The Digital Divide: How Low-Literate Freshman Search for Information

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Abstract. Prior research with low literate internet users has shown a tendency to perform fewer searches and do not 'fact check' the information they found, often being satisfied with their initial findings. Research was conducted to understand how degree seeking low literate and medium to high literate adults search for information online. Ten low literate and ten medium to high literate degree seeking freshman and five non-degree seeking low literate participants were recruited to conduct three search tasks designed to mimic a low-level college science task. Low literate degree seeking participants were found to have search habits similar to the degree seeking medium to high literate participants. Degree seeking participants performed more searches and accessed more sites for each task than the non-degree seeking participants. Non-degree seeking participants showed signs of task fatigue, while degree seeking participants did not show a similar fatigue. Results indicate degree seeking adults have higher levels of digital literacy than non-degree seeking adults.

Keywords: Literacy · Digital literacy · Search · Low literacy · Education

1 Introduction

In our current society there is a subconscious misplaced link between intelligence and reading ability. We tend to believe that anyone who is low literate is uneducated, often unemployed, and from low income areas. While there is some validity to this belief[1], there is a portion of the low literate population that is highly educated and productively working alongside medium to high literate coworkers. In 2010, research showed that 14% of persons with low literacy had completed undergraduate degrees or higher [1].

The purpose of the research presented in this paper is to better understand the digital literacy of college freshman by observing their search habits. While there is a growing body of work on information retrieval in both low and high literate communities, a focus on degree seeking adults has not been represented in research.

This study intends to answer the following questions:

[1] There is a correlation between educational attainment and literacy ability. The National Center for Educational Statistics [2] found in 2003 that people with below basic reading skills were more likely to drop out of high school.

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1. Do the search techniques of degree seeking adults with low literacy show adaptive behaviors that are different than those of their medium to high literate contemporaries?
2. Are the search techniques of college-degree seeking adults with low literacy different than their non-degree seeking adult contemporaries?

Based on these questions the following hypothesis have been made:

1. Degree seeking adults with low literacy will search with adaptive techniques that are different than their medium to high literate contemporaries, and these techniques will help them compensate for their low literacy.
2. Degree seeking adults with low literacy will search with more developed search techniques than non-degree seeking low literate adults.

2 Literature Review

In 2017, the Program for the International Assessment of Adult Competencies (PIAAC) tested American adults for literacy competencies, among others. The PIAAC defines literacy as "understanding, evaluating, using and engaging with written text to participate in society, to achieve one's goals and to develop one's knowledge and potential" [3] and grades literacy on a five-level scale. People rated at or below Level 1 are considered low literate, and those rated as Level 2 would most likely be considered low literate by other measures, or at least a portion of them would. People rated at Level 2 can match 1–2 pieces of information to the texts presented, compare and contrast information, and navigate digital texts to access requested information [3]. With this in mind, at least 19% of adult Americans are considered low literate, with a portion of the 33% rated as Level 2 considered low literate [4]. This means that slightly less than half of the American adult population cannot match information in texts, paraphrase texts, or make low-level inferences from the texts.

The Pew Research Foundation, in 2017, found that eighty percent (80%) of students were graduating from high school and that more of these graduates are matriculating to college [5]. Further, these students have been in almost constant contact with technology for most of their lives, and they tend to prefer classrooms where technology is a major part of their education [6]. Therefore, students in college today are aware of technology's necessity and their need to possess the skills to process large amounts of information to aid in their jobs and decision-making skills [7], but many first-year students are coming lacking the basic information literacy skills they need [8].

Buzzetto-Hollywood, Elobeid, and Elobaid also found that students entering college lacked digital literacy related to everyday computer applications [9], but students were are well-versed in using social media applications, online search engines, and using platforms to make and host original content [10]. One hypothesis to explain the lack of computer skills seems to stem from less access to school libraries and trained educators that can help them learn the digital literacy skills they need [11]. Geck [11] believed that most of today's college students lack the digital literacy skills needed to

survive in academia. However, the research presented here will show that this is not necessarily the case.

2.1 Information Literacy and Retrieval

Without proper access to—and the appropriate knowledge of how to access—the internet, people will not be able to access the information they need to get gainful employment, health care and coverage, entertainment, and news [12]. Traditional literacy skills have been shown to correlate with digital literacy skills, namely that people with lower literacy skills will lack necessary digital literacy skills [13].

When it comes to making online searches, users are often confronted with large amounts of results, which may or may not be relevant to the original search parameters: users, therefore, need traditional literacy skills to quickly assess the information in each result to determine its relevance [12]. People with low literacy have been shown to read every word on a webpage instead of quickly scanning information, and they are so focused on reading each word that they often miss information that is outside their area of focus [13, 14]. Further, low literate users tend to satisfy quickly, opting for partial answers, or wrong answers, instead of continuing the search for the full answer [13. 14]. Because of their quick satisfaction, low literate users will not spend time 'fact-checking' the answers they do find [14].

Users with medium to high literacy will use clues on the webpages to help find the information they are searching for, which means that such users in Kodagoda, Wong, and Kahan's research [14] followed similar trajectories in their searches. Low literate users, on the other hand, did not follow similar trajectories. Low literate users are also more likely to assume they know where the information should be, and thus abandon searches if the information was not there [14].

3 Methodology

This study was conducted at the University of Baltimore User Research lab on the Tobii t60 eye tracker computer using the Tobii software. Each of the twenty-five participants were asked to complete three different search tasks that were modeled after first year science courses. Follow up questions were asked after each prompt, and all data was recorded through the Tobbi software.

3.1 Procedure

There were twenty (20) degree seeking adults recruited from the University of Baltimore and Baltimore City Community College; five (5) additional non-degree seeking adults were selected for their low literacy and lack of college experience. All participants were asked to complete the REALM[2] to determine whether they were low

[2] The Rapid Estimate of Adult Literacy in Medicine has been shown to give an accurate estimate of literacy in a matter of minutes with very little training needed to administer the exam [13].

literate[3] or medium to high literate. Testing took about an hour and was performed in the User Research lab at the University of Baltimore.

All participants were asked to complete the following search tasks:

- Describe, in detail, the history of Pluto from discovery to no longer being a planet.
- Explain, using diagrams, how the process of mitosis compares to meiosis.
- Submit a one-page outline of your biographical sketch of Johannes Kepler.

3.2 Participants

Of the twenty (20) degree seeking participants, ten were rated as low literate and ten were rated as medium to high literate. Participants were selected from general education courses to allow for a wide representation of majors. Table 1 documents the self-reported ethnicity of participants for each population, as well as, the genders of the participants. All participants—non-degree seeking and degree seeking—reported using their smartphones or computers every day.

Table 1. Demographics of the two participant populations, both ethnicity and gender.

Population	Asian	Black	Hispanic or Latino	White	Male	Female
Degree seeking adults	2	14	2	2	9	11
Non-degree seeking adults	0	5	0	0	2	3

Participants in each population reported having experience with the internet, most degree seeking adults reported having used the internet for more than 6 years, while a slight majority of non-degree seeking adults reported less than 5 years' experience.

4 Findings

The twenty degree seeking adults performed 174 searches (102 unique); low literate degree seeking adults performed 92 unique searches and medium to high degree seeking adults performed 82 unique searches. Table 2 shows the search counts and percentage breakdowns by degree seeking literacy groups. An ANOVA single factor test was conducted to compare search totals for low literate degree seeking adults and medium too high literate degree seeking; there was not a significant difference in scores for low literate degree seeking adults (M = 9.6, SD = 6.22) and medium to high literate degree seeking adults (M = 8, SD = 5.735); $F(1, 18) = .358$, $p = .557$. The results indicate that there is not a difference in how many searches each group performed, though the small sample makes it difficult to say for certain this is true.

[3] Any degree seeking adults that scored less than 60 points on the REALM were considered low literate, while those over 60 were put in the medium to high literate group. All non-degree seeking adults tested below 60.

The five non-degree seeking adults performed 26 searches. An ANOVA single factor test was conducted to compare search totals for all degree seeking adults and non-degree seeking adults; there was a significant difference in scores for degree seeking adults (M = 17.6, SD = 8.32) and non-degree seeking adults (M = 5, SD = 3.39); $F(1, 13) = 10.292$, $p = .007$. These results indicate that there is a significant difference in how many searches degree seeking adults and non-degree seeking adults perform during tasks.

Table 2. Student search engine results by literacy rating

Search engine	Low literate degree seekers		Medium to High literate degree seekers	
	Total	Percent	Total	Percent
All Google searches	64	69%	37	45%
All Yahoo searches	21	23%	39	48%
On-site searches	7	8%	6	7%
Total	92	100%	82	100%

Degree seeking adult participants accessed 99 unique sites a total of 212 times; low literate degree seeking adults accessed sites 105 times, and medium to high literate degree seekers accessed sites 107 times. Non-degree seeking adults accessed 20 unique sites a total of 35 times. An ANOVA single factor test was conducted to compare site access totals for low literate degree seeking adults and medium to high literate degree seeking adults; there was not a significant difference in scores for low literate degree seeking adults (M = 10.5, SD = 5.276) and medium to high literate degree seeking adults (M = 10.7, SD = 3.743); $F(1, 18) = .01$, $p = .923$. A second ANOVA single factor test was conducted to compare site visited totals for degree seeking adults with non-degree seeking adults site; there was a significant difference in scores for degree seeking adults (M = 21.2, SD = 6.391) and non-degree seeking adults (M = 7, SD = 7.314); $F(1, 13) = 15.024$, $p = .002$.

These results are in line with prior work by Summers and Summers [13] and Kodagoda, Wong, and Kahan [14], low literate adults tend to accept the answer found on the first site they visit without verifying the information through other sites. The researcher asked each participant about their searches, and was told by non-degree seeking adults that more searches weren't necessary as they had found their answer, while degree seeking adults mentioned that they like to run multiple searches to find more information to ensure they have found all of the correct information possible. Similarly, non-degree seeking adults would explain that the single site they visited had all the information they needed, while degree seeking adults wanted to verify information on multiple sites or see if there was something they were missing.

Non-degree seeking low literate adults showed signs of fatigue over the course of the three tasks. On average they took just under 11 min for Task 1, just over 11 min for

Task 2, and 9 min for Task 3. On each task, non-degree seeking low literate adults took less time to say they had found all the information they needed. Degree seeking adults, on the other hand, did not show this same decrease across tasks. Table 3 shows the times and standard deviations for each population across the three tasks.

A single factor ANOVA found no significant difference in task completion between the three groups for any task. For Task 1, $F(2, 22) = .803$, $p = .461$; for Task 2, $F(2, 22) = .141$, $p = .869$; for Task 3, $F(2, 22) = .223$, $p = .802$. Though all populations spend roughly the same amount of time per task, future research should randomize the order of tasks to minimize the potential for fatigue on the final task.

Table 3. Task times for each population

Population	Task 1	Task 2	Task 3
Low literate	13 m 29 s	9 m 32 s	11 m 15 s
Degree seeking adults	SD = 1.506	SD = 1.745	SD = 1.751
Medium to high literate	10 m 47 s	9 m 2 s	10 m 37 s
Degree seeking adults	SD = 1.44	SD = 1.615	SD = 1.894
Non-degree seeking adults	11 m 19 s	10 m 51 s	9 m 10 s
	SD = 1.648	SD = 1.88	SD = 2.146

5 Conclusion

This paper set up to examine the differences and similarities in searching techniques of low literate and medium to high literate degree seeking adults. It was hypothesized that low literate degree seeking adults would have adaptive search techniques that had been developed to help them in their educational attainment. This hypothesis was based on prior work [12–14] that showed differences in search techniques of low literate and medium to high literate adults. This research found this to be true for low literate non-degree seeking adults, but not for degree seeking adults.

All degree seeking adults seem to search with more advanced digital understanding than their non-degree seeking contemporaries. This means that hypothesis one seems to be rejected as all degree seeking adults search with similar techniques, and hypothesis two seems to be accepted. This work is an important addition to the body of work on the impact of traditional literacy on digital literacy, as it does call into question the idea that digital literacy is correlated with traditional literacy for degree seeking adults.

There are a few limitations to this study; namely, small sample size, limited geographic location, and non-natural search prompts. Future work should expand the sample size and geographic location of participants to get a better cross section of American degree seeking adults. Further, task prompts should include student assignments as well as set prompts as found in this research. Set prompts allow for easier comparison of behaviors and search results, but school assignments would garner potentially better engagement from the participants.

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