Vol 3, Issue 4, Oct 2016
Journal of Health Management & Informatics
jhmi.sums.ac.ir
Original Article

Adjustment and Development of Health User's Mental Model Completeness Scale in Search Engines

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Received 29 July 2016 ; Accepted 20 Mar 2016

ABSTRACT

Introduction: Users' performance and their interaction with information retrieval systems can be observed in development of their mental models. Users, especially users of health, use mental models to facilitate their interactions with these systems and incomplete or incorrect models can cause problems for them . The aim of this study was the adjustment and development of health user's mental model completeness scale in search engines.

Method: This quantitative study uses Delphi method. Among various scales for users' mental model completeness, Li's scale was selected and some items were added to this scale based on previous valid literature. Delphi panel members were selected using purposeful sampling method, consisting of 20 and 18 participants in the first and second rounds, respectively. Kendall's Coefficient of Concordance in SPSS version 16 was used as basis for agreement (95% confidence).

Results: The Kendall coefficient of Concordance (W) was calculated to be 0.261(P-value<0.001) for the first and 0.336 (P-value<0.001) for the second round. Therefore, the study was found to be statistically significant with 95% confidence. Since the increase in the coefficient in two consecutive rounds was very little (equal to 0.075), surveying the panel members were stopped based on second Schmidt criterion and Delphi method was stopped after the second round. Finally, the dimensions of Li's scale (existence and nature, search characteristics and levels of interaction) were confirmed again, but "indexing of pages or websites" was eliminated and "Difference between results of different search engines", "possibility of access to similar or related webpages", and "possibility of search for special formats and multimedia" were added to Li's scale.

Conclusion: In this study, the scale for mental model completeness of health users was adjusted and developed; it can help the designers of information retrieval systems in systematic development of these systems and can also help librarians and informatics experts in recognizing the necessary trainings for users in order to improve their information retrieval skills. Also, as a valid and adapted scale for Iranian universities of medical sciences, it can be used for investigating completeness level of health information users' mental models of search engines.

Keywords: Mental Model Completeness Scale, Health users, Search engines

►*Please cite this paper as:*
Nakhoda M, Kazempour Z, Naghshineh N, Mirzabeigi M. Adjustment and Development of Health User's Mental Model Completeness Scale in Search Engines. J Health Man & Info. 2016;3(4):111-119.

Introduction

The term "mental model" was first introduced by Craik in 1943. He believed that mental models are internal representations of items and events of the outside world and include numbers, word and other symbols. In 1983, Johnson Laird in his book titled "Mental Models" expanded the concept of mental models and introduced it as a theory aiming to explain human deductive reasoning and the errors present in this reasoning. He believed that humans use their mental model for their reasoning (1). Mental model theory is a psychological theory that is widely used in order to observe the cognitive processes of people while using computer or mechanical systems (2). In the last two decades, mental model theory has been introduced to the area of human-computer interactions and has been used in various disciplines such as Library and Information Science, especially for interactions with computer systems. Therefore, mental model theory is a psychological theory that has seen a more special meaning in the area of human-computer interaction (3). One of the reasons for studying mental models is that user performance and user interaction with information retrieval systems are governed by users' mental model and they use their mental models to facilitate their interactions with these systems. These models enable them to

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understand the system, predict its performance and use it to their ends. If these mental models are incomplete or incorrect, they can cause problems for the users because their mental models will be different from the underlying model of the system. This difference usually cause failure in the interaction between the user and system and incomplete or incorrect mental models are the sources of the user's error. Therefore, we need to understand the mental models of the users and their level of completeness. Studies have shown that a very small number of studies about mental models in information retrieval have used web search engines. For example, Muramatsu and Pratt (4), Thatcher and Greyling (5), Li (6) and Melilo (7) have investigated the mental models of users in public search engines, but most studies investigate user mental models in other information retrieval systems (8-10). In recent years, some researchers have shown an interest in investigating the user's mental models in web search engines. However, these studies are still in their infancy and mostly have identified the user mental models in these systems rather than their level of completeness. To this day, few researchers have used a scale in order to score the completeness of mental models in information retrieval systems. And in Iran there isn't any scale in this area. Thus, it's important to develop a suitable and native scale for investigating the completeness level of search engines users' mental models.

Therefore, the aim of this study was to identify a suitable scale for evaluating completeness level of Iranian information health users' mental model (Master and PhD students in Isfahan University of Medical Sciences) of search engines. Therefore, it's necessary to expand the existing scales in order to better determine the mental model completeness of the participants.

Method

The current study uses Delphi method. In practice, Delphi method is a set of consecutive questionnaires or sessions with controlled feedback that aims to achieve agreements among experts in a certain field (11, 12). This method was first introduced in 1950 in which an American company canned RAND uses this method to make predictions with the aim of obtaining credible opinions and results from a panel of experts (13). In RAND Company's report, Dalkey et al. introduced Delphi method as a method for inference, refining and judgment regarding group opinions (14).

A Delphi study has several defining characteristics. First, the participants should be unfamiliar with each other in order to reduce the chances of their opinions being affected. The second characteristic is repeatition. This method is carried out in several stages which can vary between 2 to 10 in different studies. Feedback is the third characteristic of Delphi method. In this method, the results of the previous round and the answers of each participant are given to the other participants and the participants use these previous results to produce new answers (15).

Delphi method is used in order to reach consensus among a panel of experts in a certain field or subject. Other uses of Delphi method include:

- Design, adjustment, evaluation and validation of conceptual models in studies
- Identifying and ranking the effective factors in a study.
- Gathering current and previous information that is unknown or inaccessible.
- Identifying the key factors in a social phenomenon
- Scenario building, policymaking and defining guidelines (16).

This method can be used to gather current or pervious information that are unknown or inaccessible. In general, the most important condition for using Delphi method is the need for judgment by experts and expanded group opinions; need for group consensus in results; problems that are complicated, large, multidisciplinary, and controversial or lack enough information; and limited time and limited cost- benefit nature. Given these conditions and since the goal of this study is adjustment and expansion of mental model completeness scales for search engine users based on judgment and consensus of experts, Delphi model was selected for the purpose of this study.

2-1. Preparation of the Delphi questionnaire

By investigating the previous literature, four scales for mental model completeness of information seekers were identified. The first scale was introduced by Borgman (9), and then Dimitroff introduced a modified version of Borgman's scale (8). Later, Saxon introduced his mental model scale in 1997 which was a mixture of Borgman and Dimitroff scales, and finally Li introduced a modified version of Saxon scale (10). Table 1 shows the components of these scales and their similarities and differences.

As can be seen in the above table, the first three scales for user mental model completeness are designed for databases but the fourth scale is designed for mental model of search engine users. Also, the first two scales used bachelor students to investigate the completeness of mental models, the third model used school students, and the fourth scale used graduate students. The third and fourth scales have an extra dimension that investigates the interaction between the information seeker and system. Therefore, it can be seen that each scale has been adjusted based on the nature of information systems and the investigated population.

By investigating these scales, it was shown that Li's scale is more suitable for the present study because it is designed for graduate students who were the investigated population in this study and is also designed for search engines. However, the age of Li's scale (6) and its lack of validation for Iranian health information seekers is the main reason for the use of Delphi method in this study.

Li's scale consists of 3 dimensions and 12 items. These dimensions and items are shown in Table 2 (6).

As can be seen in the above Table, this initial scale includes understanding about the following aspects:

1. Existence and nature of the search engine: Are graduate students familiar with search engines and the use of these engines? What information do they expect to retrieve by using search engines? Do they understand that not all information can be retrieved by search engines? Are they familiar with indexing of websites and pages by

search engines? Are they familiar with different levels of credibility in the retrieved information?
2. Search features in search engines: Are the students familiar with different features of search engines including help function, marching process, different search types, limiting or expanding features and sorting and ranking mechanisms?
3. Interaction between user and search engine: Do the students understand the interaction between the search engine and user? What level of interaction they have with the search engine?
In this part, only three levels exist in interaction dimension. In the first dimension, called "magic search", the interaction between the user and system is as simple as possible. Users have no knowledge about what happens in the system that results in information retrieval. They consider their role in the search to be simply telling the subject of the search to the system and wait for the system to retrieve the information. In this level, users don't consider themselves as participants in information retrieval process. In this level of interaction, that is the lowest level of interaction, when users fail to retrieve the intended information, they give up or use the other systems.
At the second level of interaction, called "stimulus/response", users are more familiar with characteristics of the system. These users follow the massages of the system for a better search and are more active than those at the first level. These users enter their query into the system, receive the system's answer, look at the results, select some among these results, and, in case of an unsuccessful search, returns to the result list and selects another result. At this level, users know that the system might not find an exact match and instead suggests some instructions. In order words, the system helps the user in finding suitable results and makes a successful search possible. When users follow instructions of the system but don't actively guide the search, they are at this level of interaction.
At the third level of interaction, called "Negotiated dialog", users personally guide the search using feedbacks from the system. At this level of interaction, users continue the search until they reach their intended results and reformulate their search strategies. At this level of interaction, users actively use different types of search to reach their intended results. This level of interaction is the best possible interaction between the user and system (6, 10).

Table 1. Comparison of different mental model completeness scales

Scale name	Borgman	Dimitroff	Saxon	Li
Year	1984	1990	1997	2007
Study population	Bachelor students	Bachelor students	Students	Graduate students
Information system	Databases	Databases	Databases	Search engines
Scale components	1.Understanding the indexing for database 2.Understanding alphabetical indexing for database 3. Understanding the possibility of search in specialized fields 4. Understanding the overlap of search terms 5.Uderstanding the use of AND operator 6.Uderstanding the use of OR operator 7.Uderstanding the use of ANDNOT operator 8.Awareness of the possibility to use simple or phrasal terms	1.Understanding multiply or anagram index 2.Understating various fields in each background 3.Understanding different types of database 4.Understanding the possibility of keyword search 5. Awareness of controlled vocabulary 6.Uderstanding the use of AND & OR operators 7.Awareness of the possibility of search review	Dimension of database structure	Dimension of existence and nature
			1.Understanding the existence of general and specialized information in database 2.Understanding that not all information is in the database 3.Understanding the database organization 4.Understanding different types of database	1.Understanding the existence of general and specialized information 2. Understanding the limitation of information 3. Understanding the indexing of pages or sites 4.Understandig the credibility of information
			Dimensions of search characteristics a) Black Box/Find b)Stimulus/Response c) Dialog	Dimensions of search characteristics
			5.Awareness of help option in the system 6. Awareness of matching 7.Awareness about the existence of different searches 8.Awareness about limiting or expanding characteristics of the search	5.awareness about search using search assistant 6. Awareness of matching 7.Awareness about the existence of different searches 8.Awareness about limiting or expanding characteristics of the search 9.Awareness about ranking of results
			Dimension of interaction level	Dimension of interaction level
			a) Black Box/Find b)Stimulus/Response c) Dialog	a) Magic finding b) Stimulus/Response c) negotiated

As mentioned before, Li's scale was selected as the basis for this study due to its relevance. First, this scale was translated into Farsi and its validity was confirmed by three Library and Information Science experts and one English language expert (faculty member of department of English literature). Then, some items were added to this scale based on valid literature (17-23). These added items, their definitions and limits are shown in Table 3.

Using this information, we designed a questionnaire with 20 items in 3 dimensions. Among these, 7 items belonged to the dimension of existence and nature, 10 to the dimension of search feature, and 3 to the dimension of interaction level. First, every item in this new scale was evaluated by 3 faculty members. The feedback from this evaluation was used to make adjustments in the concept, grammar and scaling of these items in order to achieve acceptable validity. Then, these items were evaluated by panels of experts using Delphi method.

2-2. Selection of the members of Delphi panel

Delphi studies are carried out with the help of people with necessary knowledge and expertise about the subject of the study. These experts are known as the Delphi panel. One of the most important steps in a Delphi study is the selection of this panel of experts because the validity of the final results depends on the knowledge and credibility of these experts. Selecting members of Delphi panel is carried out using non-probability sampling and members are selected based on their knowledge about the subject and according to the criteria defined based on nature and concept of the problem (24).

There is no explicit and written rule about the number of experts in a Delphi panel and the number of members is determined based on such factors as homogeneity or heterogeneity of the sample, Delphi's goal or extent of the problem, quality of the decision, the ability of the research team, outside and inside resources, the time needed for data gathering and available resources, the range of the problem and accepted answer. The number of experts in a Delphi panel is usually less than 50 people and often 15 to 20 people at most. For a heterogenic population of experts, a sample of 15 to 30 participants is suitable (12, 16).

Table 2. Details of dimensions and components of Li's mental model completeness scale

Dimensions	Mental model components	Definition and limits
Existence/nature	1.General/specialized information	Understanding the ability of search engine in retrieving general or specialized information or understanding that user can retrieve information about general or specialized subjects
	2.Limited information	Understanding the inability of search engine to retrieve all information. Does the user know that the search engine searches its own database and not the whole web and can't retrieve all the information on web?
	3.Indexed pages or sites	Understanding the indexing of pages and websites for retrieval. Is the user familiar with search engine's components and its indexing methods?
	4.Information credibility	Understanding different levels of credibility in the retrieved information. Meaning that the retrieved information can have different levels of credibility, can be scientific or popular, presented by organizations or single individuals.
Search features	7.Different types of search	Understanding different types of search such as simple, advanced, keyword and phrasal searches.
	8.Limiting/expanding	Understanding the mechanisms for limiting or expanding the search such as Boolean operators, closeness operators, proximity, abbreviations, using symbols such as parenthesis, +, -, limiting the search to some fields, general and specific search terms and similar methods
	9.Sorting/ranking	Understanding the sorting or ranking procedure in the search results such as ranking based on link popularity meaning better ranks for pages with more incoming links from other pages.
Level of interaction	a)Magic finding	User has the lowest level of interaction with the search engine, meaning that user spends no effort for information retrieval. User simple enters what is on his mind (word, sentence or a phrase) as the search term and accepts any results that is displayed. Then moves to another engine in case of unsuccessful search
	b)Stimulus/response	User has mediocre level of interaction with the search engine. User follows the suggestions of the search engine but doesn't actively guide the search. For example, the user clicks on the correct spelling of the words suggested by the search engine. User enters the search queries and follows the links in the results without changing the search strategy.
	c)Negotiation dialog	User has the highest level of interaction with the search engine. User believes that the search is guided by the user and helped by the system. He knows the importance of his role in guiding the search and reformulates the search queries if system has problem finding a match and continues the search until a desirable outcome is reached. This user, benefits from advanced search and various operators.

Table 3. Items added to the base scale

Dimension	Item	Definition and limits
Existence and nature	1. User being aware of the differences in the results of different search engines	User understands that there are differences between the results of different search engines due to difference in their databases
	2. Use knows the components of the search engine	User is familiar with the components of search engine such as robots, databases and information retrieval software
	3. User is familiar with search and information retrieval procedure	User knows the search and retrieval process of the search engines including identifying and indexing of webpages, transfer of index information to the database, retrieval and displaying of the results.
Search features	1. User is familiar with the possibility to access related or similar pages	User knows that some search engines have the possibility to retrieve pages with similar or related information using options such as "same pages" or "searches related to"
	2. User is aware of the ability of search engines in translating pages to some languages	User knows that some search engines can translate pages to other languages with options such as "translate this page"
	3. User is aware of spellcheck in search engine	User knows that some search engines can check the spelling of words for them
	4. User is aware of various search features	User knows that search engines have different search features such as search for special formats like ppt and pdf, searching for multimedia information (sound, picture, video) and other features
	5. User is aware of the properties available in the results' page	User knows that it is possible to change some of the characteristics of search such as number of displayed results, language, etc. can be changed from results' page

In this study, the members of Delphi panel were selected using purposeful sampling. Selected individuals met at least one of the following criteria:

1. PhD in librarianship and informatics and working in a library and with at least two articles or one published book about information retrieval systems
2. Faculty members of universities or research institutions in the area of librarianship and informatics with at least two articles or one published book about information retrieval systems
3. Faculty member of universities in the area of computer sciences and working in one of the government universities and familiar with search engines
4. Faculty member of universities in the area of information technology (IT) and working in one of the governmental universities and familiar with search engines

First, elites in these areas were identified throughout the country. To this end, articles published in librarianship, informatics or information technology journals about information retrieval systems and books published in these fields and CVs of faculty members of computer science and information technology working in Iranian universities were investigated. The elites in this study are defined as experts whose area of study is information retrieval systems or have deep knowledge about these systems, specially search engines. After selecting the participants, the experts were invited using phone or Email to participate in Delphi panel. Among the initial 33 selected individuals, 20 were willing to participate in the study and in practice 20 individuals participated in the first and 18 in the second Delphi round. The Delphi panel included 14 faculty members (Library and Information Science), 2 faculty members (Computer Science), 2 faculty members (Information Technology) and 2 Librarians with PhD degree.

After determining the members of Delphi panel, the questionnaire of the first round was emailed to the members as an MSWord file. This Email contained the topic and aims of the study, its definitions, an introduction of base scale and the limits of its components, and the method of filling the questionnaire. The questionnaires were returned after 15 days in the first and 12 days in the second round. In the first round, the created scale was presented to the members of Delphi panel and they were asked to first determine the necessity of each item based on their expertise using yes or no answers and then score the importance of each item using a five option Likert scale from "very little importance" to "very important". The members of the panel were also asked to add any items

they think were missing in any of the dimensions of the scale. In this round, the experts mentioned the generalized nature of the scale and only added one option: "Awareness of users about the existence of different search engines". After return of the questionnaires form the first round and evaluating them, the questionnaire for the second round was created and emailed to the members of the panel. In the second questionnaire, the answers of other experts about each item and frequency of the answers (including the answer by the members themselves) were presented and the members were asked to state their opinions based on this information. The additional item from the first round was also presented to be scored in necessity and importance.

2-3. Validity and reliability of Delphi questionnaire

As mentioned before, the opinions of 3 experts in librarianship and informatics were used to determine the validity of the questionnaires. Also, by using SPSS software version 16, Cronbach's alpha was calculated to determine the reliability of the questionnaire. The Cronbach's alpha calculated after distribution of 10 questionnaires was 0.829, which shows a good reliability (alpha value higher than 0.70 is acceptable).

2-4. Agreement criterion in Delphi method

Various studies have used 2 to 10 Delphi rounds in order to achieve their results. In order to decide whether to stop or continue Delphi rounds, two statistical criteria have been proposed by Schmidt. The first criterion is strong agreement between members of Delphi panel which is determined based on Kendall's Coefficient of Concordance. In case of such an agreement, this coefficient remains constant between two consecutive Delphi rounds or will show an insignificant change, indicating no significant increase in the agreement between members of Delphi panel and that Delphi method needs to stop (24).

Kendall's Coefficient of Concordance is shown with W and is a method for determining concordance between several sets of rankings for N items. By using this coefficient, it is possible to determine the ranking correlation among K sets of rankings. This coefficient is calculated using the following equation:

$$W = \frac{12s}{k^2(N^2 - N)}$$

In which s is the sum of squares of deviations of Rj from average Rj $\left(s = \Sigma\left(R_j - \frac{\Sigma R_j}{N}\right)^2\right)$.

Rjis the sum of rankings for one factor,
K, is the sum of rankings and
N is the number of ranked factors.

Kendall's Coefficient of Concordance is between 0 to 1 with 0 showing lack of agreement and 1 showing total agreement. A Kendall's Coefficient of Concordance of 0.7 or higher shows desirable agreement (16).

Results

The current study was conducted in order to adjust and develop the health user's mental model completeness scale in search engines. Li's scale which is a modified version of Saxon scale was used as the basis of this study and Kendall's Coefficient of Concordance in SPSS version 16 was used to determine the agreement between the panel members in the first and second Delphi rounds. This coefficient was calculated to be 0.261(P-value<0.001) in the first and 0.336 (P-value<0.001) in the second round. Therefore, the study was found to be statistically significant with 95% confidence (P-value<0.05, sig.=0.000). Since the increase between the two rounds was very little and equal to 0.075, Delphi method was stopped according to the second Schmidt criterion and only two rounds of Delphi method was conducted. It is worth noting that for panels with more than 10 members, even low Kendall's Coefficient of Concordance is considered significant (24).

Along with Kendall's Coefficient of Concordance, in this study items that were selected as the most important items in the scale were the ones ranked as important or very important by at least 70% of the members of the panel.

Table 4 shows the frequency and percentage of people that considered each item of the scale to be important or very important.

In this study, the items with a frequency of 70% and higher in each round were selected as the items in the final scale for mental model completeness of search engine users. These items are shown in Table 5.

This scale was approved and agreed upon by the members of Delphi panel and can be used to determine the mental model completeness of health information users in search engines.

Discussion

Studying mental models can help understand the behaviors of users and differences between them when using search engines and this information can help explain why some users can search for information and are successful in their search while others have problems. One of the reasons behind studying mental models is the fact that the interaction of users and systems is controlled by the users' mental models and people use their mental models to facilitate their interaction with the system. These models enable people to understand, predict and use these systems (25). Incomplete or incorrect mental models can cause problems for users because these models will be different from the underlying model of the system itself. This means that most users who fail in their interactions with the system have incomplete or incorrect models that create user error (6). Therefore, it is necessary to investigate these models and their level of completeness.

Many researches (3, 9, 25-28) emphasize the importance of cognitive processes especially mental models in information retrieval, but Li is one of the few that actually related a scale for these mental models. Due to the importance of this scale, Li's scale was used as the basis of this study and suitable adjustments for the intended target population (MSc. and PhD students of Isfahan University of Medical Sciences) were carried out using Delphi method. Kendall's Coefficient of Concordance

was used in this study as the basis for agreement among panel members in the first and second Delphi rounds. Due to insignificant increase of this coefficient between the first and second Delphi rounds, Delphi method was stopped after the second round according to Schmidt's second criterion. At the end, the dimensions of Li's model (existence and nature, search features and interaction levels) were approved, but "indexing of sites or pages" was eliminated and three items including "difference between the results of different search engines", "possibility of access to similar or related websites" and "possibility of search for special formats and multimedia" were added to Li's scale. Therefore, it is expected to identify the groups in need of more assistance in using these systems by using this model to identify the users' mental models when using search engines, their level of interaction and their role in searching for website and provide them with the necessary training.

Conclusion

Today, there is an accepted fact that mental models are the basis for users' behaviors when interacting with different systems (25). As a result, studying these models and their level of completeness is of great importance. This study adjusted and expanded Li's scale for mental model completeness for search engines based on the needs of Iranian health information users. At the end, the main dimensions of Li's scale (existence and nature, search features and interaction levels) were approved, but some minor changes were made in some of the items. This new scale can help the designers of information retrieval systems in developing these systems according to the users' mental models and can also help librarians and informatics experts in identifying the necessary trainings for users in order to help them improve their mental models. This developed scale has been confirmed by experts. So, as a valid and adapted scale for Iranian universities of medical sciences, it can be used for investigating completeness level of health information users' mental models of search engines. Also, it is recommended that other studies adjust and develop the mental models completeness scale for other information retrieval systems such as digital libraries, databases, OPACs and so on.

Conflict of Interest

None declared.

Table 4. Frequency and percentage of people who considered the items of the scale for mental model completeness important or very important

Dimensions	Items	First round		Second round	
		Frequency	Percentage of important and very important	Frequency	Percentage of important and very important
Existence and nature	1. User is aware of the search engine's ability in finding general or specialized information	20	100	18	100
	2. User is aware of the engine's inability in finding all information	16	80	15	83
	3. User is aware of indexing method for sites or webpages	9	45	10	55
	4. User is aware of different levels of credibility in the results retrieved by the search engine	18	90	16	89
	5. User is aware of differences between the results retrieved by the search engine	16	80	17	94
	6. User is familiar with components of the search engine (robots, database, data retrieval software)	8	40	6	33
	7. User is familiar with process of search and information retrieval in search engines (identification and indexing, transfer to engine's database, retrieval and display of results)	12	60	12	66

Search features	8. User is aware of search assistance tools such as "Search tips", "FAQs" and "Help" options	18	90	16	89
	9. User is familiar with matching process for search queries and webpages in order to identify and deliver the results and knows that matched keywords are shown with a different color or with bold style in the results	17	85	16	89
	10. User is aware of different type of search such as advanced search, phrasal search and keyword searchs, etc.	20	100	18	100
	11. User is familiar with mechanisms used to limit or expand the search such as Boolean operators, Near navigation, closeness, abbreviations, use of quotation marks, parenthesis, +, -, limiting the search to some fields and specialization of search terms	20	100	18	100
	12. User is familiar with ranking procedure for the search results	20	100	18	100
	13. User is aware of the possibility of access to similar or related webpages.	15	75	16	89
	14. User is aware of the ability of search engines in translating the texts in retrieved pages to different languages	13	65	113	72
	15. User is aware of spellchecking in the search engine	10	50	8	44
	16. User is aware of different search features such as search for special formats like ppt and pdf, search for multimedia (sound, picture, video) and other features	19	95	18	100
	17. User is aware of settings in the results' page such as number of displayed results, language of the result	10	50	7	39
Interaction level	18. Level a) User has the lowest level of interaction with the search engine, meaning that user spends no effort for information retrieval. User simple enters what is on his mind (word, sentence or a phrase) as the search term and accepts any results that is displayed. Then moves to another engine in case of unsuccessful search	15	75	14	78
	19. Level b) User has mediocre level of interaction with the search engine. User follows the suggestions of the search engine but doesn't actively guide the search. For example, the user clicks on the correct spelling of the words suggested by the search engine. User enters the search queries and follows the links in the results without changing the search strategy.	14	70	13	72
	20. Level c) User has the highest level of interaction with the search engine. User believes that the search is guided by the user and helped by the system. He knows the importance of his role in guiding the search and reformulates the search queries if system has problem finding a match and continues the search until a desirable outcome is reached. This user, benefits from advanced search and various operators	17	85	17	94
Added item	21. User is aware of the existence of different search engines	-	-	10	55

Table 5. Adjusted and expanded scale for health information user's mental model completeness using search engines (using Delphi method)

Dimensions	Items
Existence and nature	1. User is aware of the search engine's ability in finding general or specialized information
	2. User is aware of the engine's inability in finding all information
	3. User is aware of different levels of credibility in the results retrieved by the search engine
	4. User is aware of differences between the results retrieved by the search engine
Search features	5. User is aware of search assistance tools such as "Search tips", "FAQs" and "Help" options
	6. User is familiar with matching process for search queries and webpages in order to identify and deliver the results and knows that matched keywords are shown with a different color or with bold style in the results
	7. User is aware of different type of search such as advanced search, phrasal search and keyword search
	8. User is familiar with mechanisms used to limit or expand the search such as Boolean operators, Near navigation, closeness, abbreviations, use of quotation marks, parenthesis, +, -, limiting the search to some fields and specialization of search terms
	9. User is familiar with ranking procedure for the search results
	10. User is aware of the possibility of access to similar or related webpages
	11. User is aware of different search features such as search for special formats like ppt and pdf, search for multimedia (sound, picture, video) and other features
Level of interaction	12. Level a) User has the lowest level of interaction with the search engine, meaning that user spends no effort for information retrieval. User simple enters what is on his mind (word, sentence or a phrase) as the search term and accepts any results that is displayed. Then moves to another engine in case of unsuccessful search
	13. Level b) User has mediocre level of interaction with the search engine. User follows the suggestions of the search engine but doesn't actively guide the search. For example, the user clicks on the correct spelling of the words suggested by the search engine. User enters the search queries and follows the links in the results without changing the search strategy.
	14. Level c) User has the highest level of interaction with the search engine. User believes that the search is guided by the user and helped by the system. He knows the importance of his role in guiding the search and reformulates the search queries if system has problem finding a match and continues the search until a desirable outcome is reached. This user, benefits from advanced search and various operators

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