The 7i Framework –Towards a Measurement Model for Information Literacy

Full paper

Katarina Stanoevska-Slabeva
University of St. Gallen
Katarina.stanoevska@unisg.ch
Sabine Seufert
University of St. Gallen
Sabine.Seufert@unisg.ch

Severina Mueller
University of St. Gallen
Severina.Mueller@unisg.ch
Nina Scheffler
University of St. Gallen
Nina.Scheffler@unisg.ch

Abstract
The networked information and media society provides us increasingly with digital information and knowledge. However, the effective and efficient use of information requires a high level of information literacy (IL), i.e. adequate capabilities to deal with information. IL is in general described as the ability to recognize problem-driven information needs, to select information sources, to access, evaluate and use information, and to reflect upon both the applied information searching and processing procedure and the information resulting from it. Despite of its growing importance, IL has been considered only sporadically in information systems research and education. There is a lack of a scientifically proven model to operationalize and measure IL. The paper contributes to fill this gap by providing a synthesis on existing research related to definition, conceptualization and measurement of IL. Based on the findings of the literature analysis the 7i model for measuring IL is proposed.

Keywords (Required)
Information literacy, information literacy measurement, the 7i model

Introduction
The networked information and media society provides us more and more with digital information and knowledge. However, the effective and efficient use of digital media requires a capable dealing with information. For example, in its report from the World Summit on the Information Society (WSIS) in year 2013, UNESCO is considering information literacy (IL) as one major practical competence relevant for the 21st century networked society. It is considered a key competence that facilitates participation in society, a self-determined life as well as lifelong learning (Gapski & Tesker, 2009). In general, IL is described as the ability to recognize problem-driven information needs, to select information sources, to access, evaluate and use information, and to reflect upon both the applied information searching and processing procedure and the information resulting from it (Balceris, 2011; Gapski & Tekster, 2009).

In 1989, the American Library Association (ALA) Presidential Committee on IL provided a useful pedagogical context for IL. Subsequently, alternative definitions have been developed by educational institutions, professional organizations and scholars. While IL was initially a research field embedded in the library science, within the last years it has been picked-up by other research disciplines as information science, educational science, and media and communication science. Despite of its growing importance, IL has been considered only sporadically in information systems research and education for example in context of research related to information overload. In practice, in order to enable development of competences to deal with information early in life, the development of IL is considered an important goal of schools. However, empirical evidence demonstrates that this goal has not been achieved yet (see for example Jones-Kavalier & Flannigan, 2006). Various studies show that adolescents easily adopt search engines and various information sources, but partially deal naively with online information (see for example Miller, 2013). This can be explained by the insufficient integration of IL as a learning objective in
existing curricula. One reason for this is the lack of a scientifically sound and proven model to operationalize and measure IL. The paper at hand contributes to fill this gap, by providing both a synthesis on existing research related to definition, conceptualization and measurement of IL and by proposing a new comprehensive framework for measuring IL.

The main research goal is the conceptualization of a framework and model for the measurement of IL in schools. In order to achieve this goal, first a systematic literature review is conducted. The systematic literature review on IL addresses the following research questions: “Which terms exist associated with IL and how is IL defined in the literature? What are salient conceptualizations and measurement models of IL? Which methods are applied in order to examine IL?” The findings of the literature research are applied for developing a comprehensive framework for measuring IL by combining and extending existing models for conceptualization and measurement of IL.

The content of the paper is structured as follows: the next chapter explains the research methodology applied. Chapter 3 provides an overview of the findings resulting from the literature analysis. Chapter 4 presents the 7i framework for conceptualization and measurement of IL developed based on the findings resulting from the literature analysis. Chapter 5 concludes the paper by providing recommendations for future research.

**Research Methodology**

In order to systemize the perspectives on IL, a structured literature review was conducted. The main focus was thereby on the research questions of how IL can be achieved, enhanced, and measured in the educational context. The literature analysis followed the approach proposed by Webster and Watson (2002) and vom Brocke et al. (2009). First a set of relevant search keywords was identified. The keywords “Information literacy”, “Internet”, and “Education” were considered to be at the same time broad enough to not limit the search and focused enough to reflect the research question as well as the focus on measuring and fostering IL in education.

These keywords were then used to search two databases: EBSCO and Science Direct. These two databases cover almost all of the relevant journals and conferences were research on IL is published. Thus, these databases were considered comprehensive enough to gain a set of literature that represents the current status of IL research.

In a first step the identified three keywords were combined for the search. For the database EBSCO the query was defined as follows: “Information Literacy AND Internet AND Education, limiters: Full Text (Online), language: English, subject: IL”. The query for Science Direct was defined in a similar way: “Information Literacy AND Internet, limiters: Open Access, topic: Information literacy”. In order to consider related terms as well, in a second step, the same search was repeated by replacing the keyword “Information literacy” with related keywords as “Information competence”, “Media literacy”, and “Media competence”. Finally, in a third step, all considered keywords and combinations were translated into German and applied to search for German publications within the EBSCO and Science Direct databases.

Overall, the systematic literature search resulted in a high number of articles: 1398 articles from the EBSCO database; and 189 Articles from Science Direct. By following again Webster and Watson (2002) and vom Brocke et al. (2009) the number of relevant papers was further narrowed down by a detailed analysis of the abstracts of this first selection of articles under the perspective of the research question. By selecting only papers explicitly dealing with IL related to the Internet and within the educational context (for example IL as a topic in library studies was excluded), a more focused article base of 49 publications (without doubles) was identified.

The resulting body of literature was analyzed with respect to three dimensions:

- Definition: How is IL defined in literature?
- Conceptualizations, operationalization and measurement models: How is IL operationalized and measured?
- Method: Which method is used to assess and examine IL?
With regard to the definition, a code was assigned for each definition given in a paper. Overall, this led to 28 codes describing a wide range of definitions associated with IL and related constructs. In order to provide insight into the utilized theoretical frameworks, published conceptualizations and measurement models developed or/applied in the literature were analyzed and aggregated. With reference to the method, we assigned a code for each method applied in a paper which resulted in six different codes. As the case study design was one frequently method, we added six additional codes to make a further differentiation of the methods used for evaluating the assignments.

**Results of the Literature Analysis**

**Overview of IL Definitions**

The origin of the IL research and its consideration in education policy goes back to the 1970s. At the beginning IL was considered in library sciences and the meaning of the term IL was clearly related to the use of knowledge available in classical libraries. Since then the landscape of available information sources and information has changed radically. With the appearance of Internet many different digital and online information sources emerged such as online libraries, online encyclopedia, open government data, social media and many other sources. At present the meaning of the term IL is again challenged by the developments in the area of social media. While previous information sources were mainly used in a search, read and use manner (Jones-Kavalier & Flannigan, 2006), social media provide information environments where information is not only searched and used but also co-created, presented and shared (Livingston, Van Couvering & Thumin 2005). Overall, driven by the dynamics of Internet developments and by different perspectives of the various fields of research considering IL, to date, no explicit definition has been established that precisely unveils IL in all its facets (Balceris, 2011; Cope & Flanagan, 2013).

With the evolution of the available information space, the original meaning of the term IL focusing on classical libraries was challenged by the growing body of different digital information environments and ubiquitously available digital information. The meaning of IL had to be constantly adjusted to account for the increasing availability of online information in various forms and the necessary capabilities to deal with it.

The results of the literature analysis presented in this paper, show that scholars approached this challenge in two ways: either by defining and creating new terms in order to denote and reflect the radical scope of the changes in the evolving information spaces, or existing and older IL definitions were extended to reflect the new developments. The first approach is in particular evident for newer papers. The literature analysis reveals that newer articles rarely define IL and if they do, they refer to existing definitions that serve as a starting point for deriving new, different definitions. Papers considering IL in context of social media, introduce new terms for denoting competences to deal with information from social media. In this context the terms new literacies and new media literacy appeared in seven out of 15 papers considering IL within the context of social media. In addition, the terms critical (information) literacy and critical media literacy were used in six out of 15 social media related papers. Another term for IL that has been introduced in literature in recent years is digital literacy. In the corpus of 49 papers, the term appeared in three articles. Digital literacy has been defined as "the ability to use technology applications and use technology to meet personal and collective needs" (Erstad, 2009: 30). While IL focusses on broad information environments that necessarily include a range of technologies, digital literacy rather refers to technological environments (Jones-Kavalier & Flannigan, 2006). Information-literate individuals attain the ability to understand information using different forms of technology. They apply information knowledge gained from a wide range of sources and perpetually enhance their skills over time (Mackey & Jacobson, 2011). Remarkable is furthermore the fact that there are a vast number of other terms that typically appear only in one of the examined 49 publications. This variety of terms contributes to the confusion with respect to IL as the distinctions and commonalities between the terms remain unclear. However, many of these terms did not attract broad attention. Furthermore, some of the terms found in the literature describe the literacy of technology rather than of information. As the aim of the research presented in this paper is to analyze necessary capabilities to deal with online information in a competent manner, the technological aspect of literacy goes beyond the scope of this study and will not be further discussed. Overall, the findings of the in-depth literature analysis reveal that IL is still by far the term most often used to denote capabilities considered as necessary to deal with information in a competent
way. Out of the 49 evaluated papers, 17 used the term IL. Further 13 articles used the term “Informationskompetenz” – the German equivalence for IL. Thus, in total, 30 out of 49 papers use the term IL. Given the wide spread of the term IL, as well as its clear reference to information this term was also kept in the research presented at the paper at hand with the aim to denote capabilities to deal with digital information of any kind. However, the meaning of the term was clearly defined and adjusted by refining, combining and extending existing definitions for IL.

Table 1 provides a chronological overview of: the definitions used to define IL, the sources of the definitions and the papers that have applied the definition.

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
<th>Authors applying the definition</th>
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<tbody>
<tr>
<td>Kuhlthau, 1987</td>
<td>The ability to read and use information for everyday life, to recognize an information need, to seek information to make informed decisions, to manage complex masses of information generated by computers and mass media, and to learn throughout life as technical and social changes demand new skills and knowledge</td>
<td>Dunn &amp; Cook Adamson, 1997</td>
</tr>
<tr>
<td>American Library Association (ALA), 1989</td>
<td>The ability to recognize when information is needed, and to locate, evaluate and use effectively the needed information</td>
<td>Ali, Hassan, Md Daud, &amp; Jusoff, 2010; Balceris, 2011; Blum, 2007; Burke, 2010; Mackey, 2005; Mackey &amp; Jacobson, 2011; Marshall, 2006; Miller &amp; Barlett, 2012; Pinto &amp; Sales, 2008; Thirion &amp; Pochet, 2009</td>
</tr>
<tr>
<td>Breivik &amp; Gee, 1989</td>
<td>Information-literate people know how to find, evaluate, and use information effectively to solve a particular problem or make a decision</td>
<td>Balceris, 2011</td>
</tr>
<tr>
<td>Bruce, 1992</td>
<td>Information literacy involves critical thinking, an awareness of personal and professional ethics, information evaluation, conceptualizing information needs, organizing information, interacting with information professionals and making effective use of information in problem-solving, decision-making and research</td>
<td>Balceris, 2011</td>
</tr>
<tr>
<td>Doyle, 1992</td>
<td>The ability to access, evaluate, and use information from various sources</td>
<td>Balceris, 2011; Chisăliţă, 2013; Shankar, Kumar, Natarajan, &amp; Hedberg, 2005</td>
</tr>
<tr>
<td>Leu, 1997; Braun, 1997</td>
<td>The ability to access, evaluate, interpret, and apply information</td>
<td>Scott &amp; Sullivan, 2000</td>
</tr>
<tr>
<td>Rader, 2003</td>
<td>A set of abilities to determine the extent of information needed; locate and evaluate information; incorporate selected information into one’s knowledge base; use information ethically, legally, and with an understanding of economic and social issues</td>
<td>Balceris, 2011</td>
</tr>
</tbody>
</table>
### The Prague Declaration, UNESCO, 2003
- The ability to identify, locate, evaluate, organize, create, use and transmit information
- Chisăliţă, 2013

### Australia New Zealand Institute for Information Literacy (ANZILL), 2004
- An intellectual framework for recognizing the need for understanding, finding, evaluating, and using information
- Balceris, 2011; Jeffrey, Hegarty, Kelly, Penman, Coburn, & McDonald, 2011

### Livingstone, Van Couvering, & Thumin, 2005
- The identification of the problem, the location where information can be found, the evaluation of the information, and the use of this information in problem solving
- Vanwynsbergh & Verdegem, 2013

### Chaka, 2009
- The practice of identifying, locating, understanding, accessing, manipulating, producing, consuming, applying, analyzing, synthesizing, evaluating and critiquing all forms of information as embodied in the different types of ICTs relevant to and prevalent in a given era
- Balceris, 2011

### Association of College and Research Libraries (ACRL), 2010
- The ability to locate, access, and evaluate information, and to understand the economic, legal, and social issues surrounding the use of information

<table>
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<tr>
<th>Table 1. Overview of IL definitions</th>
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The overview of the various definitions presented in Table 1 reveals that IL is considered to be a complex phenomenon that consists of several components or sub-competences. The chronological overview also shows that the meaning of the term has been changing during time to reflect the changing environments in which information is searched and used. Older definitions focus on the following components of IL as necessary capabilities to deal with information: identifying information needs, finding, evaluating and using information. Newer definitions reflect the bigger variety of digital information environments by introducing additional sub-capabilities of IL such as the selection of relevant information sources as well as the evaluation of information sources and of the information resulting from them. Newer definitions, in particular stemming from papers discussing IL in context of social media furthermore refer to the ability to present information as an additional necessary sub-competence of IL (see for example Jones-Kavalier & Flannigan, 2006).

Despite of the differences there are some common elements that have remained part of all IL definitions during time. One such common element is the problem orientation or problem embeddedness of IL. Other common aspects are the problem-driven identification of information needs as well as finding, accessing, evaluating and using information. Some papers also consider the ability to constantly reflect upon the applied information search and processing procedure and upon its outcomes and to learn from it an important component of IL in a dynamically changing environment.

After a process of comparison, systematization and matching of both the different definitions for IL and their components, the following generic definition of IL was extracted: IL is defined as the ability to recognize problem-driven information needs, to select information sources, to access, evaluate and use information, to present information and to reflect both the applied information searching and
processing procedure and the information resulting from it (see also Balceris 2011; Gapski and Tekster 2009). This definition serves as basis for further research presented in this paper and for the extraction of a measurement model for information literacy. It furthermore provided the basis for evaluation of the completeness of published models for measurement of information literacy.

**Conceptualizations, Operationalizations and Measurement Model of Information Literacy**

The second goal of the literature analysis was to provide a comprehensive overview of existing conceptualizations, operationalizations and measurement models of IL. The literature analysis revealed that the various approaches to IL result in different attempts to operationalize and measure it. As a result, there is a lack of suitable standardized measurement methods to capture IL holistically. Most of the proposed approaches provide merely insight into partial aspects of IL (Balceris, 2011).

A clear lack of consensus becomes evident in Shenton’s (2009) study. Shenton compares two different conceptualizations that describe the stages of IL. According to the concept of Eisenberg and Berkowitz (1995), the stages of IL contain the following components: define task, formulate information-seeking strategies, locate and access information, use information, synthesize work, evaluate effectiveness and efficiency. On the other hand, according to SCONUL’s Seven Pillars Model (SCONUL Advisory Committee on Information Literacy, 1999), the stages of IL consist of the following components: recognize information need, distinguish ways of addressing gap, construct strategies for locating, locate and access, compare and evaluate, organize, apply and communicate, synthesize and create. Although the two concepts describe the same stages on the whole, the specific terms differ widely.

A similar conceptualization is found in the work of Argelagos & Pifarré (2012). Based on a state-of-the-art literature analysis, the authors summarize five difficulties in developing different cognitive skills involved in solving an information problem: defining the problem, searching for, scanning, processing, organizing and presenting information.

A different description but again similar content has the definition of the American Library Association’s (ALA) Presidential Committee on IL used as a measurement model in Mackey’s (2005) study. The ALA was one of the first institutions that responded to the information age in 1989. The committee called for an active learning process that responded to the information age in 1989. The committee called for an active learning process that involved students in: knowing when they have a need for information, identifying information needed to address a given problem or issue, finding needed information and evaluating the information, organizing the information, using the information effectively to address the problem or issue at hand.

Pinto and Sales (2008) enhanced the ALA information literacy standards by taking into account their own expertise. Based on these sources they developed a conceptual model of information skills, containing the following stages: understanding information, identifying and defining information needs, locating and retrieving information, analyzing and evaluating information, integrating, synthesizing and using information, sharing information, and generating information while respecting intellectual property.

Two studies (Ali et al. 2010; Thirion & Pochet, 2009) applied the Information Literacy Competency Standards for Higher Education published by the Association of College and Research Libraries (ACRL) and the International Federation of Library Associations guidelines on IL. According to the association, information research skills are grouped into the following five themes: concept identification, search strategy, document types, search tools, and use of results. Based on these five themes, a questionnaire containing 20 questions to measure IL was developed by the Conference of Rectors and Principals of Quebec Universities for a Quebec survey (2002). In 2009, Thirion and Pochet used this questionnaire for their study aiming at objectively describing the initial level of IL in higher education institutions in the French Speaking Community of Belgium. In 2010, Ali et al. utilized the same questionnaire for their study of information skills in a Malaysian college.

The work of Wittich and Jasiewicz (2011) and Klein et al. (2009) also address the ACRL Information Literacy Competency Standards for Higher Education. The standards of the Association of College and Research Libraries differ from other conceptualizations in their additional focus on the understanding and implications of information. According to ACRL standards, students should be able to determine the extent of information needed, access the needed information effectively and efficiently, evaluate
information and its sources critically, incorporate selected information into one’s knowledge base, use information effectively to accomplish a specific purpose, understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally.

Beyond a solely conceptualization, Marshall (2006) developed and tested the Information Competency Assessment Instrument (ICAI). The ICAI evaluates IL from a self-assessment perspective and involves ten aspects that Marshall considered of common importance for an individual to be information literate: (1) identify a topic, (2) determine source requirements, (3) know how to search for needed information, (4) how to locate and retrieve information, (5) evaluate the information, (6) synthesize and organize the information, (7) understand ethical, legal and socio-political issues of the information, (8) appropriately use mass media for information, (9) present the information, and (10) learn from feedback and apply to other projects. Beyond the solely conceptualization, Marshall (2006) tested ICAI empirically with two different populations at two different times. The two tests revealed good reliability and validity of the ICAI as approach for measuring IL from a self-assessment perspective.

Another attempt to measure IL in a comprehensive and empirical way was made by Balceris (2011). In his work, he also conflated a wide range of definitions, concepts, and standards including those from the ALA, ACRL, ANZILL, Breivik and Gee (1989), Bruce (1992), Chaka (2009), Doyle (1992), and Rader (2003). After a comprehensive evaluation of the literature, Balceris (2011) developed and tested a measurement instrument for IL containing six stages: information source selection, information access, information evaluation, information use, and reflection of the applied information search and processing procedure and of the resulting findings. Balceris’ framework is nearly identical to the Big 6 framework proposed by Eisenberg and Berkowitz (1995). However, compared to Balceris’ (2011) framework, the framework of Eisenberg and Berkowitz (1995) does not contain information evaluation as a sub-competence of IL that considers the evaluation of found information before it is used. On that account, the framework of Balceris is seen as more suitable as the evaluation of information before it is used is considered an important component of IL.

The definitions and conceptualizations of IL proposed in the literature vary in overall scope and the number and granularity of IL components contained in them. Another source of differences in the proposed definition is the different naming of the various components of information literacy. The conceptualizations, operationalizations and measurement models for IL developed by Marshall (2006) and Balceris (2011) merge crucial aspects of the above presented frameworks and conceptualizations from two different perspectives: a self-assessment perspective and an objective perspective based on neutral IL assignments. Thus, it can be concluded that Marshall’s and Balceris’ work is complementary and closed a gap in research by conflating different approaches to a measurement instrument.

**Applied Methodology for Measuring Information Literacy**

The third goal of the literature analysis was to provide an overview of applied methodology to measure IL. The resulting findings are summarized in Table 3, which contains all papers out of the body of selected 49 papers that describe any approach to empirically measure IL. The analyzed body of literature revealed a mixed picture: three studies used qualitative methods (data collection and data analysis), 10 studies quantitative methods, and 16 studies were based on case studies out of which 11 case studies used either qualitative or quantitative methods and the remaining five case studies used a mixed method approach (combination of qualitative and quantitative methods). The case studies involved different assignments for the participants. For analyzing the participants’ assignment results and by that also their level of information literacy, a variety of quantitative and qualitative approaches has been applied. Quantitative assessments involved surveys after the assignments (applied in eight of the 16 case studies) and test evaluations (used in four of the 16 case studies). The qualitative assignment analysis involved various qualitative methods such as content analysis of homework, essays, project work, or papers (applied in six of the 16 case studies), analysis of the Internet search strategy recorded by a software program that captures the screen (applied in five of the 16 case studies), participant observation (used twice), and focus groups (also used twice).
<table>
<thead>
<tr>
<th>Authors</th>
<th>Definition</th>
<th>Conceptualization</th>
<th>Method</th>
</tr>
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<tbody>
<tr>
<td>Ali, Hassan, Md Daud, &amp; Jusoff, 2010</td>
<td>ALA</td>
<td>Concept Identification, Search Strategy, Document Types, Search Tools, Use of Results</td>
<td>Case study, Questionnaire, Citation analysis</td>
</tr>
<tr>
<td>Thirion &amp; Pochet, 2009</td>
<td>ALA</td>
<td>Concept Identification, Search Strategy, Document Types, Search Tools, Use of Results</td>
<td>Quantitative survey</td>
</tr>
<tr>
<td>Mackey, 2005</td>
<td>ALA</td>
<td>Knowing, Identifying, Finding, Organizing, Using</td>
<td>Case study, Questionnaire</td>
</tr>
<tr>
<td>Marshall, 2006</td>
<td>ALA</td>
<td>Identify a topic, Determine source requirements, Know how to search for needed information, How to locate and retrieve the information, Evaluate the information, Synthesize and organize the information, Understand ethical, legal and socio-political issues of the information, Appropriately use mass media for information, Present the information, Learn from feedback and apply to other projects</td>
<td>Instrument development and quantitative survey</td>
</tr>
<tr>
<td>Miller &amp; Barlett, 2012</td>
<td>ALA</td>
<td>Net-savviness, Critical evaluate techniques, Diversity</td>
<td>Quantitative survey</td>
</tr>
<tr>
<td>Klein et al., 2009</td>
<td>ACRL</td>
<td>Detect Information, Locate effectively and efficiently, Evaluate and manage critically, Obtain new findings, Understand and recognize implications</td>
<td>Quantitative survey</td>
</tr>
<tr>
<td>Shankar et al., 2005</td>
<td>Doyle, 1992</td>
<td>Starting, Chaining, Browsing, Differentiating, Monitoring, Extracting</td>
<td>Case study, Software program</td>
</tr>
<tr>
<td>Balceris, 2011</td>
<td>ALA, Breivik &amp; Gee, 1989; Bruce, 1992; Chaka, 2009; Rader, 2003</td>
<td>Information needs, Information source selection, Information access, Information evaluation, Information use, Reflection of the information process and findings</td>
<td>Instrument development and quantitative survey</td>
</tr>
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</table>

**Table 2. Overview of applied definitions, conceptualizations and methods**

The literature analysis of applied methods to measure IL reveals that there is no consensus among the described studies. There is also and only little empirical verification of proposed conceptualizations and operationalization of IL. Most of the described approaches to measure IL are not described in detail and it...
is difficult to replicate them. This holds in particular for the studies based on qualitative methods and situation specific IL related assignments.

Overall only two authors proposed a comprehensive solution for measuring IL comprising a quantitative measurement model for IL, an instrument to collect measurement data and have verified their model in practice. These two authors are Marshal (2006) and Balceris (2011). Both authors merge crucial aspects of frameworks and conceptualizations of IL presented in literature. It can be concluded that Marshall’s and Balceris’ work closed a gap in research by conflating different approaches to two measurement instruments that assess IL from two complementary perspectives: the ICAI model of Marshall from the perspective of self-assessment and Balceris’s model from an objective perspective based on defined generic tasks for each of the relevant IL competences identified in his model. However, both models propose a different perspective on IL, conceptualize IL differently and propose different number of sub-competences for IL. Thus, they can only be compared in limited manner and an overall generic measurement model for IL is still missing. However, the two models provide a good starting base for developing a combined model for measuring IL.

**Development of the 7i Framework on Information Literacy**

The two complementary models for measuring IL proposed by Marshal (2006) and Balceris (2011) served as foundation for development of the 7i Framework on IL that is based on combination of them. Table 3 provides an overview of the IL components (sub-competences) considered in the frameworks of Balceris and Marshall and how they have been combined and extended into the new integrated 7i framework.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Information needs</td>
<td>Identify a topic</td>
<td>Problem-driven identification of information needs</td>
</tr>
<tr>
<td>Information source selection</td>
<td>Determine source requirements</td>
<td>Identification of relevant information sources</td>
</tr>
<tr>
<td></td>
<td>Know how to search for needed information</td>
<td></td>
</tr>
<tr>
<td>Information access</td>
<td>How to locate and retrieve the information</td>
<td>Identification of search strategy for identified information sources</td>
</tr>
<tr>
<td>Information evaluation</td>
<td>Evaluate the information</td>
<td>Evaluation of information sources and resulting information</td>
</tr>
<tr>
<td>Information use</td>
<td>Synthesize and organize the information</td>
<td>Appropriate and problem-oriented use of the found information. This might also include understanding in general ethical, legal and socio-political issues of the information or subject- or problem-specific understanding of information</td>
</tr>
<tr>
<td></td>
<td>Understand ethical, legal and socio-political issues of the information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Appropriately use mass media for information</td>
<td></td>
</tr>
<tr>
<td>Reflection of the information process and findings</td>
<td>Learn from feedback and apply to other projects</td>
<td>Reflect upon the information search and processing procedure and upon the information resulting from it and learn</td>
</tr>
<tr>
<td>Present the information</td>
<td></td>
<td>Present the information geared to defined target groups</td>
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</table>

Table 3. Stages of IL considered for the 7i framework
The proposed 7i framework is shown in figure 3. It contains seven phases comprising knowledge, skills and attitudes.

![Diagram of the 7i Framework](image)

**Figure 1. The 7i framework on Information Literacy**

Each of the 7 phases of the 7i IL model refer to a certain skill part of IL. For each phase the necessary skills are described below.

The student who is information literate knows:

*Phase 1:* how to determine information needs in the context of a given problem, i.e. to determine information needs in a problem-driven manner.

*Phase 2:* which information sources apply best to the identified information needs.

*Phase 3:* which methods and search strategies suit best to access the selected information sources.

*Phase 4:* how to evaluate whether the sources and information are valid and reliable.

*Phase 5:* how to use the information appropriately in order to solve the problem.

*Phase 6:* how to present the information geared to a specific target group.

*Phase 7:* how to reflect the applied information search and processing procedure and the information resulting from it and to learn for future information search processes.

In order to measure IL with the 7i framework a questionnaire was constructed by combing both assignments (adapted from Balceris, 2011) and questions for self-assessment (derived from Marshall, 2006). Based on this combination, the 7i measurement model results in two different scores of IL: one objective score based on generic assignments and one rather subjective score based on self-assessment. The part of the questionnaire based on IL tasks is made up of 23 assignments, one to four covering each of the seven phases. Potential participants of an IL measurement study will be asked to solve assessment tasks and receive one point for each correctly completed task. To assess the overall IL level, the individual responses are scored across all the assessment tasks. Thus, a participant’s overall score on the test may range from zero to 70 points. One example for measuring the objective IL phase 1 is the following task:
Imagine your friend is calling you in the afternoon and asks you: “Could you help me with my research on Michael Porter? I have to give a presentation on him tomorrow.” You answer that you help him. What would you most likely say to your friend to help him with his problem? Please choose only one answer.

a) “What have you found out so far?”
b) “I just inform me on the Internet about Michael Porter and call you back immediately.”
c) “What is your presentation about?”
d) “Let us just look together for information on the Internet.”

According to Balceris (2011), answer c) is correct.

Figure 1. Example IL assignment part of the 7i framework

The 2nd part of the questionnaire is based on Marshall (2006) and consists of 27 statements, three to four covering each of the seven phases. Potential participants in the survey are asked to rate their feelings concerning each statement along a five-point, Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). To allow a better comparison with the task-based score, the self-assessed score is recorded by starting as well at zero points. By summing up the possible scores of the Likert scale, this results in a total score with a range from zero to 108 points. The self-assessment questions are illustrated below on the example of the questions for the phase 1 of the 7i framework:

• “I feel confident determining what topic I need to search.”
• “Sometimes I feel lost because the topic I want to research is not very clear to me.”
• “I can take a complex topic and break it down into more useful, simpler items.”
• “Confused’ is probably the best term to describe me when starting a project.”

Figure 2. Example self-assessment question part of the 7i framework

Discussion of Results and Future Research

The goal of the research presented in this paper is the development of a generic framework for the measurement of IL. In order to achieve this research goal, first a broad systematic literature analysis was conducted. Based on the results of the literature analysis the 7i framework for conceptualizing and measuring of IL was developed by combining and extending existing definitions, conceptualizations and operationalization’s of IL. Overall the paper provides three major contributions: an overview of current status of research on IL, a comprehensive and up-to-date definition of IL and a new generic comprehensive framework for measuring IL. These results provide a significant scientific and practical contribution.

The literature review contributes from scientific perspective by providing detailed insights into the current status of IL research and by identifying important research gaps. Overall, the findings of the literature research reveal that IL is a complex concept that is challenged by the dynamic developments of online information spaces. Despite of its growing importance in the networked and digital 21st society, it has not been considered in information systems research in sufficient manner yet and overall there is no consensus in science about the scope and definition of IL. With regard to the conceptualizations of IL, the analysis of the literature shows a variety of frameworks that result in different attempts of operationalizing and measuring IL. Furthermore, the described approaches to measure IL applied mainly situated and qualitative assessment methods that cannot be replicated easily. Only two authors provide a comprehensive solution including a conceptualization and measurement model for IL and an instrument for collecting empirical data on IL. These two models were combined and extended to the new 7i framework.

Another major scientific contribution is the 7i IL framework. It combines and adjusts the two verified models and adjusts them to better meet the requirements of current developments of the information space. Compared to other approaches to measure IL, the 7i framework is a generic framework and can be
applied to measure IL in different settings. It furthermore enables a complementary perspective on IL from a self-assessment and objective perspective. Finally, the 7i framework also introduces information presentation as a separate skill of IL.

With regard to the practical contribution, our measurement instrument allows educators and teachers to easily estimate their students’ level of information literacy. In addition, the instrument enables to capture progress as information literacy can be measured at various points of time. Accordingly, the 7i framework helps identifying whether IL increases over time. It further allows comparing the level of IL among classes and schools. Moreover, the instrument provides a sophisticated picture of IL as it not only reveals an overall score, but provides sub-scores for each of the seven phases. Thereby, educators and teachers can monitor which stages of information literacy cause pitfalls among the students and require further intervention.

Even though the results presented in the paper at hand provide a significant scientific contribution, several questions remain that provide the basis for future research. First of all the proposed 7i framework needs to be verified and tested in practice. In order to verify the 7i framework, a series of information measurement surveys are planned in several Swiss high school classes in two schools. By creating an index on IL, the goal of this empirical study is to classify the students by levels of IL. Beyond that, the selected classes will participate in a quasi-experiment where lectures on IL will be embedded in economics and law lessons. Within this quasi-experiment, the IL will be measured before and after the lectures related to IL. This procedure will provide insight into whether IL can be fostered in schools by targeted interventions.

Besides empirical testing of the 7i framework, further research is necessary to explore if the proposed 7i framework is sufficient to measure IL also in social media environments. The rigorous changes of the Internet within the last years and the emergence of social media might require additional skills to reflect necessary social media literacy.

REFERENCES


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