

User Competence Metrics for Cyberinfrastructure: The Case of Know COVID-19 Science Gateway

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Abstract

In the era of big data and user interactivity, cyberinfrastructure (CI) such as science gateways offers solutions to various scientific communities. It is common for gateway developers to overlook the importance of user-centric development. In response to this issue, this paper introduces the user competence evaluation metrics for gateway users. These metrics can be leveraged by gateway developers to enhance the user experience. KnowCOVID-19 is a science gateway with a chatbot interface designed for medical professionals seeking access to online publications. To establish these evaluation metrics, we conducted a usability experiment involving 20 KnowCOVID-19 users across two conditions: (1) gateway with a chatbot and (2) gateway only without a chatbot. In the observational analysis reported in this paper, we analyzed user interactions within the KnowCOVID-19 science gateway through recorded videos from the experiment. Employing the inductive coding method, this paper identified three types of user competence among KnowCOVID-19 users: a) domain competence, b) technical competence, and c) problem-solving competence. Gateway developers can utilize these three types of user competence metrics to design gateways in order to provide a better user experience with or without chatbots.

Keywords: KnowCOVID-19, Competence Metrics, User experience, Usability

1 Introduction

The primary aim of an effective cyberinfrastructure (CI) is to meet the diverse needs of its users, offer tailored solutions, and foster a robust scientific community through breakthrough scientific discoveries and revolutionary education through access to world-class research data [1]. CI such as science gateways are offering solutions to

various types of scientific problems in different domain communities [2]. In the age of big data, the user base for CI especially science gateways is rapidly expanding, and in the near future, we anticipate widespread adoption of science gateways within the vast scientific community. To promote the widespread use of science gateways among researchers and educators, it is crucial to thoroughly understand their specific requirements and provide features that cater to their unique needs.

Furthermore, recognizing the varying levels of user competence is also essential, as it enables developers to design science gateways that can cater to the different types of user competence accordingly. Even within a particular scientific community, every user is distinct, with varying levels of expertise. For instance, KnowCOVID-19, a gateway designed to support the information needs of users interested in COVID-19 literature, medical professionals and researchers accessing large databases have distinct needs. They possess different domain knowledge, and their technical proficiency varies from person to person. A noninteractive CI or science gateway will not effectively address their concerns when compared to a customized CI or science gateway that can adapt to their specific domain and proficiency levels.

Literature suggests that CI developers have often not given due consideration to the users' perspective when developing CI [3]. It is of utmost importance for CI developers to prioritize elements such as Information Architecture (IA), intuitive site navigation, and clear User Interfaces (UIs) for their users [4]. For instance, if a science gateway lacks a clear and informative UI, users may become disoriented and struggle to complete tasks. Unhappy users are unlikely to continue using the platform, which can lead to non-adoption or dis-adoption, significantly hindering its diffusion within the target scientific community. To enhance the popularity and user-friendliness of CIs such as science gateways among the scientific community, this paper proposes the implementation of user competence metrics. These metrics can assist developers in designing adaptive cyberinfrastructures or cyberinfrastructures that cater to different levels of user competence. Developers can integrate user competence metrics into their CI systems, obtaining a numerical measure of user competence by posing several questions during the signup process via a questionnaire (see Appendix A for a preview).

In this paper, we have employed a science gateway known as KnowCOVID-19 [5–7]. This science gateway caters to medical professionals, including clinicians, healthcare providers, and medical researchers. You can access more information about this science gateway via the following link: [<http://54.152.172.214:9300/Covid-19/>]. Through an analysis of 20 observations in a usability experiment, we developed three composite scales (each represents a dimension of user competence and its associated metric) that collectively make up an 18-item questionnaire for KnowCOVID-19 (see Appendix A). These metrics will be integrated into the system to enhance the user experience.

2 Study Design

We formulated our competence analysis metrics through an inductive qualitative analysis approach [8]. In this usability experiment, participants were assigned various tasks to complete, and their actions were recorded through screen capture videos while

they interacted with the science gateway platform (KnowCOVID-19). Participants were instructed to perform the tasks independently and to verbally express their thoughts as they navigated through the platform. We asked the participants to talk out loud when they navigated. We also captured their nonverbal actions for subsequent observational analysis. This particular paper is based on an analysis of the observation of participants' interactions with the science gateway and a chatbot to guide participants to navigate this gateway. This paper focuses on an observational study that examines how users navigate the science gateway platform. To conduct this study, we categorized the usability videos into two groups: one featuring the gateway with a chatbot and the other without the chatbot. Each group consisted of 10 videos and two independent coders systematically analyzed all 20 videos.

Upon completing the inductive coding process, we synthesized our observations pertaining to user competence. These distinct competencies emerged organically from the dataset in a bottom-up fashion, and we substantiated our findings with pertinent observations, justifications, and quotations gathered during the observational analysis. To transcribe the interview recordings from the usability study, we utilized Otter.ai, an AI transcription service. We have linked each identified user competence with corresponding quotations and time stamps. Before initiating the usability study, we obtained Institutional Review Board (IRB) approval (TTU IRB 2020-455) for our research. Additionally, our research team members underwent research ethics training to obtain IRB certification.

3 User Competence Analysis

Based on our user competence analysis conducted through a usability experiment and inductive coding, we have identified three primary types of user competence that have emerged from our dataset: domain competence, technical competence, and problem-solving competence. In our observational analysis, we have categorized participants based on their domain competence, navigational skills as a manifestation of technical competence, and their motivation to tackle challenges as indicative of problem-solving competence. In the following sections, we provide comprehensive definitions and characteristics of these three competencies. For further insights and supporting evidence, please refer to the relevant participant quotes in the accompanying slides (6,7 and 8).

Domain competence (It refers to the user's expertise or specialized knowledge in a specific subject or field.)

- Good understanding of the search task at hand.
- Knowledge of the right search terms, keywords, etc. to specify the search.
- Able to assess and ascertain the relevance of search results (vs. second-guessing)
- Able to explain and justify the relevance of search results.
- Able to know when the information is found, and the task is done.

Technical competence (The user's ability to effectively and efficiently use the search engine gateway's features and tools to locate the information they are seeking.)

- Familiarity with basic browser functions (opening a new tab, sorting, filtering, etc.).
- Familiarity with basic keyboard shortcuts (Ctrl-F, etc.).
- Familiarity with basic mouse clicks (right-click for features, etc.).
- Familiarity with basic Internet terminologies (links, hyperlinks, etc.).
- Moving through steps (including browser, keyboard, mouse) logically in sequence (vs. missing steps and having to backtrack).

Problem-solving competence (Motivation to adapt themselves to any new innovative technologies to complete the assigned task.)

- Show some level of calmness and/or enthusiasm (vs. being nervous and/or confused)
- Show confidence with quick actions (vs. hesitations, pauses).
- Act and try something even when unsure.
- Try another approach immediately when the first attempt does not work.
- Willing to work around usability issues.
- Know when to ask for help and guidance (chatbot, experiment moderator)

4 Metrics Development: Composite Scales and Index Scoring

To quantify the competence metrics of users, an 18-item questionnaire with three composite scales for the three dimensions of user competence (Appendix A) has been developed with items that allow users to self-report their level of knowledge/expertise when using a platform such as Know COVID-19. Using a Likert scale of 1 (strongly disagree) to 5 (strongly agree), respondents will choose the category that best describes their level of knowledge of experience when using the platform across the three metrics of competence: Domain competence, technical competence, and problem-solving competence.

To aid in our next found of data collection with human subjects (users), an application will be sent to the Institutional Review Board at Texas Tech University for permission to administer the questionnaire. Once the approval has been granted, the research team will administer the questionnaire to the new gateway user.

To ascertain the competence level of the gateway user (respondents), an index composite score will be generated for each of the three competence metrics (corresponding to the three dimensions of user competence described earlier). To derive a composite score, our customized model will treat each level of gateway user's competence independently. For instance: for the composite score of the domain competence, the responses will be summed up (e.g., $5+4+3+5+5+4 = 26$). The score will then be average i.e., $26/6 = 4.3$. This means, the particular user has a domain competence

score of 4.3 out of 5, with 5 being the maximum possible score. This method will also be used to calculate for the other two levels of competence (technical and problem-solving competence). An average score of 2.49 or below will be categorized as a low level of competence for each competence metric, while an average score of 2.5 or above will be categorized as a high level of competence. Given these index scores, the chatbot can be programmed to provide assistance and support to each user in a customized and personalized fashion, even if two users ask the same question to the chatbot. Moreover, as users continue to interact with the gateway and chatbot, their competence index score on different dimensions can improved and/or better fine-tuned to more accurately capture their user competence based on actual interactions with the gateway platform.

5 Conclusion

The overarching objective of this project is to develop a questionnaire featuring user competence metrics capable of assigning numeric values to users' competency levels within science gateways. Additionally, we intend to incorporate these metrics into the KnowCOVID-19 science gateway to assess variances in task completion and usability evaluations. In this paper, we have identified three dimensions of user competence along with their respective attributes. With a questionnaire centered around these three competencies, we can quantitatively assess the competencies of users and assign competency scores based on their self-reported responses.

Supplementary information. Please find the supplementary information in the attached powerpoint presentation and an 18-item questionnaire in Appendix A.

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Appendix A

As the first step of quantifying these metrics, a questionnaire has been developed with 18 items for users to self-report their level of comfort and/or experience via a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). An average score can be calculated for each of the three dimensions, thus generating an index score for each user based on the three dimensions.

Below is the corresponding description for each of the ratings on a 5-point Likert scale.

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

The questions will be administered with the following instruction:

Please indicate your level of knowledge or experience by selecting the appropriate rating on the 5-point Likert scale for each statement, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree."

Components One: Domain competence (It refers to the user's expertise or specialized knowledge in a specific subject or field searching for COVID-19 related information.)

Item Statements

1. When searching for information about COVID-19, I understand the search task at hand.
 1. (Strongly Disagree)
 2. (Disagree)
 3. (Neutral)
 4. (Agree)
 5. (Strongly Agree)
2. When searching for information about COVID-19, I know the right search terms, keywords, etc., to specify the search.
 1. (Strongly Disagree)
 2. (Disagree)
 3. (Neutral)

4. (Agree)
5. (Strongly Agree)

3. When searching for information about COVID-19, I am able to assess the relevance of search results (vs. second-guessing).

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

4. When searching for information about COVID-19 in general, I am able to explain the relevance of search results.

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

5. When searching for information about COVID-19, I am able to know when the relevant information is found, and the task is done.

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

6. When searching for information about COVID-19, I can effectively evaluate the credibility of information during my searches.

1. ((Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

Technical competence (The user's ability to effectively and efficiently use the gateway's search features and tools to locate the information they are seeking.) Item Statements

1. I have experience with basic browser functions (opening a new tab, sorting, filtering, etc.).

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

2. I have experience with basic keyboard shortcuts (Ctrl-F, etc.).

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

3. I have experience with basic mouse clicks (right-click for features, etc.).

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

4. I have experience with basic Internet terminologies (links, hyperlinks, etc.).

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

5. I can move through the necessary steps for a search task (including browser, keyboard, mouse) logically in sequence (vs. missing steps and having to backtrack).

1. (Strongly Disagree)
2. (Disagree)

3. (Neutral)
4. (Agree)
5. (Strongly Agree)

6. I can effectively make use of visual content on web pages and confidently navigate different interfaces on new web pages.

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

Problem-solving competence (Motivation to adapt themselves to any new innovative technologies to complete a task, and/or the natural orientation of a user towards solving a problem towards completing a task using computers.)

Item Statements

1. I show some level of calmness and/or enthusiasm when using technology rather than being nervous and/or confused.

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

2. I show confidence with quick actions when using technology, rather than hesitating or pausing frequently.

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)
5. (Strongly Agree)

3. I am willing to act and try something on a technology even when I am unsure about it.

1. (Strongly Disagree)
2. (Disagree)
3. (Neutral)
4. (Agree)

5. (Strongly Agree)

4. I try another approach immediately when my first attempt does not work while using technology.

1. (Strongly Disagree)

2. (Disagree)

3. (Neutral)

4. (Agree)

5. (Strongly Agree)

5. I am willing to work around usability issues when encountering them while using technology.

1. (Strongly Disagree)

2. (Disagree)

3. (Neutral)

4. (Agree)

5. (Strongly Agree)

6. I know when to ask for help and guidance when using technology.

1. (Strongly Disagree)

2. (Disagree)

3. (Neutral)

4. (Agree)

5. (Strongly Agree)

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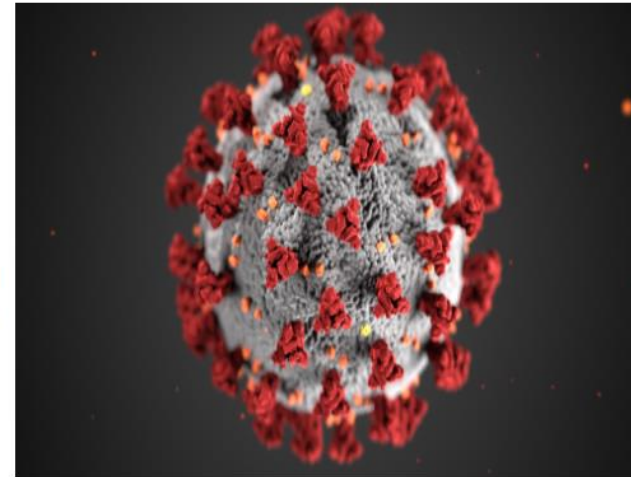
Introduction to KnowCOVID-19



KNOWCOVID-19 PUBLICATION ANALYTICS PLATFORM

KnowCOVID-19 platform provides publications filtering and analytics for you through combining machine learning models and [CORD-19](#) dataset. You can use this platform to filter publication in the short time. Just go to the WorkSpace page, choose your interested evidence level and topics, the platform will show you the publication lists. At the same time, the platform provide the related figures of the publications. From the figures, you can easily see the relationship between publications and topics. And you can see some prepared analysis results in Reports page. Also We prepare genes and drugs information in this page. In addition, Vidura chatobt can help you to use this platform, and it can answer many questions from you, login and try it!

[LAUNCH WORKSPACE](#)



Challenges for Science gateways

**CI such as
science
gateways**

Offering solutions to various types of scientific problems in different domain communities. Literature suggests that CI developers have often not given due consideration to the users' perspective when developing a CI.

Challenge

Limiting the
diffusion of
science gateways
within the target
scientific
community

Unhappy users are unlikely to continue using the platform, which can lead to non-adoption or dis-adoption



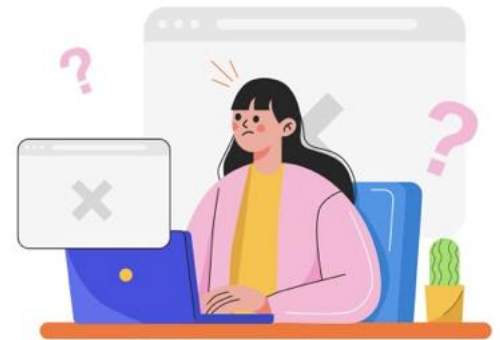
Why User Competence Metrics for Science Gateways?

Composite index score
of user competence

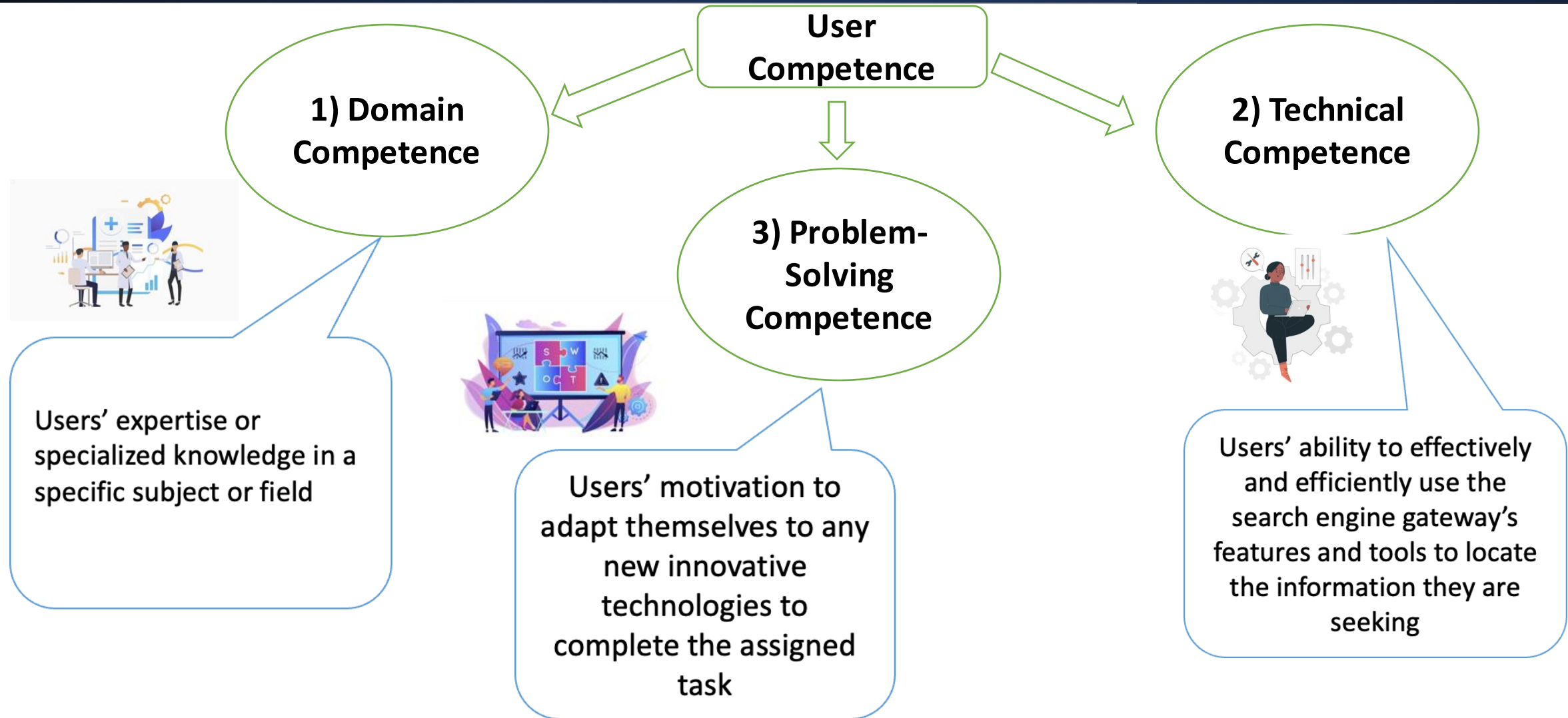
Implementation of user
competence metrics

Enhance the user
experience

Widespread adoption
of science gateways



User Competence Metrics



Domain Competence

Competence	Quote from participants
Good understanding of the search task at hand.	<ol style="list-style-type: none">1. P-2-01: I think I found one . it says the this looks like it's a review in the meta-analysis thing about how there's evidence of hydroxychloroquine being potentially beneficial it against COVID-19 in regards to respiratory recovery, and body temperature stabilization.2. P-1-01 : "I did think like there are there is some evidence on this hydro Chloroquine, you know, truly retreatment that does not show a lot of difference in terms of like, you know, there was not much difference in using this to I don't know for like it says For and control, untreated control. So I did find a alternative solution to the reaction but like, I don't know how much of it is, like useful as compared to the vaccine itself."
Knowledge of right search terms, key words, etc. to specify the search.	<ol style="list-style-type: none">1. P-2-05: Non -verbal cue, typing of the keywords for a search query.2. P-1-06: "So, they are like keywords let's see RNA that's the vaccines said vaccine right electric vaccine boosters okay I am terrible at this."
Able to assess and ascertain the relevance of search result (vs. second-guessing).	<ol style="list-style-type: none">1. P-2-02: “Yeah, so this seems to be a paper that that fits the criteria describes the details of potential medicine and treatment for COVID-19. High level of evidence because I filtered by systematic reviews, which is the highest one.2. P-1-04: “I wouldn't really call this a therapy, but I guess it's closer. I mean, it's an intervention. It's not really an antibody or anti-microbial or anything like that, but it might meet the criteria.”
Able to explain and justify the relevance of search results.	<ol style="list-style-type: none">1. P-2-04: “Okay, so I'm gonna go with that this one's case controlled the effects of COVID-19 on mental health and its relationship with death attitudes and coping styles.”2. P-1-08: "Hydroxychloroquine and Chloroquine seem to be the most common in these titles. In this one, based on the title seems to be a little more, more broad. Whereas some of these other titles were about a specific country or population. This one seems to be more about just the general efficacy of the drug. And I think that's what caught my eye at first."
Able to know when the information is found, and the task is done.	<ol style="list-style-type: none">1. P-2-08: “So I pick this one if I do, what happens then do I report it to you?”2. P-1-10: "So that's one revaccination Here's his 2020 Right, so the BCG vaccine program this year so let's say if this covers revaccination that would count. This probably counts."

Technical Competence

Competence

Quote from participants

Familiarity with basic browser functions (opening new tab, sorting, filtering, etc.).

1. P-2-10: "I don't see a way to filter by time or a way to check particularly for..."
2. P-1-02: "I assume is topic nine. Let's say filter information."

Familiarity with basic keyboard shortcuts (Ctrl-F, etc.).

1. P-2-03: "Can you do things like Ctrl F like to search for words and stuff like that?"
2. P-1-03: "...that would be nice. Am I allowed to use like Ctrl F features?"

Familiarity with basic mouse clicks (right click for features, etc.).

1. P-2-08: "yeah or you can the yellow links you can right click it an then it will take you straight there"
2. P-1-10 : "So, I mean, let me start with RCTs. And then let's look at it. This is what I didn't do last time. Here's what I need to do is I need to look through these topics to see this is what you were looking for."

Familiarity with basic Internet terminologies (links, hyperlinks, etc.).

1. P-2-02: "you might have need a copy of your base, but the ones that do have hyperlinks."
2. P-1-02 : "self-narrate here. So, I selected case control studies. You said choose any topic. So, I just selected a random number here. But now it's asking me to click on the title to go to the original source..."

Moving through steps (including browser, keyboard, mouse) logically in sequence (vs. missing steps and had to back track).

1. P-2-01: So you can click Launch workspace and we will begin and we're looking got about three or three or so minutes for this task so good you can scroll down more now.
2. P-1-08 : "...that way wanted to get the highest level evidence or at the highest level of evidence that I could. So I started with systematic reviews, sorted by relevance."

Problem-Solving Competence

Competence

Quote from participants

Show some level of calmness and/or enthusiasm (vs. being nervous and/or confused)

1. P-2-01: Non-verbal observation: excited interacting with the platform.
2. P-1-08: “All right, I think I found an article about a non-vaccine drug treatment.”

Show confidence with quick actions (vs. hesitations, pauses).

1. P-2-02: Non-verbal observation: participant was pretty much confident interacting with the platform.
2. P-1-10: Non-Verbal observations: The participant appeared highly confident and exceptionally fast when searching for relevant articles and completing the tasks. This confidence could be attributed to their professional knowledge, practical experience, or other factors.

Try another approach immediately when the first attempt does not work.

1. P-2-07: Non-Verbal observations: Participant was able to use the chatbot very well for completing the task.
2. P-1-02: “So medicinal treatment for a using high level of evidence, it says to do a literature review. In playing, I should look at more than one try to find more than one with...”

Willing to work around usability issues.

1. P-2-05: Non-Verbal observations: Participant was unsure about the use of the platform though tried hard to navigate the platform.
2. P-1-08: “I think it was pretty helpful. I would say especially when compared to, like other resources like Google Scholar, or some of these other ones, that we had to do like that, or through the university, which I remember what they're called, but I don't know, the name escapes me now. But those ones where you're more or less just searching a title or some keywords. And you're having to just kind of sift through all this kind of stuff that may not even relate to what you're trying to find.

Know when to ask for help and guidance (chatbot, experiment moderator)

1. P-2-08: Non-Verbal observations: Participant used the chatbot more than he did with the entire platform. Deploying the chatbot help him save more time.
2. P-1-05: “so I have to choose a topic to be able to go to any I mean I have to choose one of these categories to be able to go to a topic.”

Study design

Inductive
qualitative
analysis

Usability
experiment of
20
participants

Identification
of three
distinct
competencies

Formulating
competence
analysis
metrics



Metrics Development: Composite Scales and Index Scoring

Here are scale items to measure participant’s Domain Competence on 5-pints Likert scale:

Please indicate your level of knowledge or experience by selecting the appropriate number on the scale for each statement, where 1 represents "Strongly Disagree", and 5 represents "Strongly Agree.Click to write the question text -

	1. Strongly Disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly Agreee
1. When searching for information about COVID-19, I understand the search task at hand.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. When searching for information about COVID-19, I know the right search terms, keywords, etc., to specify the search.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. When searching for information about COVID-19, I am able to assess the relevance of search results (vs. second-guessing).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. When searching for information about COVID-19 in general, I am able to explain the relevance of search results.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. When searching for information about COVID-19, I am able to know when the relevant information is found, and the task is done.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. When searching for information about COVID-19, I can effectively evaluate the credibility of information during my searches.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

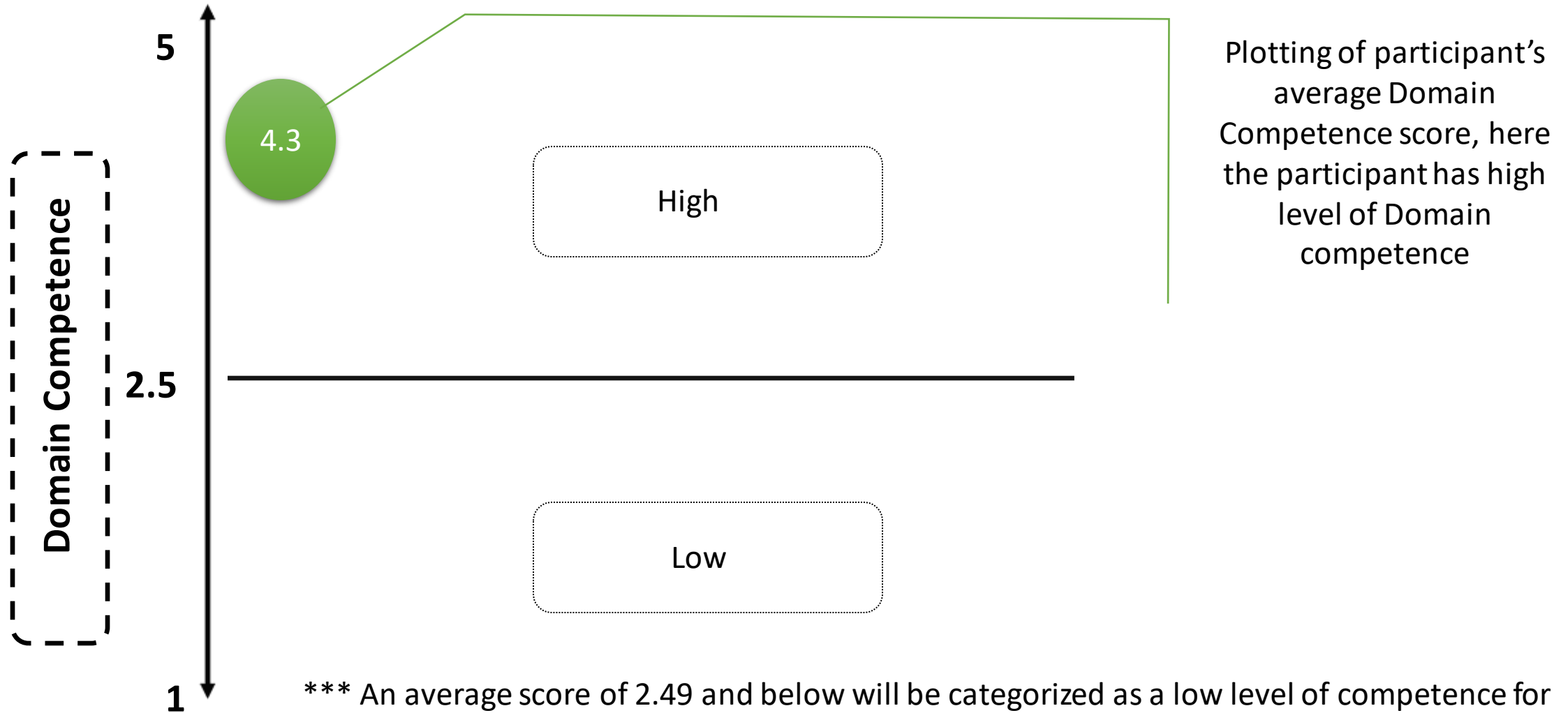
Metrics Development: Composite Scales and Index Scoring

Here is a hypothetical response from a participant on scale items. So, participant’s composite score of Domain Competence = $(5+4+3+5+4+5)/6 = 4.3$

Please indicate your level of knowledge or experience by selecting the appropriate number on the scale for each statement, where 1 represents "Strongly Disagree", and 5 represents "Strongly Agree. Click to write the question text -

	1. Strongly Disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly Agree
1. When searching for information about COVID-19, I understand the search task at hand.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
2. When searching for information about COVID-19, I know the right search terms, keywords, etc., to specify the search.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
3. When searching for information about COVID-19, I am able to assess the relevance of search results (vs. second-guessing).	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. When searching for information about COVID-19 in general, I am able to explain the relevance of search results.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
5. When searching for information about COVID-19, I am able to know when the relevant information is found, and the task is done.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
6. When searching for information about COVID-19, I can effectively evaluate the credibility of information during my searches.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Metrics Development: Composite Scales and Index Scoring

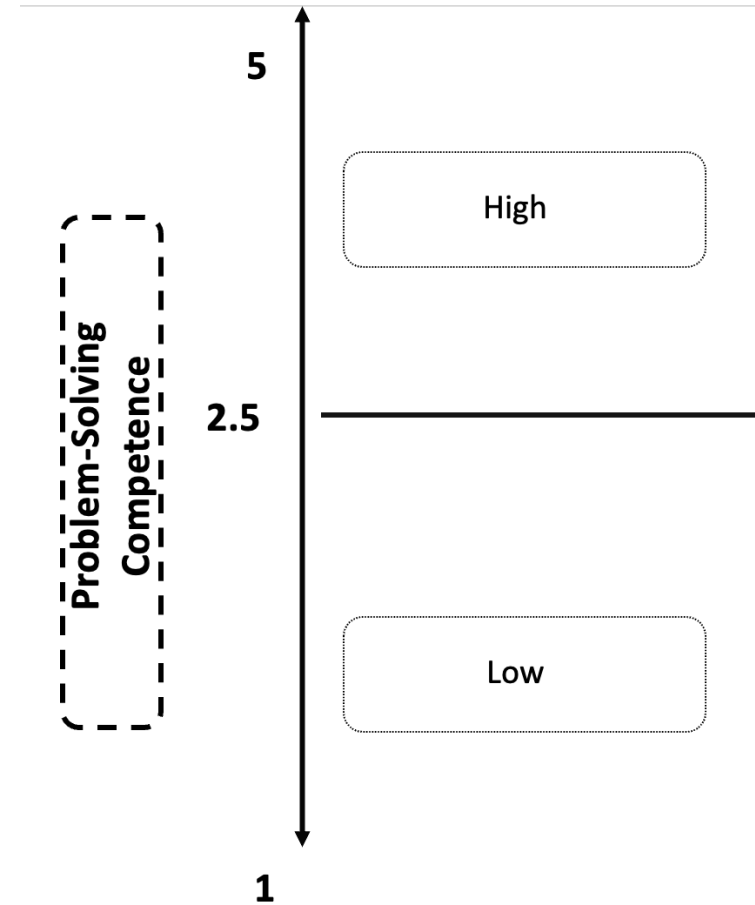
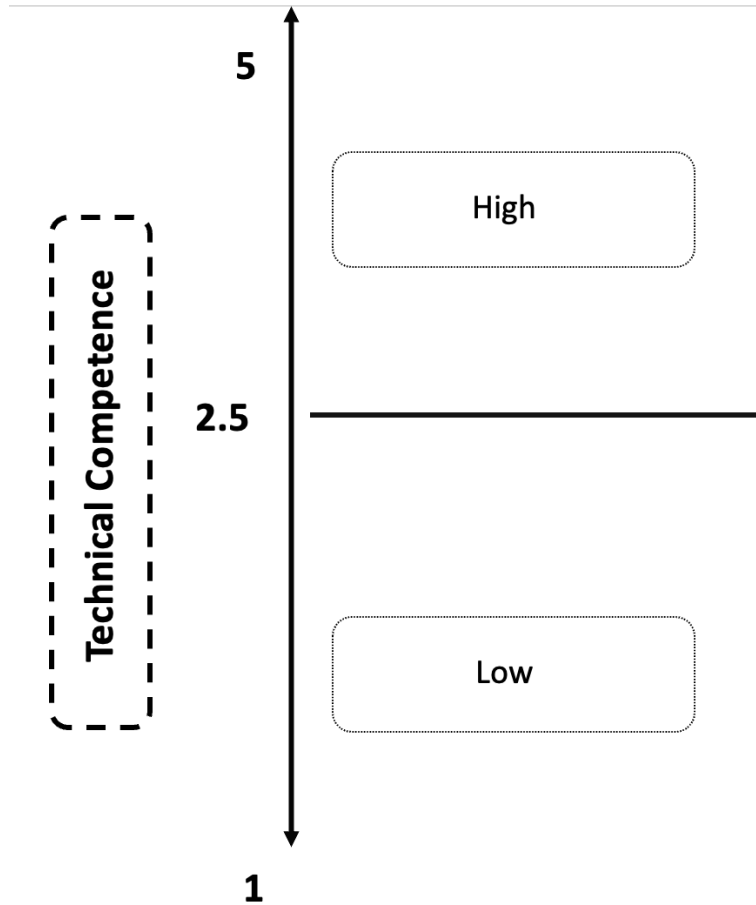


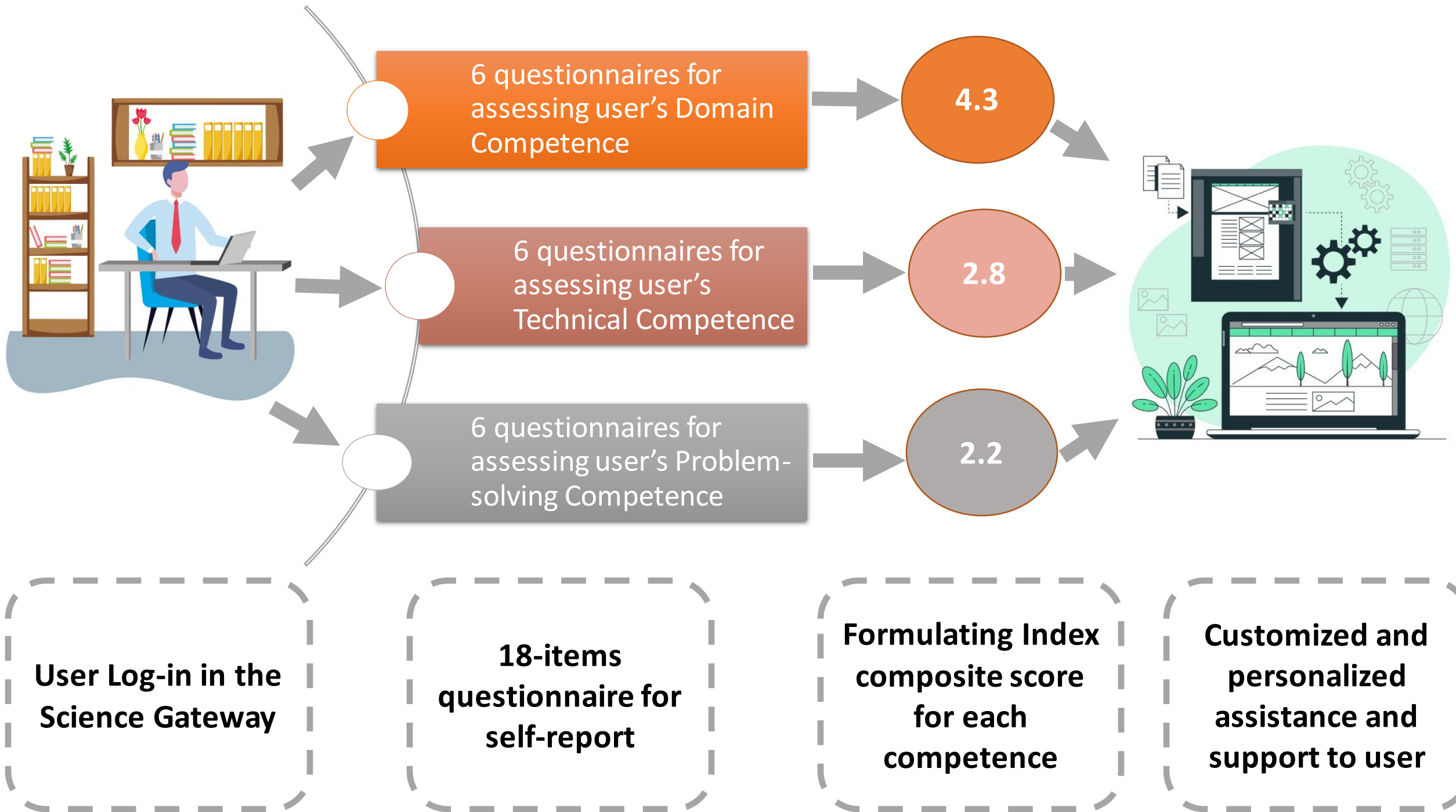
*** An average score of 2.49 and below will be categorized as a low level of competence for each competence metric,

***an average score of 2.5 and above will be categorized as a high level of competence

Metrics Development: Composite Scales and Index Scoring

Similar way composite score of Technical and Problem-solving competence can be computed.





Conclusion



The overarching objective of this project is to develop a questionnaire featuring user competence metrics capable of assigning numeric values to users' competency levels within science gateways.



This paper has identified three fundamental competencies along with their respective attributes.



With a questionnaire centered around these three domain competencies, we can quantitatively assess the competencies of users and assign competency scores based on their answers, and our science gateway can serve accordingly.

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