

Searching for the Next Billion

Global Design for Information Seeking Across Cultures

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While billions of people are established internet users, there are still billions of new users who have just come online in recent years and this growth will continue, especially on mobile in non-Western countries. Information seeking is essential to online behavior across the world, yet many prominent information-seeking platforms are heavily influenced by Western design patterns and use cases that originate from desktop. As we anticipate the future of information-seeking designs for new users, we explore opportunities to improve the experience by establishing a framework to evaluate common barriers to information seeking online across cultures.

Qualitative insights were collected from 164 participants to understand information-seeking patterns and barriers for users across three countries: Nigeria, Mexico, and India. Interviews were conducted with participants in their day-to-day environment, including home, work, internet cafes, markets, and university campuses. For every region, the overarching theme of our study was focused on barriers to information seeking. Each study also had a secondary goal based on previous learnings, new hypotheses, and emerging areas of interest. The secondary goal for each region was as follows: the Nigeria study explored perception of online information sources, the Mexico study explored local information needs, and the India study explored how users stay informed on topics of interest.

Based on this and past research, we created a framework that has five pillars to evaluate common barriers to information seeking: 1) User perception, 2) Infrastructure of internet and hardware devices, 3) Input and output, 4) Content quality of information, and 5) Context and overall journey.

INTRODUCTION

Of approximately 7.75 billion people in the world, an estimated 53% have internet access, and of those who have internet, 47% are from the developing world (International Telecommunication Union 2019). Countries like Nigeria, Mexico, and India have some of the largest growth potential for new internet users coming online due to variables including population influx and infrastructure advancements. Information seeking online is a ubiquitous behavior, but across cultures, the means by which people search online have evolved beyond the traditional search engine established by Western companies like Yahoo, Infoseek, Google and many others. Application designs that work in Western cultures present challenges for users who are not accustomed to Western design patterns, and mental models that originated from desktop do not necessarily translate for new users who started their internet experience on mobile. Based on common barriers to information seeking, technology developers anticipate new design patterns will be critical for creating a more inclusive internet experience for new users coming online.

Access to information has implications on the experiences and quality of life. The ability to use internet platforms to access information becomes increasingly important every year, especially when these platforms address meaningful everyday needs (Katz and Gonzalez 2016). The world is moving toward digitalization, whether people are ready for it or not. In countries like India, we see an increase of government official resources hosted online. This requires citizens to learn and grow their digital literacy in order to use fundamental services related to things like health, education, and electronic payments.

Search engines are often the starting point of an internet journey for billions of people around the world. Many search engines were designed by Western culture for desktop computers, but are used globally on mobile devices. This evolution in usage by cultures and devices has led to the lack of regional nuances and mobile specific needs for information seeking. Designing a search engine for global use with the expectation for it to work well for everyone is non-trivial given the varying degrees of information needs, cultural consideration, technology savvy, literacy, hardware, and internet infrastructure.

A significant amount of work has gone into researching and advancing the design of search engines, resulting in improved algorithms or design best practices for user interfaces (Croft 2008; Resnick and Vaughn 2006). Past research on mobile information access has identified device, connectivity, and language hurdles for marginalized segments of the population, and many have focused deeply on a specific country in South Asia or East Africa (Mancilla 2018; Rangaswamy and Cutrell 2012; Sambasivan et al. 2016; Steinfeld et al. 2015; Sultana et al. 2019; Wyche 2015).

In this study, we expand on the challenges of infrastructure and language by capturing the broader ecosystem of information seeking. Specifically, we explore the entire search journey that happens before interacting with the search engine, as well as challenges throughout the information-seeking experience. We also explore a range of information-seeking needs; for example, information-seeking tasks can include one-off queries, repeated queries over time, or multi-session queries that cannot be easily answered in one session. In addition, we explore behaviors across cultures in Mexico, Nigeria, and India to expand on the established body of research by covering Latin America, South Asia, and West Africa.

The intent of this study was to build a framework to understand barriers to using search engines. The scope of this research also included understanding how users currently seek out information through alternative means. As communities continue to lean on alternative platforms for information, like social media, we want to better understand the reasons for this behavior and what barriers may be preventing new users from seeking information on search engines. The information-seeking barriers framework has been used as a way to identify pain points in current and proposed search engine designs. The framework also allows us to understand the nuances and severity of specific barriers across regions. Understanding the prominence of barriers can help prioritize which issues to address as we build a global experience for information seeking.

RELATED WORK

Substantial research efforts have pushed the design and technology of search engines, including the user experience, by improving mental models over time (Mlilo and Thatcher 2011). However, there is a steep learning curve for query formulation, and users still struggle with this fundamental aspect of the service (Croft 2008; Mlilo and Thatcher 2011). Even among Nigerian graduate students who reported being “somewhat confident” in their ability to use search engines, awareness of advanced search features was low (Salako 2007).

The digital divide impacts certain segments of the population more severely than others. For example, we see women are at a “significant disadvantage” relative to men across regions, and especially in lower socioeconomic classes (Hafkin 2007; Steinfeld et al. 2015; Sultana et al. 2019). The key to unlocking online information is user education, which can have a significant impact on access to education and career development resources. Past

research in Mexico and India has shown that internet education can lead to more proactive information seeking for important needs related to learning and employment (Mancilla 2018; Mukherjee, Ilavarasan, and Kat 2019; Vishwanath, Kumar, and Kumar 2016). The more intuitive and culturally relevant search engines are for users, the more likely they are to be capable of searching and finding information for critical life needs.

Language and literacy are often barriers to information seeking. In traditional libraries, we find limited content in local languages for Nigerians (Momodu 2012). This challenge carries over to the internet as well, as most of the web content available in the world is in English. Searching for content with limited literacy can make a simple task much more complex. It requires more non-textual information seeking, which research has shown is extremely challenging (Wang and Shah 2016). Multilingualism also presents challenges in countries like India and Kenya, where there can be complications in language selection, non-structured blends of languages, and users with limited literacy in both language and technology (Rangaswamy and Cutrell 2012; Wyche 2015).

Creating text-based content online in languages other than English can be challenging. Many input options are designed for roman alphabets, but even for Romanized Indic languages, we still see significant hurdles (Gosh and Joshi 2014). As a result, people may be turning to other sources of information, such as social media, where it is easier to create and share content in local languages through visual imagery, audio recordings, or simple tap-based interactions that require less typing and spelling. The social media search trend has increased for other reasons as well, including the desire to consume content in a local language, personalized answers, fun factor, timeliness, perceived reliability, and local information (Oeldorf-Hirsch et al. 2014; Morris, Teevan and Panovich 2010; Kavanaugh et al. 2016).

METHOD

We collected insights from 164 users in Nigeria, Mexico, and India. The research projects were phased over the course of two years. For every study, the primary research objective was to understand information seeking and barriers that users face in obtaining information.

Each study also had a secondary goal based on previous learnings, new hypotheses, and emerging areas of interest. The secondary goal for each region is as follows: the Nigeria study explored perception of online information sources, the Mexico study explored local information needs, and the India study explored how users stay informed on topics of interest. Each of these secondary topics offered a different perspective on information-seeking needs that informed the final framework. The perception of online information sources influences the habits of where one retrieves information. The way someone goes about fulfilling local information needs is often varied from seeking globally relevant information. The way we seek information for a one-time topic of interest is different from how we stay up to date on topics we regularly seek out. By understanding how these different contexts impact information-seeking experiences, we are able to shape the barriers framework in a way that applies to more scenarios.

The data collection included a combination of in-depth interviews, usability tasks, and intercept interviews (see Table 1 for details). The home visits were in-depth interviews focused on information-seeking behaviors, perception of online information sources, mobile

usage, and usability tasks for information seeking on a mobile search engine. Intercept interviews were conducted to collect a wider perspective from participants not opted into a research database. The locations were public spaces and focused on information-seeking behaviors.

The participant sample included a mix of urban and peri-urban cities to include a mix of perspectives. Participants were between 18-30 years old. Based largely on income, all participants were upper-middle to lower-middle socioeconomic class respective to their location. This categorization was determined based on region and defined by local researchers from the country. There was a mix of gender across the regions and all smartphone participants were using Android OS.

Table 1. Overview of method sampling by region for a total of 164 participants.

| Method sample size per country | Nigeria (n=31) | Mexico (n=82) | India (n=51) |
|--------------------------------|-------------------|------------------|-----------------|
| Home visits (120 min) | 18 | 20 | 16 |
| Intercept interviews (15 mins) | 13 | 62 | 35 |

Interviews were conducted in English in Nigeria, Spanish in Mexico, and a mix of English and Indic languages in India. Local research agencies managed travel logistics, participant recruitment, translation, and participant incentive distribution. The interviews were conducted by a Google researcher with a local translator. All participants received a thank-you incentive that was distributed in local currency by the in-country research agency. The denomination was based on market rate for research participation based on involvement by the participant. For example, the intercept participants received a lesser incentive for the shorter 15-minute sessions relative to the 120-minute home visits.

Insights were analyzed by the Google field team, including a mix of technology developer roles: UX Researchers, UX Designers, Product Managers, Engineers, and Product Marketing Managers. The local agency researchers and translators also participated to provide additional context through the workshop. Analysis tasks included exercises like affinity diagrams, journey mapping, and thematic categorization.

Nigeria

The study took place in Lagos and Ikaram, Nigeria. Lagos has an estimated population of 21 million residents, whereas Ikaram has an estimated population of 20,000. The two cities are approximately 248 miles apart.

We collected insights from 31 participants through in-depth home interviews and intercept interviews. The intercept interviews in Lagos were conducted in a technology market called Computer Village, and in Ikaram were conducted in a produce market. In addition to information-seeking barriers, we also explored the perception of online sources of information from platforms like social media, websites, and search engines.

The analysis process included a full-day workshop with 22 field attendees from mixed disciplines, and two additional days with only lead researchers.

Mexico

The study took place in Mexico City and Ecatepec, Mexico. Mexico City has an estimated population of 8.8 million residents, whereas Ecatepec has an estimated population of 1.6 million. The two cities are approximately 15 miles apart.

We collected insights from 82 participants through in-depth home interviews and intercept interviews. The intercept interviews in Mexico City were conducted at the National Autonomous University of Mexico campus, and in Ecatepec were conducted in an open produce and home supply market. In addition to information-seeking barriers, we also explored local information needs like looking up business hours for a small neighborhood shop, or regional needs like seeking details about national elections.

The analysis process included a two-day workshop with 10 field attendees from mixed disciplines.

India

The study took place in New Delhi and Gurgaon, India. New Delhi has an estimated population of 21 million residents, whereas Gurgaon has an estimated population of 877,000. The two cities are approximately 18 miles apart.

We collected insights from 51 participants through in-depth home interviews and intercept interviews. The intercept interviews in New Delhi were conducted at the Jawaharlal Nehru University. The in-depth interviews focused on information-seeking behaviors, how users stay up to date on topics of interest, and mobile usage. Topics of interest can include a range of categories that typically require information seeking, such as hobbies like gardening, activities like shopping, news like political events, or sports like score updates.

The analysis process included a one-day workshop with 11 field attendees from mixed disciplines.

A FRAMEWORK FOR BARRIERS TO INFORMATION

A framework for evaluating information sources emerged from user scenarios throughout the search journey. As we collected more insights and perspectives from additional regions, we evolved the framework to be inclusive of new findings. There are five categories of barriers:

1. User perception
2. Infrastructure of internet and hardware devices
3. Input and output
4. Content quality of information
5. Context and overall journey

User Perception

Before users engage with any particular app for information-seeking, their impression and past experiences shaped their perception of their options. The perception of search engines was limited due to the over-simplistic text-field design that offered little guidance, limited exposure to search engines outside of academic contexts, and the learning curve of knowing how to use a search engine effectively.

Awareness of search engine capabilities was limited. Users were aware of basic search functionalities, but perceived search engines to have insufficient capabilities. Specifically, the text-based experience with search engines left users wanting more visual aid for context. Another common limitation of using a search engine was the lack of recent content, especially for current news topics.

“Google is a website where we search for meaning of some words, and any assignment given to us in English.” (P13, Nigeria)

“On Instagram you can find people who upload photos you like, while Google gives you a lot of link results.” (P29, Mexico)

“If I want to check for the latest news, I look on UC News. Searching online won’t show me new things.” (P14, India)

Expectations were defined by previous internet and search engine experiences. Searching for information online is perceived as work because participants felt you had to think of what to search for, type in your query, sift through results, and potentially repeat the process if the results were inadequate. For first-time internet users, search engine potential was unknown as there were no well-defined expectations, so users were not sure what they could search for.

“[The internet] I heard it is where you can find anything.” (P27, Nigeria)

“If there’s something I need to research, I use this app [Google], but you need to sift through answers to find the right answer because things aren’t always precise.” (P3, Mexico)

“Search is a procedure. You have to think of what to type, type it, and find what you are looking for in the text.” (P2, India)

Infrastructure of Internet and Hardware Devices

Fast and reliable internet was not feasible for most participants. For this reason, many relied on lite apps with reasonable latency (i.e. Opera Mini, Facebook Lite). These lite apps offered smaller APK sizes, taking up less memory. Many lite apps also focused their feature designs on core capabilities, meaning there were fewer features overall. This allows the application to run with lower latency.

Affordable and reliable internet access was a challenge due to relatively high data costs in Mexico and Nigeria. There was also limited broadband access in homes for India and Nigeria. This has led to high data consciousness around usage and management.

“Data is very expensive, but I get 1MB free for buying talk time every week. I use this to see Facebook. I get about 2 minutes of Facebook.” (P21, Nigeria)

“Once I run out of data, I only use Wifi until I can get more data.” (P9, Mexico)

“During the afternoons, my data becomes throttled. I can stream videos during the night or early in the morning.” (P46, India)

Device constraints were high due to an older Android device economy with smaller screens making search navigation harder, limited RAM slowing down application usage, and minimal storage availability bogging down the operating system. As a result, users found workarounds to manage or optimize their device performance.

“The main problems are the battery and the network signal. The battery problem is due to the fact that the phone is old and the network signal in this community is weak.” (P2, Nigeria)

“Sometimes it [the battery] doesn’t even make it through the day, so I have to keep it off.” (P1, Mexico)

“The phone has minimal GB, and I can only have so many apps without lag. I have to constantly delete, so I have a memory stick in which I can save my photos [from their phone].” (P16, India)

Input and Output Format

Input is a point of friction. Literacy is a challenge, including users with little-to-no written capabilities or knowledge only of common words and phrases. Searching for information without a strong grasp of written language prevents people from expressing their needs.

For those who don’t face literacy limitations, there is still the tedious process of querying. Thinking of a query requires knowing what you want to find, how to word your query, and how to spell it out. A successful query also requires an understanding of how keywords will impact search results. In many cases, this also involves query refinement, in which users must adjust the words they are using to find more accurate search results. While this is a process that exists for all searchers, those with older devices experience amplified issues due to slower response times.

The QWERTY keyboard format was also challenging for users. New internet users struggled with typing due to low familiarity with the QWERTY keyboard format. Non-Roman alphabet users, like Hindi speakers, also struggled with the QWERTY keyboard since the design was not intended for Indic languages.

An alternative is voice input, but there are challenges with this format as well, including lack of awareness. This is due to low discoverability and incorrect interpretation of the microphone icon used to trigger voice input. A second challenge for voice input is social acceptance. In some societies, speaking to your phone out loud may be considered rude, embarrassing, or even dangerous for privacy reasons. In regions like India, voice was very much accepted in public spaces, but did come with socioeconomic stigma. For some, the implications of using voice meant you were not educated enough to type.

“I don’t think it [voice input] would hear me, or I would have to speak loud so that everyone would hear.” (P14, Nigeria)

“I don’t want people to hear what I’m searching for.” (P5, Mexico)

“If I use voice, people will think I’m from the villages. (P27, India)

Video and image results were often expected due to the ubiquity of highly visual sources like Facebook or Instagram. Web search provided text-heavy content that did not enrich the experience in the same manner. In some cases, images were described as an indicator for verification of the topic or validity of the content.

“[Search engine] It is okay. It gives me the information I need. It’s neither interesting nor bad.” (P25, Nigeria)

“I looked on Pinterest for how to make sushi. Instagram and Pinterest show me how, where Google tells me and maybe shows me a diagram.” (P12, Mexico)

“If there are pictures, it is better. That way you know it happened [referencing images as a way to verify news information]” (P29, India)

Content Quality of Information

Search results were typically in English in India and Nigeria, but were often irrelevant because the content was from other English-speaking nations. For example, finding information from another English-speaking country like the United Kingdom was not useful as it lacked regional or cultural context. In India, many participants were not fluent in English, but received mobile information in English due to their phone settings being set to English. Phone language settings often influence app language by default. The English phone setting is prevalent in India and users wish to keep it for aspirational and societal reasons. For regions that are predominantly mono-lingual, as in Mexico with Spanish, there were far fewer complications.

“I have the phone in English to help me learn [Hindi speaker]” (P4, India)

For some local needs, users preferred to search in regional languages like Hausa or Hindi, but knew from prior experiences that this would yield limited or poor results. For bi-lingual users, there is an awareness that the quality of search results is often better in English versus non-English.

“I was searching for this sewing machine model for my business, but the only site selling it was in UK. I found one at the market and that is where I bought it.” (P12, Nigeria)

“I search in English, because there’s nothing if I search in Hindi.” (P7, India)

Fresh content comes from social media. While search engines provide a lot of information, they are not known as a source for recent news or local information. However, the search engines are a source of information when users want to verify information or cannot find it on other platforms.

“[How would you check the status of the current local political polls?] It’s on Snapchat.” (P17, Nigeria)

“I get my news from Forbes and CNN, I follow their page on Facebook and they send me notifications. Then I visit the post on Facebook.” (P12, Mexico)

“I follow celebrities and brands on Facebook and Instagram, and then I’ll check the trending feature on Facebook or the explore tab on Instagram.” (P32, India)

Every region has its local ecosystem of internet content that is relevant to that population. The health of the local information ecosystem, specifically the quality of the content breadth and depth, and recency of content creation differs by region and local language. The ecosystem health of local internet content directly impacts the quality of search results for people seeking information online. Many users tried searching for local business information, such as hours of operation, but were not able to find this online. Business owners were not familiar with how to create a website so they created a page on social media for their company, as this was a familiar concept.

When searching for local information needs, imagery and peer validation were critical pieces of information that users needed in order to make decisions. These are both strong components on social media platforms, making it the ideal source for local information needs. Users often could not find local information in non-social applications, and so social networks were the most reliable source for local information needs. This included leveraging social media platforms, messaging apps, and face to face communication.

“[How are these search results created?] “I don't know but most information is produced by Google.” (P25, Nigeria)

“I found this speakeasy bar on Facebook. My friend checked-in and I saw it on my feed. It looks like a fun place, and we were looking for somewhere to go.” (P12, Mexico)

“I can ask someone on WhatsApp.” (P13, India)

Context and Overall Journey

Repeat information needs like weather are simple, typically easy to access with as few steps as possible, and would be useful if surfaced proactively in application feeds or notifications. Instead of proactive content surfacing for repeat information needs, users must go through the mundane task of redoing search queries for every routine need. In addition, users expect new information to be provided, which social media often fulfills.

“I have something new to read like how to be a good wife on Facebook every day. On Google I see something new on this maybe once every 2-3 months.” (P19, Nigeria)

“I like to check the latest fashion trends on Instagram [owns a boutique shop].” (P37, Mexico)

“I check cricket scores every day in Cricbuzz.” (P 47, India)

Multi-step information needs are journeys that require several steps to obtain the required information. For example, a mother seeking information about a balanced diet for her children searched online through a search engine and Instagram. Then she wanted to cook different recipes that contained all these ingredients by watching how-to videos on Snapchat and YouTube. This took several queries on different apps and is likely a common need. Journeys like this could be improved upon by structuring information in a concise and relevant way based on information-seeking trends.

“I cook different recipes that contain all the classes of food to ensure my children eat a balanced diet.” (P23, Nigeria)

“Google gives you a lot of answers, but takes time to find it.” (P40, Mexico)

“If I see it on other sites, then I know it’s true [cross references information for verification].” (P9, India)

REGIONAL INFORMATION-SEEKING THEMES

As part of the research design, we explored barriers to information in all three countries in addition to one unique focus in each country.

Nigeria and the Perception of Online Information Sources

Search engines were often described as a transactional tool, and associated with academia. This perception stemmed from the exposure to search engines in the academic setting. Many teachers use search engines as tools that compliment curriculum. This sets the context and expectations of when a search engine is used, and what it is good for.

“I teach how to use Google so they can study better and be empowered.” (P18, Nigeria)

The perception of some Western designs, like iconography, were unfamiliar to participants. In particular, those who were new internet users struggled with common Western icons. For example, the microphone icon that is used for voice input was not recognized. Failed recognition was due to unfamiliarity with the microphone symbol, and limited awareness of voice input technology.

“I don’t know what that is, I wouldn’t tap on that [microphone icon for voice input].” (P24, Nigeria)

Participants viewed social media as a reliable source of information for places near them. The business owners we spoke to were more likely to create online profiles on social media platforms than to create traditional websites. The primary internet presence for businesses was on social media like Facebook, Instagram, and Snapchat. The rationale for why business owners chose to develop their online identity on social media included the ability to leverage an established social network and familiarity and ease of account creation. Because many participants built their business profiles on top of their personal social media accounts, they

had an established social network. This set of peers also provided immediate gratification through expressions of support, including likes and comments. Creating a profile for a business on Facebook requires minimal technology skills, and the platform offers a familiar experience from personal use. When compared to alternative methods of online presence, a website requires an unfamiliar process and most participants had no idea where to start. Many business owners were unsure of how to register or validate their shop information online for platforms like Google Search or Google Maps.

“Right now I can only manage flyers, posting on FB, and updating on WhatsApp. I don’t know how to make a blog. I don’t think I will have time for it [owns hair salon]” (P16, Nigeria)

Mexico and Local Information Needs

Peer validation was a critical piece of information seeking for local information needs such as business hours, recommended shops, and images of venues. As a result, we saw a stronger preference for social media as a local information source than traditional web content. Another common challenge was sifting through long form content on website results.

“Google is a lot of info, covering a broad timeline while Twitter is 120 characters, like here’s a link, click it. It’s fresh.” (P2, Mexico)

Many telecommunication data packages incentivized social media usage. The majority of participants had subsidized data plans that included free usage of select social media apps like Facebook, WhatsApp, or Twitter. This influences the user’s decision when information seeking as they have the option to use an app like Facebook for free, without incurring any data usage costs.

“I can check movie times by asking my friends to look it up. I normally only use WhatsApp, that’s enough for me [has free WhatsApp with data plan].” (P7, Mexico)

India and Topics of Interest

Topics of interest included any subject of content that users actively sought on a weekly basis or more frequently. Examples included gardening, fixing up cars, political news, beauty and fashion, and childcare. For each of these topics, participants had described proactively seeking out information on a regular basis (i.e. weekly or more frequently).

Participants generally favored highly visual content in the form of photographs and videos. This was often preferred over text-based experiences, and because of this preference social media was frequently used for following topics of interest. Participants described photographic content as much more enjoyable and easier to access than text. Many challenges around text content stemmed from language complexities; for example, the formality of results in Hindi was difficult to comprehend, or the limited content in Indic languages pushed users towards less relevant English results.

“I read blogs every day on Snapchat [reads BuzzFeed makeup tutorials].” (P6, India)

Notifications about tailored topics of interests with a short description were viewed as desirable among users in India. Participants liked the idea of pushed content that did not require active pursuit of information. However, the participants that liked the pushed content assumed that the notifications would be accurately tailored to their specific interest. This assumption did not account for receiving slightly off-topic content, which is inevitable today as algorithms behind that content are not perfectly tailored for every individual.

“Notifications are like a newsfeed experience [points to the list of notifications that are on the lock screen of his phone].” (P3, India)

DISCUSSION

This framework allows us to programmatically evaluate the user experience beyond traditional methods like task-based usability or log analysis, because these methods focus on behavioral data explicitly within a single product. This usage and usability data lacks an understanding of the user experience prior to the actual engagement with a search engine.

We have expanded on the existing knowledge of infrastructure and language barriers for information seeking by including a framework approach that captures the entire information-seeking journey. We have also built on the knowledge of information barriers for people beyond South Asia and East Africa by including representation from Mexico, Nigeria, and India in a holistic analysis.

The framework includes barriers throughout the journey, including barriers like perception. We see some users perceive traditional search engine designs as unfamiliar, too academic, or too much work for accessing information. The perception of information sources is greatly influenced by peers, social media ubiquity and incentivization, and contextual exposure. These factors have profound consequences on how people go about getting information, and the likelihood of even considering where they begin their information journey.

Current information sources offer a similar experience for users whether they are seeking information that is straightforward, requires multiple steps, or includes complex query needs. The burden of gathering information through multiple steps or several queries is put on the user rather than bundled together by most information platforms.

The quality of informational content available in each region can be a barrier for users, and varies based on the content ecosystem available. In particular, local information relies heavily on people from a particular region to create hyperlocal content that keeps up with rapidly changing environments.

Many of the needs discussed are successfully fulfilled on social media platforms. The trend of seeking information on social media raises the importance of the concerns about reliability and validation. The spread of misinformation becomes a reality when anyone can create content online, and viewers do not have the context they need to validate it. Future work should explore reliability concerns for common topics of interest, as well as the validation processes across regions.

CONCLUSION

In order to provide information access equally to all users, technology developers need to address user barriers to information seeking. This can be achieved by ensuring the following are accessible to people: users are aware of broader search engine functionalities to surface a mix of perspectives from different sources; users have options for limited device performance or data connectivity so they can access the internet; users are comfortable with the input options provided regardless of literacy level; users can consume information in an engaging format; users can find locally relevant content; users can collect all of the material they need to complete their information journey; and users are not inconvenienced by redundancies or additional steps.

Information seeking is a universal need, but the tools used for this need are not designed with a global perspective. As we have identified themes in barriers for users in non-Western countries, we see an opportunity to address these hurdles by applying this framework in our future work processes.

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REFERENCES

- Croft, Bruce W. 2008. "Unsolved Problems in Search: (And How We Approach Them)." *Information and Knowledge Management (CIKM '08)*. doi:10.1145/1458082.1458085.
- Gosh, Sanjay, and Anirudha Joshi. 2014. "Text Entry in Indian Language on Mobile: User Perspectives." *Interfaces and Human Computer Interaction (IHCI'14)*. doi:10.1145/2676702.2676710.
- Hafkin, Nancy J., and Sophia Huyer. 2007. "Women and Gender in ICT Statistics and Indicators for Development." *Information Technologies & International Development*, 4(2), pp-25.
- International Telecommunication Union. 2019. "Measuring Digital Development: Facts and Figures 2019." *Telecommunication Development Bureau website*, Feb 28, 2020. <https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx>.
- Kavanaugh, Andrea L., Sheetz, Steven D., Sandoval-Almazan, Rodrigo, Tedesco, John C., and Edward A. Fox. 2016. "Media use during conflicts: Information Seeking and Political Efficacy During the 2012 Mexican Elections." *Government Information Quarterly*, Volume 33, Issue 3, Pages 595-602, ISSN 0740-624X. doi:10.1016/j.giq.2016.01.004.
- Katz, Vikki S., and Carmen Gonzalez. 2016. "Toward Meaningful Connectivity: Using Multilevel Communication Research to Reframe Digital Inequality." *Journal of Communication*, 66: 236-249. doi:10.1111/jcom.12214.

- Mancilla, Yolanda Martinez. 2018. "ICT adoption as means for women's development in Mexico." Interaction Conference on Theory and Practice of Electronic Governance (ICEGOV'18). doi:10.1145/3209415.3209519.
- Mlilo, Sifiso, and Andrew Thatcher. 2011. "Mental Models: Have Users' Mental Models of Web Search Engines Improved in the Last Ten Years?" International Conference on Engineering Psychology and Cognitive Ergonomics.
- Momodu, O.M. 2012. "Rural Libraries and Community Development in Nigeria." International Journal of Basic, Applied and Innovative Research (IJBAIR '12), 1(3): 91 - 97.
- Morris, Meredith Ringel, Teevan, Jaime, and Katrina Panovich. 2010. "A Comparison of Information Seeking Using Search Engines and Social Networks." Association for the Advancement of Artificial Intelligence Conference on Weblogs and Social Media (AAAI '10).
- Mukherjee, Tuheena, Ilavarasan, P. Vigneswara, and Arpan K. Kar. 2019. "Digital Literacy Training, Impact & Moderating Role of Perceived Value Among Unemployed Women in India." International Conference on Information and Communication Technologies and Development (ICTD '19).
- Oeldorf-Hirsch, Anne, Hecht, Brent, Morris, Meredith Ringel, Teevan, Jaime, and Darren Gergle. 2014. "To Search or to Ask: The Routing of Information Needs Between Traditional Search Engines and Social Networks." Computer-Supported Cooperative Work & Social Computing (CSCW '14).
- Rangaswamy, Nimmi, and Edward Cutrell. 2012. "Anthropology, Development and ICTs: Slums, Youth and the Mobile Internet in Urban India." Proceedings of the Fifth International Conference on Information and Communication Technologies and Development, (ICTD '12). March 12-15, 2012, Atlanta, Georgia, USA. doi: 10.1145/2160673.2160685.
- Resnick, Marc L., and Misha W. Vaughan. 2006. "Best Practices and Future Visions for Search User Interfaces." Journal of The American Society for Information Science and Technology 57(6):781.
- Salako, O.A., and M.A. Tihamiyu. 2007. "Use of Search Engines for Research by Postgraduate Students of the University of Ibadan, Nigeria." African Journal of Library, Archives & Information Science. Vol. 17 Issue 2, p107-121.
- Sambasivan, Nithya, Azad, Gulzar, Aoki, Paul M., and Saswati Saha Mitra. 2016. "We Call It Hi-Fi: Exposing Indian Households to High Speed Broadband Wireless Internet." Proceedings of the Eighth International Conference on Information and Communication Technologies and Development (ICTD'16). doi:10.1145/2909609.2909651.
- Steinfeld, Charles, Wyche, Susan, Cai, Tian, and Hastings Chiwasa. 2015. "The Mobile Divide Revisited: Mobile Phone Use By Smallholder Farmers in Malawi." Proceedings of the Seventh International Conference on Information and Communication Technologies and Development (ICTD '15). doi:10.1145/2737856.2738022.
- Sultana, Sharifa, Hasan, Shaid, Mahmud, Khandaker Reaz, Raihanul Alam, S. M., and Syed Ishtiaque Ahmed. 2019. "Shada Baksho: A Hardware Device To Explore the Fears of Using Mobile Phones Among the Rural Women of Bangladesh. Proceedings of the Eleventh International Conference on Information and Communication Technologies and Development (ICTD'19). doi:10.1145/3287098.3287132.

Vishwanath, Aditya, Kumar, Arkadeep, and Neha Kumar. 2016. "Learning about Teaching in Low-Resource Indian Contexts." *Learning @ Scale (L@S '16)*, p305-308.

Wang, Yiwei, and Chirag Shah. 2016. "Exploring Support for the Unconquerable Barriers in Information Seeking." *Association for Information Science and Technology (ASIST'16)*.
doi:10.1002/pa2.2016.14505301106.

Wyche, Susan. 2015. "Exploring Mobile Phone and Social Media Use in A Nairobi Slum: A Case for Alternative Approaches to Design in ICTD." *Proceedings of the Seventh International Conference on Information and Communication Technologies and Development (ICTD'15)*.
doi:10.1145/2737856.2738019.