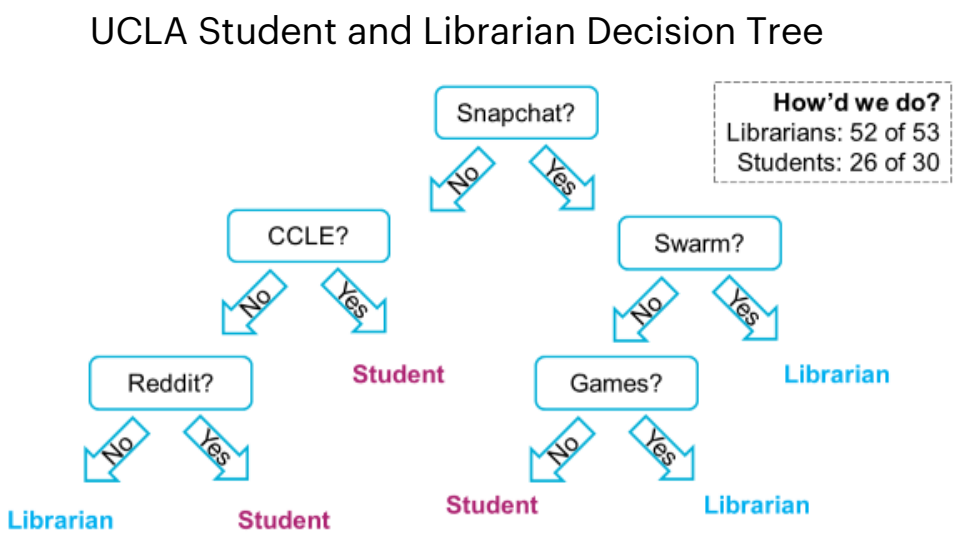


FIGURE 7. Fixed-depth decision tree classifier trained to differentiate between UCLA students and librarians.

decision tree sees that Snapchat is not present on the map, the tree then asks if CCLE, a student portal at UCLA is present. If that portal is present, then the decision tree predicts the map was drawn by a student. While we did expect CCLE to be an important feature in differentiating librarians from students, we did not expect Snapchat to be the most informative feature.

To find similarities between two sets of maps, we used calculations involving measurements of activity frequencies. For this analysis, we looked at the frequency of an activity's occurrence in one set of maps, and we multiplied it by its frequency in the other set of maps. So, if an activity is prevalent in both sets, its multiplied frequency will be large. Figure 8 shows the top ten activities in common between UCLA and HKU maps based on their multiplied frequencies.

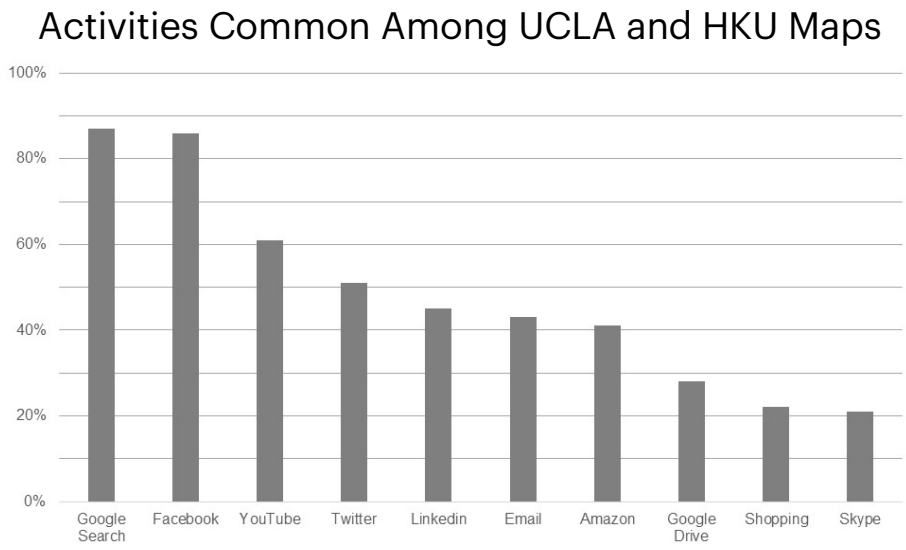


FIGURE 8. Activities common among UCLA and HKU. The height of each bar is the multiplied frequency of each activity within the two sets of maps.

Map Overlay Analysis

Next, we analyzed the geometric shapes and relative arrangements given to each activity by overlaying map images for comparison and contrast. One way to perform map overlay analysis involves using a graphics editor to trace the shapes in the map to make them machine-readable, also known as vectorization. Once the shapes are traced out in the maps, the map collections can be queried to find specific activities and to compare the maps to one another. By overlaying the shapes that people have drawn for specific activities, we can compare and contrast the modes in which people engage with that technology. By choosing an activity of interest, such as Google search, we can filter the maps to view only the shapes labeled Google search. We can then compile the shapes representing that activity to get an overall picture of how our participants engage with Google search. See appendix E for more information on how we vectorized our maps and additional advanced techniques for analyzing shapes.

Map overlays perhaps are the most convenient visual summary statistic that we used to better understand where our participants fall on the V&R spectrum. At the very least, these analysis techniques can help formulate interesting questions that allow a better understanding of the library's role in the lives of users.

> "One of our main findings is the one related with human side of digital information. In this sense, besides considering that people are useful as a source of information, we think that the increasing digitalization trend in the information world increases the need for users to have human-contact with information providers. Not only because the human provider can give good advice, but also because it seems people need human contact to find more meaning at the things they do. And also because it seems that an expert would always have the best information because he can provide more context and meaning to that information."
>
> **V&R project team member**
> UOC (Universitat Oberta de Catalunya)

Chapter 3. Findings: What Did We Learn?

Our findings from data collection and analysis using the V&R Framework identified several recurring themes:

- Humans are a valued source of information.
- Convenience is a priority when making decisions about what tools and sources to use.
- Context and situation influence behavior and decision making.
- Participants report extensive use of search engines, especially Google, and take them for granted.
- Wikipedia is used by individuals in all educational stages to familiarize themselves with a subject or topic.
- Library sources are used but not recognized or attributed to the library.

HUMANS AS A VALUED INFORMATION SOURCE

Participants often reported relying on human sources both FtF and digitally, for information even before they searched for information online. In these situations, they consult sources such as parents, friends, and teachers.[17] This is surprising since it exemplifies the importance of human resources and relationships, even in a technological, online environment, where it often is assumed that individuals rarely rely on information that is not digitally mediated, except for humans.

This finding is particularly important at UOC, which is an online-only institution. Here, despite performing academic tasks in online environments, participants denote the importance of connecting with their professors. It is vital for them to be supported by professors via email and other applications, though less so by video. Much like the UC3M and US/UK studies, UOC participants discussed the importance of having a person who can provide them with the information and sources they need. UOC researchers conclude that in an era where information overload is increasing, the use of human sources seems to have acquired more relevance.

Participants mentioned that they often value human sources because they mistrust information published online. Per participant UOCG3: “Regarding health affairs, I usually don’t search on Internet because… you have a pain on a finger and then you end up [thinking] you have bubonic plague…is not reliable…improbable things become sure. For this affair, I would use personal contacts.”

Of the types of human sources, all participant groups relied on friends and colleagues the most (55–85%). Following friends and colleagues, participants from the US, UK, and Italy (Unicatt) reported consulting peers, including classmates and faculty (if they were faculty members) in their area. Those from Madrid (UC3M) and Barcelona (UOC) relied more on non-librarian experts and professionals as compared to friends, colleagues, and peers.

Table 6. Human sources by countries/institutions semi-structured interviews

	US (N=37)		UK (N=36)		UOC (N=33)		Unicatt (N=20)		UC3M (N=38)	
Experts/Professionals	8	22%	12	33%	19	58%	4	20%	13	34%
Extended Family	16	43%	17	47%	2	6%	6	30%	10	26%
Father	14	38%	17	47%	3	9%	8	40%	4	11%
Friends/Colleagues	24	65%	24	67%	18	55%	17	85%	22	58%
Librarians	4	11%	4	11%	7	21%	3	15%	1	3%
Mother	18	49%	17	47%	1	3%	7	35%	7	18%
Other	10	27%	12	33%	6	18%	6	30%	17	45%
Peers	20	54%	17	47%	14	42%	8	40%	10	26%
Teachers/Professors	28	76%	26	72%	17	52%	12	60%	18	47%

When comparing participant engagement across educational stages, Emerging scholars (high school seniors and first year undergraduates) consistently depended on human sources more frequently across all contexts (i.e., institutional, personal), as compared to people from the three other educational stages. They also relied less on digital sources compared to the three other groups. Using parents as information sources is especially high among the participants in earlier educational stages. As stated in chapter 1, age does not determine educational stage, but it does positively correlate.

Table 7. Human sources by educational stage semi-structured interviews

	Emerging (N=60)		Establishing (N=33)		Embedding (N=33)		Experiencing (N=38)	
Experts/Professionals	23	38%	8	24%	12	36%	13	34%
Extended Family	24	40%	8	24%	5	15%	14	37%
Father	25	42%	8	24%	6	18%	7	18%
Friends/Colleagues	44	73%	22	67%	15	45%	24	63%
Librarians	7	12%	4	12%	1	3%	7	18%
Mother	31	52%	7	21%	7	21%	5	13%
Other	12	20%	10	30%	6	18%	23	61%
Peers	32	53%	15	45%	11	33%	11	29%
Teachers/Professors	48	80%	27	82%	17	52%	9	24%

As people age and transition to the higher educational stages, they report a decline in the use of human sources. One reason may be the emphasis on individual work in graduate school, before others recognize them as experts in their field. As they became more independent and immersed in their specialized areas of study, they may begin diversifying their pool of human sources. Establishing scholars, or upper-level undergraduates, for instance, also rely on human sources, but only in specific contexts, still increasingly turning to digital sources. This finding suggests that Establishing scholars are more discerning in their source use as compared to Emerging scholars. Previous project stages have had similar findings.[18]

> "The student's behaviors in both academic and personal settings are strongly influenced by their peers or friends, as well as by the environment in which they interact. Regardless the age or the course they are undertaking, if their colleagues at the classroom or other friendship context use one or another social network, they will also use it, even if they are not happy with it, or the technology does not meet all their communication needs."
>
> **V&R project team member**
> UC3M (Universidad Carlos III de Madrid)

While Emerging participants report high reliance on human sources, Experiencing participants (faculty, researchers, and scholars), report the highest levels of digital source use. Further, Experiencing participants reported successful search interactions when using digital sources. These findings reject Prensky's digital natives and immigrants metaphor, which hypothesized that older individuals are not proficient with digital technologies. Our findings suggest that individuals who are Experiencing scholars, and tend to be older, not only use digital sources frequently, but exhibit proficiency in using these sources, as shown by their successful search interactions.

Table 8. Sources by educational stage semi-structured Interviews

Source	Emerging (N=60)		Experiencing (N=38)	
Databases	11	18%	23	61%
E-books	19	32%	20	53%
Online Textbooks	8	13%	8	21%
University Databases	17	28%	16	42%
University Websites	18	30%	13	34%
Wikipedia	46	77%	23	61%
Father	25	42%	7	18%
Friends/Colleagues	44	73%	24	63%
Librarians	7	12%	7	18%
Mother	31	52%	5	13%

Social media proved a way for participants to communicate with other human sources. However, the type of use varied according to the participant's location. For instance, participants in the US, Madrid (UC3M), and Italy (Unicatt) reported less Twitter use than those in the UK and Barcelona (UOC). On the other hand, participants from the US, UC3M, and Unicatt use Facebook for many of the same activities as those in the UK and UOC do on Twitter. Social media platforms are used primarily as a general source of information for hobbies or news rather than in institutional situations, such as at work or at school. These sites still are used institutionally by students to share information and help one another with their assignments, melding institutional and personal situations. As all participants advance in their educational stage, they use social media less. Participants base their motivations for the use of specific social media platforms on whether friends or colleagues use them, rather than any intrinsic properties of the technologies.

"Given the amount of time that students spend in social media platforms and specific campus collaboration platforms, it would be nice if we had a specific person or team devoted to marketing and outreach to ensure that library information is distributed strategically and effectively via those channels, especially."

Allison Benedetti
UCLA (University of California Los Angeles)

Participants also use a variety of digital sources to keep in touch, based on with whom they are connecting and why they are connecting with them. US and UK participants surveyed in 2011 and 2013 reported an increase in their use of visible messaging, such as posting publicly on a person's Facebook wall, to stay in touch. While they keep in touch via email, their use of other forms of electronic communication have decreased, including IM/chat, media postings, phone calls, private messaging, and texting. One exception to this finding is UOC, where participants do not rely on email at all, and instead use media postings, such as a status update on Facebook or a tweet on Twitter. This finding suggests the importance of context, in this case geographical context, in shaping modes of engagement.

Table 9. Contact by first and second round emerging interviews

Contact	Emerging First Round (N=31)		Emerging Second Round (N=12)	
Email	25	81%	10	83%
Visible Messaging	12	39%	7	58%
IM/Chat	16	52%	3	25%
Media Posting	5	16%	0	0%
Phone Calls	26	84%	7	58%
Private Messaging	25	81%	6	50%
Texting	28	90%	8	67%

While not social media tools, virtual learning environments (VLE), and course management systems (CMSs) facilitate communication between students, faculty, and course content online. We observed an increase in use of VLEs and CMSs among non-US participants. This increase is likely reflective of an international push toward online learning environments (e.g., massive open online courses—or MOOCs), whether as a supplement to in-person courses or to support distance learners. VLEs were shown to be used less by 12- to 18-year-olds than by any group except the 55 to 64 group. VLEs are much more prevalent in higher education (particularly at online-only UOC), so this finding is not surprising. Coursera, edX, and Udacity were all launched the year these data were collected and have all become critical players in the online learning landscape creating greater awareness and adoption of MOOCs by universities and students alike.[19]

Table 10. Contact by educational stages

Contact	Emerging (N=43)		Establishing (N=10)		Embedding (N=10)		Experiencing (N=10)	
Email	35	81%	10	100%	10	100%	10	100%
Face-to-face	26	60%	6	60%	4	40%	7	70%
IM/Chat	19	44%	3	30%	4	40%	1	10%
Media Posting	5	12%	3	30%	2	20%	1	10%
Phone Call	33	77%	9	90%	7	70%	7	70%
Private Message	31	72%	5	50%	4	40%	1	10%
Texting	36	84%	8	80%	7	70%	5	50%
Video Chat	14	33%	1	10%	7	70%	3	30%
Visible Messaging	19	44%	4	40%	3	30%	1	10%

CONVENIENCE AS A PRIORITY

Regardless of context, participants want to get information instantly and effortlessly, thereby reporting convenience as a priority. This finding supports results from prior research from OCLC, in which participants at all age groups report convenience as the primary motivator in performing information searches.[20]

Among survey participants, convenience was a driving factor in respondents' choice of sources, except in situations where participants struggled to locate information to complete personal tasks. Here, Embedding participants, who are graduate/postgraduate students, relied equally on convenience and authority/legitimacy. For tasks in which participants engaged in satisficing (or accepting the most convenient source that meets their need), the majority used digital sources.

One interesting fact we observed is that participants' choice of source does not vary based on whether the outcome of a search is successful or unsuccessful. The survey participants tend to stick to a source regardless of their history of success with it. This finding suggests that individuals keep using sources perceived as convenient, even if they may not be the best options for the information needed. The individuals are demonstrating satisficing – using a source even though it may not be the best option in order to complete a task or get information that is "good enough."[21]

Table 11. Convenience by semi-structured interviews

Location	Convenience (n)	Convenience (%)
United States (US) (N=37)	33	89%
United Kingdom (UK) (N=36)	30	83%
Madrid, Spain (UC3M) (N=38)	35	92%
Barcelona, Spain (UOC) (N=33)	30	91%
Milan, Italy (Unicatt) (N=20)	19	95%

The interviews gave us more granular insight into how participants' desires for convenience motivate their choice of information sources. Once the need for convenience is met, people then choose the best sources for the information needed. How do participants balance this value of convenience with the risk of

not discovering the best sources for the information? They obtain a lot of results so that they have multiple sources for selection. Although convenience is less of a motivator for participants in higher educational stages who place greater value on the best sources, which may be attributed to the academic rigor demanded of their work, convenience does remain a factor.

Although participants rely on digital sources, many participants say they are wary of the quality of digital sources, mentioning a preference for other types of sources, either because they believed them to be of higher quality or because they preferred the experience of using them. However, all participant groups report convenience, ease of use, and accessibility as key motivations underlying their selection of digital sources (83–95%). Participant UOCG3 illustrates this link between digital sources and convenience: "When I learned to make béchamel sauce, my mother would have taught me gladly, but she was not available, so I searched on [the] Internet…I searched for a good video."

Not all participants envision online sources as lower quality than human ones. Participant UOCFE6 views online sources as intertwined with human ones: "I used to seek information in Wikipedia, even my colleagues said that there are wrong things on it…but I said Enciclopedia Larousse [Traditional encyclopedia] also have mistakes…the only difference is that it is printed and is impossible to correct the mistakes once you have the printed version…Mistakes are not about technology, [they] are about people."

The desire for convenience also might contribute to UC3M participants' high use of smart devices. These participants reported that smart devices were critical technologies in their personal and institutional lives. One of the reasons participants gave for using smart devices is that they can access information from anywhere at any time—essential elements of convenience.

IMPORTANCE OF CONTEXT AND SITUATION

Context and situation shape how participants engage with information using digital technologies. We define context here as a state, or condition, with specific attributes, while a situation is an event. An example of context would be where a person is geographically located, while an example of a situation is an event where a person moves locations.

Context and Situation

We divided context into three categories of differences: cultural, social, and time-based. Each of these categories includes events or situations that affect how people engage with information.

> "As to the findings during the interviews, I was pleasantly surprised to note that young researchers or students were well aware of the potentialities and 'dangers' when using technology. They were not naïve or too enthusiastic about technology especially at personal level. It was also pleasantly surprising to see they were interested in the results and follow up of this project."
>
> **V&R project team member**
> Unicatt (Università Cattolica del Sacro Cuore)

Differences among how participants reported getting their information could be attributed, in part, to cultural context. At UOC and UC3M, privacy concerns were more prevalent than reported by participants in the US, UK, or Italy. The UOC and UC3M participants reported making more of an effort to prevent the

spread of their information online, although they may consider it too difficult to engage in privacy-protecting measures. In Barcelona, privacy-related trends were extreme. Either participants did not engage in any privacy protecting measures or they abstained from using certain online resources because of privacy concerns.

It is worth noting that UOC participants attend an online university and consequently work in a different environment from participants in other places. They are reticent to post identifying information due to their perception that others are surveilling them. Per participant UOCFE7, "I don't like to post in social media my opinions or personal things…I think that [Internet] has enough information about us, both professional and academic, so, is enough." In comparison, participants from Unicatt did not express the same privacy concerns for information sharing. This may be attributed to the fact that Unicatt offers face-to-face classes and at the time the interviews were conducted, the library could not be accessed from home or outside the university system; therefore, there may be little concern for privacy in a more closed environment. UOC, on the other hand, is completely online and all information and materials are shared within the university's digital library. The dependence on virtual spaces may make individuals more aware of the risks of providing and using information in the online environment and instill the desire for more privacy in this environment.

Another cultural difference identified is the participants' use of technologies. For example, participants from Spain and Italy use tablets much more than the participants from the US and UK. However, this observation may not be an entirely cultural difference, since the US and UK studies were carried out earlier than those overseas, and tablets have become more affordable over time. In fact, the use of tablets increased in the UK and US between 2011 and 2013 and has become more similar to tablet use in Spain and Italy.

> "Perhaps I would have expected to know how the subjects feel themselves in relation to the other students when they do not know how to use a tool. Would have been interesting to know if they were calm because their companions did not know the answer or the procedure too, or that situation caused them insecurity or rage."
>
> **Daniel Lozano**
> UC3M (Universidad Carlos III de Madrid)

Cultural differences emerged when participants discussed how the amount of information available can influence the amount of time they spend selecting sources. For instance, participants from Barcelona (UOC) and Italy (Unicatt) value quantity more than those from the US, UK, and Madrid (UC3M). Participants from the latter groups appear to engage in satisficing behavior because of perceived information overload. Some participants from each of the geographic locations mentioned that they do not want to be inundated with too much information, but that they do want high-quality information. Per participant UOCU7, "I prefer to have less information, but to be sure about 90% that the information is true."

Participants report being lazy as another motivation for source selection, suggesting that they might not always take the time required to vet an information source. Laziness also may be related to convenience, i.e., individuals see themselves as lazy by taking the most convenient action at the time. The results indicate that laziness is mentioned more by the UOC participants (an online-only

university) than the participants of any other institution. This could be based on the digital library that is available within the course management system at UOC, which facilitates accessing online sources and may diminish the need or desire for students and faculty to search for information outside of this online environment.

Social context also affects people's engagement. For participants, technology use is not determined by what is the best tool for the job, but rather is shaped by context, a finding also reported in outside sources.[22] Key contextual factors shaping UC3M participants' choice of technologies or sources are the participants' social networks," which is supported by the participants' reported high use of human sources. While individuals may not like using Facebook to discuss academic assignments, they will use this network if other colleagues or friends use it. An implication of this finding is that we cannot prescriptively state that a given technology is best suited or ill-suited for a task. Instead, we must consider how contextual factors such as social networks and time shape people's selection of a given technology. The online participant survey supports this finding.

Time is another key contextual factor. As new technologies emerge, and people interact in their social networks, the technologies, networks, and sources they consult change. As participants advance through the educational stages, they do become more discerning in their choice of tools and sources. Findings from the US, UK, and UOC interviews denote that participants at more advanced educational stages reported higher database use. The participants in the advanced educational stages may report using institutional databases more than those participants in their earlier educational stages because those in the higher educational stages are familiar with and able to identify these databases and realize their utility. However, individuals in earlier educational stages may be using these databases without recognizing that they are university resources. Cultural context and university sources and policies also may interact with time to shape source utilization and adoption. Unicatt students in their early educational stages utilized and adopted new technologies, networks, and sources faster than those at other institutions.

> "The students are completely unaware of the resources that the university has in repositories, databases, etc. on their subjects. Most of the interviewees do not know the possibility of consulting books in full text, being able to develop bibliographies or access remotely the funds using virtual contexts of the campus of its university. Although some of them know how to use specialized databases, they often turn to general search engines because 'it's faster and I know I'll find it quicker.' If the university has not had a particular resource, they do not hesitate to find another way to get it (Sci-Hub)."
>
> **V&R Project Team member**
> UC3M (Universidad Carlos III de Madrid)

Unlike context, situations are events rather than states. In our research, we used situation to represent specific events in an individual's personal or institutional lives that motivated their modes of engagement. For example, the use of physical sources among students is particularly frequent in situations with high-complexity tasks. High-complexity tasks are those that cannot be addressed by asking one question or by using one tool or source, but instead require multiple questions and rely on a

combination of tools and sources. One of the reasons participants relied on physical sources is because they believed that they retain the material better when using them. Even UOC participants, who complete academic tasks in a digital environment, stated that they can study better with a printed version of the information.

Age

For the online survey, we were interested to see if contextual demographic factors like one's age or gender had a direct, measurable effect on modes of engagement.

To make this determination, we needed to come up with a way to predict a participant's position on the V&R/P&I continuum. To do this, we coded 250 randomly selected survey excerpts as either Visitor, Resident, a combination of both, and Personal, Institutional, or a combination of both. Then, we used a series of statistical models to predict a participant's position on the V&R/P&I continuum. The models chosen used the text of the survey responses to predict this position. Table 12 illustrates the models and their results. The percentages indicate the median accuracy in predicting a participant's position on each continuum.

Table 12. Model performance on V&R and P&I continuum predictions

Model	Decision Tree	Naïve Bayes	Logistic Regression
V&R	62%	66%	63%
P&I	75%	66%	74%

The results of these tests have low median accuracy rates. In other words, machine learning techniques weren't able to accurately classify individuals because of the various external contextual factors that affect engagement. There are too many external variables beyond the content of survey responses that influence a participant's position on the V&R/P&I continuum.

We also ran pivot tables using the 250 survey excerpts we coded to determine how well the variables of age, educational stage, and gender correlated with these data. Our findings show that it is not straightforward to determine which variables predict an individual's position on the V&R/P&I continuum.

Based on these two findings, there are too many external factors beyond the demographic information that shape modes of engagement to create a model that predicts modes of engagement. Findings from UOC interviews also denote that age is not a determinant factor for technology use.

While age does not have a direct influence on an individual's modes of engagement, we do see some commonalities and differences when comparing age groups. Participants across all age groups report consistent use of digital technologies, specifically computers and smartphones. Use of physical tools, including handwritten notes, organizers, and planners, appears to be more prevalent among older age groups. However, the youngest age groups also report high use of these sources. The age groups reporting the least use of physical tools are between the ages of 35 and 44 and 45 and 54. Older individuals (55 and older) may use physical tools more often given their high comfort levels with using planners, organizers, and handwritten notes. These are familiar tools that work well for them. The data indicate that individuals do not adopt every new technology but retain those technologies that work for them and that are familiar and comfortable for them to use.

Table 13. Age ranges

	12-18 (N=26)	19-25 (N=61)	26-34 (N=27)	35-44 (N=29)	45-54 (N=17)	55-64 (N=3)	64+ (N=1)
Computers	73%	95%	100%	93%	94%	67%	100%
Print/Pen/Paper	65%	89%	74%	52%	59%	100%	100%
Tablets	31%	57%	70%	69%	65%	67%	100%

EXTENSIVE USE OF SEARCH ENGINES

Participants report an extensive use of search engines as information sources, especially Google. While participants do report high usage of Google, participants from UOC and UC3M said they do not necessarily believe that Google provides the best information for either personal or institutional information needs. Experiencing scholars reported the highest frequencies of search engine use when describing unsuccessful academic information-seeking situations. Even though Google may not be successful, it is perceived to be the easiest way to obtain information. Since convenience trumps other motivational factors in shaping modes of engagement, participants report a high use of Google, even if it does not provide them with the desired results. Findings from UC3M and UOC indicate that most students are unaware of the advanced search features included with general search engines and displayed a high confidence that prevented them from questioning the engines' limitations.

DEPENDENCY ON WIKIPEDIA

Like search engines, participants frequently use Wikipedia, but this varies based on location and age. We found a decrease in Wikipedia use from those age 12 to 18 to those age 45 to 54, and those age 55 and above rely on Wikipedia more. Participants from the US, UK, and UOC reported the highest use of Wikipedia. Participants from UC3M relied more on university websites and less on Wikipedia compared to participants from all other countries. Wikipedia use also appears to have increased over time among US and UK participants. Findings show that US and UK students at the Emerging educational stage consider Wikipedia an unapproved source by their teachers and professors, but they still use this source, at least to get background on assignments. Other studies have also observed that students often rely on Wikipedia for background information before moving to other sources.[23] We learned that those in the earlier educational stages rely heavily on Wikipedia but are reluctant to admit it because they believe that teachers, professors, and tutors do not allow them to use it as a source.

NON-RECOGNITION OF LIBRARY SOURCES

A significant finding is that students from all groups rarely mentioned consulting librarians as sources when seeking information. In all contexts, the frequency of search engine use outnumbered use of social media and the library. Over time, US and UK students reported decreasing use of all types of libraries, but increased use of academic libraries. Of all participant types, faculty mentioned librarians the most, yet the proportion of these mentions is less than 50%. In terms of geographic location, the Italy (Unicatt) group reported consulting librarians the least, and the Barcelona (UOC) group consulted librarians the most.

The library and librarians seem to be more important for participants in later educational stages. Participants age 45 to 54 reported the highest use of librarians. At UC3M, the library plays an important role for students in their final years of an undergraduate or graduate program, but students beginning undergraduate studies prefer other information sources. The US/UK interviews echo this finding, where Establishing scholars reported the highest use of librarians as information intermediaries.

Aside from participants in Madrid (UC3M) (26%), all other groups reported moderate to high use of their academic libraries (56-88%). It is likely that the participants use libraries as places to work or collaborate, rather than as a source, given the low reported frequency of consulting librarians as sources for information-seeking tasks, with participant UOCG3 stating, “In fact, I don’t know how the Library works, but I think that Google must do it better.”

UOC participants indicated using the academic library more than the other participants and mentioned consulting librarians slightly more often. UOC is an online university where the learning management system integrates the academic library and embeds librarians in the digital learning environment. For this reason, students rarely visit the library website and, when they do, find it to be confusing. When they need information to which the Virtual Classroom does not link, they use other technologies—namely Google and Wikipedia. Faculty and students at UOC also report the importance of the library when gaining access to full text.

Use of the physical library appears to be shaped by collaboration. That is, more advanced students envision the library as a physical place to study and collaborate with others. As students are assigned more tasks that require collaboration, such as group projects, or a complex final study, they then begin to use the library. Even at a higher educational stage, students only view the library as a physical place. They do not consider the role of librarians as information intermediaries nor the sources the library has or how to use them.

Students from Unicatt, UC3M, as well as those at the Emerging, Establishing and Embedding stages of education in the US/UK interviews, also indicated a limited perception of the library and the services it provides. These participants envisioned the library mainly as a physical repository for books.

Comparatively, individuals at the highest educational stage, Experiencing, did not discuss the library regarding books. This observation “may be attributed to the increased range of experiences that faculty has with the library and in particular their first-hand experience with requesting and using electronic sources provided by the library.”[24]

PARTICIPANT MAPPINGS

The data we collected from participant mappings provides more nuanced information about participants’ engagement with technology than with interviews and the online surveys. Since the mapping tool allows the collection of large data sets, systemic data analysis would be extremely intensive and time-consuming. Instead, the purpose of the tool is for researchers and practitioners to collect rich data about their users and then analyze the data based on questions relevant to them. For this reason, we provide four case studies that indicate how the mapping tool can help researchers and practitioners better understand the behaviors of library users and potential users.

In the first case study, we compare the use of various online technologies by participants from HKU. For example, WhatsApp, a Facebook-owned messaging, calling, and video chat app, is highly used at HKU: 67% of participants included WhatsApp on their maps (see the top left map in figure 9). We also found that, while participants drew their usage of other online technologies in both Resident and Personal quadrant, WhatsApp usage was mapped across the spectrum. This observation indicates that participants used WhatsApp in multivalent contexts, rather than a specific context, which was indicated for the use of most other online technologies.

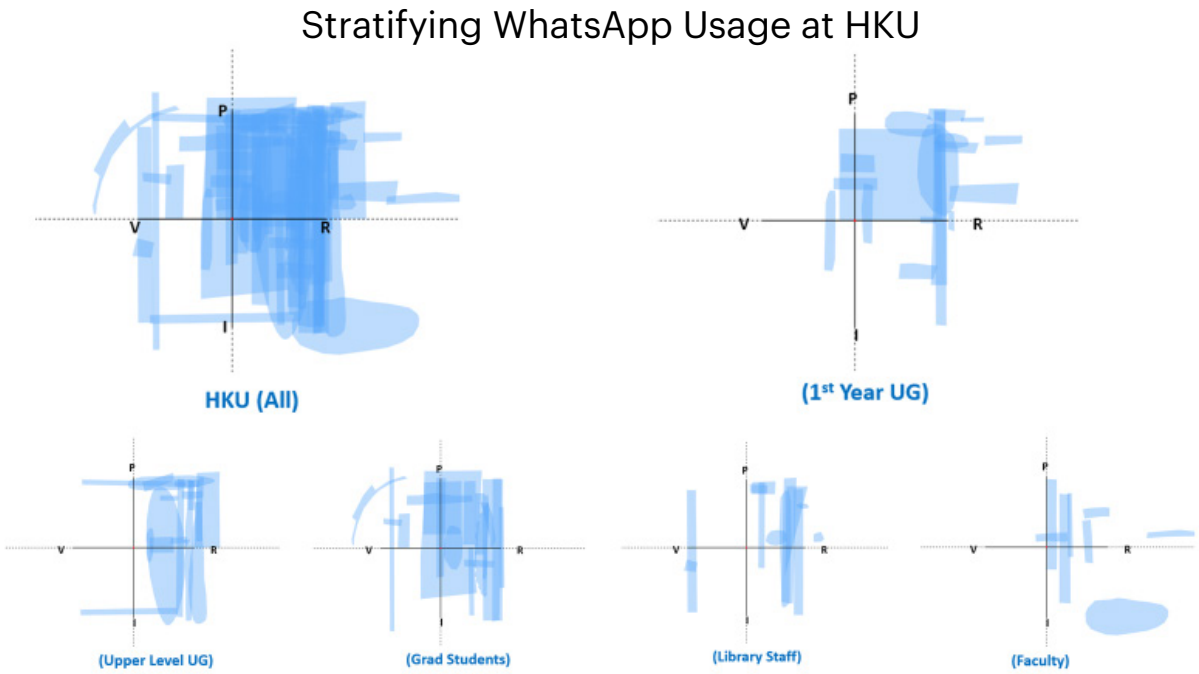


FIGURE 9. Stratifying WhatsApp usage at HKU. (Top left): WhatsApp usage of all HKU groups. (Top right): Usage among 1st year undergraduates; note the lack of institutional use. (Bottom row): The other groups tend to use WhatsApp in both Personal and Institutional situations.

Further delving into WhatsApp usage, we can see that it appears heavily documented in both the Personal and Institutional quadrants of the maps as resident behavior, which suggests that participants are making their thoughts and actions visible in this social media environment regardless of context. However, WhatsApp usage is not standard across educational levels. When we analyze the usage of WhatsApp by the type of participant, we find little institutional use from Emerging students. As participants progress in educational stage, they begin to use WhatsApp in institutional settings. Upper-level undergraduate students use WhatsApp as residents in both personal and institutional settings (see the lower-left map in 9). There is a greater resident-institutional usage of WhatsApp by graduate students. This usage may be attributed to the use of HKU libraries' WhatsApp-a-Librarian service. Library staff and faculty show an almost even distribution of Resident use in Personal and Institutional situations (see the bottom right maps in figure 9).[25]

We also compare WhatsApp use to WeChat, a Chinese social media and messaging app. WeChat is used by many HKU library participants. Some of the difference in use may be explained by an observation made by an HKU graduate student, who mentions that WeChat is used more in Mainland China and WhatsApp is used more in Hong Kong. This student also drew WhatsApp and WeChat in the same box/shape, suggesting that she sees the two messaging apps as equal and interchangeable (see left map in figure 9). This finding suggests that HKU librarians should consider integrating a WeChat-a-Librarian service as an extension to their existing WhatsApp-a-Librarian reference service— a finding also supported by prior research.[26] However, more in-depth data collection and analysis would be needed before implementing this recommendation since contradictory cases exist. For instance, an HKU faculty member placed WeChat in Personal/Visitor and put WhatsApp in Resident/Institutional. So, there is some suggestion that some people use WeChat and WhatsApp for different purposes, and thus do not envision them as synonymous for integration into virtual reference services (see right map in figure 9).

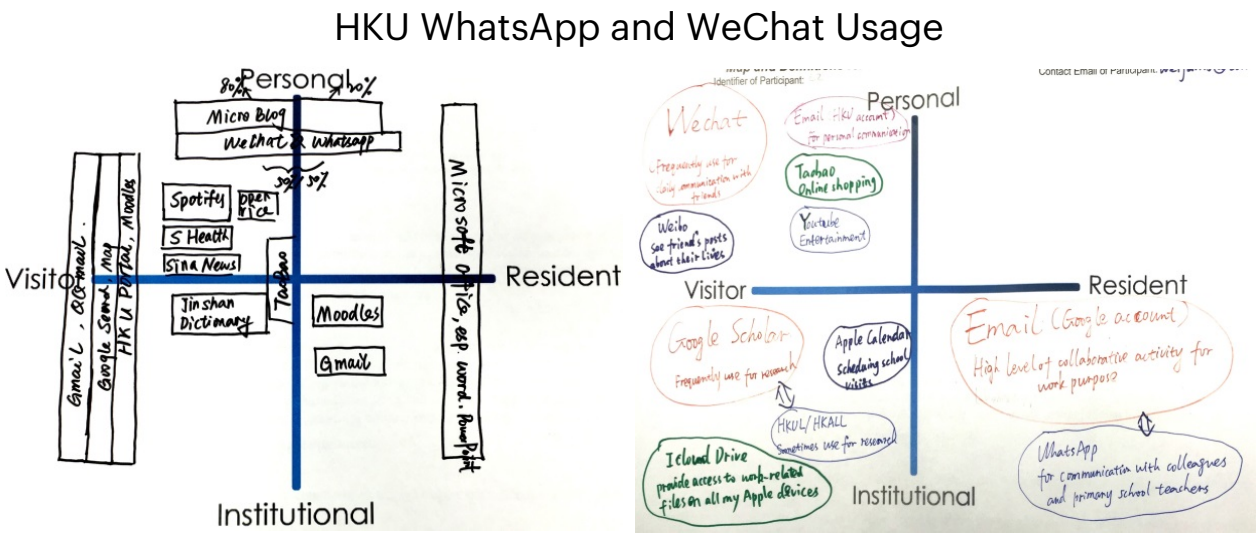


FIGURE 10. HKU WhatsApp and WeChat usage.

In our second case study, we compare the use of YouTube, an American video-sharing app, and Wikipedia among HKU and UCLA participants. In HKU, YouTube was more popular than expected. It is clear from the following maps and interview notes that YouTube is being used for a variety of reasons, including teaching and learning. "YouTube use tends to cluster in the Visitor/Personal quadrant with some institutional use at both HKU and UCLA. YouTube was the third mostly frequently reported site/activity for HKU users."[27] However, there also is considerable institutional use. HKU libraries have a YouTube page where library staff upload videos to introduce library resources, services, programs, and events.

> "At HKU YouTube is ranked even higher than Google Search (YouTube is third and Google Search is fourth). This suggests that users are turning to YouTube for information. We should consider creating informative YouTube videos to serve this purpose. For example, we could create YouTube videos to introduce the new version of our Primo discovery layer which our patrons will be using beginning this summer."
>
> **— V&R project team member**
> HKU (University of Hong Kong)

Figure 11 overlays YouTube shapes drawn by HKU and UCLA participants, allowing us to make a direct comparison between institutions. HKU participants tend to engage with YouTube as a Resident more frequently than UCLA participants. The dotted portions of the coordinate axes indicate parts of the overlay in which individuals drew shapes beyond the edge of the map template. UCLA participants stayed within bounds, and HKU participants more frequently drew outside of the defined coordinate space.

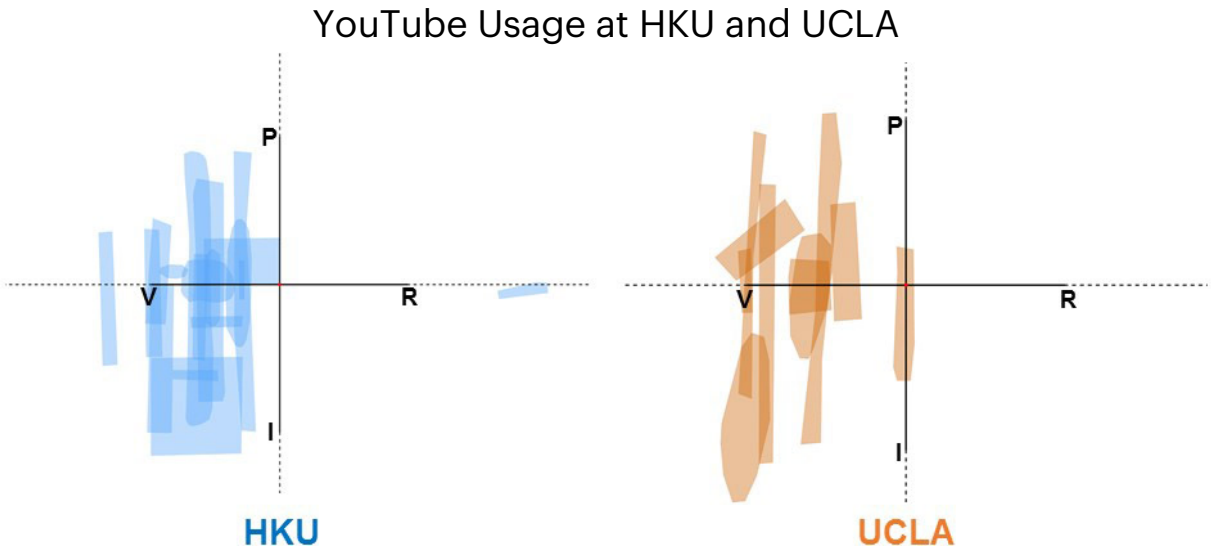


FIGURE 11. YouTube shapes drawn by HKU and UCLA participants

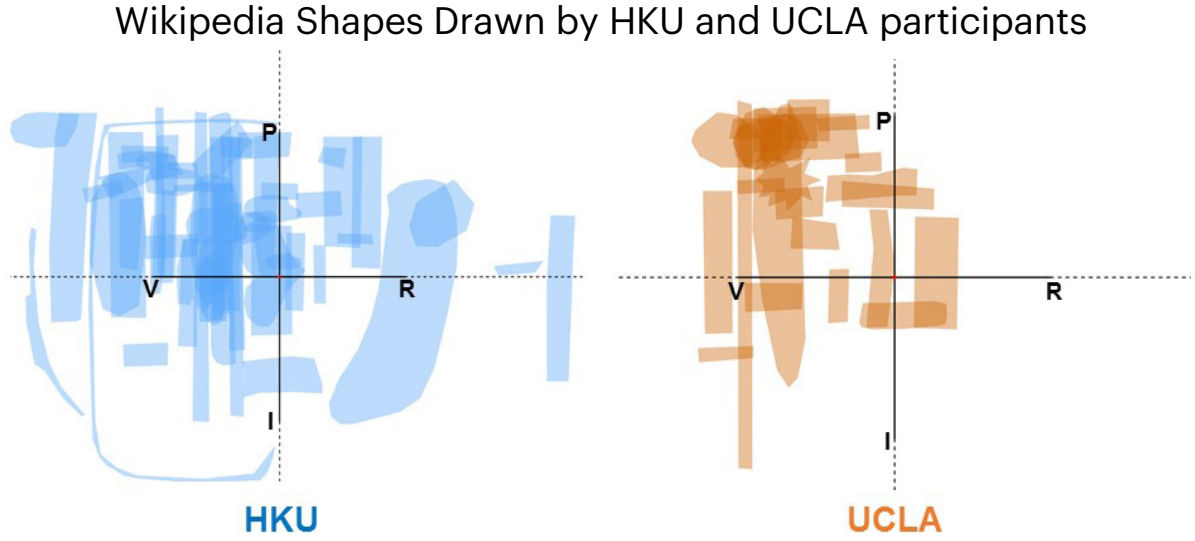


FIGURE 12. Wikipedia shapes drawn by HKU and UCLA participants.

Figure 12 compares Wikipedia usage at HKU and UCLA. Visually, Wikipedia engagement at the two institutions appears to be similar, though the HKU overlay contains what may be a shape drawn by a Wikipedia editor at the extreme end of the Resident spectrum.

Sometimes, the two groups have map overlays that are strikingly different across all activities. As an example, in our third case study we investigate the differences between maps created by librarians at UCLA, and a combined pool of both Pitt and CMU librarians. We found that, as a general trend, UCLA librarians reported very few activities on the Resident side of their maps (see figure 13), indicating the librarians do not perceive themselves as being Resident in the use of many technologies. This could be beneficial to the UCLA librarians when developing programs and services and acquiring resources by

being aware of how engagement varies among individuals. This sort of observation is much easier to make when map images are normalized and overlaid with each other, but even the normalization alone can highlight these kinds of patterns.

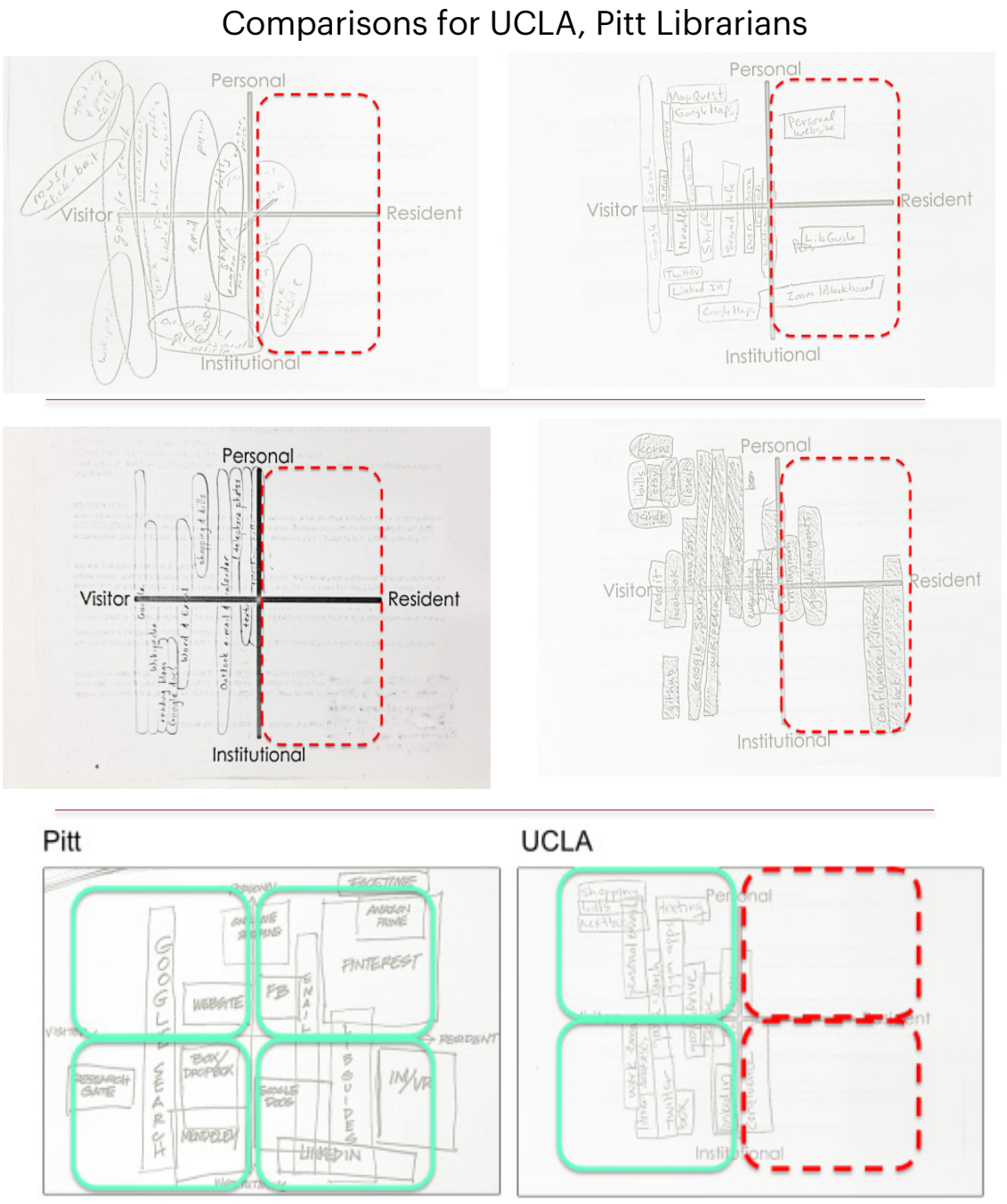


FIGURE 13. (Top two rows): Examples of maps drawn by UCLA librarians. Their maps tend to be relatively vacant on the Resident side. (Bottom row): A comparison between maps drawn by a Pitt librarian (left) and a UCLA librarian (right). The four map quadrants are shown in color; note the emptiness of the Residents quadrants of the UCLA map.

In our fourth case study, we train a decision tree algorithm to differentiate between maps drawn by UCLA students and librarians and OCLC Global Council Members. Recall from Advanced Word Frequency Analysis in chapter 2 (page 24) that the decision tree algorithm attempts to predict which group a map came from by asking a series of yes or no questions about specific technologies. In the first decision tree, all activities within the two sets of maps were considered. Snapchat emerged as the most important predictor for distinguishing between librarian and student maps. Students included Snapchat on their maps, while librarians did not. CCLE, the UCLA student portal, ranked right behind Snapchat as an important differentiator. This was slightly surprising since CCLE is a student-specific technology. The first decision tree correctly predicted 78 out of 83 maps, including 52 of 53 librarians and 26 of 30 students. Interestingly, only five activities and a maximum of three questions were necessary to predict a significant portion of our sample. Figure 14 shows the results.

As an experiment, we reprocessed the maps and excluded CCLE from the decision tree. Because CCLE, as a student-specific technology, was an obvious indicator, we wanted to find out what other technologies might distinguish librarians from students. This exclusion meant that the decision tree needed to find other labels that differentiated student maps from librarian ones. By excluding CCLE, we found that Spotify took its place in the decision tree and may be considered another important differentiating feature, one that was not apparent from the first decision tree. Removing CCLE from consideration only slightly

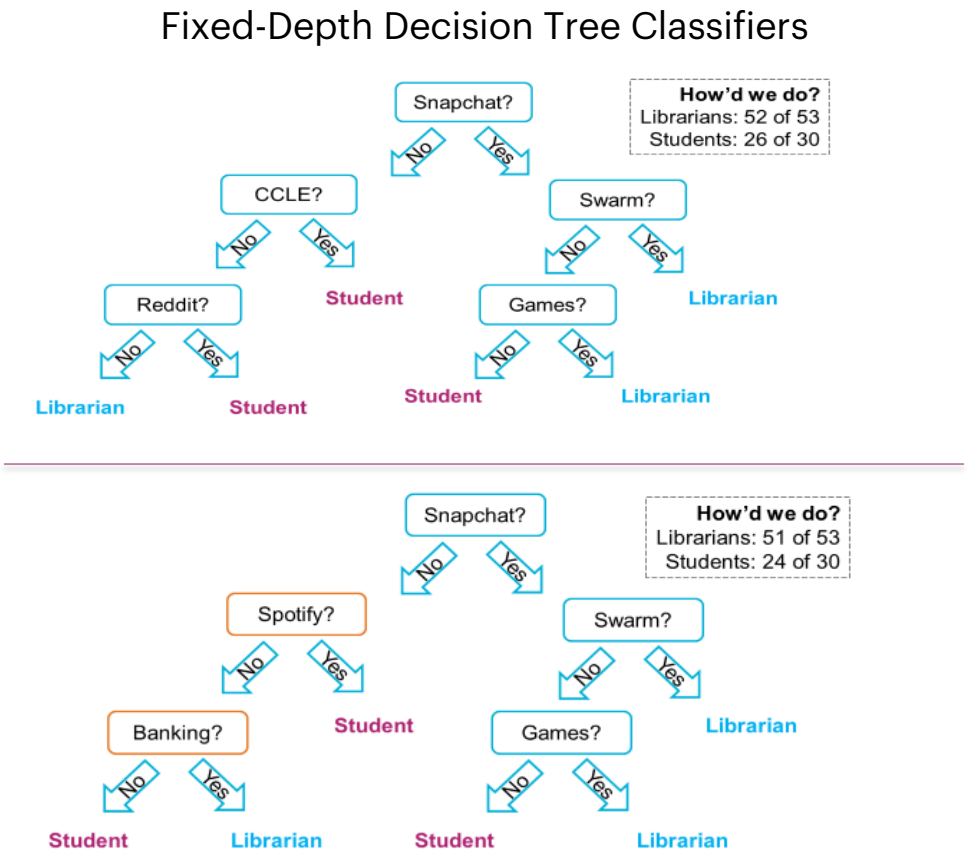


FIGURE 14. (Top) Fixed-depth decision tree classifier trained to differentiate between UCLA students and librarians and OCLC Global Council Members. (Bottom) If we refuse to allow CCLE to be used as a feature, the training algorithm finds other differentiating features shown in orange.

decreased the accuracy of the decision tree. The second tree correctly predicted 75 out of 83 maps, including 51 of 53 librarians and 24 of 30 students. Despite removing an obvious indicator of student status, the decision tree was able to find another predictor that was almost equally valuable in differentiating between groups. The ease of this substitution might suggest greater discrepancies between the technologies used by students and librarians beyond use of CCLE.

This discrepancy between those who select and provide technologies and sources and the intended participants of the technologies and sources is an important finding. In order to provide technologies that will be used by the academic community, it is imperative that librarians are aware of what is used by their constituents regardless of whether librarians use them.

> "I would like to know if patrons of different educational stages have new ideas/constructive comments on how the libraries can use digital platforms better in supporting their learning, teaching and research activities."
>
> **Esther Woo**
> HKU (University of Hong Kong)

SUMMARY

Below is a summary of the main findings related to how participants engage with technology in personal and institutional contexts:

- Convenience is important when obtaining information, but people also expect that the information gathered will be of sufficient quality.
- Technology use is not determined by what the best tool is for the job, but is contingent on context, including time, social networks, and situation.
- Age is not a determinant of online technology use since scholars in later educational stages (which correlate with age but do not denote age) report higher use of digital sources.
- Individuals at the Emerging, Establishing, and Embedding stages view the library as a container for books rather than a dynamic information resource. Individuals at higher educational stages value the library as a physical place to study and collaborate. Faculty report consulting librarians the most.
- Despite the prevalence of digital sources, human sources, both face-to-face and in the digital environment, remain important. When individuals cannot collect quality information quickly online, they go to human sources, such as parents, friends, and teachers. Emerging students report the highest use of parents as a source. Participants reported a decline in the use of human sources as they increase in educational stage.
- Students at lower educational stages are less discerning and less informed about the sources they use As they increase in educational stage, individuals appear to be more discerning in evaluating information and in using tools to locate this information.

- Although students believe that in the future their learning will occur more and more in digital environments, a lot of their learning still happens with physical sources, and they indicate being distracted in digital environments.
- Students rely on search engines to obtain information without using the advanced features. Individuals are not going to leave sites like Google, but do want additional filters to control the information they are seeing. These filters need to be visible and/or easy to locate, as well as easy-to-use, given that participants noted that they currently do not use existing advanced filters for these reasons.

The mapping sessions allowed us to compare technological engagement among different groups of users and librarians. The differences observed between these groups can be used to inform librarians about service development and delivery. “I was surprised by the fact people have several cautions about interaction with social media (such as potential addiction, waste of time, loss of concentration, privacy) and most of them apply consequently restrictive criteria regarding their behavior in aspects such as frequency of connection, not posting and just reading, etc.”

Josep Cobarsí Morales
UOC (Universitat Oberta de Catalunya)

Chapter 4. Conclusions and Recommendations: What's Next?

CONCLUSIONS

Findings from our V&R project tell us how and why individuals engage with technology, acquire their information in various contexts and situations, and how their search behaviors change as they progress through the various educational stages.[28, 29] Unlike some models, the V&R framework does not adopt a deterministic perspective—socially or technologically. From a social viewpoint, V&R, unlike other studies, is not arguing that engagement with technology can be predicted based on a fixed demographic category such as age. From a technological perspective, V&R contends that a particular tool or source will yield different outcomes for different people. Therefore, this research contends with the transmission model of information, and the LIS field's focus on access, to address a comprehensive set of issues underlying modes of engagement.

Age may be a factor in determining how individuals engage with technology and get their information. After all, educational stage appears to be a key factor and is correlated with age. However, there is no evidence that age is a key determinant. As previously stated, multiple variables may influence engagement, and it's hard to isolate these variables. Some of the factors that affect the engagement of technology include time, one's social network, educational stage, and discipline.

While our findings, both in this report and in prior publications, have demonstrated consistency across the various institutions studied, some differences exist. UOC provided an interesting point of comparison to the other institutions as it is an online-only university. Participants here denote higher use of the library, possibly due to the embedding of the virtual library into their online learning management systems. This observation supports the importance of libraries meeting individuals where they engage with technology and get information, rather than expecting individuals to change their workflows and habits in order to adopt library technologies, tools, sources, and services in individual workflows. It also suggests the potential for libraries to embed themselves creatively into the digital environments used by their communities.

> "Based on the findings we will enhance our biannual library survey by including a question on information and technology activities reflected in this study. We will also use the survey results to deepen our understanding of activities our users are engaged in and how we can respond. The popularity of Google Drive suggests that our patrons are moving away from thumb drives and towards cloud storage of their files. We need to expand these express services to align with our patrons' cloud storage behavior. At HKU, YouTube is ranked even higher than Google Search; YouTube is the third most used application and Google Search is fourth. This suggests that users are turning to YouTube for information. This finding leads us to consider creating informative YouTube videos. For example, we could create YouTube videos to introduce the new version of our Primo discovery layer which our patrons will begin using this summer."
>
> **V&R Project Team**
> HKU (University of Hong Kong)

While there were differences in the use of tools among participants from the different countries, we learned that individuals use various tools and engage differently with technology based on context and situation. Most looked for tools that integrated into their workflows, were familiar, and didn't require a lot of effort to use. This preference means there is no single answer to the question of what types of sources and tools should be made available in libraries. People often are open to trying new tools if they believe the tools will help them in some way. We also learned that individuals are more likely to try these new tools if their family, friends, colleagues, and peers use them and recommend the tools.

Applying the V&R framework to the data sources indicated a perceptual gap between libraries and users. The findings indicate that participants were unaware of many of the tools and sources offered by and available in the library, particularly those at the earliest educational stages. And, if participants used the tools and sources, many had no idea that the library provided them.

Findings from the mapping analysis demonstrate the strength of the tool in allowing researchers and practitioners to collect a rich series of data points and then analyze these data based on their specific needs. (For example, see figure 9.) When reviewing the maps completed by students, faculty, and librarians, it often was evident which maps were created by whom. Based on this, we believe it is more important than ever for librarians to continue to monitor, observe, and discuss how the academic community engages with technology in their personal and institutional lives, and to continue to compare these findings to commonly held assumptions about how and why people engage with technology and get their information. We not only have to be aware and reminded of these differences but also must do something about the way library tools, sources, and information are made available through the library, whether in the physical or virtual environments.

This awareness comes down to something basic—relationship building. How do we do that? Here are some recommendations.

> "For our university, we believe that the diffusion of our findings should lead to some improvements by:
> - Adapting our online learning system to make sure that it is responsive to the different devices used by our students and faculty
> - Providing the UOC library with information on how is the information search process of students and professors, which are their search strategies and the information sources they tend to use
> - Providing course designers and course instructors with useful information to improve their educational products and their teaching performance."
>
> **V&R Project Team**
> UOC (Universitat Oberta de Catalunya)

RECOMMENDATIONS

Convenience

In all our work addressing how people engage with technology and get their information, we have learned that convenience is a top reason for making decisions.[30] This is not a simple concept, though, since convenience is dependent upon the situation the individual is in at the time, the context, and the

information need. As we previously discussed, individuals sometimes want face-to-face interactions and physical sources, and in other instances want digital interactions and sources. How people access the digital sources also varies.

The findings from the V&R work indicate a high use of smart phones for both personal and institutional situations. Unfortunately, many library websites and catalogs do not transition and display well in the mobile environment. This characteristic is a detriment to the library's offerings and is an area that should be addressed immediately by conducting usability testing of the library's systems on different devices. Some libraries offer services via WhatsApp and other instant messaging services to take advantage of mobile technologies that people use. Paypal CEO Dan Schulman identified the mobile phone as one of the most "disruptive" technologies to industries.[31] Considering this, librarians need to find different ways to utilize its capabilities to integrate the library into the life of the user and into individuals' workflows.

Workflows

Our findings from this project also reflect the importance of workflows. One of our prior works summarizes this importance. "We cannot overestimate the importance of embedding services and sources within the spaces where people build trusted relationships with individuals. Institutions should consider digital and face-to-face community building as a cornerstone of their enterprise-wide policies. Individuals will turn to libraries or librarians for sources only if they are a part of the individuals' networks."[32] Context and situation are important factors that influence how individuals develop their workflows and determine what is convenient. Since individuals make decisions in a variety of contexts, it is difficult for librarians to anticipate what tools and sources individuals will want to use; therefore, we need to make these tools and sources available on different platforms, such as the learning management system and the digital library. Simple interface design that displays and functions well on both mobile phones and laptops is imperative.[33] If it is cumbersome to log in to a system or to share the results of searches, people will leave the system to use something easier and more familiar. If a source was convenient, participants were willing to satisfice and make do with it, even if it wasn't the best source.[34]

> "The study demonstrated that the investment of the University in new ways of teaching and learning is right. We have to keep working in the production of MOOCs and new other ways to engage students with educational technologies. For example, we need to explore and invest more in the mobile education, since it is clear that the main device is the smart phone. It also demonstrated that the course given to the students during their first year on "information skills" is absolutely needed. Perhaps it would be also needed to make a focused course before the final assignment."
>
> **Eva M. Méndez Rodríguez**
> UC3M (Universidad Carlos III de Madrid)

Our findings indicate that the UOC students still rely on physical sources. Student participants from the other universities reflect this as well, but this is a significant and somewhat unexpected finding from UOC since it is an entirely online university. This finding implies a need to consider modalities for the provision

of tools and sources for distance and online learning. It may be important to not only provide digital sources for students and faculty, but also to provide physical sources, possibly through collaboration with public and school libraries in the areas where the students live and work.

Again, librarians need to be present in both the physical and digital environments, since neither one will be the consistently effective mode of choice. The context and situation determine the format for accessing tools and sources. As reflected in prior findings, "Embedding the librarian in the academic departments and the academic courses is a way to market and provide tools and sources to the academic community. Promoting special collections on Facebook and Wikipedia will expose these sources to a wider audience."[35] Wikimedia Commons, "a media file repository" that members of the library, museum, and archive communities populate, is a good example of a way to provide greater exposure to sources.[36]

Using social media to promote collections and sources will help increase visibility and identify the situations and contexts in which to use them. The University of Nevada, Reno provides an excellent example of using social media for extending collections. The special collections librarian created profiles on Facebook for Joe McDonald, a sophomore at University of Nevada, Reno in 1913, and his girlfriend and future wife, Leola Lewis to promote the university's collection of historical materials.[37] Adding links and references to library sources at the end of Wikipedia articles is another great strategy. Many students believe they must hide their use of Wikipedia, even though faculty and tutors also use Wikipedia to familiarize themselves with topics and to get quick information about complicated subjects.[38] Wikipedia editors now are able "to link citations in Wikipedia to millions of library materials represented in WorldCat, the world's most comprehensive database of information about library collections" through a collaborative project with OCLC and the Wikimedia Foundation's Wikipedia Library.[39] The University of Washington has been adding links to their special collections in Wikipedia article reference lists for many years, as have other libraries. This strategy not only is an excellent way to promote collections but it also is a way to provide authoritative and credible sources in Wikipedia, a highly used, but selectively cited source.[40]

> "Perhaps one of the more interesting actions could be to promote the library services to students and how to use them. Now, the library resources are embedded in the virtual classroom and the students are not aware of this, but in contrast, they don't explore the full potential of academic library."
>
> **Eva Ortoll Espinet**
> UOC (Universitat Oberta de Catalunya)

Discovery and Access

Library web pages and catalogs need to provide simple and familiar interface design. People are used to using browsing for searching the web and retrieving information, even though it may not be the best strategy for locating information. Library systems often are difficult to use for browsing and have been slow to include autocorrect for misspellings and suggestions for sources if an individual cannot find the exact item. Often individuals are left staring at a screen with no items, and no explanation or suggestions for how to change their searches for different results. The library web page and catalog provide the perfect setting for a pop-up chat to answer questions at the time of need. If an individual completes a search in the library catalog that retrieves no items, a pop-up chat box could appear and ask if the individual needs help.[41] Librarians also have an opportunity to use the metadata created for sources to

develop visualizations depicting collections, to provide information in a similar way as other online sites, and to help individuals develop critical literacy skills and a basic understanding of the data that search engines and other websites can push to those searching for information.

Information Literacy

In a 2017 special report, the Chronicle of Higher Education identified critical literacy skills as one of the top trends in higher education.[42] This is not surprising based on the discussions that have emerged on the topic after the UK Brexit and the 2016 US presidential election. As Yu Liang Ting found, the digital literacy of students doesn't guarantee their ability to analyze and use the information they acquired critically.[43] This self-confidence also may be reflected in a lack of evaluation of the credibility of information on social media sites.[44] Information literacy also should include search engine literacy so that individuals are aware that these algorithms are not objective or neutral.[45] Search engine algorithms privilege certain social and cultural narratives, dependent upon who is involved in the creation and dissemination of the search engine, who is advertising on the system, and who is developing the agenda and principles of the search company.[46] These algorithms shape the kind of information pushed by search engines to individuals.

We've also learned that students choose tools based on the context of their information needs. Librarians can take the lead in helping students evaluate and make decisions for selecting the technology that is most useful for the task, rather than the technologies their peers are using, or that will save them the most time but sacrifice quality of results. For instance, perhaps the advanced features of a search engine will provide information conveniently and with more precision than using the default search engine functions. Or if a student needs information for a class on government, it may be more efficient for them to use information posted on Facebook, or social question and answer sites, rather than information provided by specific government agencies.

Teaching information literacy also can provide a means for library staff to be leaders in developing campus-wide information literacy courses. These courses should integrate information literacy into the context of the courses in the curriculum. As an example, this integration is occurring at Purdue University where the librarians are collaborating with IT staff, instructional designers, and faculty to develop a curriculum that integrates information literacy into courses.[47] Not only is this a valuable contribution to teaching and learning, but it also is an excellent example of demonstrating and marketing the library's contribution to the institution's mission and strategic goals.

Marketing

Many individuals don't know all that libraries offer. This lack of awareness became evident when people immediately mentioned books when they talked about the library. Although many individuals use library sources, many are not even aware that the library is providing these sources. This finding is supported by the Perceptions of Libraries and Information Sources report, which documented that most people do not know what services or formats of materials libraries offer.[48] Zickuhr, Rainie, and Purcell report that 22% of their participants said that "they know all or most of the services their libraries offer now. Another 46% say they know some of what their libraries offer, and 31% said they know not much or nothing at all of what their libraries offer."[49] Librarians need to market and promote tools and sources, especially one of the library's most valuable sources, librarians.

Relationship Building

We learned that people connect with other people to get their information and they often turn to those who they know and trust. The interview participants also told us that they are more apt to use tools and sources that are recommended or used by family, friends, colleagues, and peers. As Brian Matthews stated, "By focusing on relationship building instead of service excellence, organizations can uncover new needs and be in a position to make a stronger impact."[50] The human connection still is critical in both our physical and digital worlds.

Building relationships requires learning about other groups—their terminology, workflows, literature, and values. When we reviewed the library and information science (LIS) literature and the higher education literature for trends in higher education and student learning and success, we discovered that the LIS journals address service much more than the higher education literature.[51]

If librarians use the terminology of provosts, faculty, and the academic community, they may have a better chance of building relationships, and of being involved in the strategic planning of the institution. This strategic use of terminology also could lead the way for librarians to be more connected to the academic community, since our research also indicates that people want human connection. This connection can take place in both the physical and digital environments. Technology use can, and often does, include accessing other humans—not only digital resources—informing work on the affective factors of information seeking.[52] This is particularly relevant to UOC participants because it suggests that human connections are important in both face-to-face and online environments.

> "After noticing the large amount of variability in the behaviors of our interviewees, I am sure that a much larger degree of personalization in our academic programs and our information services would be very welcome. It is very difficult to achieve excellent rates of effectiveness and efficiency in learning processes with fairly standardized courses. Our research shows that definitely 'one size does not fit all.'"
>
> **Agustí Canals**
> UOC (Universitat Oberta de Catalunya)

The Academic Future

We have a lot of assumptions of how people engage with technology and how they get their information. However, it's hard to study human behavior because of the many demographic, social, emotional, and environmental variables that affect how people respond in different contexts and situations. We need more user studies to provide empirical evidence on specific groups and types of individuals.

Since we learned that most individuals do not adopt every new technology or app that becomes available, but usually retain what is familiar, comfortable, and is used by their family, friends, colleagues, and peers, we highly recommend that we study K-12 students. We need to know what technologies they embrace, how they use them, and more important, why they use them. If we focus on these aspects of their use of technologies, we will be able to develop tools and sources that will fit into their workflows when they enter college. These students are the academic future. By being better prepared to contribute to their success and learning in college, librarians become proactive instead of reactive, and can be the leaders within our academic institutions. After all, it's all about integrating the library into the life of the user.

APPENDICES

APPENDIX A: SEMI-STRUCTURED INTERVIEW QUESTIONS

1. Describe the things you enjoy doing with technology, and the web, each week.

   This is a conversational start in order to put the interviewees at their ease. We are trying to get a sense of their overall digital literacy, so that we can set their information seeking behaviours within a broader context. Do they socialise online? (See probe.) Do they 'contribute' online in the form of pictures, video, blogs, etc.?

   [**PROBES**: How important is the web for your social life, do you use it to keep in touch with your friends? What gadgets/devices/things do you use the most, is there anything you 'couldn't live without'? How much time on average do you spend online each week? Is there anything that bothers you about being online?]

2. Think of the ways you have used technology and the web for your studies. Describe a typical week.

   We are looking at interviewees' use of educational technologies more specifically for study. We hope they will start to introduce informal learning, self-directed study, peer to peer learning, etc. We anticipate they will (or may not) mention Facebook, MySpace, etc.

   [**PROBES**: How do you keep track of things? What systems for learning online do you have? Can you give us any examples of when you've asked your friends for help on assignments/homework online? What kind of online sources have you found that help you with your studies? How did you find them? What other gadgets or devices do you use for your studies?]

3. Think about the next stage of your education. Tell me what you think this will be like.

   This will hopefully encourage them to reflect on what they envisage their role will be in the next stage. What they imagine the next educational-stage to be like will be something we can cross check as we follow them through the project.

   [**PROBES**: How do you think you will use technology in the next part of your education? If you think you will need to adapt the way you use technology, what sort of changes do you think you'll make?]

4. Think of a time when you had a situation where you needed answers or solutions and you did a quick search and made do with it. You knew there were other sources but you decided not to use them. Please include sources such as friends, family, teachers, coaches, etc.

   Prompt for both academic and informal (domestic, personal…) examples.

   [**PROBES**: Did you simply take the first answer/solution you were able to find? What was the situation? What sources did you use? What led you to use them...and not others? Did they help? How? What sources did you decide not to use? What led to this/these decision/s? What did source A give you that you thought source B could not? Are there situations where source B would 'be a better choice for you? How did you decide when it was time to stop looking? How did you assess what was good enough?]

5. Have there been times when you were told to use a library or virtual learning environment (or learning platform), and used other source(s) instead?

[**PROBES**: What made you decide not to use what you were asked to use? What kinds of things do your instructors want you to do when you're looking for information? Does what you do look like that, and if not, what does it look like?]

6. If you had a magic wand, what would your ideal way of getting information be? How would you go about using the systems and services? When? Where? How?

7. What comments or questions do you have for me? Is there anything you would like me to explain? What would you like to tell me that you've thought about during this interview?

APPENDIX B: DIARIST FOLLOW-UP INTERVIEWS AND INTERVIEW PROTOCOL COMBINED

Participant Name/User Code:
Participant's Educational Stage at Time of Interview:
Interviewer:
Date of Interview:
Interview Format:
Contact Telephone Number or Skype Address:

Note: Please follow the script as closely as possible.

Turn on recorder.

Script for Greeting:

Hello, my name is _____and I am calling you for the follow-up interview for the Digital Visitors and Residents Project.

Is now still a convenient time for us to conduct the interview?

- If "Yes," continue with the script to start the interview.
- If "No," reschedule the interview:
    - When would be a good time to reschedule the interview?
    - Suggested Date and Time – record this information.

If No Answer: Leave a message, "This is the Digital Visitors and Residents research project, we will call you again and send you an email to reschedule your interview."

- Record the attempt and review the call sheet for an alternative time to call.

Script to Start the Interview:

If you will remember, the University of Oxford and OCLC Research, in partnership with the University of North Carolina, Charlotte, are collaborating on a study to increase understanding of how learners engage with the Web and how educational services and systems can attract and sustain a possible new group of lifelong learners.

Thank you for agreeing to chat with me, I really appreciate your help. It won't take much longer than an hour. There are no right or wrong answers. It is not a test. I just want you to be as honest as you can to find out what you think.

You will be compensated the usual gift card or voucher worth $20/£12 as you have for your diary submissions.

I also will be recording the interview and typing it up as you speak, so please don't think I'm not listening to you. I will be using this later so that I can remember what you have said. Everything you say is private and will not be discussed with anyone outside of the team. I will be changing your name to keep you anonymous, and will destroy the sound recording and any information you give when it is no longer needed. We want you to be aware that you can stop participating at anytime. Is this all okay? Do you have any questions before we start?

Can I ask what your academic status or what grade level you are at right now?

Let's get started.

1. Explain a time in the past month when you were SUCCESSFUL in completing an **ACADEMIC** assignment. What steps did you take?
   What resources did you choose to use? Why?
   What made you take these steps?
   What made you choose these resources instead of others?
   What made these resources easy/difficult to use?
   Why do you think your approach worked?
   What new approaches did you try?
   How did you find out about it?
   Did someone tell you or did you find it on your own?
   What made this a good choice for you?

2. Think of a time fairly recently when you struggled to find appropriate resources to help you complete an **ACADEMIC** assignment. What happened?
   What resources did you choose?
   Why did you choose them?
   What made you take these steps?
   What made you choose these resources instead of others?
   Why do you think this approach did not work?

3. Explain a time in the past month when you were successful in getting what you needed in a **PERSONAL** situation. What steps did you take?
   What resources did you choose to use? Why?
   What made you take these steps?
   What made you choose these resources instead of others?
   What made these resources easy/difficult to use?
   Why do you think your approach worked?
   What new approaches did you try?
   How did you find out about it?
   Did someone tell you or did you find it on your own?
   What made this a good choice for you?

4. Explain a time in the past month when you were NOT successful in getting what you needed in a **PERSONAL** situation. What steps did you take?

   What resources did you choose?
   Why did you choose them?
   What made you take these steps?
   What made you choose these resources instead of others?
   Why do you think this approach did not work?

5. Tell me something interesting that has happened in the past month in the social media that you used for **ACADEMIC** purposes.

   [If not understanding the question, give the following examples, bookmarking, RSS web feeds, wikis, blogs, etc.]

   What made you use this?
   Do you feel that the use of this social media technology was successful/worked for you? Explain why or why not.

6. Tell me something interesting that has happened in the past month in the social media that you used for **PERSONAL** situations.

   [If not understanding the question, give the following examples, bookmarking, RSS web feeds, wikis, blogs, etc.]

   What made you use this?
   Do you feel that the use of this social media technology was successful/worked for you? Explain why or why not.

   What do you have to add to our discussion today about how you got information in the past month for both **PERSONAL** and **ACADEMIC** situations?

7. We would like to talk to you again next month instead of the written diary. Are you willing to talk to us again next month?

   [If yes, schedule date and time. If no, make them aware of revised Google doc and follow up with email and link to the Google Doc.]

8. I need to send you the gift card, I just wanted to confirm that the email address we've been contacting you with would be fine. We will send an electronic voucher. Will that be all right?

Script to Close the Interview:

Thank you again for your time and answering the questions. Before we close, what questions or concerns do you have? If not, thank you for your participation in our research study.

Turn off recorder.
Length:
Audio file name:

APPENDIX C: ONLINE SURVEY DEMOGRAPHIC PRE-SURVEY SCREENING

Welcome! Thank you for agreeing to participate and for your interest in the Digital Visitors and Residents online survey.

Before the survey, we need to collect some demographic information. Please remember that you will not be compensated for taking the demographic screening. If you are chosen to participate in the online survey, you will be notified by email.

1. **Gender**
   Please select the gender with which you identify.
   Mark only one oval.
   - Male
   - Female

2. **Age**
   Please indicate your age.
   Mark only one oval.
   - 12-18 years old
   - 19-25 years old
   - 26-34 years old
   - 35-44 years old
   - 45-54 years old
   - 55-64 years old
   - 64+ years old

3. **Academic Level**
   Please indicate your academic level.
   Mark only one oval.
   - High school/Secondary School
   - First Year Undergraduate
   - Second, Third, or Fourth Year Undergraduate
   - Graduate, Post-graduate, or PhD Student
   - Scholar or Lifelong Learner
   - Other:

4. **Academic Discipline**
   Please indicate your academic discipline.
   Mark only one oval.
   - High school/Secondary School
   - Professions & Applied Sciences (i.e., Agriculture, Architecture, Business, Education, Engineering, Journalism, Law, Social work)
   - Formal Sciences (i.e., Computer sciences, Logic, Mathematics, Statistics, System sciences)
   - Natural Sciences (i.e., Space sciences, Earth sciences, Life sciences, Chemistry, Physics)
   - Social Sciences (i.e., Anthropology, Archaeology, Economics, Geography, Political sciences, Psychology, Sociology)
   - Humanities (i.e., History, Linguistics, Literature, Performing Arts, Philosophy, Religion, Visual Arts)
   - Undeclared Other:

5. **Name and Location of Educational Institution**
   Please provide the name of your school or college/university and the name of the US or UK city and the name of the US state.

6. **Parent or Guardian Education Level**
   Please indicate the highest level of education a parent or legal guardian has attained. If you have a second parent or legal guardian, please indicate them in the next question.
   Mark only one oval.
   - No high school diploma or no secondary school qualifications
   - High school diploma or GED or compulsory education level qualification (GSCEs or NVQ) or equivalent
   - Professional training, Associate degree or A Levels, Btecs, or higher level NVQs or equivalent
   - Undergraduate degree (Bachelors or BSc) or equivalent
   - Graduate or Post-graduate degree (Masters, MSc, or PhD) or equivalent
   - Other:

7. **Second Parent or Guardian Education Level**
   Please indicate the highest level of education a second parent or legal guardian has attained. If you live in a single parent home or with one guardian, please indicate below.
   Mark only one oval.
   - This question does not apply to me
   - No high school diploma or no secondary school qualifications
   - High school diploma or GED or compulsory education level qualification (GSCEs or NVQ) or equivalent
   - Professional training, Associate degree or A Levels, Btecs, or higher level NVQs or equivalent
   - Undergraduate degree (Bachelors or BSc) or equivalent
   - Graduate or Post-graduate degree (Masters, MSc, or PhD) or equivalent Other:

8. **Location Where You Currently are Working or Studying**
   Please indicate the country of your current work or study.
   Mark only one oval.
   - United States
   - United Kingdom
   - Other:

9. **Email Address**
   Please indicate your preferred email address that we can contact you at. This will be used to inform you if you are selected for the online survey.

10. **Statement of Interest**
    Please choose one option from below.
    Mark only one oval.

- If selected, I am interested in participating in the online survey that will take approximately 45 minutes to complete. When I complete the survey, I will receive a $20/15 GBP Amazon online voucher.
- I am NOT interested in participating in the online survey.

APPENDIX D: ONLINE SURVEY QUESTIONS

ID

1. Participant ID *
This can be found in the email invitation sent to you.

Questions 2-8
Think of a time in the past month when you had either a Personal or Academic/Professional situation where you needed answers or solutions and you did a quick search and made do with it. You knew there were other resources but you decided not to use them. *Please include all sources, including human sources, such as friends, family, teachers, teaching assistants, tutors, coaches, colleagues, professors, etc. and answer the following questions.*

2. What was the situation? *

3. Did you simply take the first answer/solution you were able to find? *
Mark only one oval.
Yes
No

4. What resources did you use? *

5. What made you choose these resources instead of others? *

6. What made these resources easy or difficult to use? *

7. How did you decide when it was time to stop looking and that the answer was good enough? *

8. Have there been times when you were told to use a library or virtual learning environment (or learning platform), and used other resource(s) instead? *
Mark only one oval.
Yes Skip to question 9.
No Skip to question 10.

Question 9
9. What made you decide not to use what you were asked to use? What kinds of things do your instructors, tutors, or colleagues want you to do when you're looking for information? *

Questions 10-14
Think of a time in the past month when you were successful in completing an ACADEMIC/PROFESSIONAL assignment. *Please answer each of the following questions.*
10. What steps did you take and why? *

11. What resources did you choose to use? *

12. What made you choose these resources instead of others? *

13. What made these resources easy or difficult to use? *

14. Did you try any new approaches to finding information? *
Mark only one oval.
Yes Skip to question 15.
No Skip to question 17.

Questions 15-16
15. What new approaches did you try? *

16. How did you find out about it? Did someone tell you or did you find it on your own? *

Questions 17-20
Think of a time in the past month when you *struggled* to find appropriate resources to help you complete an ACADEMIC/PROFESSIONAL assignment. Please include sources such as friends, family, teachers, teaching assistants, tutors, coaches, colleagues, professors, etc. *Please answer each of the following questions.*
17. What steps did you take and why? *

18. What resources did you choose to use? *

19. What made you choose these resources instead of others? *

20. What made these resources easy or difficult to use? *

Questions 21-24
Think of a time in the past month when you were successful in getting what you needed in a PERSONAL situation. Please include sources such as friends, family, teachers, teaching assistants, tutors, coaches, colleagues, professors, etc. *Please answer each of the following questions.*

21. What steps did you take and why? *

22. What resources did you choose to use? *

23. What made you choose these resources instead of others? *

24. What made these resources easy or difficult to use? *

Questions 25-28
Think of a time in the past month when you *struggled* to find what you needed in a PERSONAL situation. *Please answer each of the following questions.*

25. What steps did you take and why? *

26. What resources did you choose to use? *

27. What made you choose these resources instead? *

28. What made these resources a good choice in this situation? *

Question 29-30

Think of something interesting that has happened in the past month in the social media that you use for ACADEMIC/PROFESSIONAL WORK. *Please answer each of the following questions.*

29. Describe what happened. *

30. Did you find the results of using social media useful in any way? Please explain why or why not. *

Questions 31-32
Think of something interesting that has happened in the past month in the social media that you use for PERSONAL situations. *Please answer each of the following questions.*

31. Describe what happened. *

32. Did you find the results of using social media useful in any way? Please explain why or why not. *

Questions 33
33. Is there anything that bothers you about being online? *
Mark only one oval.
Yes Skip to question 34.
No Skip to question 35.

Question 34
34. Which of the following about being online do you worry about most? *
Check all that apply.
- Concerns about levels of privacy
- Connecting with people I have never met face-to-face
- A desire not to be perceived as vain or egotistical
- The risk of wasting time
- Other:

Question 35
If you had a magic wand, what would be your ideal way of getting information? Please include all sources, including human sources, such as friends, family, teachers, teaching assistants, tutors, coaches, colleagues, professors, etc.

35. Please describe this ideal way of getting information. Include when, where and how you would use it. *

Question 36
36. What comments or questions do you have for us?

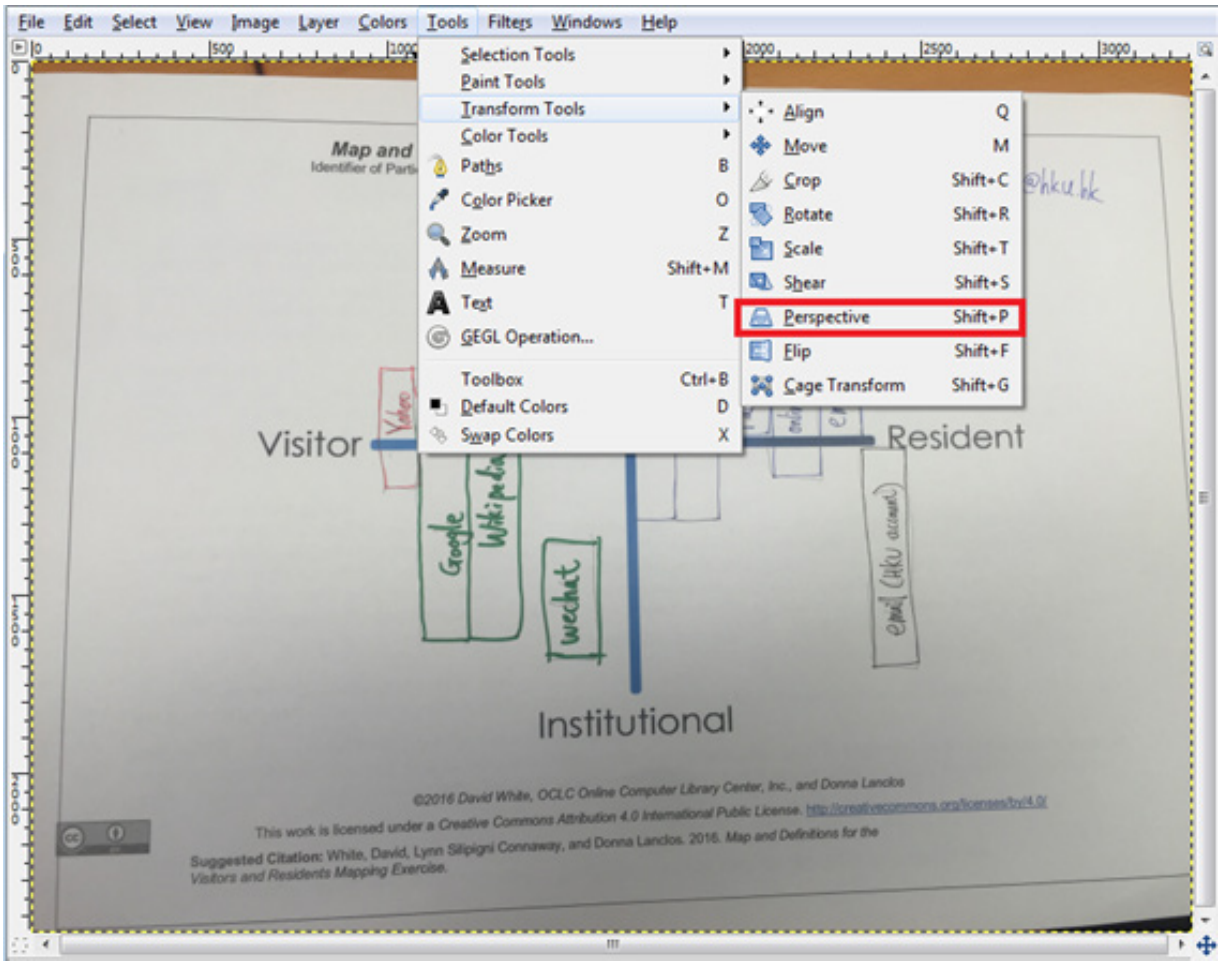
APPENDIX E: MAPPING EXERCISE NOTES FOR DEVELOPERS

This appendix includes additional information for software developers or librarians interested in implementing some of the computational techniques for analyzing V&R maps.

Vectorizing Map Images for Computational Analysis

Extracting data from maps is a bit of up-front investment, but the effort can be worth it. In our map analysis experiments, we first scanned or photographed our map images to get a digital picture file, usually a JPEG or TIF image, of each map. Then, we normalized each image a technique that includes a couple of steps. When a map image is acquired using a digital camera, there is usually a perspective transformation that must first be accounted for, and removed, from the image. We did this using the "Perspective" transform tool in the free and open-source GIMP image editor. We also usually removed the shadows and other artifacts that show up in a picture using an image editor's dodge tool and color transformations. Figure 15 shows an example workflow that transforms a raw map image captured by a cell phone camera to a normalized image.

GIMP Image Editor Tools



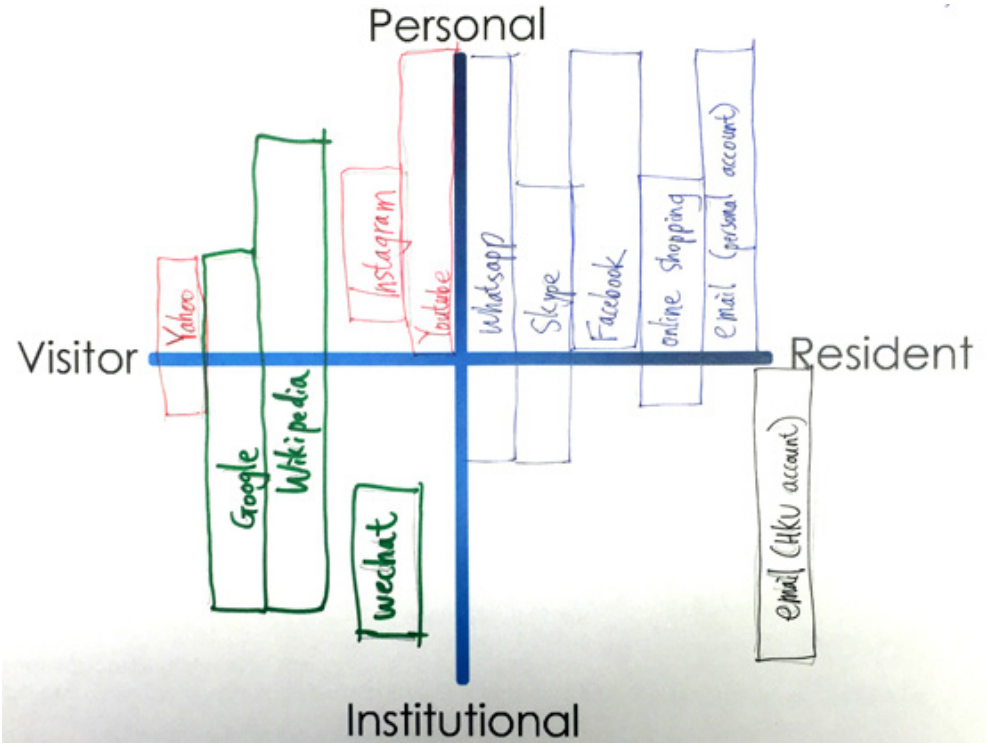


FIGURE 15. (Top) Using the GIMP image editor to remove a perspective transform from an image. (Bottom) The image after perspective removal, shadow removal, and color contrast enhancement.

After we normalized the images, we made shapes within the images machine-readable (a process commonly called “vectorization”) so that we could analyze them with software. To do this, we imported them into an application called Inkscape, which is a free and open-source Scalable Vector Graphics (SVG) editor. We first adjusted the size and the position of the image within Inkscape so that all our map images are registered (aligned) with each other. In other words, we put all the images in the same coordinate system so that we could overlay them for analysis.[53] We then traced the contours around each of the shapes. At the end of the process, each map was represented by a collection of SVG shapes, such as squares, ovals, polygons, and polylines, within the coordinate system. Finally, we transcribed the written text within each shape and stored it in the description text field that the SVG file format provides within each shape.

Since SVG is a popular, non-proprietary, W3C-standardized XML file format, it is quite convenient for data analysis. Data in this format is readily imported into scripts or computer programs, making the data within the maps accessible to any kind of algorithmic processing that you would like to try. As a simple example, a researcher with a background in a programming language like Python could write a simple program to read a collection of these SVG files and measure the correlation between Resident usage of Facebook, and Resident usage of Google search.

Figure 16 shows an example workflow of image vectorization. We start with a normalized map image, import it into Inkscape and align it with the red box, trace around each shape and transcribe the text within each shape into its description field. You can use other SVG tools such as Adobe Illustrator for vectorizing and annotating maps as well. In this report, we discuss the methods that we prefer, but you are welcome to explore the possibilities and various data processing techniques available to you.

Workflow of Image Vectorization

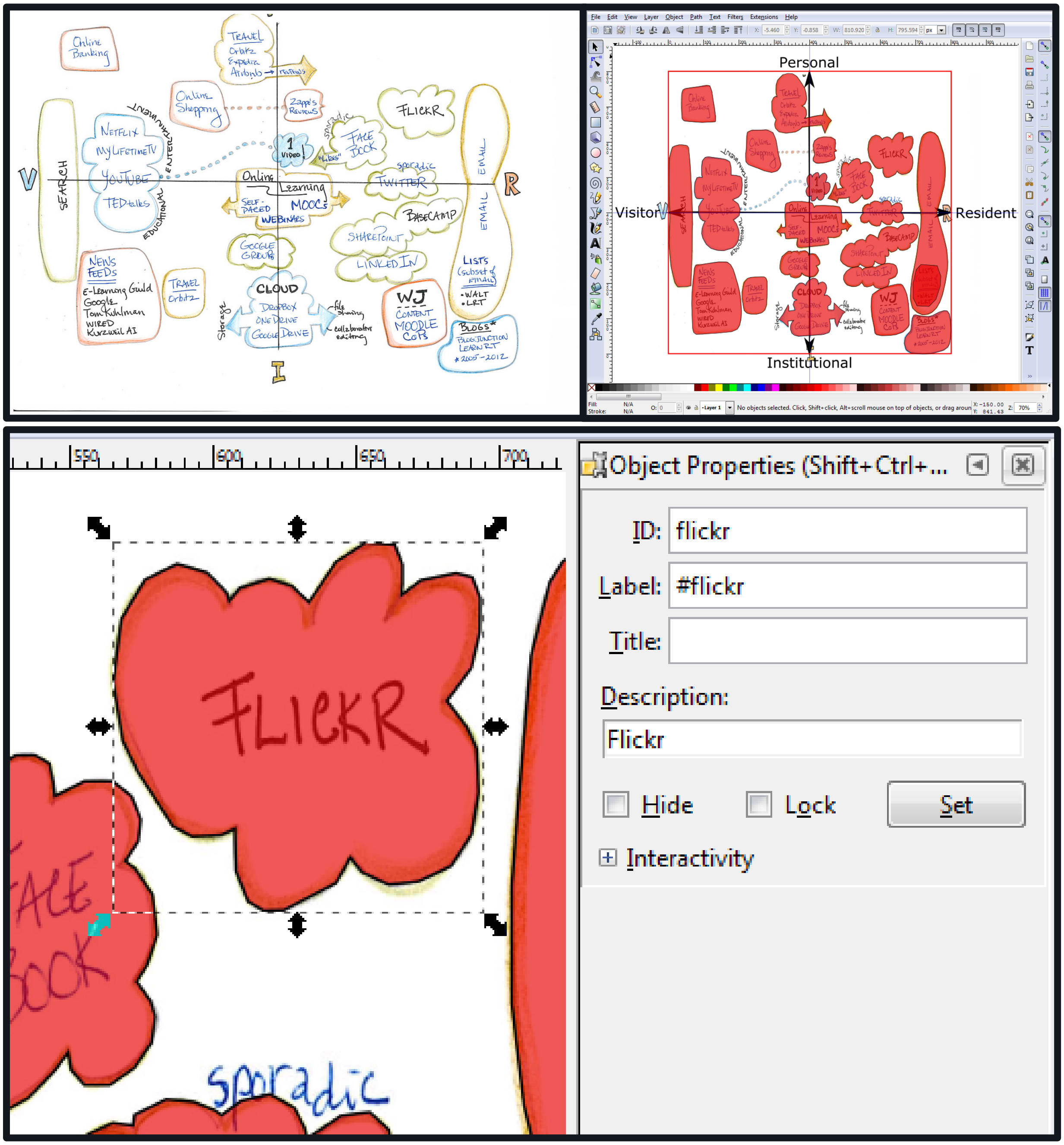


FIGURE 16. (Top left) A normalized map image. (Top right) Tracing around each shape using Inkscape. (Bottom) Transcribing shapes' text into their description fields.

From Gestalt to Geometry and Analytics: The Analysis of Shapes

Mathematics and computer science provide a host of tools for going above and beyond merely looking at arrangements of shapes from multiple maps. There is a large body of literature related to statistical shape analysis[54] and applications of these techniques are seen in a wide array of fields including medical

imaging, optical character recognition, interpretation of hand gestures, and bird migration.[55] We highly encourage creative and courageous researchers to explore the vast literature and toolboxes available and apply them to the problem of understanding their participants through V&R maps.

We started with a simple and straightforward first approach by considering how shapes overlap. For example, if two participants engage with Google search in a similar fashion, then we might expect their drawings of this engagement to appear in similar parts of the map. Perhaps these shapes, if overlaid, will have some overlap. Figure 17 shows an example of this scenario.

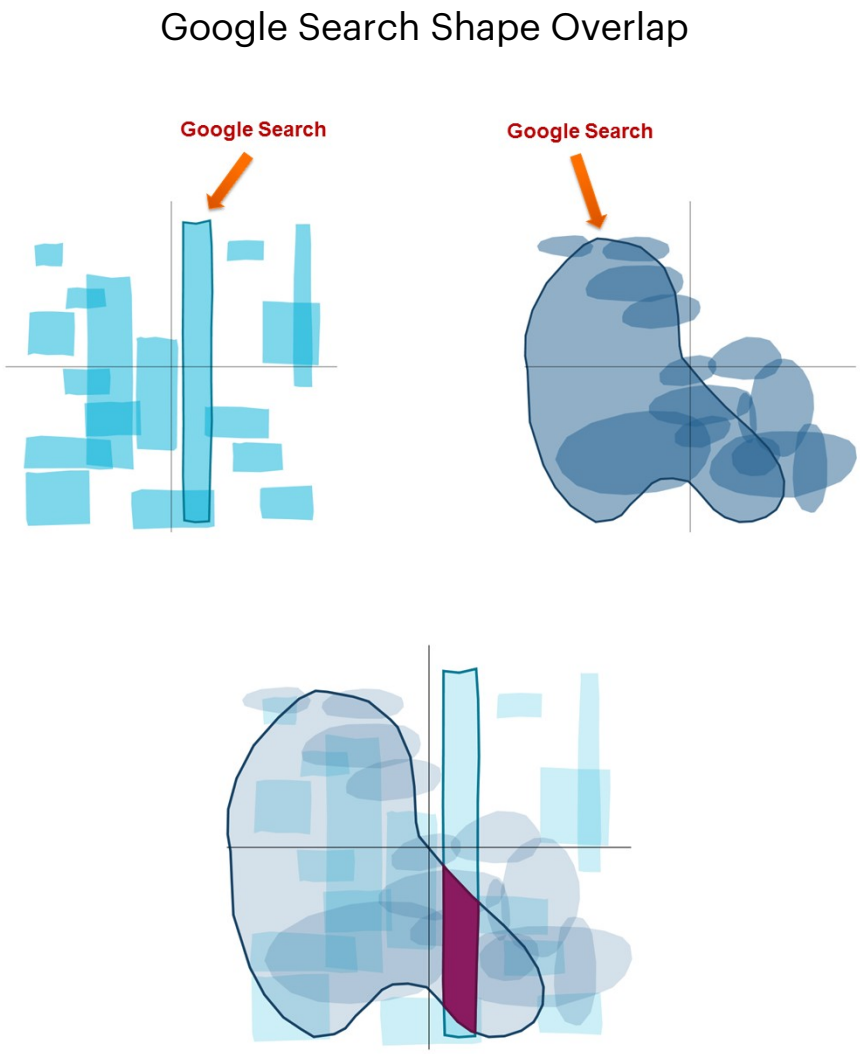


FIGURE 17. Measuring the overlap, or intersection, of a "Google Search" shape found in maps drawn by two different participants.

The shape overlap can immediately provide some useful information for data processing. It can be used to find two participants who have similar maps, or to find a participant that has the most in common with other participants based on overlap area. Checking overlap alone, though, is not always sufficient. What if two regions have the same shape, and are right next to each other in an overlay without any overlap? This sort of arrangement can make overlap analysis difficult to use.

In our analysis, we were inspired by literature on shape matching and statistics. We used a calculation called an earth mover's distance (EMD) to analyze overlay maps of a group of participants' engagements with a single activity.[56] We calculated an average shape, called a medoid, and its location on the map. This medoid represents how the average participant from that group engages with the activity. Figure 18 gives an example of an overlay of participants' reported Facebook usage, with the medoid shape shown in purple. Based on this picture, the "average" participant considers Facebook to be a Personal and Resident activity. We then looked at how the other shapes were distributed around the medoid. Shapes close to the medoid suggest more typical engagement, while shapes farther from the medoid suggest some deviation from the average mode of engagement. Understanding the centrality and spread of engagement with technology can help us to adapt our services and support to match our participants' preferred methods of engagement. Specifically, knowing where the average usage is can help librarians target the common case; finding outliers can help to reveal opportunities to reach other kinds of participants and potentially increase adoption.

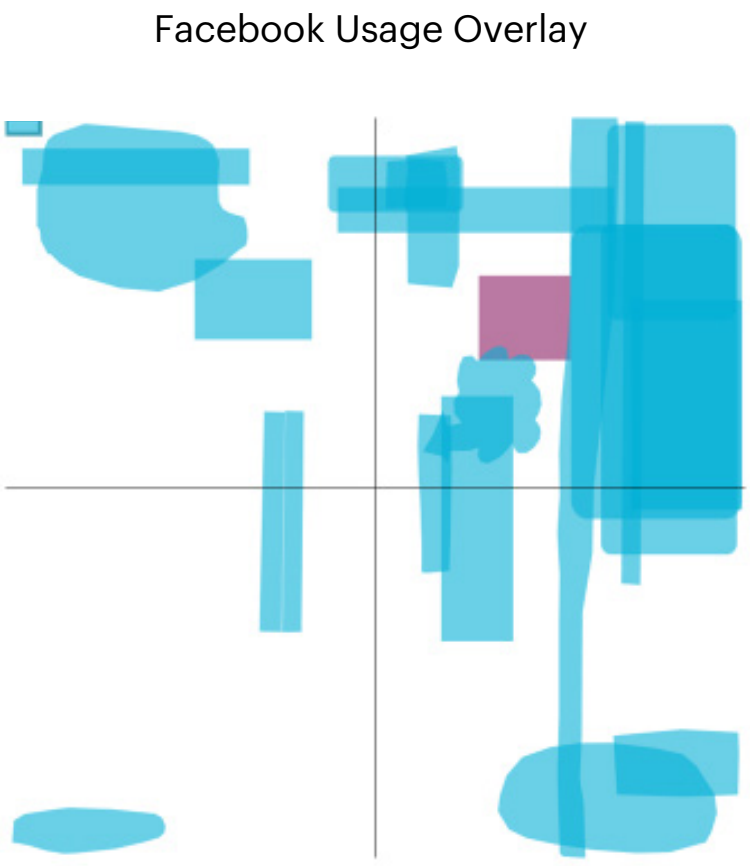


FIGURE 18. An overlay of participants' Facebook usage. The medoid shape is shown in purple.

APPENDIX F: GLOSSARY

Context: the set of circumstances or facts that surround a particular event or situation, be it personal or institutional

Embedding participants: graduate/postgraduate students, includes students seeking master's degrees and doctorates

Emerging participants: students in the last year of high school/secondary school and the first year of undergraduate study

Establishing participants: upper-level undergraduate students

Experiencing participants: faculty, researchers, and scholars

Institutional: engagement situations in which participants seek to fill academic, professional, or work information needs

Personal: engagement situations in which participants seek to fill everyday life information needs

Resident: a mode of engagement in which people live a portion of their lives online

Situation: an event which shapes or triggers an individual's mode of engagement

Visitor: a mode of engagement in which people see the web as a series of tools

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