

Steinerová, Jela

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Information literacy studies and human information behaviour

Výskumy informačnej gramotnosti a informačné správanie človeka

Jela Steinerová

Comenius University in Bratislava, Department of LIS, Faculty of Arts, Slovakia

Abstract

The paper is aimed at presentation of qualitative studies of information literacy and human information behaviour with the emphasis on concepts of informed learning, information culture, information landscapes and information fluency. Results of our own studies of information behaviour of students, managers, doctoral students and researchers in Slovakia are summarized. The objectives were to identify contexts and patterns of information behaviour, information literacy, information ecology and creativity. Qualitative and combined methods of studies have been applied (interviews, modelling, information horizons). Results are represented by a model of the information ecology of academic information environment composed of semantic, cognitive, and behavioral dimensions. A model of methodological literacy of doctoral students is presented and three information use patterns (interactive, sequential, evolutionary). Relationships between creativity and information literacy are identified in a model of creative information spaces. Results of information behaviour study of researchers in Slovakia are interpreted in methodological, expertise and open science factors. The qualitative paradigm and trends of research in information literacy and information behaviour are stressed.

Keywords: *information literacy, information behaviour, phenomenographic studies, information horizons, methodological literacy, creative information strategies, information behaviour of researchers*

Abstrakt

Cieľom príspevku je informovať o kvalitatívnych výskumoch informačnej gramotnosti a informačného správania človeka s dôrazom na koncepcie informovaného učenia, informačnej kultúry, informačnej krajiny a informačnej fluencie. V tomto kontexte sa prezentujú výsledky vlastných výskumov informačného správania študentov, manažérov, doktorandov aj vedcov v SR. Ciele výskumov boli najmä identifikovať kontexty a vzorce informačného správania, informačnej ekológie, informačnej gramotnosti a kreativity. Využili sa kvalitatívne a kombinované metódy výskumov (rozhovory, modelovanie, informačné horizonty). Výsledky reprezentuje model informačnej ekológie akademického informačného prostredia obsahujúci sémantický, kognitívny a behaviorálny rozmer. Predstavuje sa model metodologickej gramotnosti doktorandov a tri vzorce využívania informácií (interaktívny, sekvenčný, evolučný). Identifikujú sa vzťahy kreativity a informačnej gramotnosti v modeli kreatívnych informačných

priestorov. Zo štúdie informačného správania vedcov v SR sa identifikujú metodologické faktory, expertné faktory aj faktory otvorenej vedy. V závere sa zdôrazňuje význam kvalitatívnej paradigmy a trendy výskumov informačnej gramotnosti a informačného správania.

Kľúčová slova: *informačná gramotnosť, informačné správanie, fenomenografické výskumy, informačné horizonty, metodologická gramotnosť, kreatívne informačné stratégie, informačné správanie vedcov*

Introduction

Information literacy can be explored from different perspectives. It is a complex concept which was first coined in 1974 by Paul Zurkowski in relation to information industry. Since then, a large community of researchers and library and information practitioners has grown. Librarians have always been concerned with skills of their users and efficient use of documents. However, the issue of efficient use of information is complex, cognitively and socially driven information processing, which depends on cognitive states, contextual tasks and information environment, including information sources, tools and systems. Therefore, the original research of information literacy has been soon formed, both at practical and theoretical levels. Many international cultural organizations continued to follow this topic, including ALA-ACRL, IFLA, UNESCO, SCOUNL, CILIP and others. Many frameworks, initiatives, models and guidelines have been developed, including the Central European Information Literacy framework¹, National Forum for Information Literacy (NFIL), LILAC (Librarians' Information Literacy Annual Conference), to name a few. One of the most comprehensive approaches is a recent series of large annual European conferences on information literacy (ECIL), which started in 2013 in Istanbul. The community of researchers and practitioners has come together in closer discussions and strengthened international collaborations.

In this paper, we will focus on the research-oriented part of information literacy studies which contributes to new views and advancements of information literacy concepts. The information literacy research will be related to the studies of human information behaviour. In the second part results of our studies of information behaviour and information literacy of selected groups of users in the academic information environment in Slovakia will be presented focused on doctoral students, information managers and researchers. In conclusion, benefits of qualitative methodologies and trends in information behaviour an information literacy research will be interpreted.

Information literacy research: selected qualitative studies

In the information literacy research we can see many traditions focused on different contexts, user groups or communities. The most traditional community of studies were students who always used information while learning in schools and universities. Based on many empirical studies and models of human information behaviour the process models of identification of information needs, information seeking and use were dominant within information literacy standards and guidelines for students. As an example we can mention the Big6 Model² or the SCOUNL 7 pillars of information literacy³. It should be noted that the empirically grounded information search process (ISP) model by Carol C. Kuhlthau⁴ is most significant in theoretical development of process-oriented information literacy studies. The model is holistic, integrating affective, cognitive and activity components as opposed to traditional bibliographic approach. At present it has been transformed into the framework of guided

¹ Achieving an information society and a knowledge-based economy through information literacy. 2006.

Proposal for an information literacy platform and an action plan for Central and South-east European countries: Policy recommendations and practical directions. Z. Pejova et al. Ljubljana: ICPE, 2006.

² Eisenberg, M., Berkowitz, R. 1988. Curriculum Initiative: An Agenda and Strategy for Library Media

Programs. Norwood: Ablex. 1988., Eisenberg, M., Berkowitz, B.: The Big6 Skills (2009), <http://www.big6.com/>

³ Bent, M., Stubbings, Ruth. 2011. Information Literacy models. SCOUNL. Retrieved from:

<http://www.sconul.ac.uk/sites/default/files/documents/coremodel.pdf>

⁴ Kuhlthau, C.C. 1993. Seeking Meaning: A process Approach to Library and Information services. Norwood, Ablex: 1993.

inquiry⁵. In the context of higher education especially studies of Sheila Webber and Bill Johnston contributed to new perspectives on information literacy research⁶.

Alternative approaches have appeared in holistic and experiential perspectives which explored information literacy as life-long experience of people in the information environment. This framework has been established with the use of phenomenography and other qualitative methodological approaches to human information behaviour and information literacy. Information literacy studies have been broadened into further communities, overcoming limitations of formal education and learning. Related everyday information activities lead to new holistic frameworks, such as informed learning, information culture, information landscapes, and information fluency. As an example we can mention especially the model of **Seven faces of information literacy** by Christine Bruce (1997)⁷ and her concept of **informed learning**⁸. Phenomenography was applied to relations between information use and learning especially by Louise Limberg⁹. Phenomenography is a relational approach to research, which was first developed by Ferenc Márton at the University of Gothenburg in educational research. Further similar approaches include works of Annemaree Lloyd, Mandy Lupton, and others. A review of qualitative research in information literacy was presented by Sabine Cisek¹⁰.

Based on this perspective we refer to information literacy as understanding, cognitive skills and a personal information style. Human information behaviour is here determined as broader concept of multilayer human activities in information processing based on adaptations of humans to information environment and making sense in information interactions¹¹. Information literacy can be determined as a set of knowledge and skills, attitudes, values, and efficient information practices.

In the research context the definition of information literacy as part of **information culture** has been introduced¹². At the personal level information literacy means „the adoption of appropriate information behaviour to identify, through whatever channel or medium, information well fitted to information needs, leading to wise and ethical use of information society“¹³. This broader view is connected with information culture, especially social actions based on cultural norms. Information literacy is then viewed as cognitive and social development and practical activity. The authors explain the concept of **Information**

⁵ Kuhlthau, C.C., Maniotes, L.K., Caspari, A.K. 2015. Guided Inquiry. Learning in the 21st Century. Sec. ed. Santa Barbara: Libraries Unlimited 2015

⁶ Webber, S., Johnston, B. (2013). Transforming Information Literacy for Higher Education in the 21st Century: A Lifelong Learning Approach. Chapter 2. In: Hepworth, M., Walton, G.. *Developing People's Information Capabilities: Fostering Information Literacy in Educational, Workplace and Community Contexts*. London: Emerald 2013, 15-30.

Webber S, Boon S & Johnston, B. (2005). A comparison of UK academics' conceptions of information literacy in two disciplines: English and Marketing. *Library and Information Research*, 29(93), 4-15.

⁷ Bruce, Ch. (1997). *Seven Faces of Information Literacy*. Blackwood: Auslib Press, Adelaide

⁸ Bruce, C. (2013). Information literacy research and practice: an experiential perspective. In: Kurbanoglu, S., Grassian, E., Mizrahi, D., Catts, R., Špiranec, S. (eds.) *ECIL 2013. Proceedings of the ECIL 2013*. Springer, Heidelberg, 2013.

⁹ Limberg, L. (2007). Learning Assessment as Task in Information Seeking Research. *Information Research* 12(1), papercolis28. Retrieved from: <http://InformationR.net/ir/15-4/colis28.html>

¹⁰ Cisek, S. (2014). Qualitative Research in the Field of Information Literacy in the Second Decade of the 21st Century. In: ECIL 2014. S Kurbanoglu et al. (eds.). Cham: Springer 2014, 170-179.

¹¹ Steinerová, J. (2005). *Informačné správanie: pohľady informačnej vedy*. Bratislava: CVTI SR, 2005.

¹² Webber, S., Johnston, B. (2013). Transforming Information Literacy for Higher Education in the 21st Century: A Lifelong Learning Approach. Chapter 2. In: Hepworth, M., Walton, G.. *Developing People's Information Capabilities: Fostering Information Literacy in Educational, Workplace and Community Contexts*. London: Emerald 2013, 15-30.

¹³ Webber, S., Johnston, B. (2013). Transforming Information Literacy for Higher Education in the 21st Century: A Lifelong Learning Approach. Chapter 2. In: Hepworth, M., Walton, G.. *Developing People's Information Capabilities: Fostering Information Literacy in Educational, Workplace and Community Contexts*. London: Emerald 2013, 19.

Culture as a holistic view of people and their information behaviour in social, educational and economic contexts. Creativity and critical thinking is emphasized as part of information culture and life-long learning. The aims are to cultivate information literate citizens who can be actively engaged in information culture of the society.

Informed learning seeks to „understand the experience of information use for learning“¹⁴. It means the interpretation of information literacy based on information experience of people in information use in communities and contexts. Phenomenographic approach applies the perspective of exploring information experiences in community settings. Information use is explained through the eyes of the people and focuses on multiple aspects of information at a time and changing people’s experiences of using information to learn. This approach acknowledges the role of particular groups and communities (e.g. health information literacy, religious information literacy).

Information landscapes are regarded as representations of information environments that help us understand and realize information practices. They have been developed as a holistic concept of further expansions of information literacy research with the use of qualitative methods. A. Lloyd claimed the the “landscape is... something one experiences and explores, an engagement which “allows [one]... to map the landscape, constructing an understanding of how it is shaped”¹⁵. In this approach information literacy is regarded as a sociocultural practice¹⁶. Exploring and mapping information landscapes relate to the process of being informed. The landscapes can be individual or collective and can also represent the knowledge of communities of practice¹⁷.

Another alternative approach was framed and expanded as **information fluency** which means a conceptual understanding of and ability to adapt to changing information environments¹⁸. As a reponse to new conceptual advancements in information literacy, authors determine alternative concepts, especially transliteracy, metaliteracy, multiliteracies, etc. Information fluency provides a multiple level concept with the emphasis on understanding, personal information styles and domain differences.

Further qualitative approaches have been applied to examination of information literacy. A review of three qualitative perspectives, namely phenomenography, sociocultural approach and discourse analysis was presented by Limberg, Sundin and Talja (2012)¹⁹. In the educational context the concept of guided inquiry applied both qualitative and quantitative studies of students²⁰. Based on these approaches we can determine an alternative paradigm of information literacy. In our view, the concept of information literacy is composed of information practices, information use, values, critical analytical thinking, understanding and construction of knowledge. Two dimensions of the concept are composed of both generic information literacy and domain-specific literacies.

¹⁴ Bruce, Ch. S., Somerville, M.M., Stoodely, I., Partridge, H. (2013). Diversifying Information Literacy Research: An Informed Learning Perspective. In: Hepworth, Mark, Walton, Geoff. *Developing People’s Information Capabilities: Fostering Information Literacy in Educational, Workplace and Community Contexts*. London: Emerald Library and Information Science. 2013. Vol. 8, 226.

¹⁵ Lloyd, A. (2010). Information literacy landscapes: information literacy in education, workplace and everyday contexts. Oxford: Chandos. 2010, 2.

¹⁶ Lloyd, A. D. (2007). Recasting Information Literacy as Sociocultural Practice: Implications for Library and Information Researchers. *Information Research* 12(4), papercolis34 (2007), <http://InformationR.net/ir/12-4/colis34.html>

¹⁷ Whitworth, A. (2014). *Radical Information Literacy. Reclaiming the Political Heart of the IL Movement*. Oxford: Chandos 2014. 233 p.

¹⁸ Bawden, D. (2014). Being Fluent and Keeping Looking. In: *Information Literacy. Lifelong Learning and Digital Citizenship in the 21st century*. ECIL 2014. Ed. S. Kurbanoglu et al. Springer, Cham, 2014, 19-30.

¹⁹ Limberg, L., Sundin, O. Talja, S. (2012). Three theoretical perspectives on information literacy. *Human IT*, 11/2, 93-130.

²⁰ Kuhlthau, C.C. , Maniotes, L.K., Caspari, A.K. 2015. *Guided Inquiry: Learning in the 21st Century*. Sec. ed. Santa Barbara: Libraries Unlimited 2015. 254 pp.

The relationships between human information behaviour and information literacy can be determined as complementary approaches^{21,22}. Information literacy is part of and adoption of human information behaviour. The differences of research communities in these two topics are epistemologically driven. Human information behaviour refers to understanding of cognitive information processing, it is focused more on research, development of models and theories. The practical outcomes can inform systems design and services. Information literacy research is aimed at development of models of information use, including information literacy programs, standards, guidelines, training, courses. The ambitions of information literacy research reach beyond understanding the concept in order to influence development of information capabilities. Information behaviour is embedded especially in sociocognitive and social psychological methodological traditions. Information literacy often connects with pedagogical and psychological educational research methodologies.

Studies of information behaviour and information literacy in Slovakia

Our studies of human information behaviour were related to the academic information environment. Since 2002 we have conducted a series of surveys of human information behaviour. In the first stage we organized a large questionnaire survey in academic libraries focused on students, teachers and researchers, and other studies of elderly people, visually impaired in libraries and internet users. We applied mainly quantitative methodology (questionnaires and analyses). One of the concluding results was the identification of two information styles of users, the pragmatic and the analytic styles. The pragmatic style was connected with students (shallow information processing) and the analytic style with researchers and teachers (deeper information processing)²³. In the second stage we organized a qualitative study focused on relevance assessment and relevance experience with selected 21 doctoral students at the Faculty of Arts, Comenius University. We used the methodology of phenomenography relating relationships of doctoral research and relevance assessment. Main results helped us determine perception of relevance (2.0) in digital environment, supported by digital collaboration, participation and deep semantic representations. We also used the concept mapping methodology for representation of results and determined 10 types of relevances. The final model synthesized perception of relevance, subjective and objective components of relevance, positive and negative emotions and dynamism in time and space²⁴. The third study explored the information ecology of the academic environment based on surveys, experiments and a qualitative study of 17 managers. In the final model we identified the semantic, cognitive/visual and behavioral dimensions of the information ecology. Recommendations for building information strategies of universities and new community models of information infrastructure have been proposed with the emphasis on creativity and digital scholarship²⁵. Further qualitative studies focused on methodological literacy, doctoral students, creativity and information behaviour of researchers.

²¹ Hepworth, Mark, Walton, Geoff (2013). *Developing People's Information Capabilities: Fostering Information Literacy in Educational, Workplace and Community Contexts*. London: Emerald Library and Information Science. Vol. 8. 287 p.

²² Case, D. (2014). Developments and challenges for information-related research: the implications for methods and scope. Keynote paper delivered at ISIC, The Information Behaviour Conference, Leeds. In: ISIC Proceedings 2014. Leeds, Leeds Business School.

²³ Steinerová, J. (2005). *Informačné správanie: pohľady informačnej vedy*. Bratislava: CVTI SR, 2005.

²⁴ Steinerová, J., Grešková, M., Šušol, J. (2007). *Prieskum relevancie informácií. Výsledky analýz rozhovorov s doktorandmi FiF UK*. Bratislava: CVTI 2007. 150 p

²⁵ Steinerová et al. (2012). *Informačná Ekológia Akademického Informačného Prostredia*. UK, Bratislava (2012).

Methodological literacy of doctoral students

The study of information practices of 19 doctoral students from different disciplines (e.g. mathematics, philosophy, law, musicology, psychology, computer science) was part of a broader project on cognitive travelling in the web environment. We used a qualitative methodology of semi-structured interviews. Our findings were in line with similar studies of doctoral students. For example, we have found that information need was driven by natural curiosity and internal motivation. Other motivational factors included interactions with supervisors and interest in topic. The important role of informal information interactions and information sharing has been proved. Doctoral students need guidance and navigation in concepts, expert (international) contacts, writing and citing. Based on these analyses we identified the importance of methodological knowledge in different disciplines which related to modes of research and knowledge production and use²⁶.

The concept and a model of methodological literacy of doctoral students has been determined. Methodological literacy can be understood as knowledge of problem statement, project management, analyses, syntheses, interpretations, knowledge of main methodological paradigms and methods of research. It is also related to management of research projects and publishing, communication, collaboration and research ethics. We also identified main ecological information interactions as orientation/navigation, acquisition, selection of information, concept structuring, knowledge organization and relevance judgments, learning and interpretation, social networking and participation. In the digital environment the use of digital tools for knowledge production, discovery and cultivation of the information environment are significant. The model is depicted in Fig. 1.

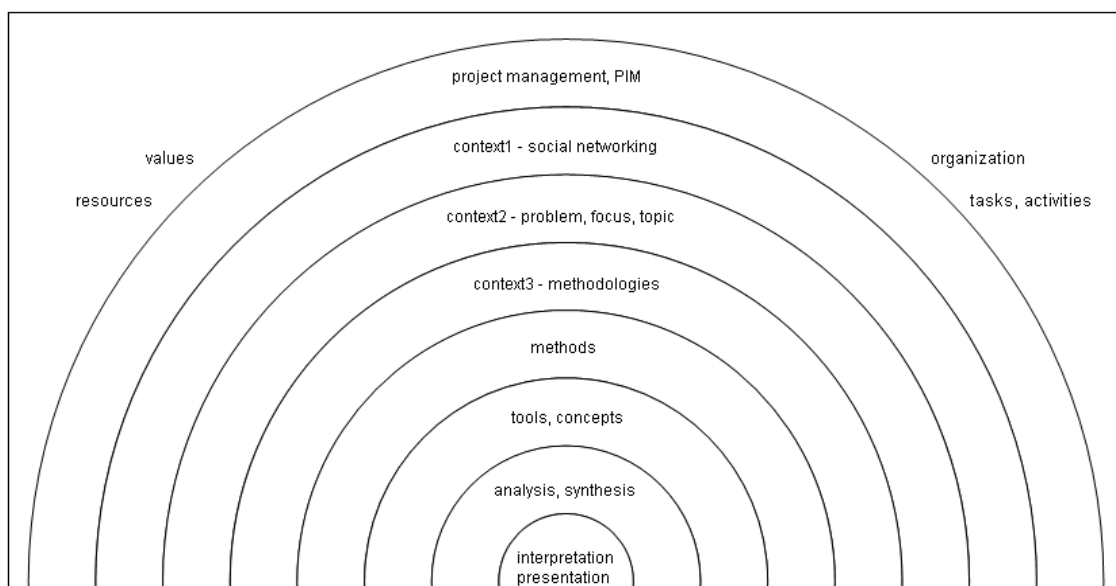


Fig. 1. Model of methodological literacy of doctoral students (Steinerová 2013, 152)

The model represents nested interactions composed of research management, knowledge of methodologies, methods, tools and concepts. It is integrated by values and knowledge of resources embedded in tasks and information activities. General epistemological processes of analysis, synthesis, interpretations and presentations are depicted as main methodological literacy processes. Based on the model methodological courses for doctoral students can be designed, including design of community portals of methodological knowledge (e.g. case studies, best practices, good examples, etc). Our study confirmed the need to cultivate information styles of doctoral students and build value-added services for them.

²⁶ Steinerová, J. (2013). Methodological Literacy of Doctoral Students – an Emerging Model. In: Worldwide Commonalities and Challenges in Information Literacy Research and Practice. ECIL 2013. Ed. S. Kurbanoglu et al. Cham: Springer Int., 148-154.

Methodological literacy can be supported by visibility, availability and convenience of sources and services²⁷.

Differences in information use patterns of doctoral students

In the next study we focused on disciplinary differences among doctoral students and identified their information use patterns. The concept of an information horizon represents a map (visual metaphor) of information resources and services based on current information need. Methodology of drawing information horizons was part of the interviews and focused on information use experience. The qualitative methodology of information horizons mapping was established in information science by studies of information behaviour of different user groups (e.g. Sonnenwald 2005²⁸, Savolainen 2008²⁹, Erdelez 2005³⁰). Drawings represent mental models and metaphors of information use. Visual analyses of 17 information horizons determined information resources, relationships, and relevance. Quantitative analyses were applied with regard to preferences of information sources and other aspects of information use.

The results pointed to subjective experience and disciplinary differences. Each information horizon was categorized and represented by varied metaphors. Differences between disciplines have been found according to the type of research (theory, empirical research, design). While in theoretical research one's own knowledge can be regarded as a main source of information use (e.g. social psychology, musicology, philosophy, Japanese poetry), in technical sciences and mathematics the information horizon represents a problem-solving area. We noted the information strategy of monitoring of several selected known resources in molecular biology, informatics and social media.

As a result three different information use patterns have been derived. *The interactive pattern* was marked by multiple interactions and links with resources. Finding context and making sense of information was typical for natural and social sciences. The exemplars of metaphors include „sun“ (centric multiple loops) or „fan“ (branching). *The sequential pattern* indicated the process-driven pattern of information use, e.g. „filtering“, „chaining“, „problem solving“. This pattern has been noted mainly with technical sciences and sciences. *The evolutionary pattern* indicates knowledge growth and learning („spiral“, „steps“). It refers especially to understanding, interpretation and cognitive development and was found with social sciences and humanities.

Relations to information literacy were identified by information use patterns and factors. The electronic resources were the first and most often consulted in technical sciences. More detailed categorization of information was noted with social sciences and humanities and with older students. People as information resources dominated in theoretical research. Implications for value-added services and systems and training were also derived. 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)³¹.

²⁷ Ibid.

²⁸ Sonnenwald, D.H. (2005). Information Horizons. In: *Theories of Information Behavior*. Medford, Inf. Today 2005, 191-197.

²⁹ Savolainen, R. (2008). *Everyday Information Practices. A Social Phenomenological Perspective*. Lanham, Scarecrow Press.

³⁰ Erdelez, S., Means, T. (2005). Measuring changes in information sharing among life science researchers. In *Knowledge Management: Nurturing Culture, Innovation and Technology*. New Jersey, World Scientific. 2005, 29-40.

³¹ Steinerová, J. (2014). Information horizons mapping for information literacy development. In: Kurbanoglu et al. (eds.). *Information Literacy. Lifelong Learning and Digital Citizenship in the 21st Century*. ECIL 2014. Cham: Springer, CCIS. 492, 70-80.

Creative information strategies

Since creativity was confirmed as one of the main values of information ecology in the academic environment, we further explored relationships between creativity and information literacy. One of the main challenges of information literacy research is to understand creative information strategies. In this study we applied meta-analysis of three surveys of information managers, artists, researchers and information professionals, using conceptual modeling and information use patterns³². Phenomenographic studies determined relations between information literacy, learning and information use. For example Bruce³³ identified information literacy experience as orientation and the learning experience. However, not very much research in information literacy considered creativity. Creativity is determined as production of new original ideas and products. Research in creativity concentrates on creative mind / personality, creative process and creative product. Cognitive abilities as adaptations and production of new original ideas are typical for creative personality; creative mind is manifested by insight, planning and exploration. Creative information strategies can be determined as creative information problem solving, planning and sense making in information use. Creative information strategies integrate human creativity and intuitive information processing. Balance between knowledge of domains, thinking and intuition, experience and emotions is required. Creativity research can inform information literacy research (e.g. Anderson 2012³⁴).

Based on the analysis of information use patterns, we can determine several types of creative information strategies. For example, analytic (professional) and intuitive information strategies, or process-oriented, interactive and evolutionary strategies³⁵. We also determined ecological information interactions as those information activities which are close to natural human information behaviour³⁶. Implicit knowledge is made explicit and successful strategies are re-used.

Sources and factors of creative information strategies were identified in several empirical studies³⁷. These factors include exploration, intuition, knowledge representations, dynamic reconstruction of information structures, and ecological awareness of information environment. Holistic experience of information environment can also serve as a source of creative information strategies. Following our analyses we developed a model of creative information strategies in three dimensions (Fig. 2).

³² Steinerová, J. (2015). Looking for Creative Information Strategies and Ecological Literacy. In: S. Kurbanoglu et al (eds). *Information Literacy: Moving Toward Sustainability. ECIL 2015. Rev. Sel. Papers.* Cham: Springer Int.l, 2015, CCIS 552, 3-12.

³³ Bruce, C. (2013). Information literacy research and practice: an experiential perspective. In: Kurbanoglu et al. (eds.) *ECIL 2013. Proceedings ECIL 2013.* Cham: Springer (2013), 11-30. CCIS 397

³⁴ Anderson, T (2012). *Information Science and the 21st Century Information Practices: Creatively Engaging with Information.* In: Bawden, D., Robinson, L. *Introduction to Information Science.* London: Facet, 275 (2012)

³⁵ Steinerová, J. (2015). Looking for Creative Information Strategies and Ecological Literacy. In: S. Kurbanoglu et al (eds). *Information Literacy: Moving Toward Sustainability. ECIL 2015. Rev. Sel. Papers.* Cham: Springer Int., 2015, CCIS 552, 3-12.

³⁶ Steinerová, J. (2014b). Ecological information interactions for digital libraries. In: Návrat, P. et al (eds.). *Cognitive Traveling in Digital Space of the Web and Digital Libraries. Yield of the Interdisciplinary Multi-Partner Project TraDiCe,* 158–169. STU, Bratislava (2014)

³⁷ Steinerová, J. (2015). Looking for Creative Information Strategies and Ecological Literacy. In: S. Kurbanoglu et al (eds). *Information Literacy: Moving Toward Sustainability. ECIL 2015. Rev. Sel. Papers.* Cham: Springer Int.l, 2015, CCIS 552, 3-12.

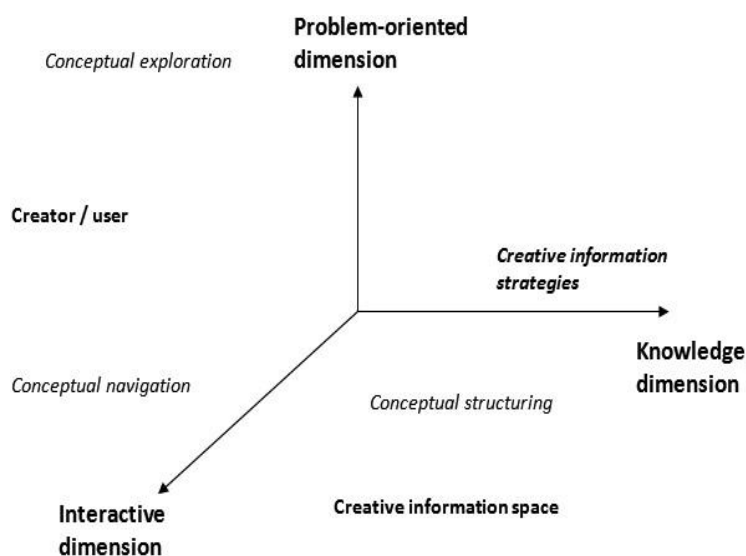


Fig. 2 Conceptual model of creative information spaces (Steinerová 2015, 10)

The creative information space was derived from information use patterns and creative information strategies. Main dimensions include problem-oriented, knowledge and interactive dimensions. Supportive creative information strategies are identified within these dimensions, namely the conceptual exploration, conceptual structuring and conceptual mapping, and conceptual navigation. Other creative strategies include visualization, knowledge representation, pattern recognition and categorization. The interactive dimension supports adaptations, collaboration, knowledge discovery, multiple revisions. Further cognitive sources of creative information strategies are metaphors, analogies, intuition, emotions, empathy, but also ill-structured problems, ambiguity, and imperfect information³⁸.

The model can be used for building digital creative information spaces for information literacy development. Ecological features as conceptual infrastructure, multiple knowledge representations, pattern recognition, analogies, associations, metaphors, visualization, clustering, and collaboration can be considered for navigation and learning. Systems and services which support implicit knowledge discovery can be improved by further research of creative information strategies.

Information behaviour of researchers – research information literacy

In the framework of a research project on digital scholarship we conducted a qualitative study of information behaviour of 19 selected researchers in Slovakia. The main research question was focused on determination of domain differences with regard to information behaviour of researchers and their perceptions of elements of open science. We applied the methodology of semi-structured interviews based on a conceptual design of the study. The subjects were internationally recognized experts in their fields. The disciplines covered social sciences, humanities and sciences, e.g. archival studies, archaeology, philosophy, nuclear physics, astronomy, molecular biology, medicine, linguistics, computer science, chemistry, and others³⁹.

Results of first analyses pointed to interesting relations of research information literacy with the open science concept. Open science refers to relationships of scholarship with broader public, transparency of research processes and open access to data and publications. Digital scholarship is focused on transformation of information and research processes into digital

³⁸ Steinerová, J. (2015). Looking for Creative Information Strategies and Ecological Literacy. In: S. Kurbanoglu et al (eds). Information Literacy: Moving Toward Sustainability. ECIL 2015. Rev. Sel. Papers. Cham: Springer Int.l, 2015, CCIS 552, 3-12.

³⁹ Steinerová, J. (2016). Open Science and the Research Information Literacy Framework. Paper proposal for ECIL 2016 Conference. Manuscript. 10 p.

environment and digital information infrastructure for scholarly communication and practices. We analyzed a number of studies and models which interpreted changing information behaviour of researchers and digital scholarship⁴⁰. The open science concept in social, technological and community dimensions requires re-conceptualization of the concept of research information literacy.

A number of authors presented related concepts of research, scholarly and scientific literacies^{41, 42}. A comprehensive picture was outlined by the ACRL Framework, Information Literacy for Higher Education.⁴³ In this framework the emphasis is put on understanding, values and experience in contexts. Ways of learning, participation in communities and metacognitive strategies are factors that determine holistic interpretation of information literacy as strategic exploration. Constructivism and process approach are applied in order to construct meaning based on values and dialogue.

Research information literacy can be determined as the ability to understand and use information in order to conduct research in disciplines. Scientific literacy is a broader term and means the capacity to use scientific knowledge and understand its impact on society. However, not very much attention was paid to perceptions of open science. Understanding open science principles is an important part of research information literacy in academic communities. That is why we analyzed data from our study of information behaviour of researchers in relation to open science factors.

These analyses point to common patterns and disciplinary differences in perceptions of knowledge infrastructure. Common patterns revealed critical analytical information practices (information fluency). Practical experience and expertise is manifested by reliance on authoritative information sources, personal international expert networks and long-term domain expertise. Open science factors were identified by researchers, especially promotion of results for broader public and open access. Further features include participation, collaboration, peer networking, and information sharing. Technological determination was found especially with “big data” sciences, i.e. astrophysics, physics, molecular biology, archaeology, social sciences. In humanities, the tendency towards building digital collections and digital libraries was noted (e.g. archival memory system PamMap, Slavic languages atlas, archaeological photographic digital collections). Further open science factors were identified, such as policies, evaluation of results, access to data and publishing. Awareness of researchers' social networks has been noted, including trends of alternative metrics (altmetrics). Main differences emerged from domain-specific research objects, research statements, methodologies, procedures, data acquisition and data management. The cultured of disciplines lead to differences of information behaviour as reflected in publishing, communication and information use patterns. Methodological modes of social sciences, humanities, sciences and technical sciences have been identified.

These findings resulted in development of an **ecological framework of encapsulated research information interactions**, which is composed of methodological factors, open science factors and expertise factors. Factors of open science include promotion, open access and participation. Several gaps with regard to open science were identified, namely the awareness of open access (OA) potential and promotion of research results.

⁴⁰ Borgman, Ch. L. (2015). *Big Data, Little Data, No Data. Scholarship in the Networked World.* : MIT Press, Cambridge

⁴¹ Karvalics, L.Z. (2013). From Scientific Literacy to Lifelong Research: A Social Innovation Approach. In: *Worldwide Commonalities and Challenges in Information Literacy Research and Practice. ECIL 2013.* Ed. S. Kurbanoglu et al. Springer, Cham: 126-133.

⁴² Koltay, T., Špiranec, S., Karvalics, L.Z. (2016). *Research 2.0 and the Future of Information Literacy.* Amsterdam: Chandos

⁴³ ACRL Framework for Information Literacy for Higher Education. (2016). Board of Directors. 1-19, Febr. 2, 2015. Approved Jan. 2016. Retrieved from:

http://www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/infolit/Framework_ILHE.pdf.

Finally the research information literacy has been re-conceptualized as understanding based on the complementary ecosystem of expertise factors, methodological factors and open science factors. Research information literacy relates to sense making and knowledge discovery integrated with motivation and research interests. The framework can be useful for development of knowledge infrastructures, including systems and services which actively support researchers in information activities, communication and collaboration. Efficient partnerships between researchers, information professionals, librarians, research managers, institutions and agencies are recommended. Needs for re-skilling of information professionals emphasize analytic skills, data management and creativity.

Conclusions

Information literacy is an important topic of information science research and is manifested in many contexts, namely learning and education, everyday participation in communities, research and policies. In order to better understand information literacy we need to focus on research of human information behaviour and understand cognitive and social contexts of information processing.

The complexity of the phenomenon is influenced by several factors, especially by context-dependence, personal information styles, community or workplace practices and values. For development of information literacy in the academic environment we have to take into account several actors as stakeholders in the academic information environment. As an example, we mentioned our studies of information practices of students, doctoral students, information managers, and researchers. From the viewpoint of information interactions the holistic concept of information ecology represents a promising framework for information literacy research. The most significant factors are information use patterns, methodological literacy, creativity, and expertise and digital tools. In digital environments we can identify enhanced features of communication and collaboration (collaboratories, community portals, social networks, e-learning). Several common patterns of information use include monitoring of information sources, information sharing and data and information management.

For practical information work we can recommend enhancement of communication in communities and support of the open science features. Creative information strategies, methodological and research information literacy are beneficial for practical digital services and systems, including re-skilling of information professionals.

Although there are limitations of qualitative methodologie, the analysed studies determined deeper contexts of information literacy. These contexts are manifested by informed learning, information culture, information landscapes and information fluency, and also by ACRL 2015 information literacy framework for higher education⁴⁴. The guidelines introduced the „threshold“ concepts that should open new ways of thinking about information literacy. Metaliteracy is regarded as an overarching set of abilities of creators and users and metacognition as self-reflection in a changing information ecosystem. Information literacy is redefined as the set of integrated abilities encompassing reflective discovery of information, understanding the production and value of information, use of information and ethical participation in communities based on dialogue and discussions. Trends in information behaviour research point to holistic approaches, studies of special communities (older people, youth), domain-oriented literacies, rich varieties of experience, digital environment and social media, information sharing, and personal information management.

The qualitative paradigm of information literacy research has highlighted innovative and contextual elements embedded in information experience and variations of information use

⁴⁴ ACRL Framework for Information Literacy for Higher Education. (2016). ACRL Board of Directors. 1-19, Febr. 2, 2015. Appr. Jan. 2016. Retr. from: http://www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/infolit/Framework_ILHE.pdf.

in different contexts and communities. Trends in information literacy research consider both individual and social construction, personal information literacy styles, domain-specific literacies. For future agenda the important focus will be transition from generic to discipline-based rich information experience. Objective and subjective information, transformative and collective aspects of information literacy are drivers for the research. New conceptual connections with communitarian or everyday-life information and links of scholarly work with public good and public services can guide further research in order to better understand people's information experience.

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