

**Analyzing the psychometric properties of a questionnaire designed to
assess information literacy skills – Recommendations to develop a better
instrument**

Bachelor Thesis

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Abstract

Information Literacy is an increasingly important skill in today's age of information. Information literacy is a set of skills concerned with recognizing a need for information, locating, accessing, and using information effectively. There are different instruments to measure information literacy skills one of which is a questionnaire developed by Steinrück et al. (2020). This study investigates the validity and reliability of the questionnaire, by analyzing the factor structure. Results included that the expected factor structure, of four underlying factors, based on the four standards of information literacy as defined by the ALA (2000) was not supported by the data. Based on the results suggestions were made on how to adapt the questionnaire to accurately measure information literacy. The author emphasizes the importance of question-wording to avoid measuring related constructs and gives insight into items that should be removed from the questionnaire.

Introduction

Over the past years, there has been an increasing interest to find valid and reliable tools for assessing information literacy (IL) in higher education. IL is an increasingly important skill in today's age of information and is defined as "a set of abilities requiring students to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (ALA, 2000). In the past year, the amount of information created, captured, copied, and consumed has increased rapidly. This growth in information can, for example, be seen in the academic domain as the amount of scientific and technical journal articles rose from slightly over one million in the year 2000 to two and a half million in 2018 (World Data Bank, 2022). As the amount of available information increases, IL as a skill also

becomes more important, to efficiently handle information in terms of accessing, analyzing, and using it.

In the early 2000s little to no adequate tools for assessing information literacy existed (O'Connor et al., 2001). Since then some methods have emerged to assess IL in higher education, mainly through multiple-choice questionnaires, tests, portfolios, or simulations. Most of these methods were used in case studies and assessed IL after a specific course or after instructions from librarians (Walsh, 2009). This indicates a lack of existing tools to assess IL on a broader scale and independent of previously administered courses or instructions. Steinrücke et al. (2020), in their study on information literacy skill assessment in digital crisis management training, developed a questionnaire as a validation measurement to assess IL. While this questionnaire was used to verify the information literacy skill assessed in a dilemma game, it was designed as a tool to measure IL independent of previously administered courses or instruction.

A clear understanding of the construct of IL, different viewpoints on IL, and its overlap and differences with critical thinking are important to evaluate, whether a tool is measuring IL. In addition to the above-given definition of Information Literacy the ALA (2000) defined five standards each with several performance indicators to assess the information-literate individual. (1) “The information literate student determines the nature and extent of the information needed.” (ALA, 2000, p.8). This standard is concerned with the individual defining a need for information, being able to identify types and formats of sources for that information, considering costs and benefits, and reevaluating the nature and extent of needed information. (2) “The information literate student accesses needed information effectively and efficiently.” (ALA, 2000, p. 9) The second standard is about assessing, appropriate investigative methods, and search strategies, retrieving information using a variety of methods, being able to refine search strategies and extracting, recording and

managing the needed information and sources properly. (3) “The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.” (ALA, 2000, p. 11) Summarizing main ideas, applying initial criteria for evaluating information and sources, synthesizing main ideas to constructs and new concepts, comparing new knowledge and prior knowledge to determine added value or contradictions, comparing different viewpoints, validating information through discourse and determining if the initial query should be revised are all indicators for the third standard. (4) “The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.” (ALA, 2000, p. 13) The three indicators for this standard are that the information literate individual applies new and prior information to plan and create a product/performance, revise the development process for the product/performance and communicates the product or performance. (5) “. ” (ALA, 2000, p. 14) This last standard includes the indicators that the information literate individual understands ethical, legal and socio-economic issues surrounding information and information technology, follows laws, regulation, etc. related to access and use of information sources and acknowledges the use of information sources when communicating the product and performance. The definition of IL and the standards set by the ALA show some overlap with critical thinking and decision-making.

Ennis (1993) defines critical thinking as “reasonable reflective thinking focused on what to believe or do” and adds the twelve characteristics, some of which overlap with information literacy skills. Characteristics like “grasping the meaning of a statement”, “judging whether certain statements contradict each other”, “judging whether a statement is specific enough” or “judging whether an inductive conclusion is warranted” (Ennis, 1993, p. 180) are in line with different indicators of information literacy skills. For example, people need to grasp the meaning of statements to properly select the main ideas from the

information at hand, they need to judge whether certain statements contradict each other when they compare new and prior knowledge to determine the added value and contradictions and to refine search strategies or revise initial queries they need to be able to judge whether statements or information are specific enough. Furthermore, information literate people are capable to recognize interrelationships among concepts and extend their synthesis to construct for example new hypotheses, wherefore they need to be able to judge whether inductive conclusions are warranted from the information they have at hand. Both Ennis's definition and the definition of IL by the ALA, include higher-order thinking skills from Bloom's Taxonomy of educational objectives (Ennis, 1993; Reece, 2005). Most often the three upper levels, analysis, synthesis, and evaluation, are offered as a definition for critical thinking, sometimes the levels of comprehension and application are added (Ennis, 1993). These upper five levels relate to the definition of IL as well and further demonstrate some overlaps of skills required for both being an information literate individual as well as a critical thinker. One difference between critical thinking and information literacy is that critical thinking focuses more on private mental activities, while information literacy also includes public events (Weiner, 2011). Albitz (2007) argues on the other hand that it is more a problem of definition, in which "librarians define the skill set needed to become a life-long learner as information literacy while teaching faculty members are more likely to describe a similar skill set as critical thinking skills".

Librarians understand Information Literacy as the development and acquisition of skills that underpin effective learning in the educational setting (Bundy, 2004). This point of view includes students as central figures developing and demonstrating individual skills that support lifelong learning and it sees information as an objective entity accessible through print or digital sources (Lloyd, 2005). Lloyd (2005) adopts a more holistic view of information literacy derived from the workplace and sees IL as a constituent part of learning

to work together as well as to socially construct an understanding of the workplace, which is understood by everyone involved. This more holistic view of IL adds does not only see information as accessible through print and digital sources but also accounts for institutional, social, and physical information that can come from a range of knowledge sites (Lloyd, 2005).

The questionnaire developed by Steinrücke et al. (2020), might bridge a gap between the librarian perspective of information as an objective entity accessible through print and digital sources of text and Lloyds' more holistic view of also including institutional, social, and physical forms of information. It was developed based on the ALA standards, which stem from a librarian's definition of information literacy and are directed towards students in higher education but was formulated in a more general way defining information not only coming from print or digital sources and was originally administered to people in the workplace.

Considering the original use of the questionnaire as a validation tool for measuring information literacy in the context of crisis-management decision-making, it is important to also have a look at what constitutes decision-making. Steinrücke et al. (2020) established that the skillset needed in the decision-making process in the context of crisis management decision-making, consisting of gathering, comprehending, and interpreting information, is well described by IL. Scott and Bruce (1995) stated that decision-making consists of gathering and processing information. These definitions of Steinrücke et al. (2020) and Scott and Bruce (1995) show a great overlap with the definition of information literacy given by the ALA (2000). In difference to the standards developed by the ALA (2000), these definitions summarize the first two standards into gathering information, and the third and fourth standards into comprehending/interpreting or processing information. In the context of decision-making, the fourth standard furthermore actively incorporates the decision-making

aspect as it is about using information efficiently to accomplish a specific purpose. As proposed by Steinrücke et al. (2020) the decision-making process can be very well described by IL, though the construct of decision-making groups this similar skillset into two compressed subcategories instead of various standards.

This study aims to investigate the validity and reliability of the questionnaire developed by Steinrücke et al. (2020) as an appropriate instrument to measure IL skills and to give suggestions and insight into how the questionnaire needs to be adapted to better measure IL skills. The questionnaire was originally used as a validation measure in a workplace setting and as explained adopted a more holistic view of information and information literacy. It is not unusual that studies and instruments assessing information literacy are often qualitative or much lengthier. Maurer et al. (2016) for example used a questionnaire that consisted of over 30 questions and took a more qualitative approach. Fain (2011) and Dunn (2002) conducted quantitative and qualitative multi-year studies to investigate the information literacy skills of students. The questionnaire developed by Steinrücke et al. (2020) is an instrument designed to quantitatively measure information literacy while being short and easy to administer and thereby being much more applicable to a larger population.

This far the questionnaire has not been tested on a bigger sample and questionnaire design is an iterative process, that involves piloting, defining, and refining the instrument to increase validity and reliability (McGibbon, 1997; Lietz, 2010). In the scope of this study, the questionnaire is being tested on a sample of university students. IL is an important skill for students both to succeed in the educational setting and to become lifelong learners (Webber & Johnston, 2000). IL education mostly happens at the university level and IL initiatives are often led by librarians (Dunn, 2002). Studies have shown that first-year university students only have poor to average information literacy skills (Fain, 2011; Dunn 2002). While a sample of university students can not be seen as representative of the general population, it

does include a group of people that have not undergone specific IL instructions like first-year students at the beginning of their studies, as well as people that did get some IL instructions as IL skills are an important aspect of undergraduate programs (Webber & Johnston, 2000).

This study can be seen as a pilot test of the questionnaire to give insight into validity and reliability to give suggestions on how the questionnaire needs to be adapted to better measure information literacy. Therefore, the study aims at answering the questions (1) “Does the questionnaire developed by Steinrücke et al. (2020) measure the four standards of information literacy as intended and if not in what way is information literacy assessed by the questionnaire?” and (2) “How reliably does the questionnaire measure information literacy?”.

Methods

Participants

Participants that did not complete the questionnaire were excluded. Therefore, the study included 114 participants that completed the questionnaire, 80 (70.2%) of which are female, 33 (28.9%) male, and 1 (.9%) undefined. The participants' age ranged from 17 to 28 years ($M = 21.4$, $SD = 2.27$). The sample consisted of 101 Bachelor students (88.6%), 11 Master students (9.6%), and 2 Ph.D. students (1.8%). Of the Bachelor students, 42 (36.84%) were first-year students, 27 (23.68%) were second-year students, 23 (20.17%) were third-year students and 9 (7.89%) were in their fourth year or higher. Of the Master students 5 (4.38%) students were in their first year, 5 (4.38%) students were in their second year and 1 (.87%) was in his/her third year. Finally, of the two Ph.D. students, 1 (.87%) was in his first year and 1 (.87%) was in his second year. Convenience sampling and snowball sampling were used as a method to acquire participants. Participants were either contacted directly via messengers and asked to participate in the study as well as to forward the participation link and study description to their fellow students, or they entered the study through the SONA system of

the University of Twente, where students of the university fill in each other's studies.

Participants had to be university students and capable of understanding English to participate in the study.

Materials

The questionnaire used in the study consisted of 27 questions, seven of which were demographic questions about the background of the participants and the other 20 questions aimed at measuring the skill IL. The questionnaire was administered online through the website Qualtrics. In the seven demographic questions, participants had to fill in age, gender, nationality, university, level of their studies (Bachelor/Master), year of study they are in, and their study program. The 20 questions about the skill of IL were measured on a 7-point Likert scale. The original questionnaire was translated from Dutch into English to apply to this study.

Procedure

Before taking part in the study, participants were presented with general information about the study and the purpose of the research. They were informed that the research aims to investigate the psychometric properties of a questionnaire that intends to measure IL, that participants had to be students and understand English, and that participation takes approximately 15 minutes. Participants were forwarded to the questionnaire if they clicked on the link following this information. There, a short information sheet was shown, again summarizing the above-mentioned details as well as a short consent form, which they had to actively agree with. Afterward, participants were asked to fill in the seven demographic questions and the 20 questions about IL. Ethical approval for this study was obtained from the Ethics Committee at the BMS faculty of the University of Twente in November 2022.

Data Analysis

Firstly, all participants that did not complete the questionnaire were excluded from the analysis. The scores of the negatively formulated questions (items 6, 9, 10, 17, and 19) were recoded in reverse order. KMO and Bartlett's test of sphericity was conducted to see if the data is appropriate for factor analysis. A confirmatory factor analysis (CFA) with the specified model which item belongs to which factor was run to see if the expected factor structure can be found in the data. Afterward, a fixed factor analysis (FFA) was run, where the number of factors was limited to four, to evaluate whether the questionnaire measures four distinct factors as expected, allowing for alterations in item-factor combinations. Lastly, an explorative factor analysis (EFA) was run with a follow-up FFA based on the results of the EFA, to explore the factor structure from a data-driven perspective. Cronbach's alpha was calculated, when possible, for the factors of the fixed factor analysis that had three or more items loaded onto them. Since the study aims at investigating, whether this questionnaire can pose as a good instrument to measure information literacy in a broader population all participants were included in the analysis. Stevens (2012) suggests using a cut-off of 0.4 for factor loadings, considering the explorative nature of the study, it was decided to first report all factor loadings.

Results

The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, $KMO = .71$. Bartlett's test of sphericity $X^2(190) = 558.06, p < 0.001$, indicating the correlation structure is adequate for factor analysis. First, a CFA was performed with the specified model in which the items were assigned to the factors as the questions were assigned to the standards when the questionnaire was developed. Maximum Likelihood (ML) was used as an extraction method. This model did not show a good fit ($CFI = .668, RMSEA = .08, SRMR = .09, X^2 = 301.26, df = 164, p < 0.001, AIC = 7374.53, BIC = 7500.40$).

Secondly, a fixed factor analysis was run where the number of factors was limited to 4 (see Table 1), but the model was not specified, and principal axis factoring was used as an extraction method. This model was still not a good fit (RMSEA = .05, SRMR = 0.06, $X^2 = 558.06$, $df = 190$, $p < 0.001$, $BIC = -393.95$) and could only explain 34% of the variance. Cronbach's alpha for factors 1, 2, and 3 were .67, .63, and .53 respectively.

Table 1

Pattern Matrix FFA, 4-factor solution.

Items	Factors			
	Factor 1	Factor 2	Factor 3	Factor 4
Q2	0.60	-0.06	-0.03	0.01
Q1	0.56	0.03	0.14	-0.15
Q5	0.47	0.12	-0.12	0.15
Q8	0.41	0.05	0.21	0.03
Q16	0.39	0.37	-0.12	0.24
Q15	0.38	-0.13	0.30	0.23
Q18	0.30	0.10	0.20	0.25
Q3	0.29	-0.12	0.25	0.15
Q4	0.28	0.22	0.16	0.04
Q10	0.04	0.69	-0.02	0.07
Q9	-0.07	0.65	0.07	-0.22
Q19	0.05	0.46	0.20	0.09
Q17	0.01	0.35	0.15	-0.12
Q6	0.15	0.32	-0.14	0.17
Q14	0.02	0.02	0.60	-0.10
Q13	0.19	0.08	0.59	-0.01
Q11	-0.20	0.17	0.46	0.36
Q7	-0.17	0.08	0.19	0.18
Q20	0.03	-0.02	-0.02	0.80
Q12	0.14	-0.24	0.26	0.37

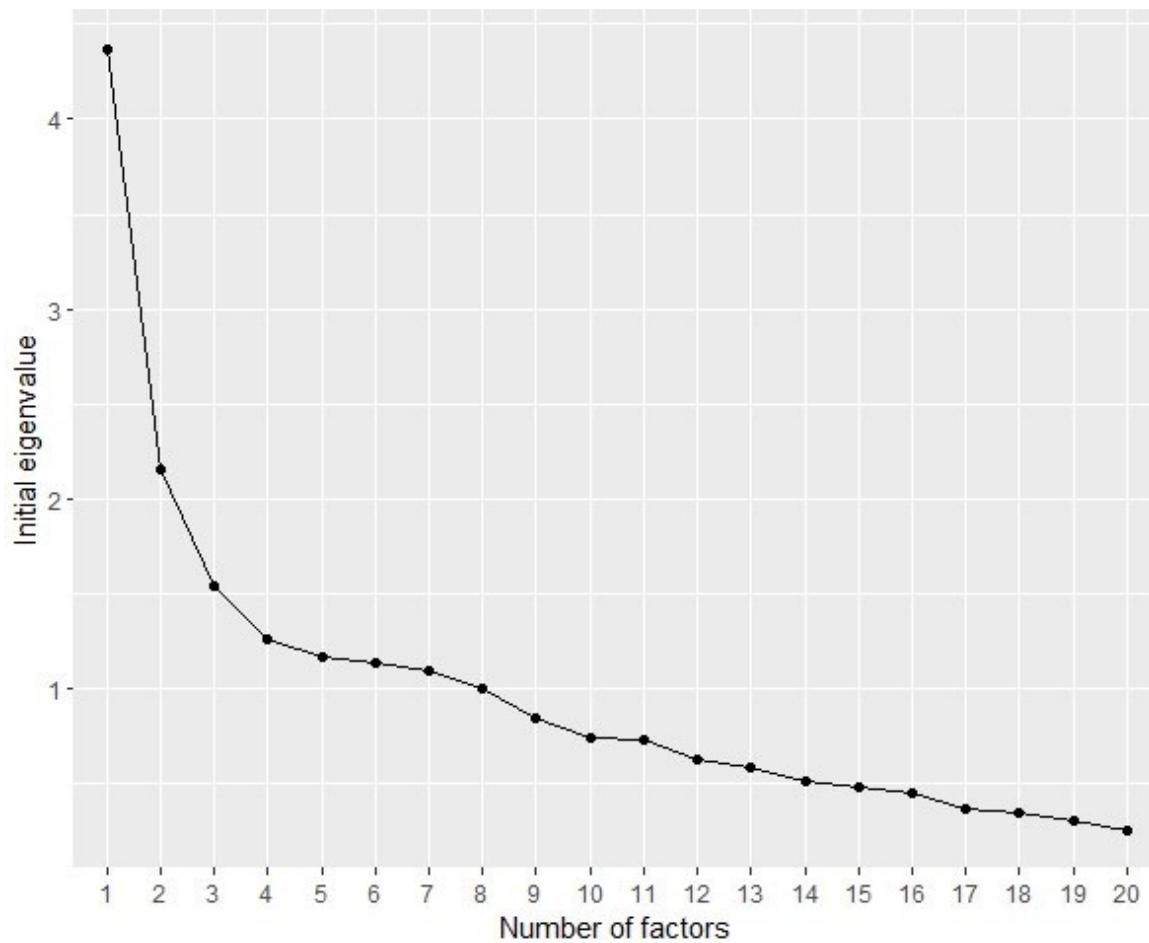
Note. Extraction method, principal axis factoring; Rotation method, oblimin rotation.

Lastly, an exploratory factor analysis was performed to investigate the factor structure without fixing the factors beforehand. The elbow criterion (see Figure 1) proposes to only look at the 4 factors as every additional factor only explains very little of the variation in the data. The analysis with a Kaiser criterion of Eigenvalues greater than 1 on the other hand yielded a seven-factor solution as the best fit for the data accounting for 68.72% of the

variance. Thus based on the exploratory factor analysis another fixed factor analysis was run where the number of factors was limited to 7. This analysis showed the best fit with (RMSEA = .00, SRMR = 0.03, $X^2 = 558.06$, $df = 190$, $p < 0.001$, $BIC = -264.75$). The results of the EFA showed that most items load onto two factors while the other seven items load onto the remaining five factors (see Table 2 & 4). The questions loading onto the first factor are mainly concerned with critically looking at information, for example, is the information sufficient, are there any contradictions which sources do the information come from. Furthermore, they deal with adapting to new information and evaluating the importance of information. The questions that load onto the second factor are mostly concerned with search strategies and sources. Only one item respectively loads onto factors 3, 4, and 7. The first is about summarizing information, the second is about identifying concepts and searching for information based on that, and the third is about looking at information in conjunction. The two questions that load onto factor 5 are about searching for additional information and re-evaluating information for a second time while the two questions that load onto factor 6 are about incorporating both information and experience into the decision-making process. Cronbach's alpha for factors 1 and 2 were .73, and .61 respectively.

Figure 1

EFA Scree plot.

**Table 2**

Pattern Matrix FFA, 7-factor solution.

Items	Factors						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Q16	0.65	0.23	-0.01	0.06	-0.18	-0.10	0.06
Q2	0.64	-0.07	-0.12	-0.03	0.01	-0.06	-0.07
Q8	0.56	-0.03	-0.19	-0.01	0.24	0.01	0.16
Q5	0.47	0.18	-0.17	-0.01	-0.05	0.14	-0.05
Q18	0.47	0.05	0.10	-0.10	0.10	0.02	0.08
Q4	0.39	0.05	0.12	0.15	0.00	-0.08	0.09
Q20	0.36	-0.03	0.24	-0.20	-0.19	0.24	0.21
Q3	0.28	-0.14	0.21	0.04	0.02	0.08	-0.19
Q10	0.11	0.68	0.04	-0.03	0.08	-0.14	-0.04
Q6	0.04	0.53	-0.01	-0.05	-0.09	0.20	-0.17
Q9	-0.12	0.52	-0.12	0.29	0.12	-0.07	0.11
Q19	0.14	0.34	0.24	0.07	0.10	-0.13	-0.02
Q17	-0.17	0.20	0.08	0.58	-0.08	0.17	0.10
Q11	-0.30	0.04	1.09	0.07	0.05	0.03	-0.05
Q1	0.54	-0.26	-0.04	0.72	-0.11	0.09	-0.20

Q13	0.10	0.14	0.03	-0.12	0.66	0.13	0.00
Q14	-0.05	-0.01	0.04	-0.04	0.66	0.04	0.05
Q12	-0.07	-0.16	0.02	0.17	0.00	0.86	0.28
Q15	0.03	0.11	-0.02	0.13	0.09	0.75	-0.14
Q7	0.05	-0.09	-0.03	0.02	0.05	0.11	0.60

Note. Extraction method, principal axis factoring; Rotation method, promax.

Table 3

Factor Correlations. Fixed-factor analysis with 7-factor solution.

	1	2	3	4	5	6	7
1							
2	0.23						
3	0.49	0.16					
4	0.08	0.24	0.08				
5	0.34	0.13	0.33	0.30			
6	0.50	-0.03	0.29	-0.25	0.09		
7	-0.03	0.23	0.19	0.13	0.12	-0.14	

Table 4

Questions by Factor

Factor	Highest Loading Items	Common Topic
1	Q2, Q3, Q4, Q5, Q8, Q16, Q18, Q20	Critically looking at information, adapting to new information, evaluating the importance of information
2	Q6, Q9, Q10, Q17, Q19	Search strategies, sources,
3	Q11	Summarizing information
4	Q1	Identifying concepts
5	Q13, Q14	Searching for additional information, re-evaluating information
6	Q12, Q15	Decision making based on information and experience
7	Q7	Information in conjunction

Discussion

The initial CFA, which used the specified model in which items were assigned to the factors in correspondence to how the questions were assigned to the standards in the design of the questionnaire, showed that this model is not a good fit. The expected factor structure was not supported by the data and furthermore, the questions are not well related to the standards as intended by the design of the questionnaire. The results from the fixed factor analysis, where the model was not specified, but the number of factors was limited to 4, was still not a very good fit, but it gave some indication that the questions related differently to underlying constructs than expected. This further supports the claim that the expected item-factor associations are not accurate and that the underlying constructs need to be investigated in a more explorative fashion. Yet the reliability of the factors in the fixed-factor analysis was still questionable with alpha ranging from .53 to .67.

The EFA with a seven-factor solution showed a better fit, but most items were grouped into the first two factors while the remaining items spread out over the other five factors. Costello and Osborne (2005) proposed to determine the number of relevant factors

explaining the data more on the elbow criterion than on Kaiser's criterion of Eigenvalues >1 . Going by the elbow, the first four factors are most relevant for explaining our data, indicating that the questionnaire measures the four standards of information literacy. If this is the case the items that load onto factors 5, 6, and 7 respectively, should be removed from the questionnaire as they measure some additional related construct. Furthermore, the items that load onto the first four factors should be revised as most items load onto the first two factors while only one item respectively loads onto factors three and four. The items that load onto the first two factors are mainly concerned with critically looking at information, adapting to new information, evaluating the importance of information, search strategies, and sources. These topics are prominent in the first three standards of IL as defined by the ALA (2000). In the scope of decision making, the clustering of the questions into these two factors is explained better, as questions that load onto the first factor are concerned with processing information and the questions that load onto the second factor are concerned with gathering information, which suits the understanding of decision making by Scott and Bruce (1995). The construct of IL on the other hand distinguishes the gathering and processing of information on the one hand from each other, but on the other hand also from using the information for a specific purpose. "Gathering information" in the framework of IL is separated into the first standard "The information literate student determines the nature and extent of the information needed.", and the second standard "The information literate student accesses needed information effectively and efficiently." (ALA, 2000). "Processing information" in the framework of IL has been conceptualized in the third standard "The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system." (ALA, 2000). While in the framework of decision making both gathering and processing information are naturally already connoted with the active use of the information to make a decision, in the framework

of IL this active use of the information is separate into the related but distinct fourth standard “The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.” (ALA, 2000).

The questionnaire was originally developed as a validation measure to examine IL in the context of crisis management decision-making. Considering the grouping of items into the two main categories of gathering information and processing information, the questionnaire does measure skills relevant to IL, but in a framework that is more closely related to decision-making than to IL itself. This is further supported by the data, as none of the factors determined by the analysis, are concerned with using the information to accomplish a specific purpose, which in the framework of decision-making is unnecessary, since it is a precondition that the gathered and processed information is used to make a decision. Since the concepts of IL and decision-making overlap, the questionnaire likely gives insight into IL skills, but only in the scope of decision-making.

McGibbon (1997) stated that the process of developing a questionnaire is a circular process that involves repeated piloting to define and refine the instrument. This process aims to translate definitions and concepts into indicators that can be used to measure the construct at hand (Murray, 1999). The definition and concepts of decision-making and information literacy share a great amount of overlap, and to measure IL in its framework instead of in the framework of decision-making, the wording of the questions plays an important role. Elaine (1993) explained that in the process of developing a questionnaire, it is important to be aware of implicit assumptions in question-wording. The questionnaire from Steinrücke et al. (2020) was originally developed in the context of crisis management decision making and this is also reflected in the wording of the question. Many of the items include phrasings like “to make a good decision”, “to achieve the goal” or “adjust my decision-making process” (see Appendix A). One example of this is item 5 “I can adjust my decision-making process when new

information arises about the situation” (see Appendix A). The item was intended to measure the fourth standard of information literacy, using the information to accomplish a specific purpose, but is grouped with items that are more concerned with critically looking at or processing information. Explicitly including the decision-making in the wording of the questions, implies that the processing of information goes hand in hand with using the information for a specific purpose, in this case making a decision. Item 16 on the other hand, which has the highest factor loading for factor one, is formulated quite neutrally “I check whether different sources of information contradict each other.”. It was intended to measure the third standard, evaluating information critically, and shows the highest factor loading of all items under the factor that can be best described by critically looking at information, adapting to new information, and evaluating the importance of information. Following this pattern items 1, 2, 3, 5, 9, 12, 13, and 15 all have some wording about decision-making or achieving a goal in them, hence including an implicit assumption that the information gathered or processed is part of a decision-making process. Another interesting example of this is item 1 “In order to be able to make a good decision, I identify/define important key concepts of the situation and actively look for information based on these key concepts.”, which is intended to measure standard one and is the only item that has a high factor loading for factor four. Yet it does also have a relatively high loading for the first factor, while except for the part of making a decision, it has little overlap in content with the other items that load onto the first factor.

The items loading onto factor five show moderate factor loadings and are the only two items that consider the aspect of time. They were intended to measure to different standards of IL, and considering their moderate loading on a common factor, they seem to measure a related but independent construct.

Items 12 and 15 show high factor loadings for factor six, and in the original questionnaire design they were intended to measure the fourth standard of information literacy. Furthermore, factor six shows a moderate correlation with factor one, and the items of factor one while being about processing information, are always related through decision-making to use the processed information for a specific purpose.

Lastly, item 1 shows a moderate to high loading for factor four. It was intended to measure the first standard of IL and is the only item loading onto factor four. It also included wording related to making a decision and has a moderate loading for the first factor. The item might indeed measure the first standard of IL, but again the wording relates this to decision-making.

Recommendations

Firstly, considering a cut-off value of .4 for factor loadings as proposed by Stevens (1992), items 4, 20, and 3 that loaded on factor one and items 19 and 17 that loaded on factor two should be removed from the questionnaire. The items loading onto factors one and two, with factor loadings higher than 0.4, should be rephrased in a way that decision-making is not included as part of the question, to avoid any implicit assumptions through wording as described by Elaine (1993). Then five items remain that measured the first factor and three items remain that measure the second factor. Considering the relationship between gathering and processing information in the framework of decision-making and the four standards of IL, the questions of factor one likely measure skills relevant to the third standard of IL, and the items of factor two likely measure skills relevant to the second standard of information literacy. When the aspect of decision-making is removed through rephrasing the questions, the items no further relate the gathering and processing of information to using it for a specific purpose. Then items 12 and 15 are the items measuring the fourth standard of IL, about using information for a specific purpose. For better performance, the two items should

be rephrased, so that using the information to make a decision is changed to using information for a specific purpose. To measure the first standard of IL, item 1 should be included, yet again rephrased to exclude decision-making and solely focus on defining concepts and actively looking for information. Furthermore, items 7, 11, 13, and 14 should be removed from the questionnaire, they load onto unique factors, namely factors three, five and seven, and appear to measure different constructs. The factor correlations imply that the measured constructs are related to factor one, yet they do measure distinct constructs and in contrast to the other items they are loading on unique factors. Therefore, no clear connection to the IL standards can be made.

Taber (2018) states that at least three items should be included for each dimension measure, to provide useful information about shared variance. Thus at least one item measuring the fourth standard and two items measuring the first standard of IL should be added to the questionnaire. Since before factor analysis, there is little information on how many items will fit and how well they will fit, some more items can be included to better measure the standards. The number of items that should be used to measure a construct depends on the complexity of the construct (DeVellis, 2016). Standard one as defined by the ALA (2000) consists of four indicators and standard four consists of three indicators, thus at least one question per indicator should be included to adequately investigate the standards. Attention needs to be paid to formulating the items neutrally and developing items that only refer to a single construct (Krosnick et al., 2009). A final recommendation for items 12 and 15 is to exclude experience from the phrasing of the items. The experience was included regarding Lloyds' (2005), holistic perspective of IL, in which not only text-based sources can pose as information. Following this understanding of IL, it does not mean that any experience can be treated as information, but only experience in the specific context can be treated as information like fire-fighting training exercises in the context of firefighting (Lloyd, 2005).

Thus, in the phrasing of these questions information and experiences should not be separated, as the experiences, the question is referring to are treated as information. It is advised to include this in the prenote of the questionnaire and clarify whether that information can be digital or printed text-based sources, but also conversations with colleagues, training exercises, or videos. The part about the context of decision-making situations and approaches to making decisions should be removed from the prenote to avoid confusion about constructs and possible priming effects (Parkin, 2008).

Limitations

Limitations of the current research are related to the self-assessment style of the questionnaire, the sample, and the original context in which the questionnaire was used. Students tend to overrate their IL skills on self-assessment instruments (Maurer et al., 2017). Overconfidence is generally a problem in forms of self-assessment and the educational context, commonly, students overestimate their actual skill levels (Dunning et al., 2004; Maurer et al., 2017; Tousignant & DesMarchais, 2002). This is problematic as the data generated through forms of self-assessment is not representative of the skills the reportees possess, meaning it is questionable how useful these questionnaires are when trying to measure IL skills. Self-assessment questionnaires in this regard are more useful to get a picture of the skill level people perceive to have than of their actual skill level. Furthermore, the sample used in this study is not representative of the general population. It is established that university students at the beginning of their studies possess low to average IL skills and tend to have not yet undergone specific IL training (Fain, 2011; Dunn, 2002). Yet depending on universities and their programs IL training happens to different extents and at different points in time (University of Twente, 2022). So, while testing the questionnaire on a sample of students did give insight into some of the problems the questionnaire has, it should be tested on a more diverse sample to make statements about its applicability to a larger

population. Finally, regarding the original use of the questionnaire as a validation measure of information literacy skills in the context of crisis management decision-making, the results of this study give indications that the questionnaire does measure skills relevant to IL under the umbrella of decision-making. Survey research suggests that the context in which a questionnaire is used, influences its validity and reliability, as respondents in a specific context like the crisis management decision-making context might have higher inter-rater reliability (Chandler & Lyon, 2001). While the questionnaire in its current form does not pose a good instrument to measure IL skills in general, with more iterations, data collection on a more diverse sample and in different domains and contexts, the questionnaire can be refined to become a valid and reliable instrument measuring IL skills.

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- ○ ○ ○ ○ ○ ○
- 4) I distinguish between sources that are important for the situation and sources that are not.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 5) I can adjust my decision making process when new information arises about the situation**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 6) I only use sources I already know to gather information.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 7) I always look at individual pieces of information in conjunction.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 8) I always look critically at incoming information.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 9) Even if the information viewed has no added value for the decision-making process, I sometimes still make a decision.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor	Kind of agree	Agree	Fully agree
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disagree

- ○ ○ ○ ○ ○ ○
- 10) Instead of looking for information, I rely on my experience and intuition when I know little about the situation, even if there is plenty of time to gather information.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 11) I always take notes when I gather information and I summarize it.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 12) When I make a decision, in addition to new information, I always include my previous experiences from similar situations.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 13) I think twice about available information before making a decision.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 14) Even if it can take a lot of time, I still ask for extra information.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor disagree	Kind of agree	Agree	Fully agree
○	○	○	○	○	○	○

- 15) To make a decision, I use both new information and my own experience.**

Completely disagree	Disagree	Kind of disagree	Neither agree nor	Kind of agree	Agree	Fully agree
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mee oneens

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- 4) **Ik maak onderscheid tussen bronnen die belangrijk zijn voor de situatie en bronnen die dat niet zijn.**

Volledig mee oneens	Mee oneens	Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens	Mee eens	Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- 5) **Ik kan mijn besluitvormingsproces aanpassen op eventuele nieuwe informatie over de situatie.**

Volledig mee oneens	Mee oneens	Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens	Mee eens	Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- 6) **Ik gebruik alleen bronnen die ik al ken om informatie te verzamelen.**

Volledig mee oneens	Mee oneens	Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens	Mee eens	Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- 7) **Ik bekijk losse stukken informatie altijd in samenhang.**

Volledig mee oneens	Mee oneens	Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens	Mee eens	Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- 8) **Ik kijk eigenlijk altijd kritisch naar binnenkomende informatie.**

Volledig mee oneens	Mee oneens	Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens	Mee eens	Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- 9) **Als de bekeken informatie geen toegevoegde waarde heeft voor de besluitvorming, neem ik soms alsnog een besluit.**

Volledig mee	Mee oneens	Beetje mee	Niet mee	Beetje mee	Mee eens	Volledig mee
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oneens		oneens	eens en niet mee oneens	eens		eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10) In plaats van informatie te gaan zoeken, vertrouw ik op mijn ervaring en intuïtie als ik weinig over de situatie weet, ook als er ruim de tijd is.

Volledig mee oneens		Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens		Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11) Ik maak altijd notities wanneer ik informatie verzamel en ik vat deze samen.

Volledig mee oneens		Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens		Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12) Als ik een besluit neem, betrek ik naast nieuwe informatie altijd mijn eerdere ervaringen uit vergelijkbare situaties.

Volledig mee oneens		Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens		Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13) Ik denk twee keer over beschikbare informatie na voordat ik een besluit neem.

Volledig mee oneens		Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens		Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14) Ook als het veel tijd kan kosten, vraag ik toch extra informatie.

Volledig mee oneens		Beetje mee oneens	Niet mee eens en niet mee oneens	Beetje mee eens		Volledig mee eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15) Om een besluit te nemen, gebruik ik zowel nieuwe informatie als mijn eigen ervaring.

