Interaction Design Project II

Design intervention on Google Scholar to enrich the information retrieval experience

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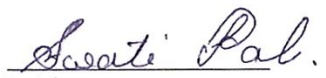
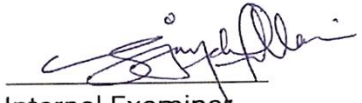
Approval Sheet

This Interaction Design Project-2 titled "Design intervention on Google Scholar to enrich the information retrieval experience" by Mithun Murali (Roll Number: 216330008) under the guidance of Prof. Swati Pal, is approved for partial fulfillment of the requirement for the degree of "Masters in Design" in Interaction Design at the Industrial Design Centre, IIT Bombay.



Guide



Internal Examiner

External Examiner

Declaration

I declare that this written document represents my ideas in my own words. Where ever other ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea, data, fact, or source in my submission. I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Introduction

The Internet has become the medium of choice for many people to seek information, acquire knowledge, draw conclusions, and solve problems. The Web has become an external memory for its users and even influences how they think and learn, resulting from the search engine. The search feature has been integrated into the operating systems and programs of all types of computing devices. Users can conduct searches anywhere, at any time. Therefore, it has become almost instinctive to locate the search function whenever we need information. The fundamental interaction model of all search functions is fairly similar across all platforms, consisting of Query input, Result Displaying, and Interaction. The development of AI has enabled modern search engines to comprehend some natural language queries and provide concise, direct responses.

Multiple industries require access to accurate information. Thus, a vertical search engine concept has emerged. The primary characteristics of vertical search engines are the semantic analysis of the entered key text and the restriction of the result pages to provide the user with more specific results. For example, YouTube is a vertical search engine only for video output. Amazon's search function is a vertical search engine for displaying only items available for shopping.

There are many academic digital libraries that doctoral students use for their research. The information retrieval from these platforms is tedious and time-consuming, as this research has discovered. It is found that the requirements of the users vary according to the stage of the study. The underlying factor that leads to this research is the fact that all doctoral students struggle with swift information retrieval even though they are all experts in digital technology and digital mediums.The primary objective of this study is to investigate the various vertical search engines used by doctoral students for academic literature reviews and to develop design interventions that facilitate efficient information retrieval.

Scope

- Current academic library interfaces are analyzed in terms of their benefits and drawbacks.
- Evaluating the user-friendliness of the most popular website for academic literature references.
- Exploring the possibility of optimizing and redesigning Google Scholar's search interface to reduce the effort target users require to retrieve information.
- Evaluating the redesign prototype's user-centricity.

Literature Review

This research aims to investigate the relationship between user perception and user behavior during the search for research papers and to compare those criteria between scholars in different stages of their doctoral studies. This project investigates the target user's information-searching behavior and strategies during complex information retrieval. Academic research is a time-consuming and difficult process because it requires scholars to search for, discover, and locate relevant, helpful, and credible information. There is an abundance of information available to users in the digital library, resulting in a significant drop in search and retrieval efficiency.

The information-gathering requirements or goals change depending on the field of study or the domain. The four most frequent information-seeking requirements are 1. Fact Verification, 2. Knowledge Enhancement, 3. Knowledge Acquisition, and 4. Knowledge Discovery. [1]

The major information-seeking models are looked at and understood. Users end up with one of these models based on their expertise in the field and other factors. [2] The five most prevalent information-seeking models include the Lookup-based retrieval model, the dynamic (berry-picking) model, Vakkari's three-stage model of information-

seeking, the exploratory search model, and the model by Meho and Tibbs.

Lookup-based retrieval model: [1]

The user formulates a query to describe the desired information, then views the search results and selects the required documents. This information retrieval model is typically adopted by inexperienced users. This closely resembles the search pattern that the majority of users employ when conducting searches on general-purpose search engines.

The dynamic model (berry-picking): [1]

Here, the user begins with a vague understanding of the required information, which evolves as searches are performed. The user is then provided with additional information about the subject. In addition to traditional lookup retrieval, this model allows users to follow citations, navigate within a journal or conference proceedings, and search the works of particular authors as part of the learning process.

Vakkari's three-stage information-seeking model: [1]

This model divides search tasks into three stages: pre-focus, focus formulation, and post-focus. The pre-focus phase involves initiating the search and conducting a broad investigation of the topic. In the focus formulation stage, users thoroughly refine and investigate their objectives. Users collect, synthesize, and implement their search results in the post-focus phase.

Exploratory search model: [1]

Here, users begin with a vague objective and seek to develop knowledge and understanding by interactively querying the data to identify potentially significant and relevant subsets. Such procedures are frequently used when the required information is open-ended and multifaceted.

Meho and Tibbo's model: [1]

This model was developed to describe the specific needs of social scientists. The search procedure has four interconnected phases: searching, gaining access, processing, and concluding. This model is very similar to the previous models and shares several attributes.

It is also observed that the successful retrieval of information depends on a variety of other factors, such as the need for searching for specific literature, the user's

expertise, background, in-depth topic knowledge, cognitive abilities, etc.

Systematic Literature Review (SLR) Techniques:

The three most important SLR techniques are Forward Chaining, Backward Chaining, and Journal/forum Browsing. [3] Forward Chaining is a data-driven technique in which the user reaches a goal or makes a decision based on available data. This method facilitates the formation of multiple conclusions. In addition, it provides a reasonable foundation for conclusions. Figure (1) depicts the forward chaining process flow. Backward chaining involves breaking down a specific task into its parts. The entire task is then revisited, beginning with the final task and working backward. This method begins with the desired outcome and works backward using inference rules to determine which facts satisfy the objective. The process flow of backward chaining is depicted in Figure (2), where the decision is dissected back to the data points or facts.

The third technique of Systematic Literature Review is Journal browsing or forum browsing which is the amalgamation of forward chaining and backward chaining. The user will navigate in both directions of the query and search process.

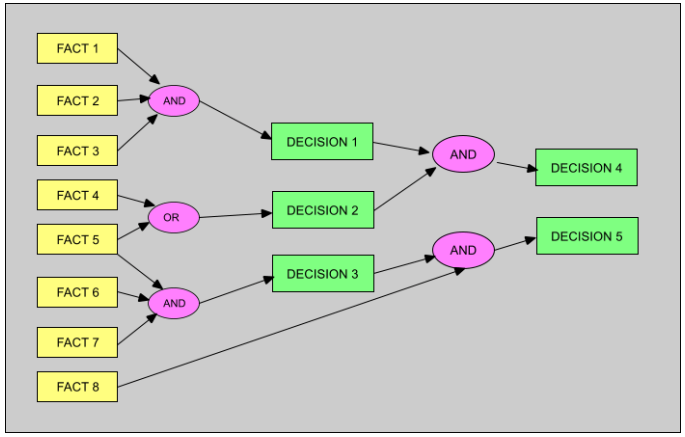


Figure 1: Forward Chaining (High Res.)

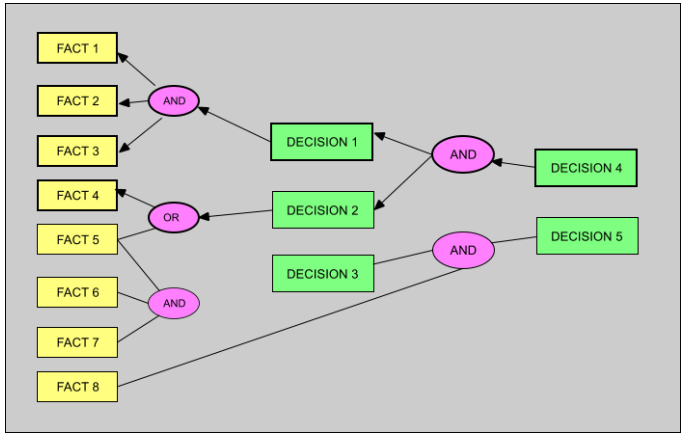


Figure 2: Backward Chaining (High Res.)

Primary Research

After completing the literature review, I focused on the primary research. First I started with the pilot study where my aim is to verify my research direction.

Methodology

The research is conducted in two phases. Phase 1 is the pilot study to validate the direction of this project, and phase 2 is the collection of qualitative data. The purpose is to observe the decision-making procedures used by Ph.D. research students while doing search tasks. Here, I conducted think-aloud sessions with users to better understand how they accessed information from the available interfaces. The study is conducted on Ph.D. candidates from the first to fifth years. To evenly distribute the user group's level of competence, at least two users are chosen to serve as representatives each year. I instructed the participants to run a fresh search in their preferred digital library and simultaneously orally express their thoughts. The important components of their information search and selection process are abstracted away using the think-aloud method.

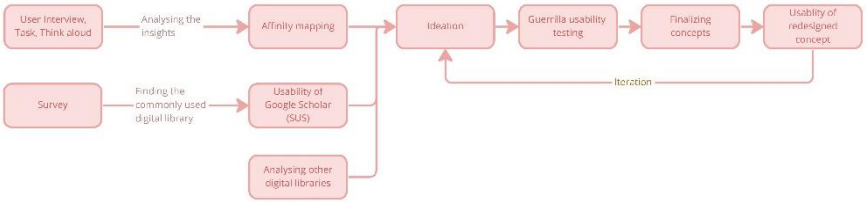
To learn more about the user and their information-retrieval behaviors, a few questions are asked simultaneously:

1. Tell me about your background and research interest.
    a. which year of study.
    b. expected to finish in how many years
2. How often do you search for literature for your research?
    a. has it changed over the years?
    b. has the keyword quality improved?
    c. small phrase search or a long-phrase search?
    d. deciding factors while choosing a research paper to read?
3. What are the digital libraries that you use to find literature?
    a. What do you think about your colleague's choice of DL?
    b. Own subscription or institution subscription?

4. Tell me about your experience in using this library so far.

    a. Experience of using the DL in 1st year to the current year or study... differences.
    b. What criteria do check before selecting a paper from search results?
    c. What are the advantages of the current DL that you regularly use?
    d. Problems or difficulties with the current DL

5. How do you deal with the search results that don't



get you exactly what you are looking for?

6. Tell me about a situation that led you to abandon the search for a literature
7. How would you know that a particular research paper is matching your needs even before opening it?

Figure 3: Method adopted (High Res.)

Phase 1: Pilot study

The initial phase of the primary research consisted of a pilot study conducted to lay the groundwork and gain an understanding of the fundamental structure of the information retrieval process employed by doctoral scholars. I conducted three semi-structured interviews and observed participants performing a search task to accomplish this. Participants used their favorite digital library to search & retrieve a research article along with think aloud protocol.

Learnings:

- These interviews helped me in gaining a fundamental understanding of the thought process of doctoral scholars.
- Subjecting them to a simple search exercise helped establish the fact that retrieving information from the academic literature is a time-consuming, difficult task.
- The pilot study also revealed that the needs and desires of the user depend on a variety of factors, such as the study year, subject type, information processing speed, etc.
- Because of the difficult nature of this search and information retrieval task, users are subject to a certain amount of cognitive load.
- There are numerous digital libraries that the user uses, which do not adhere to strict uniformity regarding their interface elements. This causes users to experience a moment of ambiguity when switching between digital libraries.

After completing this stage, I concluded that users incur an existential cognitive load when searching for academic literature. Therefore, I decided to continue in the same direction with additional user research to comprehend the various categories of target users and the digital libraries they use and identify the most frequently used library or academic literature source.

Based on the findings of the user study, I decided to investigate the existing digital libraries that users use. I intend to find the advantages and disadvantages of these digital libraries.

Analyzing existing Digital Libraries

Literature Source	Pros	Cons
Science Direct	Single click pdf download option Group download multiple papers pdf Full abstract read in the dropdown Option for graphical abstract	Citation not displayed
Taylor & Francis	Pdf quick download Full abstract read on drop down	Unnecessary 'full text' option Citation count is displayed but not prominent
Google Scholar	Quick date filter option PDF availability displayed Easy to give keyword alert Quick save paper and label option Quickly jump to 'Cited papers' Easy bibliography or Citation export options	Incomplete abstract Index words not displayed Search phrase matching criteria not clear Do not have advanced search options Sort by Citation not available PDF download option not given
ACM	Extremely good 'advanced search options Quick and easy sorting options	The abstract is not displayed completely Index words not displayed No option for quick download of pdf
Scopus	The abstract is displayed completely in the dropdown Citation displayed	Download access is not clear on the search result page.

Figure 7: Comparing the existing Digital Libraries

Phase 2: Qualitative data collection

The participant pool consists of twelve Ph.D. research students, between their first and fifth years of research, they will be between the ages of 27 and 35 years old. This study collects qualitative data on the information retrieval strategies employed by users of digital academic libraries. The collected data will determine the user-centricity of the current interfaces and analyze and articulate their advantages and disadvantages.
To gain a deeper understanding of this domain, I conducted the following:

- 12 semi-structured interviews with IIT Bombay Ph.D. students from various departments. I ensured that each year was represented by at least two participants.
- I conducted a user survey to determine the most frequently used and preferred literature sources.
- Based on the survey results, I conducted a quick usability evaluation of the most preferred academic literature source/digital library. This enabled me to recognize that even the finest digital sources have some flaws.

Contextual inquiry

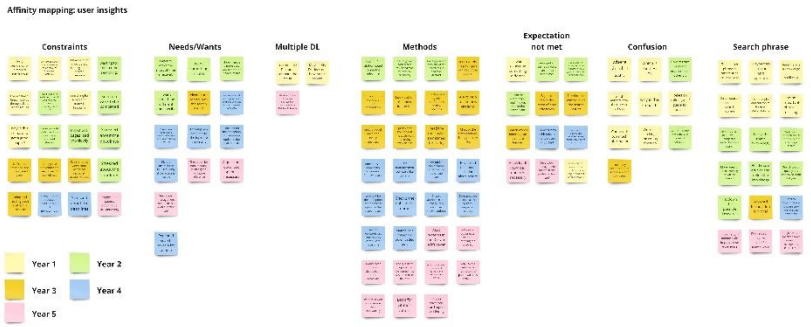


Figure 4: Creating the affinity diagram post the interviews (High Res.)

Figure 5: Demystifying the interviews (High Res.)

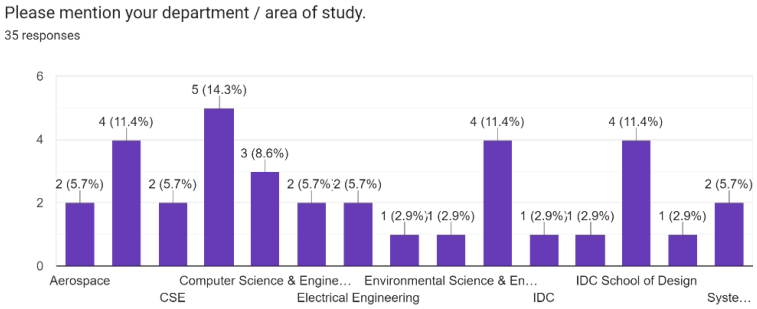
I pulled out some insights from the contextual inquiry related to the information retrieval part of the academic literature search engines. These are some focal points for which I could generate potential design solutions :

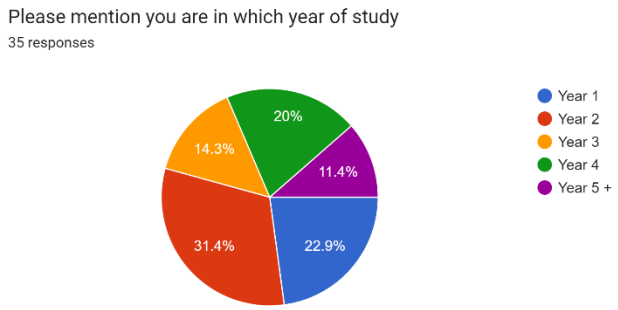
- New users always seek a refined search result if they are unable to locate the desired research paper.
- New users are concerned about the amount of time wasted perusing irrelevant content on the search results page.
- It requires numerous clicks to reach the desired resource.
- Users are eager to make the most of their time and agree on the amount of time wasted perusing search results.
- Users anticipate a more intuitive method for sorting search results by desired topics.
- Many users initially examine the number of citations to determine relevance.
- It is difficult for users to access each search result's abstract individually.
- Users concur that the index words within a paper aid in determining its direction.
- The majority of users report having expected something different.
- Sometimes, redundant search results irritate users.
- Feels like a loss of motivation when finding a good article takes a long time.
- There are times when novice users are unsure of where to begin.
- Some new users are still trying to determine which digital library is the best.
- When a relevant article is published in another library and the user could have missed it, the user experiences difficulty.
- Users concur that they desire reliability.
- The search term is extremely basic for new users.
- Some users believe that their approach may not be the optimal one.
- According to expert users, a knowledge gap must be addressed.
- Some users employ multiple DLs and then compare the results.
- Even experienced users agree that it is tedious to read the abstracts of each search result individually.
- Users assert that there is a great deal of work to be done, but that the search process is redundant and consumes their productive time.
- Users assert that they require greater control over search results.

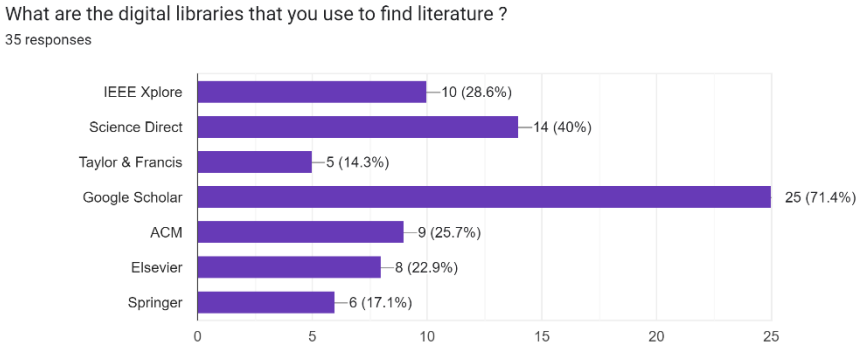
- To save time, some advanced filter options can be made available on the main page.
- Create alerts to receive new citation alerts.
- Relies on colleagues or mentors for guidance.
- Some users carry a list of topics and sub-topics with them at all times for quick access to search results.
- Free access papers and restricted access papers should only be displayed initially.
- It is essential to be aware of recent developments in the field.
- Keep an eye out for the pdf or free access option in the search results.
- Immediately scan the paper if the abstract lacks specifics.
- Occasionally, read the conclusion for clarity.
- Generally, citations serve as my primary filter.
- The indexing of search terms can be tailored.
- It is essential to be aware of recent developments in the field.
- Very important to thoroughly understand the topic before changing the search terminology.
- Feels irritated when access to a piece of paper is restricted. No pdf.
- For a picture abstract to be useful, the image must be legible.
- The bookmarking option is also useful for future reference.
- A rapid PDF download option is required.
- It is difficult to locate research papers on India.
- Similar to advanced search, alert options can be improved.
- Need an option for paper management in the profile section.
- Some users will abandon the search if the results are extremely vague and unrelated.
- Additionally, too many options on the screen are confusing.
- Suggested papers popping up are annoying.
- Need an option for paper management in the profile section.
- Maintains a folder for pdfs that have been downloaded.
- Expert users select a paper without even reading the abstract.
- Experience improves information-finding abilities.
- Expert users provide extremely specific keywords to narrow search results.

User Survey

I conducted a user survey to determine which digital library is the most popular and preferred by users. I distributed a survey to 35 prospective doctoral students at IIT Bombay. The results are as follows:







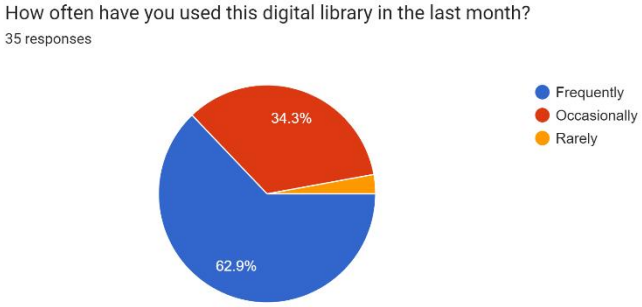


Figure 6: User survey results (High Res.)

From the survey, it is evident that the most commonly used literature source is Google scholar. My further studies will be focused on Google Scholar.

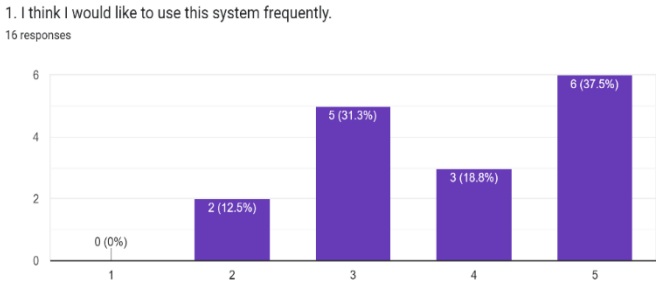
Google Scholar - System Usability Scale

The System Usability Scale [4] is the most well-known questionnaire used in user experience research. Since the beginning of digital technology, the SUS has existed, and its experimental validity and dependability have been repeatedly demonstrated.

When a SUS is used, participants are asked to score the following 10 items with one of five responses that range from Strongly disagree to Strongly agree:

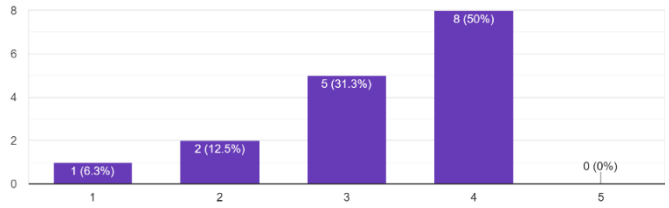
1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

The output of the SUS questions focused on Google Scholar is as follows: Here rating 1 denotes Strongly disagree and rating 5 denotes strongly agree.
Click here for a high-resolution image of SUS output and click here for the calculation.



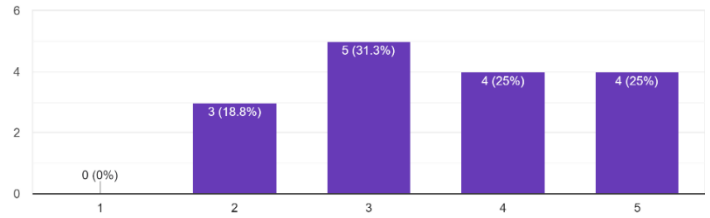
2. I found the system unnecessarily complex.

16 responses



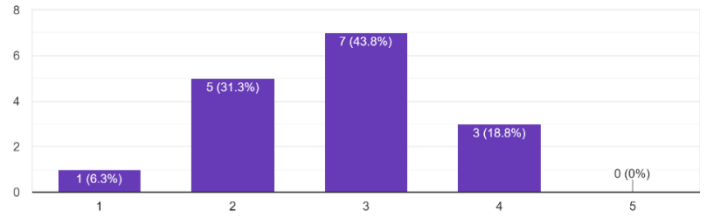
3. I thought the system was easy to use.

16 responses



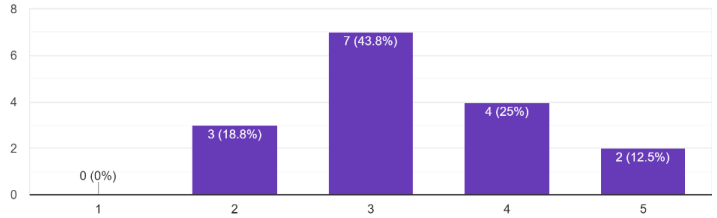
4. I think that I would need the support of a technical person to be able to use this system.

16 responses



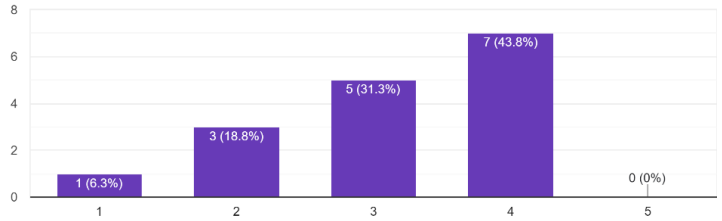
5. I found the various functions in this system were well integrated.

16 responses



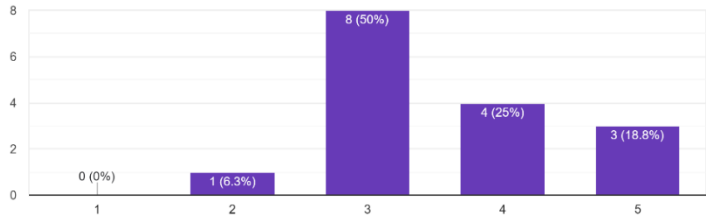
6. I thought there was too much inconsistency in this system.

16 responses



7. I would imagine that most people would learn to use this system very quickly.

16 responses



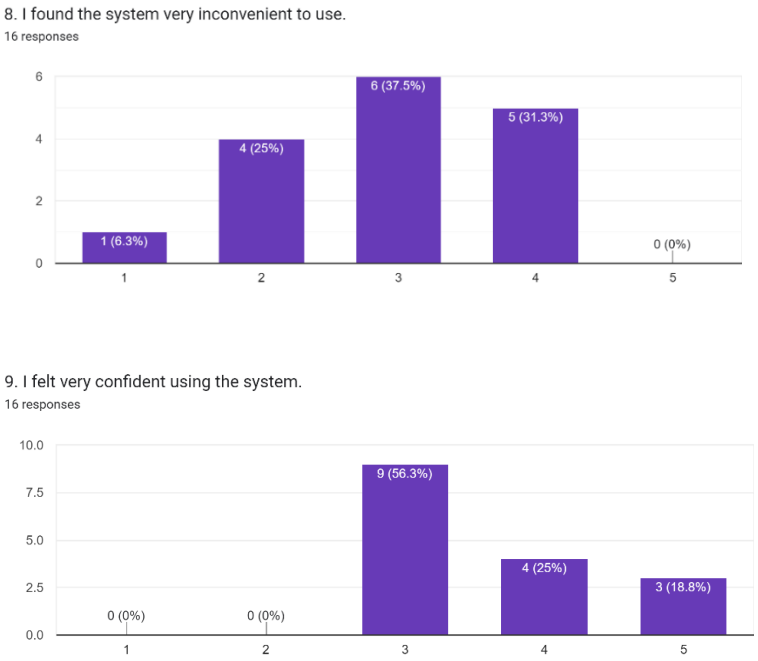


Figure 8: Google Scholar SUS results (High Res.)

The mean score of all the participants is 57.66 which is less than the average line of 68. The standard deviation is 17.28. Since the usability score is below 68, we can conclude that all the participants in the usability test rated Google Scholar as below average concerning user-centricity. Click here for detailed calculations of this SUS.

User Categories

I developed three personas for doctoral students, based on their stage or year of study. This is essentially a classification of the user's proficiency. I combined the first- and second-year doctoral students into the **Beginner persona**. The third and fourth years are then combined to form the **Intermediate persona**. The final category, or **Expert persona**, consists of users who are in their fifth year of doctoral studies or beyond.

User Journey

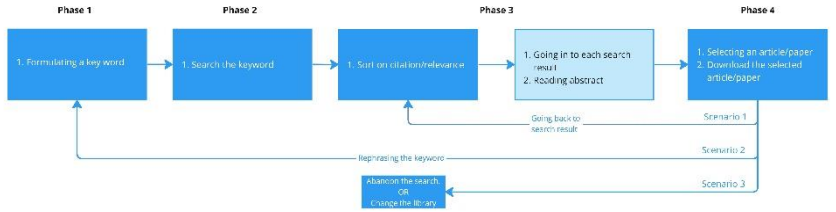


Figure 9: User journey- Beginner persona (High Res.)

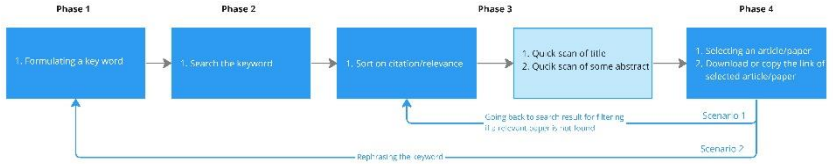


Figure 10: User journey- Intermediate persona (High Res.)

Figure 11: User journey- Expert persona (High Res.)

User Persona - Beginner

Name: Rohan
Age: 25
Language: Hindi, English
Education: Mtech, IIT-G
Preferred Digital Library:
Google Scholar, Science Direct

Goals

- Want to complete PhD on time
- Want to work on social commitment to society

Motivations

- A sense of doing good work
- Praise from family, friends
- Want to contribute to the community
- Part of IIT-B community

Frustrations

- Lack of direction
- Lack of self-confidence
- Time consuming research .

Behavior

- Takes initiative
- Sincere
- Always seeks out new knowledge

Figure 12: User persona 1 (High Res.)

Empathy Map

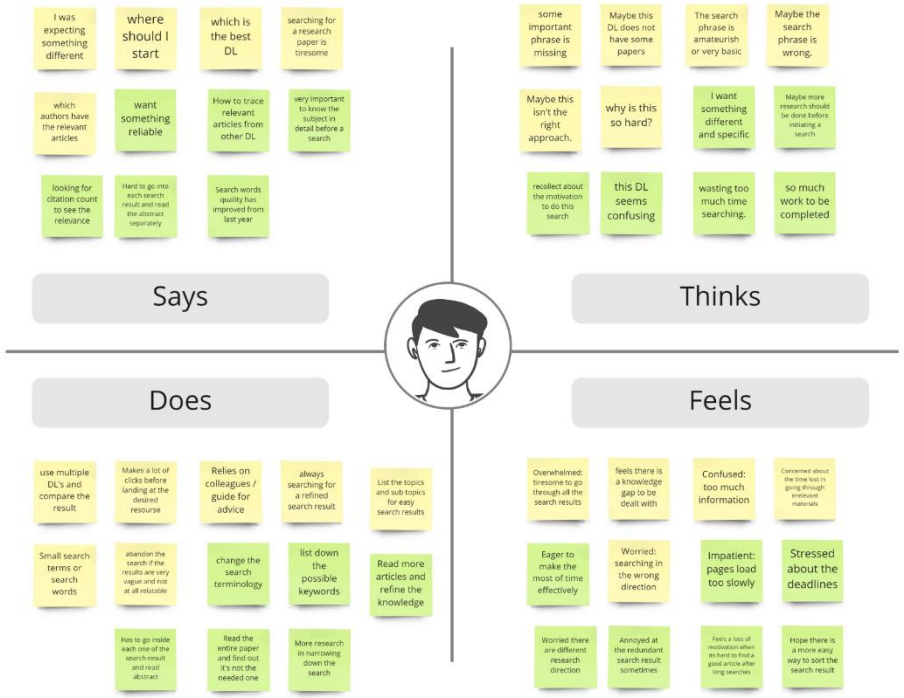


Figure 13: User persona 1 -Empathy Map (High Res.)

User Persona - Intermediate

Name: Riya
Age: 28
Language: Marathi, English
Education: M.Des, SPA Delhi
Preferred Digital Library:
Google Scholar, T&F

Goals

- Want to complete Ph.D. on time
- Enter teaching profession

Motivations

- Sense of satisfaction on achievements
- Need to contribute to the society

Frustrations

- Worried about future
- Stressed out from academic pressure.

Behavior

- Studious
- Helpful

Figure 14: User persona 2 (High Res.)

Empathy Map

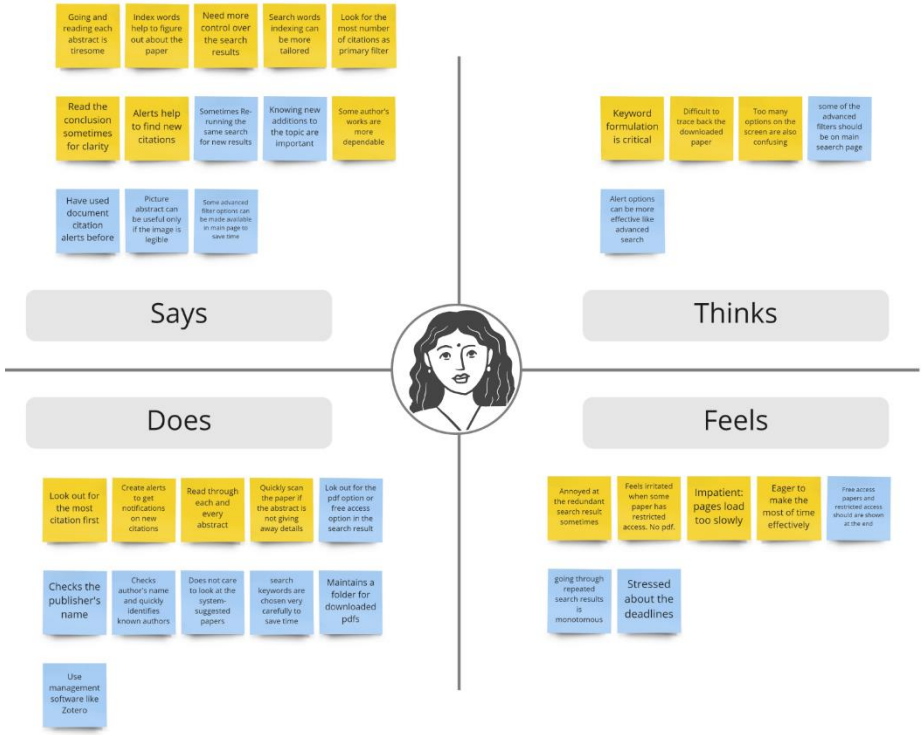


Figure 15: User persona 2 -Empathy map (High Res.)

User Persona - Expert

Name: Rohit
Age: 32
Language: Tamil, English
Education: M.Tech, IIT-M
Preferred Digital Library:
Google Scholar, T&F, Scopus

Goals

- Want to complete Ph.D. on time
- Do further research in the domain
- Publish papers on the research

Motivations

- Going abroad for further research
- Better standard of living abroad

Frustrations

- Sometimes Worried about completing Ph.D. on stipulated time.
- Report making process takes a lot of time.

Behavior

- Relaxed
- East going

Figure 16: User persona 3 (High Res.)

Empathy Map

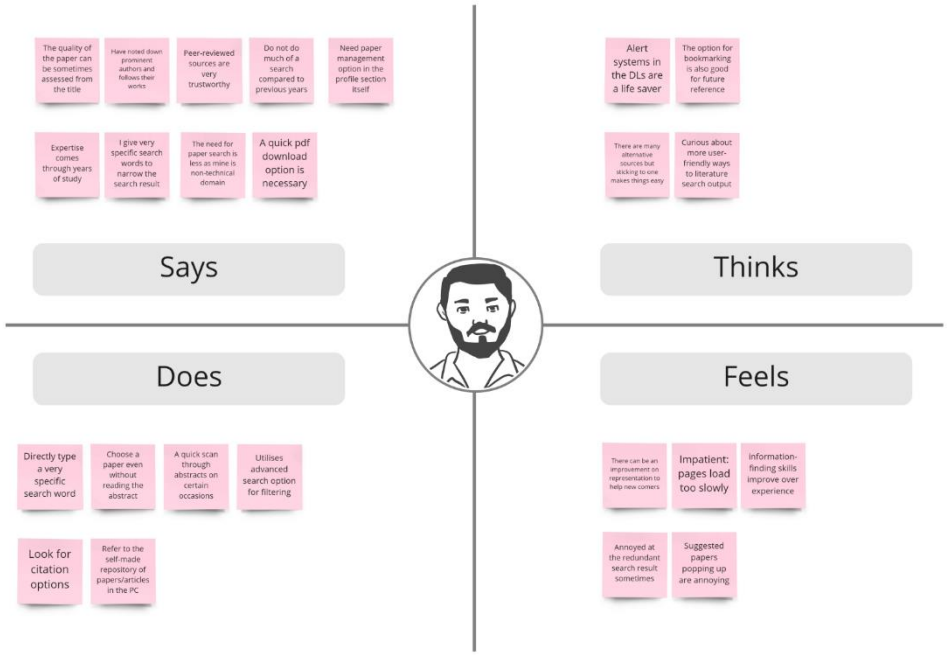


Figure 17: User persona 3 -Empathy map (High Res.)

Ideation

Ideation sprint

Based on the user research and survey, Google Scholar ranks as the most popular source for accessing research papers. The SUS results also showed that users aren't happy with Google Scholar, even though it is the most popular digital library/source. During the first ideation sprint, I focused on obvious gaps in the existing Google Scholar search results page, including:

- An incomplete and redundant abstract displayed on the search result page
- The absence of keywords or index words for the paper.
- No options for search phrase matching are provided to users.

I explored concepts for subtle changes to the existing design that would meet the user needs identified through user research.

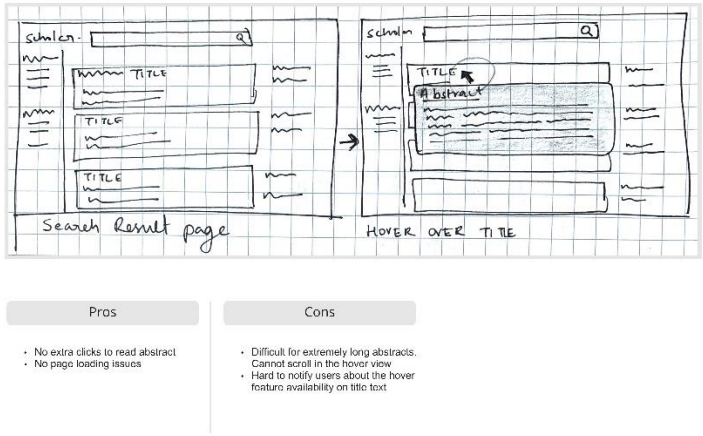


Figure 18: Ideation sprint- Abstract quick read (High Res.)

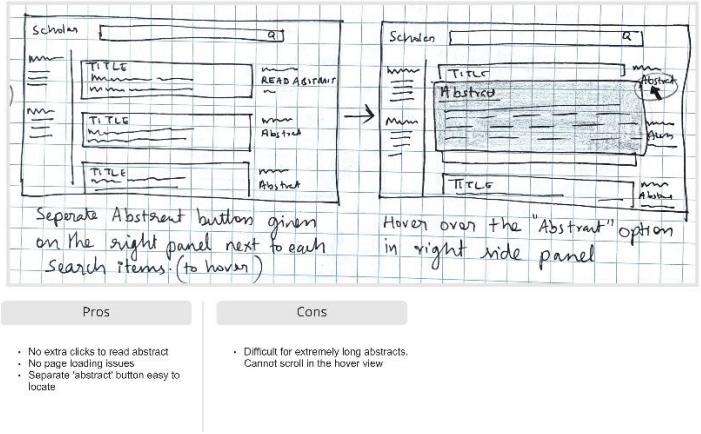
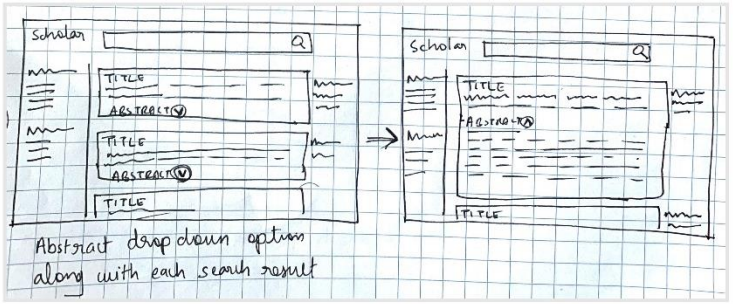
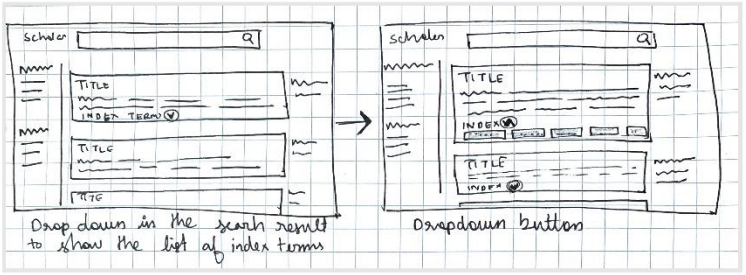


Figure 19: Ideation sprint- Abstract quick read (High Res.)



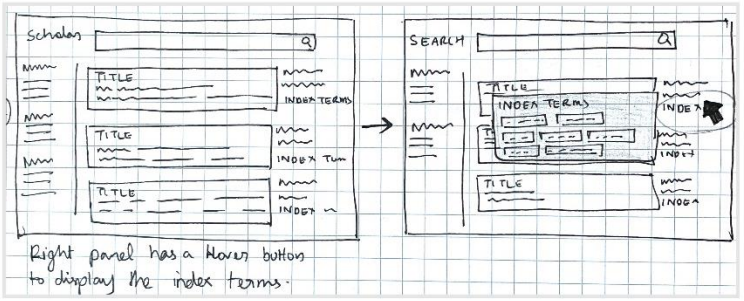
Pros	Cons
• No extra clicks to read abstract • No page loading issues • Separate 'abstract' button easy to locate • Drop down, easy to collapse	• Difficult for extremely long rare abstracts. Cannot scroll in the hover view

Figure 20: Ideation sprint- Abstract quick read (High Res.)



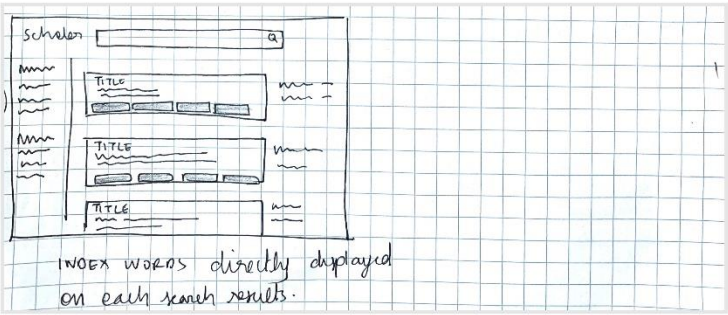
Pros	Cons
• No extra space is required as this is a drip down • Index words displayed with the individual search result are easy to locate • No extra clicks to reach the list of index words	• Could misunderstand as buttons •

Figure 21: Ideation sprint- Index terms/keywords (High Res.)



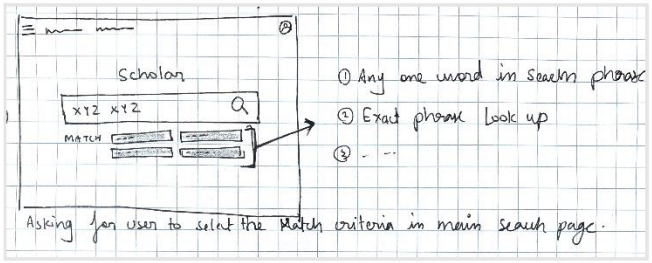
Pros	Cons
• Index words displayed separately are easy to notice and legible • No extra clicks to reach the list of index words	• Could misunderstand as a hyperlink

Figure 22: Ideation sprint- Index terms/keywords (High Res.)



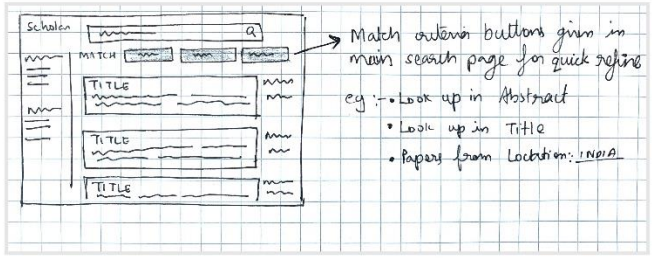
Pros	Cons
• Index words displayed with the individual search result are easy to locate • No extra clicks to reach the list of index words	• Could misunderstand as buttons • Extra screen space is required and the layout to be changed if there are more words

Figure 23: Ideation sprint- Index terms/keywords (High Res.)



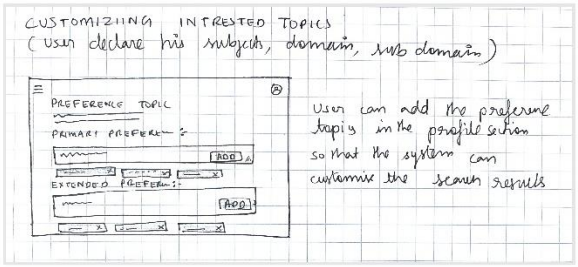
Pros	Cons
• No need to go to the advanced search feature; can quickly select the criteria on home page	• Cannot view dynamic search result; each time user need to go back to the home screen to alter the criteria

Figure 24: Ideation sprint- search phrase matching (High Res.)



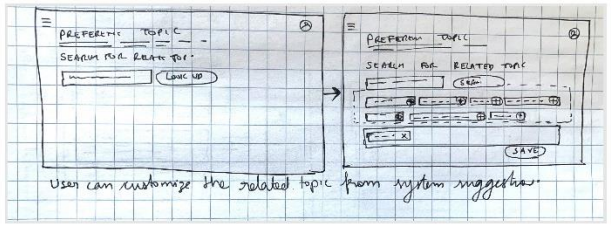
Pros	Cons
• No need to go to the advanced search feature; can quickly select the criteria on the search result page • Can view dynamic search result	• Difficult to accommodate more criteria in the layout

Figure 25: ideation sprint- search phrase matching (High Res.)



Pros	Cons
• Users can specify the area of study and customize the search result • Unwanted search results are avoided • Precise indexing of the keywords can be done	• Users will have to edit the preferred topics throughout the journey of the doctoral study.

Figure 26: Ideation sprint- preferred topic user input (High Res.)



Pros	Cons
• Users can specify the area of study and customize the search result with the help of system. • Unwanted search results are avoided • Precise indexing of the keywords can be done	• Users will have to edit the preferred topics throughout the journey of the doctoral study.

Figure 27: Ideation sprint- system suggested topic (High Res.)

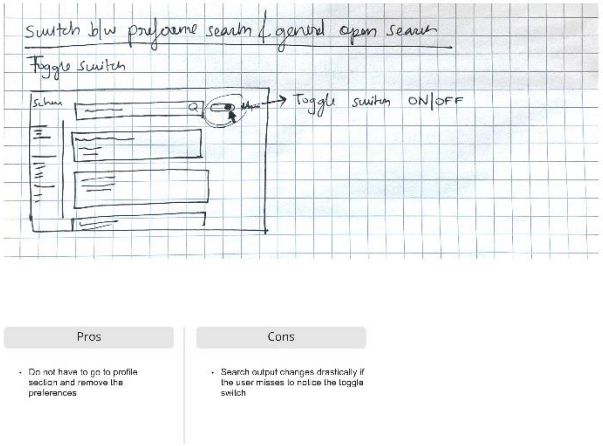


Figure 28: Ideation sprint- switch b/w preferred topic (High Res.)

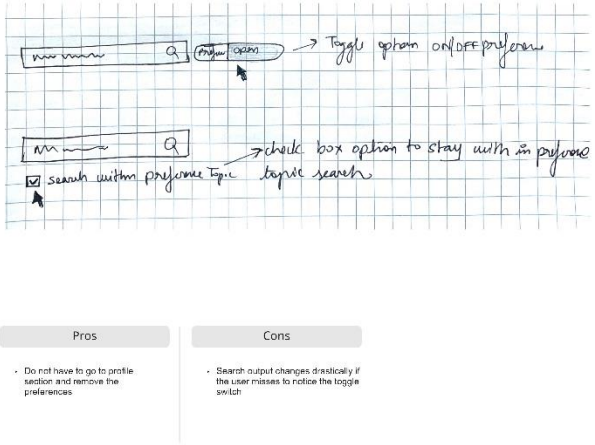


Figure 29: Ideation sprint- switch b/w preferred topic (High Res.)

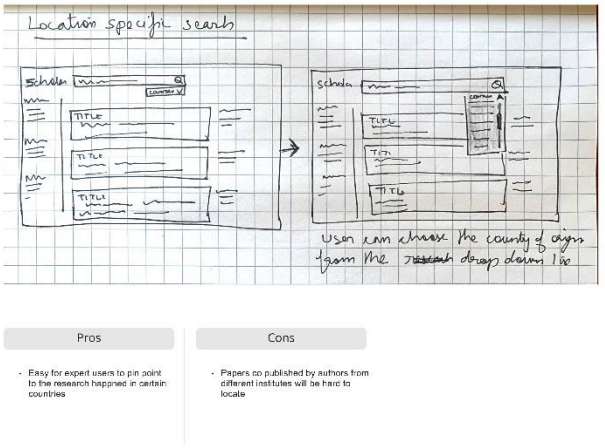


Figure 30: Ideation sprint- Location specific search (High Res.)

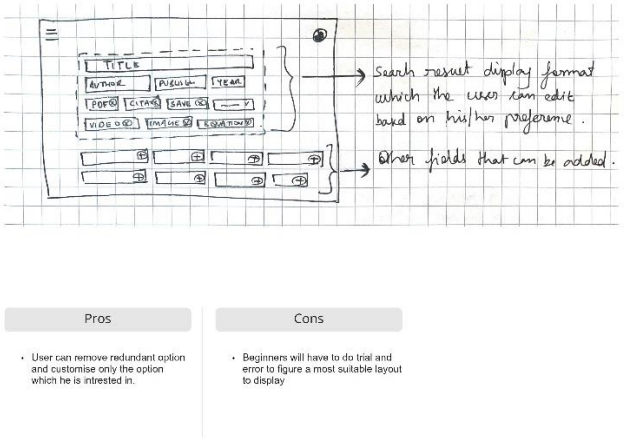
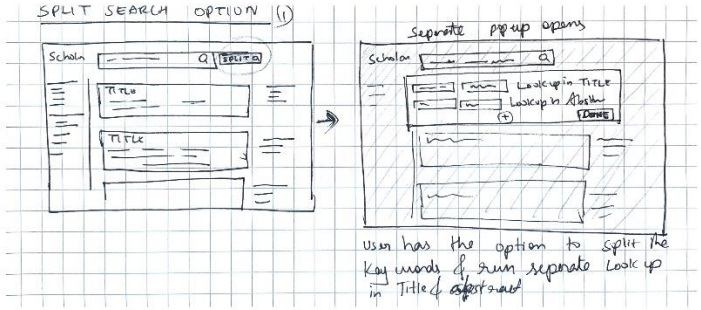
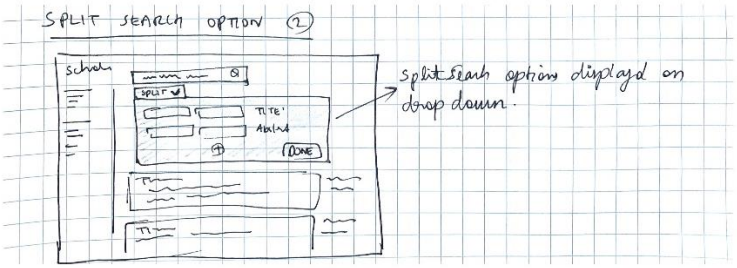


Figure 31: Ideation sprint- Customize search result display (High Res.)



Pros	Cons
• convinient to pin point where the search key words has to appear. • A way of quick filtering and tailoring the keywords as per the user need	• This could be confusing for some users until they are used to it

Figure 32: Ideation sprint- Split search option (High Res.)



Pros	Cons
• convinient to pin point where the search key words has to appear. • A way of quick filtering and tailoring the keywords as per the user need	• This could be confusing for some users until they are used to it

Figure 33: Ideation sprint- Split search option (High Res.)

Intermediate Usability Testing

Before finalizing the ideas, I chose to create a mid-fidelity prototype with a moderate level of detail and obtain feedback from user. This step helped me comprehend the user's perspective on the newly generated concepts. I recruited 4 users from the primary research to evaluate the new design subjectively and requested their feedback. I created the prototypes based on their subjects so that it's more relatable for them. I asked them to search for a predefined topic along with the Think Aloud method.

Each user is presented with the prototype and instructed to first explore the design. They attempted to navigate the prototype. Due to inexperience with the Figma prototype, there was an initial hiccup. Before I explained that it was a prototype, which is a redesigned simulation of the actual search engine, users expected to see a search function. Then they quickly grasped the navigation system. Each user selected a topic from the search panel, analyzed the prototype, and provided insightful feedback using the 'think aloud' technique.

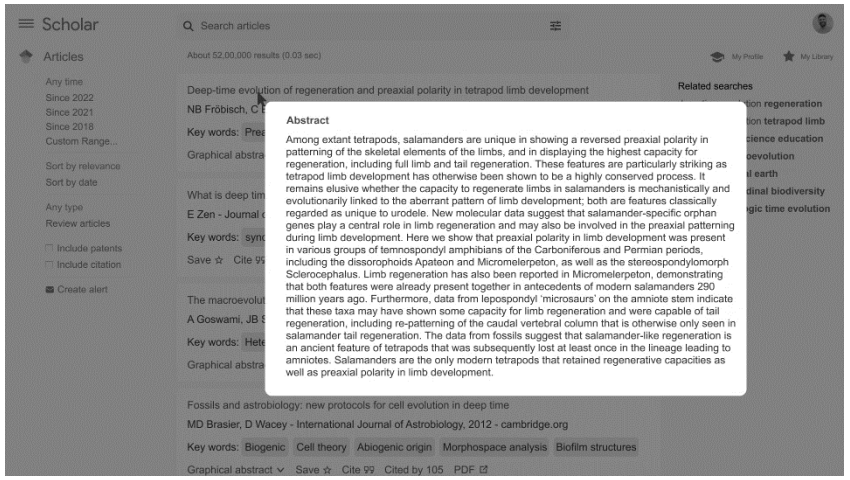


Figure 34: Usability testing screen – Abstract (High Res.)

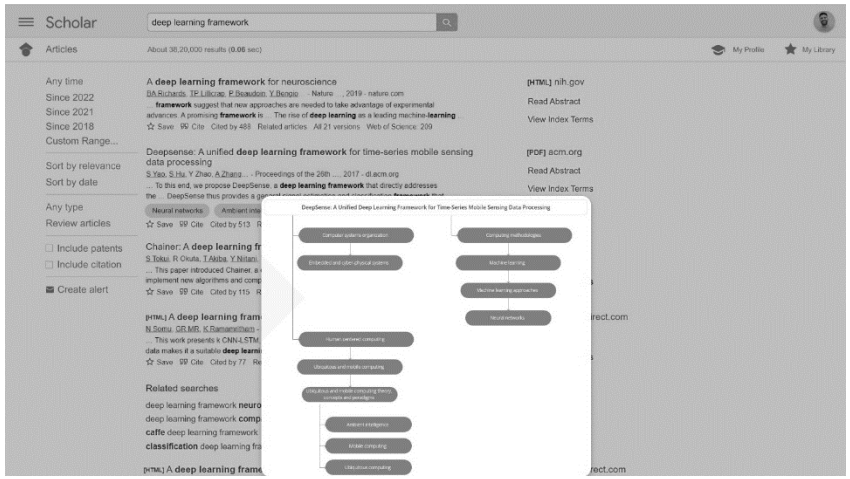


Figure 35: Usability testing screen – Graphical abstract (High Res.)

Figure 36: Usability testing screen - home (High Res.)

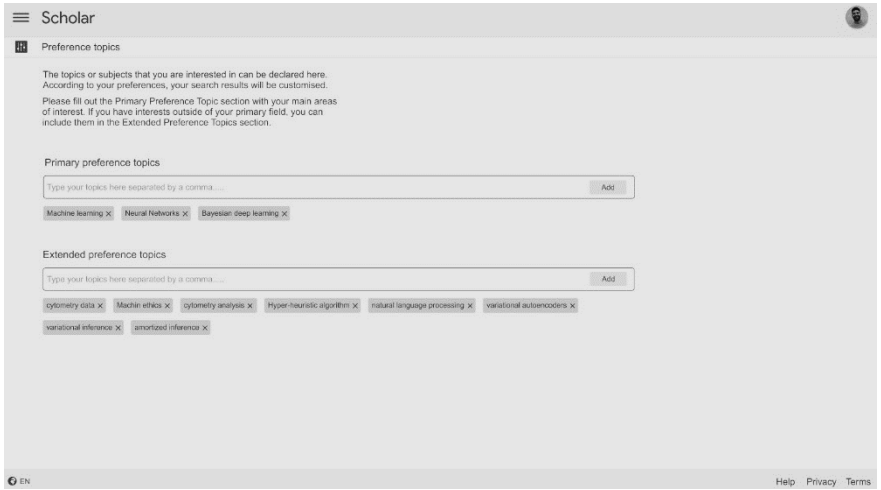


Figure 37: Usability testing screen - customization (High Res.)

These are some of the screens on which the intermediate user testing is done. Figure 34, 35, 36, 37.

Some of the user comments are: -

User 1: It makes me feel better to see the index words right away. Now, it's easy to judge the paper quickly.

User 2: Not helpful to read the abstract when you hover. When the cursor moves, it gets very difficult to read. I don't like the hover thing here.

User 3: Making my own layout could be helpful, but I'll have to change it every time my needs change.

User 4: I don't know how the preference topic will work in real-time, but if it does, it could be interesting.

Finalization of Concept

The intermediate user testing shed light on further refining the ideation sprint-generated concepts. Now, I intend to translate the testing session's user feedback into a high-fidelity prototype. This prototype is intended to closely represent the user's requirements and eliminate any concepts that received negative user feedback.

The concepts/ideas that got discarded are:

- Reading the abstract using the hover functionality on the primary search result. (Refer figure 18)
  Discard reason: Users were unable to focus because they were required to read a lengthy text in hover without moving the mouse pointer.

- The abstract read hover on the right panel (Refer figure 19)
  Discard reason: Users found it difficult to concentrate as its reading large text without moving the mouse pointer.

- Index term hover/drop down interaction from the main search result (Refer figure 21)
  Discard reason: Users prefer a direct display of the index terms or keywords over a display on hover.

- Index term hover interaction from the right-side panel (Refer figure 22)
  Discard reason: Users prefer a direct display of the index terms or keywords over a display on hover.

- Adding 'search within' options beneath the primary search bar. (Refer figure 24)
  Discard reason: The user finds it difficult to return each time if the preference has to be refined to a different area.

- Idea: Separate dropdown box or menu for Location Search (Refer figure 30)
  Discard reason: Users prefer this in the advanced search option as opposed to a separate drop-down menu on the search results page.

The concepts/ideas that are selected for further development are:

- Abstract drop-down option along with each search result. (Refer figure 21)

- Image abstract drop-down option along with each search result similar to text abstract.

- Keywords/Index word display along with each search result. (Refer figure 23)

- Preferred topic user customization options. (Refer figure 26)

- Switch between preferred search and general search. (Refer figure 28)

- Location-specific search options in the advanced search.

- Customize ‘search result display layout’ as per user needs. (Refer figure 31)

Redesigned Sections

Homepage

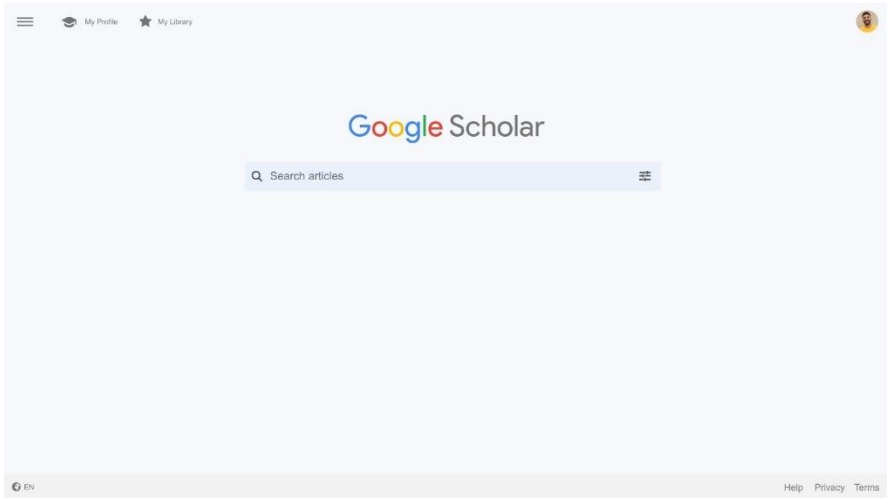


Figure 38: Home page (High Res.)

The home page is CTA for search is removed and there by prompting the user to use the enter key to trigger the search function.

Integrated advanced filter

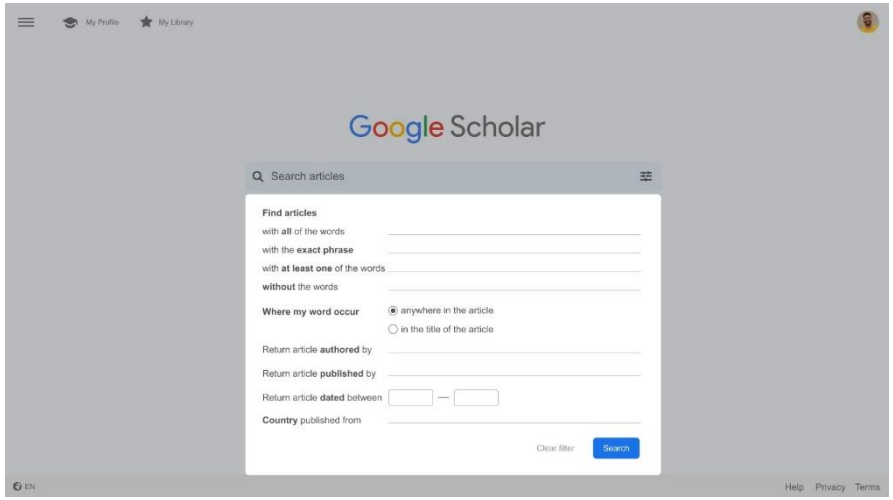


Figure 39: Integrated advanced filter (High Res.)

Users can quickly trigger the advanced search function from the search bar itself. This enables the user to try different keyword lookup combinations faster than the previous version

Search result page

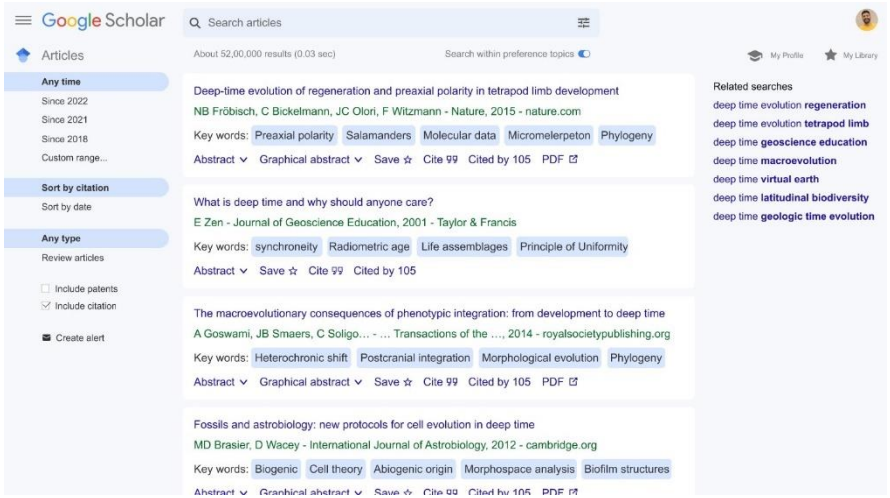


Figure 40: Search result page (High Res.)

The main search result page is redesigned with the keywords of each article shown individually. Partial abstract section is removed.

Abstract reading

Figure 41: Abstract reading (High Res.)

The simple drop-down option enables the users to quickly go through the abstract of each section. With this user need not click and go to each link to check on the abstract.

Graphical Abstract

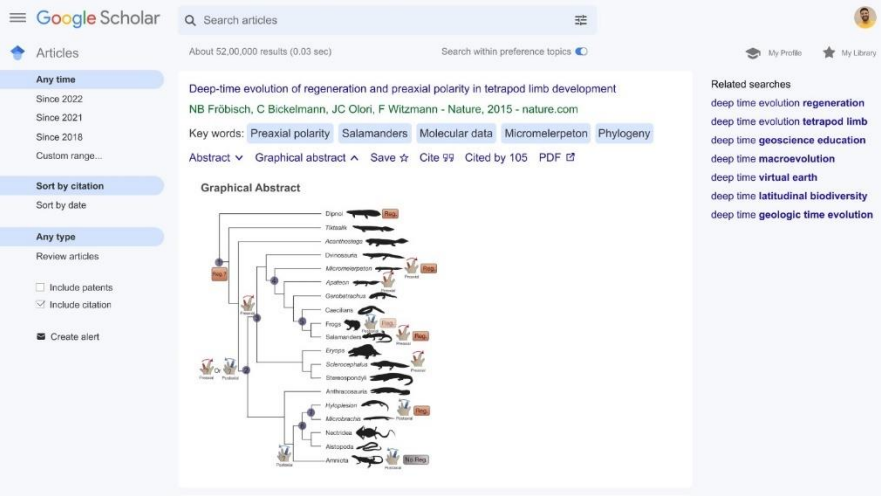


Figure 42: Graphical abstract (High Res.)

The simple drop-down option enables the users to quickly go through the image abstract of each paper. with this user need not click and go to each link to check on the graphical content.

Integrated advanced filter

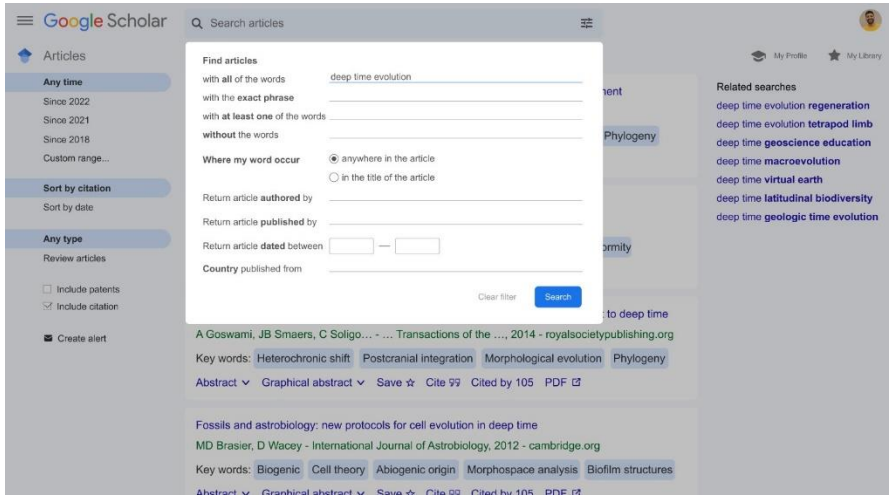


Figure 43: Integrated advanced search (High Res.)

Users can quickly trigger the advanced search function from the search bar in the main search result page. This enables the user to try different keyword lookup combinations faster than the previous version.

Customization option

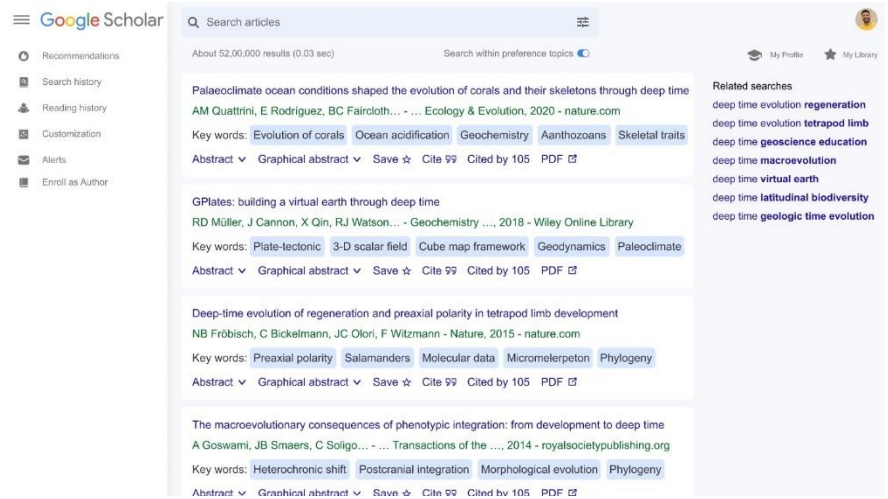


Figure 44: Final concept scree- Customization (High Res.)

‘Customization’ feature is integrated in to the left side panel along with other features.

Customization – Preferred topic

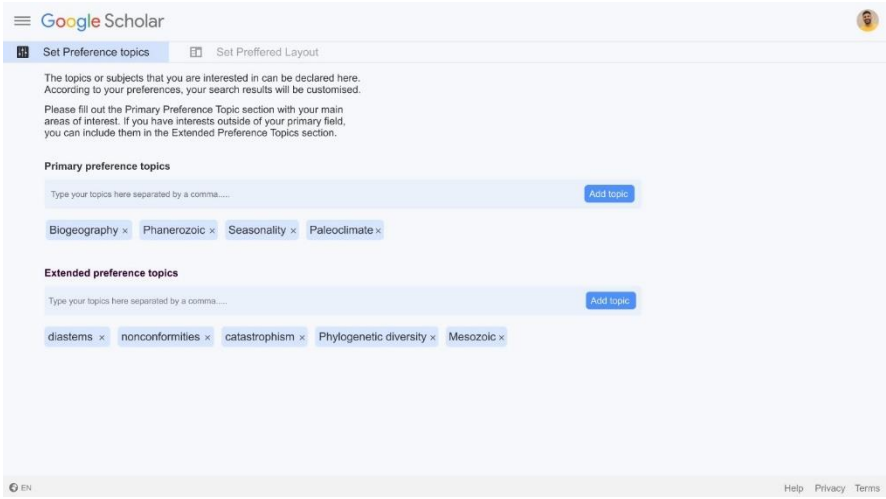


Figure 45: Final concept scree- Customization (High Res.)

User can give his preferred topics and declare them to the system so that the search result will be confined to the boundaries set by the user.

Customization – Preferred layout

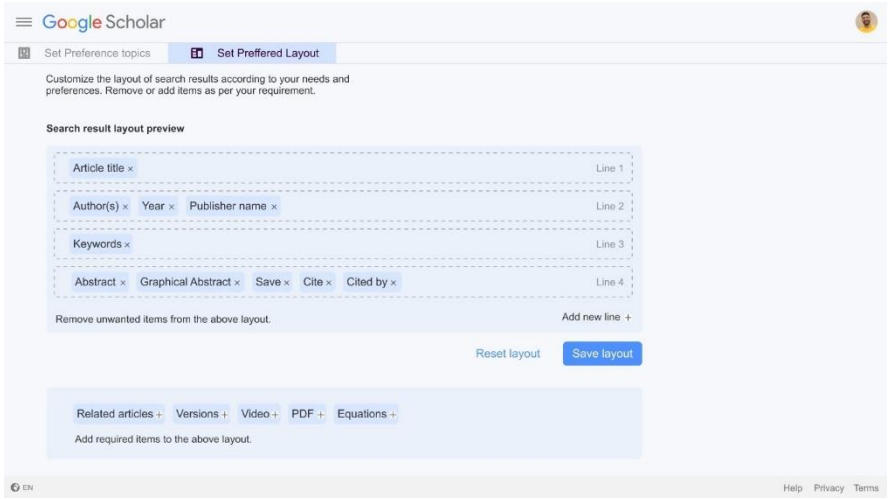


Figure 46: Final concept scree- Customization (High Res.)

The user can now set the layout of the search output and there may carter the system as per his needs. Redundant items can be removed and required items can be added.

Click the below link to launch the prototype

Figma Prototype

Usability Evaluation

The next stage of this project is evaluating the completed prototype with the end users. One of the objectives of this study is to determine how effectively users can learn this system and use it to select a research article with the fewest possible clicks. Another objective is to determine whether the users are satisfied with this product.

Method

This usability testing will be conducted in two separate rounds. The first phase, which is the hands-on testing by the user, is followed by the second phase, which is an analysis of the redesigned Google Scholar based on the system usability scale (SUS). Users are given the initial instruction to explore the prototype on their own as part of the first phase. The users are then given particular search tasks to complete on the prototype, that is relevant to the subject matter that they are studying. During the course of the search activity, users are encouraged to verbalize their thoughts out loud. After that, the users are prompted to think out loud while they explore and interact with the various customization options contained in the prototype. During this phase, the users are interviewed with an aim of understanding more about their thought processes through the use of subjective questions.

Participants

The selection of participants was quite similar to that of the initial user study, which gathered input from students in all five years of the Ph.D. programme. In order to conduct this usability test, I enlisted 10 participants, 2 from each year of the Ph.D. programme. I ensured that there was equal participation from technical and nontechnical Ph.D. students.

Observations from User task

Here are some of the positive comments from the users:

"The search result keywords are useful."

"This 'abstract' dropdown is beneficial because it saves me from having to navigate to the publisher page for each search result."

"The search bar has advanced search options that will help me quickly change the search criteria to meet my needs."

"As I am at the beginning of my research, the preference topic search could be greatly useful to me. However, it must be tested in real-time, not with this concept design."

"Customizing layout options will be very effective because I will be able to set my preferences and remove unwanted items."

Here are some of the negative comments from the users:

"There are very few sorting options available here. I'd like to have more choices."

"Each article should include a PDF download link."

"The graphic abstract content is illegible. Zoom options should be available."

"The keywords or search terms are not highlighted in the abstract."

Observations from User task

The SUS questionaries gave a mean score of 89.75 which is above the average threshold of 68. This clearly indicates that the users are satisfied with the redesigned concept of Google Scholar.

Click Here to view the SUS result from the participants.

Future Scope

The project has been completed with participants from IIT Bombay. Further research on research scholars working solely in the arts and humanities domains can be conducted. This may create more opportunities for advancement in this area.

The desktop version of Google Scholar is the primary focus of this project. As it is difficult to read articles on smaller devices, there are hardly any mobile users of Google Scholar. Users may, however, use the mobile version, if available, to search for and bookmark research papers for future reference. As a result, further development of Google Scholar for smaller screens is inevitable, and its design can be taken up in the future.

Reflection

Information retrieval (IR) is a vast domain, and my focus is to enrich the IR experience for research scholars. Initially, the project aimed to understand their needs while they try to retrieve significant information from the vast pool of digital academic libraries. As my research progressed, I understood that there were not enough studies focused on research scholars or academicians in this regard. Also, I was surprised to find out that it is stressful for all users, no matter how skilled they are with digital mediums while trying to find research articles in these libraries. There were a lot of other factors that I had to consider, such as the users' domain knowledge, cognitive skills, etc., which makes my scope very broad and complicated. My knowledge of the iterative design process from IDC aided me in approaching the problem space and churning out solutions suitable for all user categories. It also made me realize that a solution is never final as there is room for more and more iterations as time progresses.

At IDC, I had the intention of gaining knowledge from the various projects that were completed by my colleagues. Whether it was in terms of presentation styles, report formats, work processes, or the nature of the work itself, there is always a new skill that one reveals that another reveals that can be further developed. I find these projects as golden opportunities to sharpen my skills and realize that there is a lot to learn and that it is a continuous improvement process..

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