Information Horizons Mapping for Information Literacy Development

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Abstract. This paper develops a new insight into information literacy research using the methodology of phenomenography and information horizons. The study is part of a larger project on information behavior of doctoral students. The main research question concentrates on variations in experiences of information use as a result of the analysis of 17 information horizons. Results confirm more detailed granularity of categorization with humanities and social sciences and emphasis on electronic resources with technical sciences. Three patterns of information use are derived: the interactional, the sequential, and the evolutionary patterns. Systems and services for support of variations in information literacy are proposed, e.g. better navigation for the interactional pattern, stronger categorization for the sequential pattern, and support of terminology for the evolutionary pattern. Expansion of information literacy models to broader contexts of workplace and worldview has been proposed.

Keywords: Information horizons, information literacy, information mapping, phenomenography, disciplinary differences.

1 Introduction

The purpose of this paper is to develop a new insight into the information literacy research based on a qualitative study of doctoral students. The concept of an information horizon represents a map (visual metaphor) of information resources and services based on a current information need. It can expand our understanding of methodological literacy of doctoral students regarded as information practice and experience in information problem solving.

This study is part of a larger research project on information behavior of PhD. students. We applied a qualitative methodology of semi-structured interviews with 19 doctoral students in different disciplines. Drawing the information horizons was part of these interviews. Differences in information needs and strategies in disciplines were noted. Common characteristics of information behavior of PhD. students include finding focus, expert support, networking and collaboration. In this study we ask the following research questions: What are the patterns and differences in the information horizons maps? How is information use experienced? Which metaphors hidden in information horizons are useful for information literacy research?

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The paper presents sections on phenomenographic background and methodology of information horizons mapping. Further on, data collection and analyses of information horizons are summarized. The section on results includes preferences of information resources (electronic, traditional, human), metaphors, specific resources and information pathways. In conclusion, we derive three patterns of information use and recommendations for information literacy and information services.

2 Related Research: Phenomenography in Information Literacy Research

The theoretical background of our research was formed by phenomenographic tradition of information behavior and information literacy research (e.g. [1-3]). The most important phenomenographic principle focuses on different experiences of PhD. students with information resources and information use. It also connects to the Bruce´s concept of information control over the information environment [1-2] and the informed learning concept [4].

The complexity of relationships between subject and object and variations of information use with regard to experiencing information environment are the focus of our research in line with phenomenographic research [5]. Phenomenography was applied to information literacy research especially by Bruce [4] and Limberg [3]. In our previous research we applied the phenomenographic research to relevance [6], [7]. Resulting models of relevance were applied to information literacy and different ways of experiencing relevance as cognition, inference, in-built mechanism, or an intersubjective picture were determined [7]. Following this we focus on information use experience represented by the information horizons rather than on skills or attributes of information literacy. We suggest that information literacy should be part of the information culture as emphasized by Webber and Johnston [8] and information practice [9]. The contextual factors are values in personal, economic, organizational, educational and social contexts of information use.

The framework of this research connects information behavior research and information literacy. A large body of literature has been published based on research of information behavior of academics (e.g. [10-11]). In comparison to information behavior research information literacy is broader [12], includes cognitive, affective, social, educational and ethical dimensions of interactions with the information environment and personal information spaces. While information behavior research concentrates on understanding information needs, seeking, and uses in contexts, information literacy research tries to help users develop information needs in contexts, enhance knowledge, build theories and practical programs and training. These two topics overlap and in this respect we can determine information literacy as “the adoption of appropriate information behavior…to identify information well fitted to information needs leading to wise and ethical use of information in society” ([8, p. 19].

Doctoral students can experience difficulties in narrowing the research topic as noted with young students by Head [13] and in our study [14]. It has been proven by the model RISE (Research and Information Search Expertise) by Chu et al. [10].

In two longitudinal studies of post-graduate students they stressed the need for tailor-made training in knowledge of resources and search techniques. Information literacy develops in four stages from novice level through advanced beginner, to competent and proficient levels and informs design of information literacy programs.

Information resources horizons as a methodology of the empirical research of environmental activists and unemployed were applied by Savolainen [9]. Some interesting findings confirmed the drivers of information needs for everyday information use as the content, availability, accessibility and topicality.

3 Information Horizons Mapping as a Methodology of Research

Information horizons mapping means examination of the ways of experiencing preferences in information resources, services, social networks and particular contexts of information needs and uses. The qualitative methodology of information horizons mapping was established in information science by studies of information behavior of different user groups, e.g. [15-18]. Students are asked to draw pictures/maps of information spaces and resources – information horizons – as part of the interviews. Drawings represent mental models and metaphors of information use. The resources can be determined both socially and individually. The information horizons can represent their information landscapes as defined by Lloyd et al. [19].

The methodological concept of the research was part of the design of the project [14]. Deeper analysis of information horizons produced from interviews with 17 doctoral students can shed more light on information needs and information literacy. In line with previous phenomenographical research [18] the methodology of our study points to disciplinary differences in information use and literacy. Although still a part of the mainstream research on educational context, more emphasis is laid on information literacy as informed learning focusing on people´s information experiences [4], [22]. Information horizons represent the experience and subjective interpretations of information use by doctoral students contextualized in different disciplines. Information literacy is creative and subjective, sometimes collectively transformed and our focus is shifted from behavioral towards interpretive approach.

Visual analyses of 17 information horizons determine such factors of information literacy as information resources, relationships and relevance assessment. The original methodology of information horizons outlines a “big picture” of information needs in contexts, different disciplinary practices and information use patterns.

4 Sample and Data Collection

For data collection we used semi-structured interviews with 19 PhD. students as representatives of social sciences, humanities, sciences and technical sciences. However, only 17 students drew the graphical representations of their information horizons. Basic demographics data include nine males and eight females. The research domain includes nine students in social sciences and humanities, four

students in natural sciences, four students in technical sciences. As for the type of research, seven students follow theoretical research, seven empirical research, and three combined research.

The subjects were selected as representatives of main disciplines of humanities, sciences and social sciences taught in the faculties of the Comenius University, the Slovak University of Technology Bratislava, the Technical University Košice and the Economic University. The study participants were asked to describe verbally and represent graphically a situation of information seeking and use. The details of information horizons included types of information resources (people, libraries, electronic resources), relationships between resources, the order of resources, the intended use of information, procedures, metaphors, specific resources, the position of self. An example of an information horizon is represented in Figure1 illustrating the metaphor of a "tree of knowledge" (social psychology).

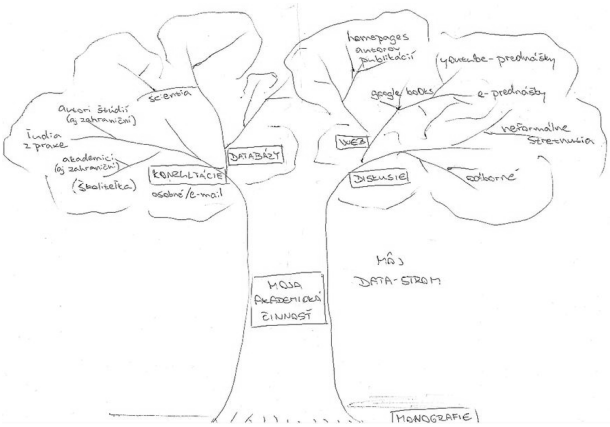

Fig. 1. Information horizon – an example (IH3)

5 Results of Analyses

Findings from the interviews suggested that the main information problems of doctoral students are finding focus, expert support, networking and collaboration. The most important strategies include browsing, filtering, citations, and monitoring of journals and authors. We also introduced a model of methodological literacy based on information interactions, use of methodologies and concept mapping [14].

The analyses of information horizons were based on the framework of types of information resources, information activities, position of self and metaphors. Most frequent and least frequent resources, priorities and order were discussed. Two groups of researchers analyzed the data and interpretations. The objects of information horizons were put into a matrix including the main demographic data – gender, year of study, research domain, type of research and predominant information resources – electronic versus traditional resources and electronic resources versus people. The general information horizons matrix - summary is illustrated in Table 1.

Table 1. Information horizons matrix - summary

	Frequency of Attributes			
Gender	F-8	M-9		
Year of Study	1-5	2-2	3-6	4-4
Research Domain	SH-9	NS-4	T-4	
Type of Research	ER-7	TR-7	C-3	
Predominant IR (E vs P)	E-11	P-3	B-3	
Predominant IR (IR vs H)	IR-10	H-4	B-3	

Gender – F/Female, M/Male; Research Domain – SH/Social Sciences and Humanities, NS/Natural Sciences, T/Technology; Type of Research – TR/Theoretical Research, ER – Empirical Research, C – Combined Research Methods; Information resources (IR) – E/Electronic IR, P/Printed IR, H/Humans, B/Balanced IR.

Based on deeper analyses of information horizons as illustrated in Tables 1 and 2 we can see that the type of research (empirical or theoretical) influences preferences of information resources. In the empirical research there is a tendency to prefer electronic resources over traditional ones. People as information resources are dominant in the theoretical research. In the experimental research the subjects claim preferences of documents (both traditional and non-traditional). More detailed granularity (i.e. detailed categorization) of information resources was identified with subjects from social sciences and humanities (*on an average 7,3 resources on one subject*). The granularity of information resources of subjects from technical sciences was lower than with social sciences and humanities (*6,3 resources on average*). The highest level of granularity of categorization was found with social sciences and humanities (*e.g. hierarchy - tree of knowledge, multiple relations – integrated circuit, filtering, networking*). An example of this type of information horizon mapping is illustrated on Figure 2 (Japanese studies).

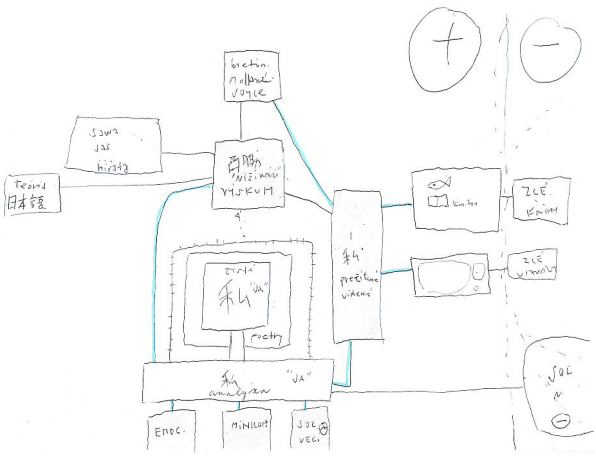

Fig. 2. Information horizon – an example (IH4)

6 Preferences of Information Resources

As for the use of types of information resources, the electronic resources are preferred mainly by technical and natural sciences (4) with the emphasis on Google as the first resource and hierarchical ordering (2). The detailed analysis of information resources is illustrated in Table 2.

The most frequently mentioned resources were books, articles, internet (Google, web) and colleagues (13 subjects). Documents (books, literature, monographs) emerged as the most important priority resource, then the advisor and colleagues from workplace. Many subjects also indicated electronic resources as the first consulted resource (7). But the strongest relationships can be seen between young scholars and their advisors (weight 1.18). As for the library, it was not indicated as the most important resource for the subjects. Friends (2) and social networks (4) are described as marginal resources. Surprisingly, almost all subjects indicated the use of other informal information resources (14), (e.g. *pub, concerts, meditation, media, meetings etc*.) which are placed as more important than traditional formal resources (*databases, PhD. colleagues, social networks*).

Table 2. Information horizons – priority of resources (**priority**/coupling)

	1	2	3	4	5	6	7	8	9	11	12	14	15	16	17	18	19	Fqn	Wgt
Library	**1**								**3**		**1**					**2**		4	**1.75**
	1								1		1					2			1.25
Books	**1**	**2**	**1**	**2**				**2**	**1**	**2**	**1**	**3**	**2**		**1**	**2**	**1**	13	**1.62**
	1	2	1	1				1	2	1	1	2	1		1	3	1		1.38
Journal Articles	**1**	**2**		**2**	**1**	**1**	**2**		**3**		**2**	**2**	**2**		**2**	**2**	**1**	13	**1.77**
	1	2		1	1	1	1		2		1	2	1		1	2	2		1.38
Electronic IR	**1**	**3**	**2**	**3**		**2**	**1**		**3**	**2**	**2**				**2**			9	**2.33**
(Full-texts)	1	1	2	2		2	1		2	1	1				1				1.56
Internet – WWW	**1**	**3**	**2**	**3**		**2**	**1**	**1**	**2**		**1**		**1**		**2**	**2**	**3**	13	**1.85**
– Google	1	1	2	2		2	1	1	1		1		1		1	1	5		1.54
Social Networks	**3**						**1**		**3**						**2**			4	**2.25**
	4						1		2						1				2.00
Advisor	**2**	**1**	**2**		**2**	**2**	**2**		**3**	**1**		**1**	**1**			**1**		11	**1.64**
	2	1	2		1	1	1		1	1		1	1			1			1.18
Colleagues	**2**		**2**		**2**	**2**	**1**	**2**	**3**	**2**	**1**	**2**	**1**		**1**	**1**		13	**1.69**
(Work)	3		2		1	2	1	1	1	1	1	2	1		1	2			1.46
Colleagues (PhD.	**2**		**2**			**2**	**2**	**2**	**3**	**3**		**2**	**1**		**2**			10	**2.20**
Students)	2		2			2	1	1	1	1		2	1		1				1.40
Friends	**3**		**3**															2	**3.00**
	4		3																3.50
Other		**3**	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**3**	**1**	**2**	**2**		**2**	**2**		14	**2.00**
		2	3	1	1	3	1	1	2	1	1	2	1		1	3			1.64

Priority (1st row) – 1/High, 2/Middle, 3/Low; Coupling (2nd row) – from 1/Strong to 5/Weak

The analysis of information horizons was represented by many tables and interpretations and point to contexts of information use and attitudes to information resources. Some subjects noted special resources (*e.g. citations, e-lectures, technical information, court documents, mathematic exercises*) and noted the negative effects of media (e.g. *"bad books",* IH4). Some of them drew the "pirate" electronic documents indicating their awareness of electronic piracy and protection of intellectual property (IH9, IH17). It is also interesting that for several subjects an important resource is represented by their self (*me – meditation, experience, inspiration – e.g. poetry*) noted especially in social sciences and humanities.

7 Metaphors, Activities and Information Pathways

As for the metaphors embedded in information horizons, some of them represent more traditional information seeking situations (e.g. a problem solving – a process from the beginning to the end), others point to more complex ideas of networking of people and resources (multiple interactions) or filtering. The horizons represent the metaphors which connect with activities, several horizons represent the tools as part of the activity theory. The concept of a tool is interpreted broadly, often including one´s own cognitive activity (e.g. *"my academic activity" transforms data to information in a "knowledge tree", or "me" – my emotions, my experience, meditation, my personality developing from high school to PhD,*).

The analyses of metaphors confirm differences between disciplines which are driven by the type of research (theory, empirical research, design, philosophical reflections), social forces, traditions of research and communication. While in theoretical research the information use represents one´s own knowledge as a main resource (e.g. social psychology, musicology, philosophy, Japanese poetry), in technical sciences and mathematics the information horizon represents a problem-solving area (including the problem statement) or concentration on several selected known resources (monitoring in molecular biology, informatics, media, social networks). In several information horizons it was proven that workplace information and information for education and research overlap.

Three information pathways were indicated in the set of information horizons, i.e. the procedure from me to resources (man activates) (5), procedures on an abstract level of development of one´s knowledge (4), or procedures from resources (e.g. references) to me and multiple interactions (selection, filtering, fan) (4). The centric metaphors (sun, star) indicate such activities as selection and filtering. Other important activities include knowledge evolution (learning), problem solving and multiple interactions. More frequent descriptions of cognitive development and knowledge evolution were noted in social sciences and humanities (4). The analysis of metaphors and pathways helps determine patterns of information use experience.

8 Patterns of Information Use and Information Literacy

Based on the analysis of metaphors represented by information horizons we have identified three major information use patterns.

1. *The interactional pattern (seven occurrences)* is marked by multiple interactions and directed links with resources. It can be defined as finding context and making sense of information. Examples include *cyclic – multiple loops, centric principles* – (e.g. sun), *networking, branching* (e.g. fan, unpackaging) and *monitorin*g. This pattern was noted especially with social and natural sciences.
2. *The sequential pattern (five occurrences)* indicates the information process*, e.g. filtering and selection, chaining, problem solving, progressing from reference resources to other resources.* It can be defined as information problem solving. This pattern was noted mainly with technical and natural sciences.
3. *The evolutionary pattern* indicates the knowledge growth and learning *(five occurrences, steps, spiral).* It is defined mainly as understanding and cognitive development. This pattern was identified especially with social sciences and humanities.

The patterns represent cognitive and social relations in understanding of information and information use. Findings indicate that information strategies are cognitively driven by topics, types of sources and predictability of relevance. The context is formed by the type of research (theory, experiment, programming). The role of cognitive authorities was confirmed as part of information literacy, e.g. close relations with advisors, known sites, convenience and decision making (selection, filtering, problem solving). The core processes include finding context and cognitive development (big picture, terminology, tasks). Patterns of knowledge growth and successive revelation of resources from general references to detailed information are linked with cognitive discovery of resources.

Resources can be divided into the starting resources, reference resources and focusing resources as confirmed by the analysis of interviews [14] and previous research [9]. The common need of doctoral students to support monitoring, learning and production (syntheses) was confirmed in line with guided learning [21].

Several dimensions of information literacy were derived, i.e. awareness of information resources and strategies (monitoring), communication in communities (people – advisors, colleagues, family, friends), influences of places (school, library, pub), knowledge growth and changing information strategies, confirmation and (re-) use of successful information experiences. These findings are in line with similar studies on learning for building personal knowledge and disciplinary knowledge [20] and expanding information literacy to workplace experience and worldview [12], [4]. Differences in disciplines were also proven by the phenomenographic research by Webber et al. [11]. Research limitations follow the problems of a qualitative interpretative research (subjectivity). However, our analyses were validated by parallel analyses of two groups of researchers and analyses of interviews.

9 Conclusions

Information interactions are marked by influences of information, people and discovery of information environment. The natural pattern represents cognitive development in non-linear pathways. The information landscape of doctoral students can be divided into three abstract patterns of information use, i.e. the interactional pattern, the sequential pattern, and the evolutionary pattern. The boundaries between these patterns are loose. The interactional pattern is closer to natural and social sciences, the sequential pattern to technical and natural sciences, and the evolutionary pattern links with social sciences and humanities.

Differences in disciplines in information horizons were noted in preferences of information resources. The electronic resources were the first and most often consulted in technical sciences. The inner world of the subject occurred more often in social sciences and humanities. More detailed categorization was noted with social sciences and humanities and with students in later years of their studies. People as information resources dominated in theoretical research.

Information literacy of doctoral students is complemented with workplace information literacy and embedded in growing information culture and community. Development of an information literate person is situated in contexts of personal development and social relations, focused not only on skills.

Our findings can be applied to development of models, value-added services and training programs. The interactional pattern needs support in identification of valuable resources and navigation in the information space. The sequential pattern needs support in detailed categorization of resources. The evolutionary pattern needs support in acquisition of new knowledge and construction of meaning (e.g. terminology, focus). All patterns are marked by research interests and curiosity.

Information horizons are influenced by the type of research, experience and levels of knowledge - from novice to expert knowledge. Information literacy is not only subjective construction of meaning, but can also be socially and collectively developed. Drawing information horizons can help develop shared understandings of contexts. This qualitative methodology reveals more breadth and depth of information use than traditional methodologies.

Implications for practice of digital systems point to personal information management, filtering, monitoring, and terminological support. Interface design can facilitate multiple interactions and knowledge evolution (e.g. past and future information horizons, mapping tools). Information horizons mapping helped us understand new contexts of information literacy, namely expansion to workplaces, worldview and lifelong learning.

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