Validation of the EDUSS Framework for Self-Actualization Based on Transparent User Models: A Qualitative Study

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ABSTRACT

Self-actualization is the process of striving toward full potential and achieving higher goals in one's life. Originally studied in psychology, this concept has been adopted by various disciplines, including recommender systems, as a means of addressing issues like the filter bubble problem and promoting transparency. In an earlier work, we developed a theoretically-sound framework named *EDUSS* to systematically design interactive visualizations of transparent user models for self-actualization. We aim in this paper to validate the effectiveness of using the EDUSS framework to support self-actualization. To this end, we implemented interactive visualizations of transparent user interest models designed with the help of the EDUSS framework into the transparent Recommendation and Interest Modeling Application (RIMA). Further, we conducted a qualitative user study (N=10) to investigate the effect of these visualizations in supporting users to achieve self-actualization. Our study showed qualitative evidence validating that applying the EDUSS framework to design systems for self-actualization has the potential to help users reach self-actualization goals to a certain extent.

KEYWORDS

Self-actualization, Transparent User Models, Explainable User Models, Visualization, Recommender Systems

ACM Reference Format:
Mouadh Guesmi, Clara Siepmann, Mohamed Amine Chatti, Shoeb Joarder, Qurat Ul Ain, and Rawaa Alatrash. 2023. Validation of the EDUSS Framework for Self-Actualization Based on Transparent User Models: A Qualitative Study. In *UMAP '23 Adjunct: Adjunct Proceedings of the 31st ACM Conference on User Modeling, Adaptation and Personalization (UMAP '23 Adjunct), June 26–29, 2023, Limassol, Cyprus.* ACM, New York, NY, USA, 10 pages. https://doi.org/10.1145/3563359.3597379

UMAP '23 Adjunct, June 26–29, 2023, Limassol, Cyprus

ACM ISBN 978-1-4503-9891-6/23/06…$15.00
https://doi.org/10.1145/3563359.3597379

1 INTRODUCTION

Self-actualization is a concept that has been studied extensively in psychology and has been found to be a key factor in achieving personal fulfillment and happiness [28, 36]. In recent years, there has been a growing interest in using technology to help individuals achieve self-actualization. One approach that has gained traction is the use of transparent user models to reach self-actualization [8, 12, 37]. A transparent user model is of great interest in the field of human-computer interaction (HCI), as it can be exploited to enhance the interaction between humans and computers [2, 5, 17]. This concept is an essential component of personalized systems that allows users to understand how their data is being collected, stored, and used by a system, with the goal of increasing transparency and trust between users and the system [23]. The process of making user models transparent is supported by several features that are within the scope of ongoing research. Openness, scrutability, and explainability have received the most attention in a variety of disciplines due to their significant impact on the user's perception of the systems and the outcomes they provide [1, 9, 22, 31]. Interactive visualization tools are frequently employed to make the user model open, scrutable, and explainable[9, 25, 32–34, 42–44]. Nevertheless, since user modeling is heavily associated with personalization, user models may be susceptible to one of the most well-known issues in this regard, namely the filter bubble problem, as personalized systems provide limited content because they trap users in their current state [24, 46].

Several recent studies started to investigate the concept of self-actualization and propose it as a solution to the filter bubble problem as it might help individuals broaden their interest horizons to increase diversity and discover unexplored topics to increase serendipity, and avoid turning humans into "input" for systems rather than acknowledging the opportunities for taste development [8, 24, 27, 37, 45, 46]. In this paper, we aim to go "beyond accuracy" and take the concept of self-actualization to the user modeling level in order to help users explore, develop, and understand their unique personal preferences and interests.

In our prior work [12], we focused on developing a theoretically-sound framework named *EDUSS* to systematically design interactive visualizations of transparent user models for self-actualization following a human-centered design (HCD) approach to support users achieving different self-actualization goals in the scientific research domain. Building upon our previous work, we are interested in

investigating the concept of targeting self-actualization through transparent user models and examining the benefits and challenges of this approach, as well as considering its potential for future development. The primary research question of this paper is as follows: *What is the potential impact of interactive visualizations of transparent user models, designed based on the EDUSS framework, on users' ability to achieve self-actualization?* To answer this question, we incorporated the interactive visualizations of transparent user interest models developed with the help of the EDUSS framework into a transparent Recommendation and Interest Modeling Application (RIMA). RIMA presents an ideal platform to integrate these visualizations as it is an online scientific publication recommender system that provides explainable user models and recommendations based on users' interests. Then, we conducted a qualitative user study (N=10) based on moderated think-aloud sessions and semi-structured interviews with researchers to investigate the effect of these visualizations in supporting users to achieve self-actualization. The results of our study provide qualitative evidence that interactive visualizations of transparent user models helped users reach self-actualization goals to a certain extent. We believe that transparent user models can aid in reaching self-actualization by enabling individuals to understand their actions better, make informed decisions, and act in accordance with their objectives and values.

2 RELATED WORK

2.1 Self-Actualization

Self-actualization stems originally from psychology where it is defined as the desire for self-fulfillment [7], a continuous lifelong process to maintain, recover, and develop individual's self-concept via reflection and the reinterpretation of various experiences [36], and the complete realization of one's potential as manifest in peak experiences which involve the full development of one's abilities [29]. Initially studied by psychologists, the concept of self-actualization was later adopted by other disciplines, such as computer science, to provide novel solutions to a number of existing problems (e.g., filter bubble problems). Given the original definition of self-actualization, a system designed to promote self-actualization should aim not only for optimal accuracy, but also to help users develop their interests and support their personal growth. For instance, the first attempt to consider self-actualization in recommender systems (RS) was reported in [24], where the authors argued that building "Recommender Systems for Self-Actualization" (RSSA) can overcome the filter bubble problem by not just providing users with the best possible recommendations, but supporting users in developing, exploring, and understanding their own unique tastes and preferences. Building upon this work, new RSSA are proposed that have the potential to help users in understanding their unique tastes through development and exploration by providing alternative recommendation lists that go beyond the traditional Top-N list [15, 45].

2.2 Transparent User Modeling for Self-Actualization

User models in the recommender system domain represent the input level of the recommendation pipeline. They are built based on users' interests and preferences and are used to predict the suitability of items to be recommended. The rise of distrust and skepticism related to the collection and use of personal data, and privacy concerns has generally led to an increased interest in the transparency of black-box user models, used to provide recommendations [37]. Many researchers stressed the importance of enabling transparency by opening, scrutinizing, and explaining the black box user profiles, that serve as input for the recommender system. This can help users build a more accurate mental model of the system and detect biases which is crucial to producing fair recommendations, thus leading to increased trust in the system [9], become aware of their interests used for the recommendations and detect wrong assumptions made by the system [41], contribute to scrutability, allowing users to provide explicit feedback on their generated user profiles [8], and facilitate users' self-actualization [8, 37]. In this respect, self-actualization can be employed at the recommendation input level to promote transparency by supporting users in exploring, developing, and understanding their own interests. It can be used to guide interaction based on goals [12, 38].

The benefits of designing recommender systems for self-actualization have been supported by further studies connecting user profile explanations with self-actualization goals. For instance, Graus et al. [8] described how explaining the typically "black box" user profiles which serve as input for a news recommender system can improve transparency, scrutability (provide explicit feedback on the constructed user profiles), and self-actualization for users. Likewise, Sullivan et al. [37] developed a conceptual framework to explain the user profile for self-actualization in the news domain. This framework was composed of three layers namely transparency, contextualization, and self-actualization that enabled users to address various queries based on different goals. The self-actualization layer was designed to facilitate user control and goal-directed behavior. The authors evaluated the framework by creating an explanation interface that targeted two self-actualization goals (i.e., broadening horizons and discovering the unexplored) and observed that presenting users with distinct self-actualization goals significantly affected their reading intentions for news recommendations. Harambam et al. [16] conducted empirical research to validate the practicality of the RSSA strategies suggested in [24]. The authors conducted focus groups or moderated think-aloud sessions to systematically study how people evaluate different control mechanisms for the three different phases in the recommendation process (i.e., data input, process, and output) in a News recommendation prototype. The results indicated that users highly valued control over the input (via an intelligible user profile) and the process, particularly when these mechanisms were linked to achieving personal self-actualization objectives.

2.3 The EDUSS Framework

In our prior work [12], we developed a theoretically-sound framework named *EDUSS* to systematically design interactive visualizations of transparent user models for self-actualization following a human-centered design (HCD) approach to support users achieving different self-actualization goals in the scientific research domain. EDUSS is a conceptual framework for self-actualization goals of transparent user modeling consisting of five main goals, namely, *Explore*, *Develop*, *Understand*, *Scrutinize*, and *Socialize* (see Fig. 1).

Figure 1: The EDUSS Framework for self-actualization goals of transparent user modeling [12]

The goal *Explore* means discovering new things but still within one's circle of interests. Likewise, *Develop* aims at developing new tastes and preferences but from outside one's circle of interests. For *Understand*, it aims at helping users understand their own tastes better by explaining the user model. The goal *Scrutinize* gives users agency (i.e., view, edit, correct) over their generated model. *Socialize* is one of the characteristics of Self-actualized people who can benefit from their community and mutual support, which requires that one should be unselfish and provide support to others as well as being open to the idea of receiving help from others. This framework was drawn from a qualitative research approach by investigating the self-actualization concept from psychology and computer science disciplines and deriving a set of self-actualization goals, sub-goals, and mechanisms. In this work, we aim to validate this framework by evaluating its effectiveness in supporting users in achieving the defined self-actualization goals using transparent user models.

2.4 Evaluation of Self-Actualization

Self-actualization has been studied extensively in various fields, such as psychology, education, and business. Various models and methods have been proposed for evaluating self-actualization, including questionnaires [19], psychological tests (e.g., Personal Growth Initiative Scale) [21, 35], behavioral observations [20], and interviews (e.g., semi-structured interviews, in-depth interviews, and narrative analysis) [16, 40]. Interviews are a widely used method to assess self-actualization in the scientific literature as they often provide rich descriptions of the participants' experiences and perceptions of self-actualization. Furthermore, interviews enable researchers to probe deeper into the subject's personal journey of self-actualization and offer a better understanding of their unique perspective.

Given that the concept of self-actualization is highly subjective and the novelty of the EDUSS framework, a qualitative approach would be the appropriate method to utilize in order to obtain in-depth insights into users' unique perspectives and expectations from a system providing transparent user models aiming at assisting users to achieve different self-actualization goals.

3 INTERACTIVE VISUALIZATIONS OF TRANSPARENT USER MODELS FOR SELF-ACTUALIZATION

3.1 RIMA Application

The transparent Recommendation and Interest Modeling Application (RIMA) is a content-based recommender system that produces on-demand content-based explanations with varying level of details [4, 10, 11, 13]. It aims to recommend scientific publications based on the interest model of the user. This application was developed with the intention of providing open, scrutable, and explainable user interest models as well as explainable recommendations, enabling users to explore, develop, and understand their own interests in

order to provide more transparent and personalized recommendations [9, 14]. RIMA aims to recommend scientific publications based on the interest model of the user. Given these aims, RIMA presents an ideal platform to incorporate interactive visualizations of transparent user interest models designed with the help of the EDUSS framework, and investigate the effect of these visualizations in supporting users to achieve self-actualization.

The user interest models in RIMA are automatically inferred from users' publications. The application uses Semantic Scholar IDs provided by users to gather their publications and infer users' interest models based on their publications. Then, an unsupervised keyphrase extraction method is applied to the publications to obtain *keyphrase-based interests*. We employed an embedding-based keyphrase extraction method SIFRank [39] with the pre-trained model SqueezeBERT [18] to extract weighted keyphrases from an author's publications in order to generate the interest model. Next, in order to address semantic issues such as acronyms (e.g., MOOC and massive open online course), synonyms (e.g., technology enhanced learning and elearning), and lexical variants(e.g., elearning and E-learning), the knowledge base DBpedia [26] is used to semantically enrich and obtain more comprehensive and precise keyphrase-based interests. DBpedia Spotlight [30] as an entity linking service is used to connect keyphrases to concepts in the DBpedia knowledge base. Lastly, the user interest model will be presented to users leveraging information visualization techniques. RIMA offers scrutable user interest models where users can manipulate (i.e., add or delete interests, or change interest's weight) their interest models.

3.2 Implementation of the Visualizations of Transparent User Models

The pages and the visualizations are implemented according to the prototypes in [12], however, some modifications have been made due to either the technologies used or the realization of certain ideas. Given that the original self-actualization goal names could sound technical and complicated, we renamed the tabs in the user interface to make them more understandable to a general audience, replacing *Scrutinize* with "My interest", *Develop* with "Discover", *Understand* with "How does it work?", and *Socialize* with "Connect". The implemented pages and visualizations are depicted in Figure 2.

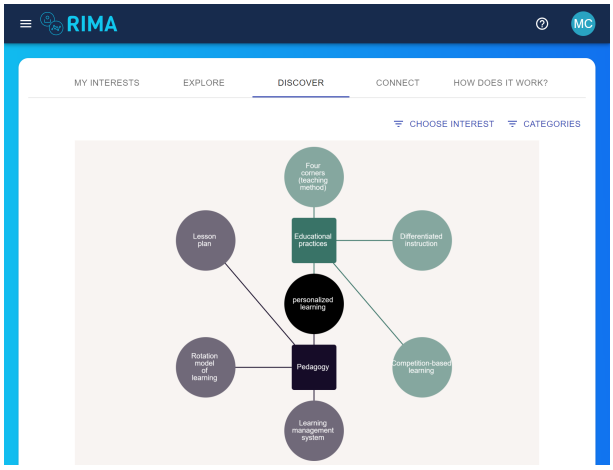
3.2.1 "Explore". This page and the employed interactive visualization are designed to support users in achieving the self-actualization goal *Explore* by searching for new interests, but still within their current circle of interests (see Figure 2a). The visualization employed on this page is a node-link diagram, showing the new interests suggested to the user as well as their connection with the initial interest from the user interest model, upon which the suggestion was based. The strategy behind obtaining new interest suggestions is to consult a knowledge base. In this stage, Wikipedia was chosen as each Wikipedia article contains relevant interests in the form of hyper-texts or links. For each user interest, we start by extracting all the links and hyper-texts from their corresponding Wikipedia article using Wikipedia API. Then, we count how frequently each link/hyper-text is mentioned. After that, the top three frequent links/hyper-texts are taken and provided as new interest suggestions. Three options are provided to users to interact with this visualization, appearing around each interest node namely "Expand" (enlarge the list of suggested interests), "Learn more" (get a brief description for each new suggested interest), and "Add to my interests" (add new interests to user's interest model). Furthermore, the users can filter the interests shown in the node-link diagram based on their current interests.

3.2.2 "Discover". Similarly, this page is designed to support users in achieving the self-actualization goal *Develop* by searching for new interests, but at this stage outside the current circle of interests (see Figure 2b). Initially, the idea discussed when developing the *Develop* prototype in [12] was to use the field of study from Semantic Scholar as a source of new interests. However, it was challenging to determine which interests would be sufficiently distant from the current interest yet relevant to be suggested on the "Discover" page, but also ineligible for inclusion on the "Explore" page. We decided to utilize Wikipedia as a source to get new interests since articles in Wikipedia can be listed in several categories, therefore, the strategy was to get new interest suggestions from the categories where the original interest is listed in. Similar to the approach in "Explore", the starting point is an interest from the current interest model, but instead of links/hyper-texts, the categories where this page is listed are extracted. After that, three random pages from each category are fetched to be presented to the user as potential interests. The visualization employed on this page is a node-link diagram, where the center node is one of the current user interests, while on the next level, we provide Wikipedia categories that encompass related interests. On the following level, new interests from each category are suggested to the user. Users can interact with this visualization either by adding a new suggested interest to their profile by clicking on the "Add to my interests" button or deleting a suggested interest from the view. Also, the user has the possibility to filter the interests and categories shown in the node-link diagram.

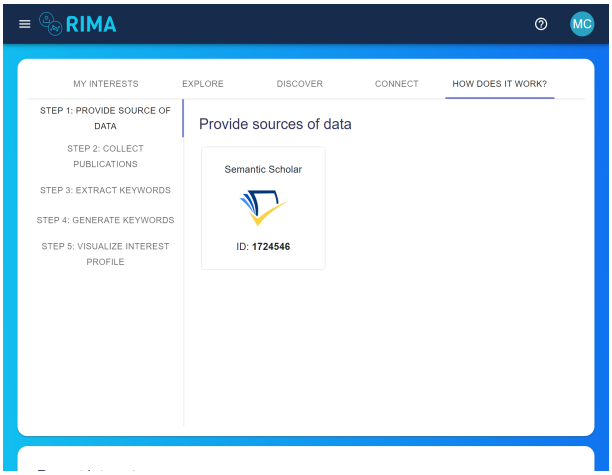
3.2.3 "How does it work?". Through this page, we aim at supporting users in achieving the self-actualization goal *Understand* by revealing the inner working of the system regarding the generation of user interest models. The explanation of this process is provided in two levels. Initially, users are presented with an overview consisting of the main steps of the algorithm in the form of a navigation panel (see Figure 2c). Then, each step can be expanded upon clicking on it where a more detailed and personalized explanation using users' personal interests is provided where several visualizations are used such as bar chart and node-link diagram (see Figure 2d). The generation process is illustrated in five main steps; (1) the data source is revealed (in this case semantic scholar website using the user's semantic scholar ID), (2) the number of fetched publications for the last five years, (3) the extracted keywords from all publications are shown, (4) the semantic enrichment step where each keyword is connected to a DBpedia concept (in case of not matching any concept, the keyword will be omitted), and (5) the final interest profile is visualized and showed to the user.

3.2.4 "My Interests". This page and the corresponding interactive visualization are designed to assist users in achieving the self-actualization goal *Scrutinize* (see Figure 2e). On this page, we provide users with an overview of their profile by opening their

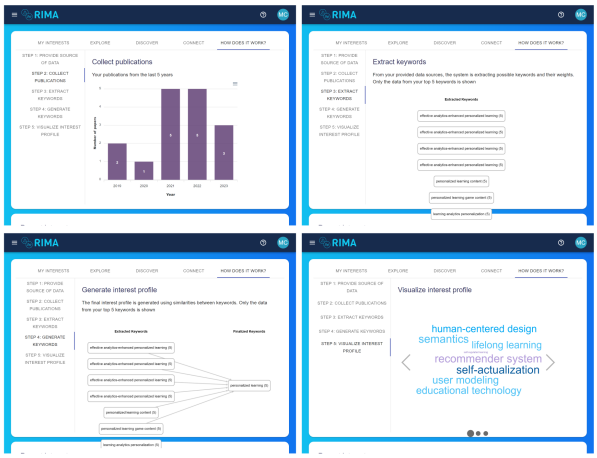
(a) Page "Explore" developed for the goal *Explore*



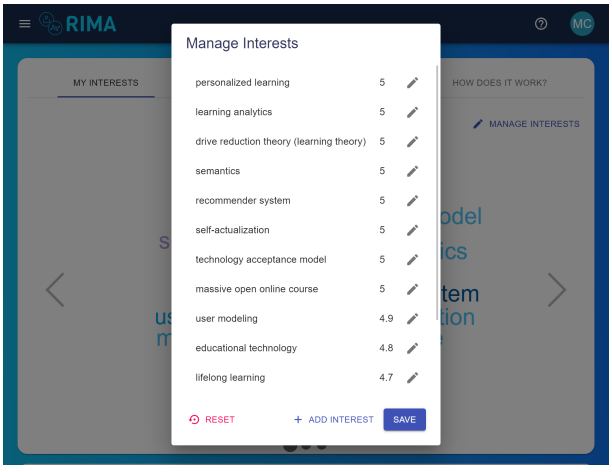
(b) Page "Discover" developed for the goal *Develop*



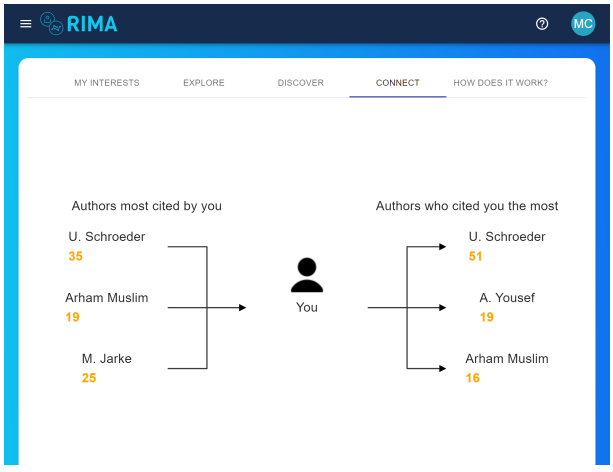
(c) Page "How does it work?" developed for the goal *Understand* - Overview



(d) Page "How does it work?" developed for the goal *Understand* - Expanded



(e) Page "My Interests" developed for the goal *Scrutinize*



(f) Page "Connect" developed for the goal *Socialize*

Figure 2: Screenshots of the final implementation of the five self-actualization goals

interest model by displaying the user's interests as well as their corresponding weights given by the extraction algorithm, indicating the importance of the interests. Also, users can add new interests, delete irrelevant ones, or edit their weights. Word cloud was the employed visualization on this page where it encodes the data by using the size of the interests as an indicator for the weights. Users can interact with this visualization either by clicking a specific interest where a set of options will be provided around it namely "Why this interest?", "Edit", and "Similar Interests", or through the "Manage Interest" functionality which allows them to see all the interests listed where they can manipulate them. The "Why this interest?" option provides a brief explanation of why a specific interest was added to the profile by revealing its source (e.g., from publication or manually added) and showing more information about the corresponding publication that it was extracted from. The "Edit" option offers the user the ability to either delete the interest or change the weight of a specific interest. The "Similar Interests" option gives users suggestions for similar interests. This is a local view of the page "Explore" with the current interest being the seed item.

3.2.5 "Connect". The purpose of this page is to aid users in achieving the self-actualization goal *Socialize* by presenting authors who might be of interest to them. Inspired by a similar feature provided on the Semantic Scholar website, a node-link diagram was used chosen to support this aim (see Figure 2f). This visualization illustrates (a) authors who influenced the users and (b) authors who were influenced by the users. Moreover, information about the publications where users cited the authors who influenced them, or publications where they were cited by the authors is provided. Additionally, users can compare their interests with the interests of the suggested authors. A Venn diagram is utilized to illustrate the comparison between them, accessible upon clicking on a specific author. We utilized the Semantic Scholar API to retrieve two lists of authors, which are (L1) all references cited by the user and (L2) all references citing the user. Next, each time an author appears in either list, their count increases by one. In order to enable the user to connect with new authors, papers for which the user is an author are not considered. However, co-authors will be considered when appearing in other papers that the user is not part of. After that, the top three authors from each list will be presented to the user in the node-link diagram.

4 VALIDATION OF THE EDUSS FRAMEWORK

4.1 Study Design

The target group of our study is researchers, as we need their Semantic Scholar ID to extract their research interests. A total of ten participants (female n=4, male n=6), age range from 26 to 43, from different fields of study (electrical engineering (n=5), computer science (n=3), mechanical engineering (n=1), and biotechnology (n=1)) took part in the evaluation. Most of the participants were from Germany (n=8), one from Pakistan, and one from Syria. Most participants stated that they are fairly familiar with visualizations, while their familiarity with recommender systems was more mixed. The overall duration of the interaction and interview ranged from 58 minutes to 107 minutes. This study consists of two main parts which are (a) interaction with the system and (b) semi-structured interview. All study sessions took place online via Zoom and were recorded. The participants were asked for consent and were informed about the scope of the study before the session began. Also, they were debriefed about the study goal at the end. The study was reviewed and accepted by the ethic's committee of the University of Duisburg-Essen. Participants were initially given a short general introductory video about the RIMA application. Afterwards, we conducted moderated think-aloud sessions where participants were asked to build their ideal research interest profile. We prepared the interest profiles of all participants beforehand using their Semantic Scholar ID which is publicly available on the Semantic Scholar website. In order to ensure that participants will interact with each page related to different self-actualization goals, we gave them various tasks covering all the provided functions. Specifically, for the "My interest" page, participants were asked to (1.1) "Edit at least one interest", (1.2) "Find one similar interest" and (1.3) "Get to understand how the system created your interests". For the "Explore" page, they were asked to (2) "Find one potential interest that could be relevant to your research, that was missing in your current profile and investigate it". Regarding the "Discover" page, participants were asked to (3) "Find two new -not expected- interests to investigate based on at least two of your current interests". As for the "Connect" page, they were asked to (4.1) "Compare your interests with one of the authors, who influenced you the most", (4.2) "Compare your interests with one of the authors, who were influenced by you the most". Lastly, for the "How does it work?" page, they were asked to (5) "Go through each step and try to understand how the system works". Following a think-aloud approach, participants were also asked to say anything that comes to their mind during each interaction. After that, we conducted semi-structured interviews to gather in-depth feedback. The questions for this interview were designed to evaluate the effectiveness of the transparent user models in helping users achieve different self-actualization goals. These questions were derived from the EDUSS framework, particularly from the self-actualization sub-goals, as they encompass the desired outcomes (see Table 1). The questions were presented in a random order, and they were phrased in a way to avoid overlapping with either the name of the pages or the tasks. The participants were asked to answer a general question related to each page (e.g., related to "Explore", does the system help you to expand your original interests?) and were encouraged to elaborate more on their provided answers. They are also asked to identify which page of the application (i.e., "My Interest", "Explore", "Discover", "Connect", or "How does it work?") this question is associated with.

After asking all the questions related to each of the five self-actualization goals, we want to get a deeper understanding of how our participants have generally perceived self-actualization through interacting with our system. As self-actualization is the process of striving toward full potential and achieving higher goals in one's life [1], we asked the participants "What is a good researcher for you?", as this question can help us to get insights into the qualities attributed to good researchers. The answer to this question then leads us to another question which is "Do you think this system helps you to become a better researcher?". This question targets the general sense of self-actualization as it is connected to the higher goal of

[1] https://dictionary.apa.org/self-actualization

Goal	Sub-goal	Page	Question
Explore	Support users in exploring their own unique tastes; discovering new things but still within one's circle of interests	Explore	Does the system help you to expand your original interests?
Develop	Developing new tastes and preferences which can be outside one's circle of interests	Discover	Does the system help you to get surprising interests?
Understand	Understanding the inner working of the system	How does it work	Do you understand how the system works?
Scrutinize	Tell the system if it is wrong and correct it	My Interests	Do you think it is possible for you to correct wrong assumptions made by the system regarding your interests?
Socialize	Connect people based on shared preferences	Connect	Do you think the system helps you find researchers with similar interests?

Table 1: Interview questions asked to determine the degree of self-actualization and fulfillment of the self-actualization goals.

striving to become a better researcher. As each page is designed to fulfill a specific self-actualization goal, we want to make sure that users can discriminate between these pages. Specifically, we want to investigate the users' perception of the "Explore" and "Discover" pages as they are similarly designed and provide relatively close outcomes. Therefore, participants were asked "Do you see any differences between Explore and Discover? If yes, what are these differences?", followed by a set of open-ended questions aimed at investigating if users were able to associate the goal with its relevant page. These questions are "If you want to discover new interests, that are related to your current interest profile, which page would you visit?", and "If you want to discover new interests, that are unexpected, which page would you visit?". The participants are then provided with a definition of each of the self-actualization goals and informed which pages correspond to each goal. They are then asked whether they believe the goal is achieved. This was included in order to receive direct feedback on the self-actualization goals.

4.2 Analysis and Results

Through our qualitative analysis of the moderated think-aloud sessions and the semi-structured interviews, we aim at gaining insights into the effectiveness of the EDUSS framework in helping users reach a self-actualized state using transparent interest models. We adhere to the use of the thematic analysis method [3] and opted for a top-down approach, thus, our themes were established prior to the beginning of the analysis. Notes and transcripts of the interview recordings were made for the analysis. We derive our themes from the EDUSS framework, meaning that each goal of the EDUSS framework corresponds to a theme in the thematic analysis, namely *Explore, Discover, Understand, Scrutinize* and *Socialize*. We added an additional theme for *Self-actualization* to assess the overall perception of this concept among users. After that, we coded and analyzed the results of the interviews with respect to our themes. We report our results in regard to each of our themes, as well as to what extent they agree with the provided definitions of each self-actualization goal.

4.2.1 Explore. Six participants agreed that the system helped them reach this goal. The remaining four participants stated that this goal is reached to a certain extent. For instance, **P7** reported that *"It could help if the selection of the topics would be optimized"*. Seven participants associated the page "Explore" with the goal *Explore*. However, three participants named "Discover" as a relevant page, and two participants named both pages. Given the definition of this goal, all participants agreed that this goal could be achieved through the associated page "Explore".

4.2.2 Develop. Six participants also agreed that the system helped them reach the goal *Develop*. On the other hand, the remaining four participants stressed the need for better interest suggestions. For example, **P6** stated that *"It could help, yes. If the content would be more helpful"*. When asked which page the goal *Develop* could be associated with, both pages "Explore" and "Discover" are named five times. When asked about the definition of this goal, eight participants agreed on the given definition as well as that this goal could be achieved through the associated page "Discover", while two participants disagreed because the provided content was not satisfying for them. As expected, the distinction between the goals *Explore* and *Develop* was not as clear, and both goals get associated with both pages. When asked about possible differences between the pages "Explore" and "Discover", all but one participant saw differences between the pages. Five of them could discriminate that the suggestions on page "Explore" are closer to their current interest profile, and the page "Discover" contains suggestions that are outside of their circle of interest. This is in line with the definition of the goals defined in EDUSS. Two other participants gave the expected page when directly asked about which page they would visit to find either interests related to their current interest profile or unexpected interests. However, one participant named the page "Connect", though she would also agree that "Explore" would be better to use to find interests related to their current interest profile, while "Discover" is more helpful to find unexpected interests. The reason behind her choice was that she found new relevant interests by comparing her interest with other researchers on the "Connect" page. Her answer indicates that these are interconnected goals i.e., *Socialize* aims at helping people find new interests by comparing theirs with other researchers while exploring new interests (*Explore* and *Discover*) can help users find similar researchers.

4.2.3 Understand. All participants agreed that the system helped them reach this goal. However, a closer examination of the data reveals a more nuanced picture. For example, when asked about which part of the system (i.e., page, feature, function) they associated this goal with, one participant perceived the question in a totally different way as if she understood how the system should be used. It seems that this participant associated the open question

"Do you understand how the system works?" more with the understanding of how the system should be used. Further, when asked to summarize what is shown on the page "How does it work?", eight participants were able to explain how the system generates the user profile. However, only six participants associated the page "How does it work?" with the goal *Understand*. Given the definition of this goal, all participants agreed that this goal could be achieved through the associated page "How does it work?".

4.2.4 Scrutinize. Nine participants agreed that the system helped them reach this goal. On the other hand, the only participant who disagreed that the system helped them reach the goal *Scrutinize* thinks that the provided functionalities are not good enough and it was only partially possible to correct the system as she claimed *"**P4:**Yes, a little bit. I was able to remove interests, but I also clicked on a lot of interests, where I did not get further recommendations. I think the system still needs some work"*. Also, this participant associated the goal*Scrutinize* with the page "Explore" instead of the page "My Interests". As for the remaining participants, all of them associated the goal *Scrutinize* with the "My Interests" page. Nonetheless, some participants named additional parts of the system such as the pages "Explore" and "Discover" to be associated with this goal. When asked about the definition of goal *Scrutinize*, nine participants agreed that this goal could be achieved through the associated page "My Interests".

4.2.5 Socialize. While all participants associate the page "Connect" with the goal *Socialize*, the agreement that the system helps them reach this goal is mixed. Four participants agreed that the system helps them reach this goal, while three participants disagreed. Three participants agreed to a certain extent, for example, **P3** claimed *"I expected seeing someone I didn't follow but I need to"*. Also, **P2** wants a possibility to contact the researchers presented as they stated *"If there is a possibility to connect the researchers, I agree"*. Participants who disagreed that the goal *Socialize* is met, gave reasons similar to the ones of the participants who partially agreed and added that the interests of the researchers presented are not relatively similar. For instance, **P5** mentioned that *"I assume that they have similar interests, but the ones shown in the application are very far away"*. When asked about the definition of this goal, the obtained results were surprising as only two participants agreed with the definition and the page that is associated with.

4.2.6 Self-actualization. Most participants (8 out of 10) do not fully agree, that the system helped them reach a self-actualized state. This has multiple causes, which all stem from the phrasing of the question: "Do you think the system helps you to become a better researcher?". Four participants were skeptical if an application can help them with becoming better researchers. For instance, **P8** stated that *"I am not sure that it will help me become a good researcher because it is not a workshop"*. Another reason mentioned by six participants is that the system can not help with the characteristics (e.g., honesty, transparency, and scientific practices) associated by the participants with a good researcher. These characteristics were collected by asking the question "What is a good researcher for you?". While most participants (7 out of 10) named characteristics related to discovering new interests and being curious, they only agreed to a certain extent that the system could help them in becoming better researchers due to that at the current state, the newly suggested interests are not good enough to be really helpful. However, other characteristics such as curiosity and exploring new interests which are supported by the system present the reason behind not fully rejecting the system. On the other hand, three participants mentioned other functionalities which have been mentioned with regard to being helpful in becoming a better researcher such as the possibility to compare interests and get to know researchers which are provided on the "Connect" page. Nevertheless, the participants suggested improving the "Connect" page by showing more researchers and providing functionalities such as filtering and contacting the researchers shown.

5 DISCUSSION

The following discussion offers an in-depth examination of the participants' experiences and perceptions regarding the goals of the EDUSS framework, highlighting the strengths and limitations of the system in overcoming the filter bubble problem, and shedding light on the extent to which the system facilitated the achievement of the defined self-actualization goals.

Regarding the distinction between the *Explore* and *Develop* goals, the results showed that the participants had difficulty differentiating between these two goals, although they could easily distinguish between the two associated pages "Explore" and "Discover" to these two goals. Thus, we can assume that our system supported the participants in achieving these two goals to a certain extent. This is due to the fact that providing alternatives "beyond accuracy" is not always satisfying for users and that better results could be achieved if the quality of the suggested interests was higher. For the goal *Understand*, the participants' perception of the system's understandability varied, likely due to the way the related question was phrased, which could have been interpreted differently by different participants. To gain a more comprehensive understanding of the system's objective understandability, we propose that a set of tasks be offered in conjunction with the question. As for the goal *Scrutinize*, the participants showed a high agreement with all questions, indicating that the system can help users reach this goal by making them first aware of the set of interests that were automatically generated by the system, then allowing them to rectify their interest models. This finding aligns with the expectations put forth by Guo [15], which propose that the development of self-actualization-oriented systems would empower users to exert greater control over their choices, leading to increased decision satisfaction. However, regarding the goal *Socialize*, the results showed a variance between the open-ended questions and the definition question. We think that the main reason behind this variance lies in the different phrasing of these two questions. While the open questions asked the participant about the ability to find new researchers, the definition question was about the ability to connect with researchers with similar interests. This difference in phrasing may have contributed to the lower agreement on the definition compared to the results of the open-ended questions, as based on the word used "connect", participants reported that they expected to have a feature allowing them to contact other researchers. The definition provided in the EDUSS framework was abstract, and the meaning of "connect" is broad, including seeing oneself as part

of a community, which is not necessarily based on direct contact. This has created a gap between the framework definition of *Socialize* and participants' perception of the page "Connect" as they understood it in a way that they are able to directly contact other researchers. However, we believe that the agreement would get higher if the improvements mentioned by the users such as contact possibilities and showing more researchers are considered. Overall, participants perceived the system as lacking effectiveness in facilitating self-actualization due to certain unsupported characteristics like honesty and areas for improvement such as the inclusion of a feature to connect with similar researchers. Additionally, our findings indicated that even when providing alternatives "beyond accuracy," maintaining a good quality and meaningful novelty of the suggested interests is essential.

In conclusion, a system designed to support self-actualization must explicitly incorporate these "beyond accuracy" suggestions while carefully fine-tuning the balance between accuracy and these alternative suggestions. This necessitates optimizing both the relevance of interest suggestions and the qualities associated with "beyond accuracy" simultaneously, and as claimed by [6], it is crucial to strategically increase serendipity to avoid confusing users or having a distrust effect.

6 CONCLUSION AND FUTURE WORK

In this paper, we aimed at validating the EDUSS framework using the RIMA application by investigating the potential impact of leveraging transparent user models to support users in achieving self-actualization. For each self-actualization goal, an interactive visualization that was designed based on EDUSS is implemented and integrated into RIMA. Then, we presented a qualitative investigation of users' unique perspectives and expectations from a system providing transparent user models aiming at assisting users to achieve different self-actualization goals. Our preliminary results showed qualitative evidence that a system designed using EDUSS has the potential to help users reach self-actualization goals to a certain extent. Furthermore, our evaluation, combining open-ended questions, the (page, goal) association, and comparing definitions of the self-actualization goals given by the EDUSS framework and participants' understanding, builds a foundation questionnaire to further validate the EDUSS framework through a quantitative approach. While we are aware that our results are based on a small sample size in a qualitative study and that the results cannot be generalized, we are confident that they represent a necessary step towards a richer understanding of how systems supporting self-actualization can leverage the EDUSS framework to design interactive visualizations for transparent user models. Future directions concern the generalization of findings with a quantitative approach, including more heterogeneous participants. Furthermore, to assess the scalability of the EDUSS framework, its potential use should extend beyond recommender systems to include the design of other systems, such as intelligent tutoring systems and adaptive systems. Overall, the evaluation of self-actualization requires a comprehensive understanding of the concept and its various dimensions, as well as a sensitive and culturally-aware approach that acknowledges individual differences and contexts.

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