

The anticipated and assessed contribution of information types in references retrieved for preparing a research proposal

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Abstract

This small-scale empirical study focuses on students' anticipated and assessed contribution of references retrieved during the preparation of research proposals. It explores how the expected contribution of types of information before searches differs from the assessed contribution of relevant references found by the types of information. Twenty-two psychology undergraduates searched the PsychINFO database for references at the initial and end stages of a seminar for preparing proposals. Data about their subject knowledge, search goals, and utility assessments were collected using several methods. They were asked to predict and assess the utility of information types provided by relevant references for the proposals. At the beginning of the process, they found fewer general types of information and more specific types of information than they expected. However, the students tended to accept references according to their expectations. By the end of the process, the expected importance of general information types declined and the importance of specific information types increased. At the end of the task, students became more proficient at recognizing the utility and topicality of references. They also became more critical in accepting found information to match their expectations.

Introduction

When people search or assess the information items they have found, their main goal is to look for information that would contribute to their current information needs. Several studies (Harter, 1992; Saracevic, 1996; Sutton, 1994; Vakkari, 1999; Wang & Soergel, 1998) emphasize that the ultimate goal in choosing and using a document is its contribution to some purpose. Thus, they assess its situational relevance and utility. Most studies on situational relevance have focused on studying relevance criteria used to predict the value of the documents (e.g., Barry, 1994; Bateman, 1998; Park, 1993). Studies analyzing the contribution of the information items found relating to the task performance are common (Cosijn & Ingwersen, 2000; Vakkari, 2000). There is a lack of studies where users' expectations are directly compared with the assessed contribution of information items found. By comparing the expected and assessed contribution of information items, one may infer the success of the end users' searches.

End users search for information to solve a problem or to make progress on the task at hand. They have a more or less developed mental model of the type of information required. They use this model when assessing the expected contribution of the documents they find (Sutton, 1994; Vakkari & Hakala, 2000). It is through this mental model that they attempt to infer from clues provided by the document representation whether the document will in fact contribute to their task. Thus, they assess the elements of the document representation from the perspective of the expected and desired use of the document.

Most studies have analyzed judgments at a certain point in time. This begs the question of how relevance evaluations change during task performance (Vakkari, 2000). We can expect that subjects' changing understanding of the task is also reflected in their information needs and relevance judgments. There are a few longitudinal studies (Bateman, 1998; Tang & Solomon, 1998; Vakkari, 2000; Vakkari & Hakala, 2000) that attempt to answer this question.

The aim of this study is to compare students' expected and assessed contribution of references retrieved during the preparation of research proposals. Moreover, it explores what kinds of information contribute to the writing of research proposals and how kinds of information are related to topicality and usefulness when assessed by students.

Related studies

Next, we will review studies on the relationship between searchers' subject knowledge and relevance assessments of retrieved information items. In studies on relevance criteria, the usefulness of information has been indirectly taken into account. Studies have identified and listed several criteria. One central finding is that the criteria most frequently mentioned by users, regardless of the type of situation, is information content (Schamber, 1994). In information content, the most important dimension is topicality, or what the user sees the document as being about with respect to his or her task (Barry, 1994; Vakkari & Hakala, 2000; Wang & Soergel, 1998).

Kuhlthau (1993) has shown that the stages in learning task performance differentiate the types of information required. In the initial topic selection and exploration stages, people are looking for general background information for framing the task. Before finding a focus, their thoughts about the task tend to be general and undifferentiated and their actions involve seeking background information. After the focus has been formulated, thoughts about the task become clearer and more directed. This guides the searcher to seek pertinent and focused information.

Wang and Soergel (1998) defined document value as the user's perception of the desirability or potential utility of a document. They found that functional value dominated the researchers' decision-making process in choosing documents from a printout of a database search. The functional value is the perceived utility of documents to make a contribution to the specific task at hand. The functional value was correlated with the topicality and orientation/level of the document. Thus, topicality and orientation interpreted as kinds of information seem to predict a document's potential to contribute to the task at hand.

Tang and Solomon (1998) studied a student's relevance assessments of information items retrieved for writing a term paper. They observed the student twice. First, they observed her during the assessment of the bibliographic records and documents obtained immediately after the search session. Then, they observed her a month later when she had become familiar with the texts. The results showed that her perception of the information needed for the task changed between the interaction with the initial search results and reading the texts. This was measured, for example, by counting terms and topical expressions marked by the student in the two rounds of observation. This study provides evidence of the gradual change in the student's mental model of the task and consequently a change in the student's understanding of what information would be useful. During the process, the student became more selective and confident in her choices.

When studying relevance criteria used by students in different phases of preparing research proposals according to Kuhlthau's (1993) model, Vakkari and Hakala (2000) demonstrated that students were not only searching for documents on the topic in general, but also for documents regarding particular aspects of the topic. Topicality was constantly the most important criterion for choosing references throughout the process. Although less frequently mentioned, the required types of information played a systematic role in choosing references. References to general and theoretical information were searched for in the prefocus stages. Their significance diminished in the postfocus stages. The role of methodological information increased as the process proceeded. When the students assessed the relevance of the documents acquired, the trends described above concerning their references corresponded to trends in document judgements. The one exception is that the significance of information types as criteria grew considerably compared with topicality. Evidently, full texts facilitate a more profound and differentiated assessment of the items found (cf. Harter, 1992).

The findings reported in Vakkari (2000) confirm that the topicality of documents refers to different types of information depending on the stage students are in during the writing process for their research proposal. Students were asked to describe the contribution of the documents they obtained for the task. Vakkari identified seven categories of contributory information: background information, theories and models, methods, cases, facts, empirical results, and focused information. The results showed that the students' progress through the process differentiated the types of contributions they construed from the information in the documents. At the beginning, the contribution consisted typically of background information about the topic, as well as models and conceptualizations of it. In the focus formation stage, the text obtained commonly supported the process by still providing mostly background information and theories, but to a lesser extent. In this stage, text with methodological advice or information about cases gained more footing.

Toward the end of the process, students used the documents acquired to obtain focused information and empirical research results.

In conclusion, the results suggest that when users progress in their task, they become more knowledgeable about the topic, increasing selectivity and decreasing the number of items judged as useful. The studies also suggest that the types of information vary during the task process, which contributes to its performance. In the initial stages of academic tasks, users found general background information and theories the most useful. As the task proceeds, such information loses ground to methodological and more specific types of information.

Research questions

The type of information required for a task depends on the subject area. This study aims to analyze the contribution of information in one subject area during the process of writing a research proposal for a small-scale empirical study of undergraduates. The context is academic. Results shed some light on the contribution of information in this context.

The specific research questions are:

- What type of information do the students expect to be useful in search sessions at different stages of the proposal writing?
- What types of information do students assess as contributing in the references retrieved?
- Do the students find the types of information that they expect to?
- How were the topicality and usefulness of references related to the contributing information types during proposal preparation?

Research design

The study subjects were 22 undergraduates in psychology who attended a seminar on preparing a research proposal. The seminar meetings continued for 3 months during the autumn term of 2000. At the beginning of the seminar, the students selected their own topic and were expected to create a proposal.

In their searches, the students used the PsychINFO system. This is the major bibliographic database in psychology with which none of the participants were familiar. Of the 22 students, 18 attended a 1-hour training session for PsychINFO. During the training sessions, the basics of the system were explained, including the use of Boolean operators, field restrictions, thesauri, indexes, and search formulation supports. The analysis showed that the searching behavior of those who participated in the training differed from that of those who did not in only one respect: only those who attended the training session used the NOT Boolean operator.

Data

The students were asked to make two observed searches for their proposal during the seminar. They made their observations once at the beginning and then when they were finishing their proposals at the end of the seminar. Moreover, we conducted pre- and postsearch interviews in both search sessions. The aim was to find out the students' presearch expectations and the postsearch assessments at the pefocus and postfocus stages of Kuhlthau's (1993) model.

In the presearch interview, we used a questionnaire based particularly on Kuhlthau's process survey questionnaire to measure the student's current topic knowledge, feelings, thoughts, and actions in the respective problem stages (see Kuhlthau, 1993, 97-98). To measure the presearch expected contribution, we used the questionnaire presented in Appendix A. The categories of contributing information are defined in detail in Table 1. These categories are derived from Kuhlthau's (1993) model and from Vakkari's (2000) findings. Vakkari's findings focus on what type of information students found as contributing when writing a research proposal for a master's thesis. The categories based on Kuhlthau (1993) indicate the purpose of using the information in different stages of the task process. Those based on Vakkari (2000) reflect the content of contribution. The participant was asked to indicate on a four-point scale how accurately these categories reflect the information s/he wished to find for her/his task. The ratings were: 1 = totally, 2 = to some degree, 3 = to a lesser degree, 4 = not at all. The student was also asked to rate the topicality of the

references by using the same scale. Moreover, a semistructured interview was conducted measuring the participant's knowledge of the topic and search goal. After the preinterview, each participant made a search in PsychINFO. Students voiced their thoughts aloud during the recorded search sessions. The transaction log was also recorded.

During the search, the student marked the references s/he thought would be useful in her/his respective task. We asked the participant to select references s/he assessed as useful for her/his proposal writing. Thus, we were interested in the situational relevance of the references, specifically those that might contribute to the student's task (Cosijn & Ingwersen, 2000). After the search, the student printed the marked references and evaluated them on a four-point scale: 1 = totally useful, 2 = partially useful, 3 = potentially useful, 4 = not useful. In the analysis, we took into account only references that were useful at least to some degree.

TABLE 1. Contributing information types

Type of contribution	Definition
General background information	Cannot be described in detail, orients to the topic
Research methods	Support in the use of methods or techniques
Empirical research results	Provides empirical research results
Specific information	Can be described in detail, contains particular information
Ideas for research topic	Helps in identifying a research topic
Ideas for problem formulation	Supports in constructing a focus for the topic
Results confirming topic selection	Confirms that the topic constructed is relevant and supports in developing argumentation

The postinterview data were collected by using a questionnaire on the student's assessment of the usefulness of the references found (see Appendix B). The student was asked to rate on a four-point scale how accurately the information types (see Table 1) indicate the utility of each reference found for her/his task. For the study, we calculated the average assessment of references per student on each information type to determine how all the references found by one student could fulfill what s/he had expected.

In the first session, the students took 30 to 60 minutes for their searches. In the second session, the students used 30 to 45 minutes for searching. In both sessions, they used an additional 20 to 30 minutes for evaluating the references marked.

Results

Although most of the variables measured in our study are on ordinal scales, we used the mean value to illustrate the differences between expectations and assessments. We chose to use the mean value because it gives a more detailed picture of the differences than a mode or median comparison could. The significance of difference within and between sessions was calculated by using Wilcoxon's test for two related samples.

Differences within search sessions

At the beginning of their project, the students expected to find mostly general background information (Table 2). Specific information was least expected. This corresponds with Kuhlthau's (1993) theory of information-seeking process and Vakkari's (2000) empirical research findings. However, the students found significantly less general background information ($p = .002$) and more specific information than they expected ($p = .017$). This can be explained partly by the fact that out of 150 useful references, 75% were classified as empirical studies in the PsychINFO database. It is probable that students assessed types of publication giving information on empirical studies as giving specific information. The students' lack of subject knowledge in the beginning of the project is probably the reason for this assessment. Thus, the sparse supply of documents providing general information in the database partly explains why the students accepted more references providing specific information than they expected, and fewer references of a general nature.

At the beginning, students evidently had vague ideas about their research topic. Consequently, it was difficult for them to articulate exactly what the specific information would be. As our later factor analysis indicated, they found specific information, which helped them in selecting the topic and formulating a focus

for their project. Reading the references found provided support in structuring the topic. Consequently, it also assisted them in articulating more specifically what kind of information would help their task.

It is plausible that the students did not find general background information to the degree they expected such as in the form of a review of their topic. On the other hand, if one has only a vague idea of the topic, it is also difficult to say what kind of background information would be useful even if retrieved. This may partly explain the difference between expected and assessed information.

TABLE 2. The change of average expected and assessed contribution per student within sessions (Information types describes the contribution 1= totally, 2= to some degree, 3= to a lesser degree, 4= not at all).

Contribution	Session I			Session II		
	Expected	Assessed	P	Expected	Assessed	p
General background information	1.3	2.1	.002	2.3	2.4	.795
Specific information	2.8	1.9	.017	1.8	1.9	.642
Research methods	2.1	2.4	.173	1.6	2.3	.027
Empirical research results	2.1	2.0	1.00	1.5	2.0	.054
Ideas for research topic	2.6	2.4	.414	3.8	3.4	.019
Ideas for problem formulation	1.9	2.3	.124	2.2	3.1	.005
Results confirming topic selection	2.2	2.3	.410	2.4	2.8	.224
Number of participants	22	21 ^a		22	19 ^a	

^a Out of 22 participants 21 in the first search session and 19 in the second session found one or more useful references.

At the end of the project, the students mostly expected to find empirical research results and research methods (Table 2). Research methods were found significantly less often than anticipated ($p = .027$). Also, empirical research results were found clearly less often than expected ($p = .054$). Based on comments recorded during the search session, students appeared to have trouble defining search terms that could limit the results on specific measuring tools used in empirical psychological research. One student pointed out that the measuring tools used in empirical tests were (unfortunately) usually not mentioned in references.

Ideas for the research was the least expected and assessed information type at the end of the project, although students found significantly more of this type of information than they expected ($p = .019$). This can be explained by the fact that most of the students did not expect to find this type of information at all. Consequently, the change between the expectations and assessments could only be mostly decreasing. Therefore, using Wilcoxon's test, even a smaller change in one direction can be significant.

Ideas for problem formulation were found significantly less often than expected ($p = .005$). In the first search session, students also found fewer ideas for problem formulation than expected, but the difference was not significant. Low subject knowledge at the beginning of the task is probably the reason that the ideas found were more outstanding than at the end of the task.

Differences between search sessions

The expectations changed between the sessions. At the end of the task, the students expected significantly less general information ($p = .001$). However, they expected more specific information ($p = .004$), research methods ($p = .080$), and empirical research results ($p = .013$) than in the beginning (Table 3). The need for ideas for the research topic decreased significantly between sessions ($p = .001$). Results confirm Kuhlthau's (1993) information-seeking process model, which states that people are looking for general background information in the initial stages of the information-seeking process and more focused information at the end of the task. Also, Vakkari's (2000) research results are in agreement with our results, although Vakkari's study examined results on the basis of their assessed contribution.

The assessment of found references showed that the importance of general background information decreased to a certain extent ($p = .074$). The importance of references, which contributed to the students' task by providing them with ideas for identifying a topic ($p = .003$) and formulating a research problem ($p = .007$), decreased significantly during the process. The decrease in ideas for research topics is understandable,

since there was no longer a need to select a topic at the end of the task. The reason why the ideas for problem formulation were not found is explained earlier in this article. The importance of research results confirming topic selection decreased only slightly. By the end of the process, the references were assessed indicatively less useful than in the beginning ($p = .099$).

TABLE 3. The change of average expected and assessed contribution of references per student between sessions (Information types and topicality describes the contribution 1= totally, 2= to some degree, 3= to a lesser degree, 4= not at all; References are useful 1= totally, 2 = partly, 3 = possibly).

Contribution	Expected contribution			Assessed contribution		
	Session I	Session II	p	Session I	Session II	p
General background information	1.3	2.3	.001	2.1	2.4	.074
Specific information	2.8	1.8	.004	1.9	1.9	.825
Research methods	2.1	1.6	.080	2.4	2.3	.861
Empirical research results	2.1	1.5	.013	2.0	2.0	.668
Ideas for research topic	2.6	3.8	.001	2.4	3.4	.003
Ideas for problem formulation	1.9	2.2	.096	2.3	3.1	.007
Results confirming topic selection	2.2	2.4	.308	2.3	2.8	.155
Topicality				1.7	1.9	.211
Usefulness				2.2	2.5	.099
Number of participants	22	22		21	19	

Patterns of contribution at the beginning of the task

For analyzing the patterns of expected and assessed contribution of information types, we calculated a factor analysis by using individuals as the units of analysis. The factor extraction method was the principal component in the analysis. The rotation used was varimax.

In the first session three factors were extracted for the anticipated and assessed contribution of references (Table 4). In the first factor of anticipated contribution the ideas for problem formulation had high positive and general background information had a high negative loading. The second factor consisted of specific information and research methods. Ideas for the topic selection had a high negative loading in this factor. The third factor consisted of empirical research results that could confirm the chosen topic as reasonable. Based on the high positive loadings we named factors as: 1) ideas for problem formulation, 2) specific research methods and 3) empirical confirmation.

TABLE 4. Factors of expected and assessed contribution of references per person at the beginning of the task (N=20, underlining: absolute value $>.50$).

Information types	Expected contribution			Assessed contribution		
	Ideas for problem	Specific methods	Empirical confirmation	Specific ideas	Methods results	&General information
General information	-.86 ^a	-.08	.03	.24	-.07	.92 ^a
Specific information	-.10	.78 ^a	.33	.80 ^a	.24	.01
Research methods	.25	.72 ^a	.23	-.06	.95 ^a	.09
Empirical research results	-.47	.24	.67 ^a	.43	.79 ^a	-.29
Ideas for research topic	.42	-.79 ^a	.11	.79 ^a	.02	.37
Ideas for problem formulation	.84 ^a	-.16	-.12	.91 ^a	-.04	.06
Topic confirmation	.04	.14	.91 ^a	.71 ^a	.17	.35

^a Absolute values ($>.50$) used for addressing the factors.

In the first session, none of the factors of expected contribution had high positive loading for general background information. This can be explained by the high average of the expected contribution of general information. Therefore, it was not as discriminating in factor analysis as the other information types.

Several factors reflected the contribution of found references. First, specific information had a high loading as well as did all variables reflecting students' attempts to find a topic and to formulate a focus. This factor encompasses the processes of finding specific ideas for structuring a topic. Second, research methods and

empirical research results had the highest loadings. Last, the general background information was the only variable that had a high loading.

TABLE 5. Pearson's correlations between expected and assessed contribution, ISP, topicality and usefulness per person at the beginning of the task (N=20).

Variables	Stage in ISP	Assessed contribution			Topicality
		Specific ideas	Methods results	&General information	
Stage in ISP		-.40 ^a	-.04	-.13	
Expected contribution					
Ideas for problem	.09	.44 ^a	.09	-.07	
Specific methods	.25	-.35	.47 ^a	.01	
Empirical confirmation	.13	-.03	-.45 ^a	.42 ^a	
Topicality		.39 ^a	.23	.05	
Usefulness		-.18	.30	.01	.44 ^a

^a $r > .37$ and $p < .05$.

In order to determine how the dimensions of expected and assessed contribution were related within the sessions, we calculated correlations between the factors (Table 5). Also included in the correlation analysis are the stage in the information-seeking process (ISP), topicality, and usefulness of references.

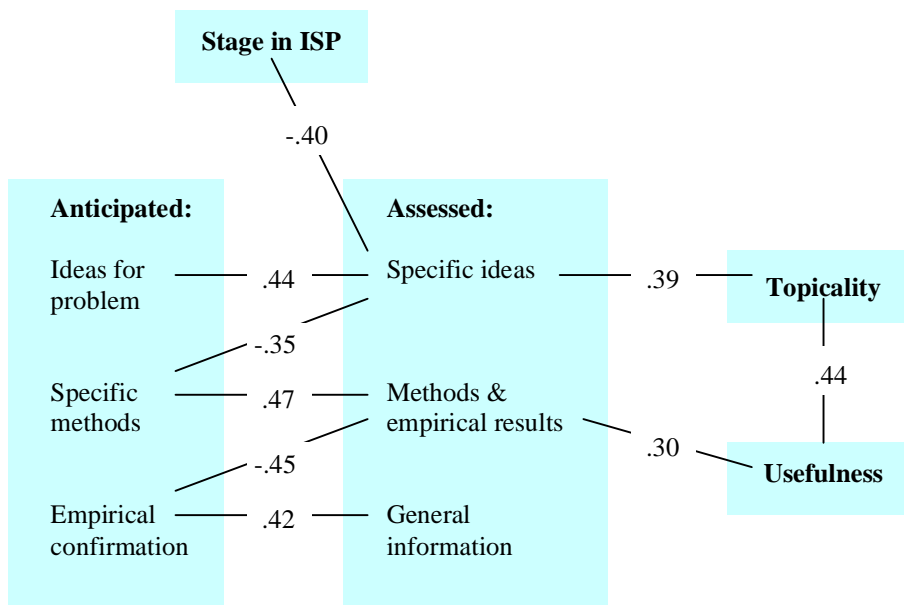


FIG. 1. Pearson's correlations between expected and assessed contribution, ISP, topicality and usefulness per person at the beginning of the task (N=20, $r > .30$ and $p < .10$).

The most outstanding correlations, where the significance level is less than .10, are illustrated in more detail in Figure 1. Results show that students looking for ideas for problem formulation found contributing references that gave specific ideas that could help in and confirm topic selection and support in problem formulation ($r = .44$). When references containing specific ideas were found, they were also assessed as highly topical ($r = .39$). The students who found specific ideas as contributing were further in the information seeking process ($r = -.40$).

When specific information and research methods were expected, students accepted references providing information about research methods and empirical research results ($r = .47$). They rejected specific information that gave ideas for topic selection and topic formulation ($r = -.35$). They also found references containing empirical research results and methods useful ($r = .30$). We suppose that they were so familiar with the topic that they did not need specific ideas in problem formulation but needed empirical research results and information about research methods.

Those expecting empirical research results for confirming topic selection chose references that would provide general background information ($r = .42$). For some reason, they also rejected references assessed to give empirical research results besides research methods ($r = -.45$). One explanation for this is that these references were not seen as confirming expected results. In addition, the methods may have not matched the student's topic.

Patterns of contribution at the end of the task

In the second session, three factors were extracted for expected and assessed contribution (Table 6). In the first factor, anticipated contribution to specific information and research methods had the highest loadings. We labeled this factor specific methods and empirical research results. In the second factor, labeled general ideas for problem formulation, general background information and ideas for problem formulation had the highest loadings. Lastly, in the third factor of empirical confirmation, information types received the highest loadings.

TABLE 6. Factors of expected and assessed contribution of references per person at the end of the task ($n=18$).

Information types	Expected contribution			Assessed contribution		
	Specific research methods	General ideas for problem	Empirical confirmation	Specific methods results	& Ideas problem	forGeneral confirmation
General information	-.18	.88 ^a	.13	-.02	.11	.96 ^a
Specific information	.82 ^a	-.15	.05	.90 ^a	-.11	.05
Methods	.93 ^a	.04	.01	.69 ^a	-.04	.02
Empirical results	-.02	.04	.95 ^a	.76 ^a	.26	.06
Ideas for topic	-.15	.62 ^a	-.26	-.06	.91 ^a	.03
Ideas for problem	.15	.85 ^a	.07	.06	.91 ^a	.23
Confirming results	.59 ^a	-.09	.60 ^a	.43	.54 ^a	.60 ^a

^a Absolute values ($>.50$) used for addressing the factors.

In the first factor of assessed contribution the specific information, empirical research results and research methods had high loadings. In the second factor the information types that gave ideas for topic selection and for problem formulation had the highest loadings. In the third factor general background information and results confirming topic selection had the highest loadings. The factors of assessed contribution of references are called: 1) specific methods and results, 2) ideas for problem formulation, and 3) general confirmation.

TABLE 7. Pearson's correlation between expected and assessed contribution, ISP, topicality and usefulness per person at the end of the task ($N=18$).

Variables	Stage in ISP	Assessed contribution			Topicality
		Specific methods & results	Ideas formulation	forGeneral confirmation	
Stage in ISP		-.13	.59 ^a	-.10	
Expected contribution					
Specific methods	-.20	.00	-.08	.09	
General ideas	.44 ^a	-.03	.24	-.14	
Empirical confirmation	.14	.05	.07	.43 ^a	
Topicality		.45 ^a	.04	.75 ^a	
Usefulness		.04	.43 ^a	.38	.34

^a $r >.39$ and $p <.05$.

In the second session, those who were looking at empirical research results for confirming their topic accepted references that contained general information confirming their topic selection ($r=.43$) (Table 7). These references were also seen as highly topical ($r=.75$) and useful ($r=.38$). Otherwise the students tended to select references as useful regardless of their anticipations. Those who were in the earlier stages of the information seeking process expected general ideas for topic formulation ($r=.44$) and accepted references that gave ideas for problem formulation ($r=.59$). Those references were also assessed as highly useful ($r=.43$). References were found as highly topical if they gave specific methods and empirical research results

($r=.45$) or general information ($r=.75$). The most outstanding correlations, where the significance level is less than .10, are illustrated in more detail in Figure 2.

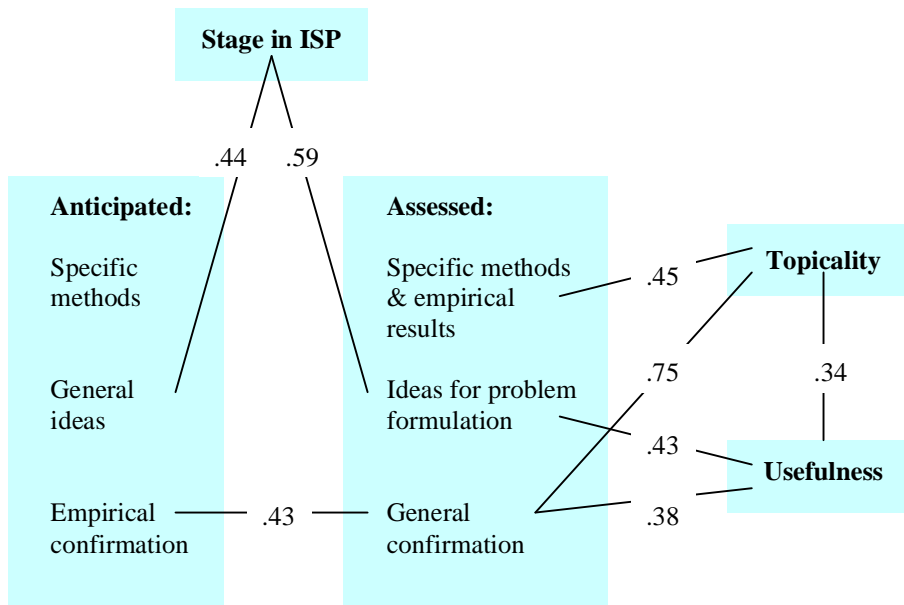


FIG. 2. Pearson's correlation between expected and assessed contribution, ISP, topicality and usefulness per person at the end of the task ($N=18$, $r > .30$ and $p < .10$).

The contribution of references for research proposals

The main object in our study is to examine utility assessment made during the search sessions. Therefore we didn't explore the contribution of the references to the students' proposal writing. However, we asked the students to send us a copy of their research proposals for finding out the share of the citations that are congruent with the useful references found in the searches in our study. Out of 22 participants 19 returned their research proposal. Because some of the students wrote their proposals in pairs, altogether 15 proposals were returned.

From the total number of 248 references assessed as useful in two search sessions there were five cases where the student picked up the same reference that is already found in the first session either by her/himself or by the group mate. When these duplicates and 24 references found by those who didn't return their research proposals are discounted there were 219 possible unique sources to cite to in the returned research proposals. There were 209 citations in the proposals, from which 16 were congruent with the references found in the two search sessions done for this study. Thus, about 8% of the retrieved references contributed directly to the construction of the proposal.

Discussions and conclusions

Our study explored the relation between the expected and assessed contribution of information types in references retrieved to prepare a research proposal. The results showed that at the beginning of the proposal presentation the students expected to find mainly general background information. In scale from 1 = describes the contribution totally to 4 = describe the contribution not at all, the expected contribution of general information was 1.3 on average. After the focus formulation, the expectation of more specific and pertinent information increased (mean value changed from 2.8 to 1.8; $p = .004$). This is in line with Kuhlthau's (1993) theory and Vakkari's (2000) empirical research findings. However, our results showed that at the beginning of the task the assessed contribution of references could differ significantly from their expected values. On average, the students found less general information than they expected (anticipated = 1.3, assessed = 2.3; $p = .001$). Specific information was found more often than expected (anticipated = 2.8 to assessed = 1.8; $p = .004$). Yet, a more detailed examination based on factor analysis showed that the students assessed the contribution of references mostly according to their expectations. Ideas for problem formulation were found when expected ($r = .44$ between ideas for problem expected and specific ideas found). Students

who expected methodological information tended to find it ($r = .47$ between specific methods expected and methods and result found). Only the students who expected finding empirical research results that could confirm their topic selection had problems in finding precisely the expected type of information.

At the end of the task, when the students had formulated their focus, the connections between the expected and the assessed contribution of information were looser. Evidently, at the beginning of their task, the students knew so little about the subject that they did not try to find anything other than what they expected. At the second session, after they had conducted more research and learned more about their topic, the students were better able to recognize different kinds of contributions. Students probably also became more open to accepting other types of information than they expected. Moreover, it is understandable that because of increased subject knowledge students could more easily change their goals during the search session. They could attempt to look for something different than they expected when the search began. This is in agreement with Park (1993) that the person's relevance criteria are affected by her/his experiences, perceptions, and the degree of knowledge.

The utility of the found references was based mainly on the topicality ($r = .44$) at the beginning of the task. The methods and empirical results were seen as useful ($r = .30$). References giving specific ideas for the topic were also found useful ($r = .39$). At the end of the task, references giving general confirmation were seen as topical ($r = .75$) and useful ($r = .38$). Moreover, the ideas for problem formulation were found to be useful ($r = .43$). The specific methods and empirical results on the topic were favored by students ($r = .45$). It is plausible that at the beginning of the task the topicality of the references was more important than the contribution of information types. After students have read some literature about the selected topic and focused, they seem to more easily recognize topical and useful references. In other words, students seem to become more proficient in recognizing the contribution and utility of information types for their topic. This corroborates the findings of Tang and Solomon (1998) and Vakkari and Hakala (2000) about the increasing selectivity when choosing references in task performance.

In conclusion, the results suggest that in the beginning of the task the students were more concerned with finding the types of information they expected than about the strict topicality or usefulness of references. At the end of the task, the students had learned more about their topic. They were able to point out more easily other types of information as topical and useful than they expected before beginning the searches.

It seems that in the beginning of the task the students based their assessment more on the aboutness, i.e., on the general topicality of the references, than on the situational relevance in the sense of how to use the information types provided. The latter seemed to gain more footing when the students learned more about their subject. As Harter (1992) suggests, relevance is constructed in users' minds. In the beginning, the students were more able to assess how the topic of the references matched their vague understanding of the subject. However, when their mental construct evolved, they were better able to assess how to use information in the references.

Based on bibliographies in students' proposals, approximately 8% of retrieved references contributed to the writing of the research proposal directly. Correspondingly, Wang and Soergel (1998) reported an average of 37% of acceptance from retrieved documents in their study, although their study is not directly comparable to ours. Wang and Soergel explored the document selection of full-text documents longitudinally, but did not explore the contribution of retrieved documents to the participants' performance in their papers, proposals, and theses. On the other hand, we did not explore how the availability of the full texts cited in references affected the document selection and output.

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Appendix A

Please indicate to which degree the following types of information reflect what you wish the searched literature to give to your work at its current stage in the following scale: 1= totally, 2= to some degree, 3= to a lesser degree, 4= not at all.

- General background information
- Research methods
- Empirical research results
- Specific information
- Ideas for research topic
- Ideas for problem formulation
- Results confirming topic selection

Appendix B

Please assess the usefulness of each reference you marked for the current stage of your task on the following scale: 1= totally useful, 2= partially useful, 3= potentially useful, 4= not useful.

Please indicate to which degree the following statements describe the utility of each reference you marked for the current stage of your task on the following scale: 1= totally, 2= to some degree, 3= to a lesser degree, 4= not at all.

- The reference is topical for my task
- Contains general background information
- Gives information on research methods
- Gives information on empirical research results
- Contains specific information
- Contains ideas for research topic
- Brings ideas for problem formulation
- Contains results confirming topic selection

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