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Designing a model to measure information intelligence based on the Indices and measures

Asefeh Asemi [1], Vahid Agha-Kishi Zadeh[2], Adeleh Asemi [3], Ahmad Shabani[4], Andrea Ko [5]

1. Institute of Data Analytics, and Information Systems, Doctoral School of Economic, Business, and Informatics, Corvinus University of Budapest, Hungary. ORCID: 000-0003-1667-4408. E-mail: asemi.asefeh@uni-corvinus.hu
2. *Corresponding Author, Department of Knowledge and Information Science, University of Isfahan, Isfahan, Iran. E-mail: vahidkishi281@yahoo.com
3. Department of Software Engineering, Faculty of Computer Science and Information Technology, Universiti of Malaya. ORCID: 0000-0002-9193-2430, Email: adeleh@um.edu.my
4. Department of Knowledge and Information Science, University of Isfahan, Isfahan, Iran. ORCID: 0000-0003-0466-6240. E-mail: shabania@edu.ui.ac.ir
5. Andrea Ko, Corvinus University of Budapest, Hungary. ORCID: 0000-0003-0023-1143. E-mail: andrea.ko@uni-corvinus.hu

Abstract

Measuring information intelligence is especially important in information societies. The present study aimed to identify indices and measures effective and design a model for measuring information intelligence. The research used a mixed method to achieve objectives. Data collection tools included the study of scientific literature and interviews. The research population included related published literature related to scientific theories, information science experts, and psychology experts. Based on the research findings, 14 indices and 97 measures were identified as effective for measuring information intelligence in two dimensions of management and information retrieval. After weighing and prioritizing the indices, finally, a model is presented for measuring information intelligence. From the findings, it is concluded that in the information society, officials should first determine their information strategies and then address the strategic goals of the information society. One of these strategic goals can be to increase the level of information intelligence of individuals, organizations, and society. To do this, effective indices must be identified for measuring and strategies to increase the level of information intelligence of the target community. It is suggested that this be one of the priorities of an information society.

Keywords: Information Society, Information Intelligence, Gardner Multiple Intelligence Theory, Information seeking behavior, Information Intelligence Measurement Indices, Information Intelligence Measures, Information Intelligence Measurement Model.

1. Introduction

In today's global society, information and data are the most important sources of income generation. For this reason, information and communication skills are considered important categories. (Martin et al, 2014; Naghib et al 2020; Aghakishizadeh et al, 2018; Ashrafi Rizi and Kazempour, 2016). Proper use of

information and data requires information intelligence of society at the required level. It seems that in a society where the level of informational intelligence has not developed to an appropriate level, it will face many challenges in the path of progress. Many efforts have been done by experts in the field of knowledge and information science in the development of theories of information-seeking behavior and the development of literacy topics and information-communication skills, etc., in dealing with the transformation of the information society (Gomez- Barroso, 2018; Tang et al 2021; Sedera et al, 2022; Zuo et al, 2022). It seems necessary to plan factors beyond these fields in the category of information intelligence to respond to the needs of society along with technological advances. Measuring the level of information intelligence of an individual, organization, and society can show the weaknesses and strengths of a society in its interaction with information. If we want to give an example to show the importance of measuring information intelligence, we can point to an area where gold mines are found in abundance; But we do not know the level of proficiency and expertise of gold extraction and exploitation experts. To measure the level of expertise of these people, different methods are used to identify their strengths and weaknesses and in the same direction to develop individual, organizational, and social skills (Jalali Dizji et al 2018; Jafarzadeh et al, 2018; Habibi Azar et al, 2019). In this way, the maximum use of gold resources will be made in this area. Current research has tried to analyze the content of published literature in the category of information intelligence. In the current research, the eight dimensions of intelligence (Gardner, 2011) were considered in the investigation of effective indices for measuring informational intelligence. These dimensions include visual-spatial intelligence, verbal-linguistic intelligence, logical-mathematical intelligence, musical (rhythmic) intelligence, physical-motor intelligence (body-movement), intrapersonal intelligence, extra personal intelligence, and naturalistic intelligence. Also, based on Spink (2010), information intelligence can be proposed by developing Gardner's multiple intelligence model. The definition of information intelligence by Spink (2010) and Gardner (2011) mentioned information goals such as identification, collection, organization, and application of information. In the current research, effective indices, and measures for measuring information intelligence have been identified. The current research aimed to determine the effective indices and measures for measuring informational intelligence using content analysis and considering the multiple dimensions of intelligence. Therefore, the specific objectives of the research were as follows:

1. Identification of effective indices in measuring information intelligence.
2. Identifying the measurement parameters of each indicator affecting information intelligence according to the multiple dimensions of information intelligence.
3. Getting experts' opinions about the indices and measures identified to measure information intelligence.
4. Designing a measurement model for information intelligence.

2. Information Intelligence

Library Philosophy and Practice
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The human cognitive system is always busy receiving, managing, retrieving, and processing data and information from its surrounding environment (Villagran and Martin, 2022; Rabin et al, 2022; Molapour et al, 2021; Spink, 2012). Human is constantly learning and acting to deal successfully with thecomplex and unstable environment; through the perceptual system (Behi Mehr and Mansourian, 2017; Ahmadi et al, 2016). Human awareness of the interacting environment leads to adaptation, growth, and survival (Aghazadeh and Saneh, 2015). Human awareness is based on intelligence. Intelligence is the sum of the general and universal capabilities of an individual and includes the ability to act purposefully, think logically, and deal effectively with the environment and phenomena related to it, and defines the general lines of a person's behavior (Wasserman, 2018). In this research, intelligence in its operational concept is a set of effective indices in the development of the special mental abilities of people. "Information is the knowledge and insight obtained through investigation and study, which is obtained in the face of data, facts, currents, and new situations" (Merriam Webster, 2022). Linking information with intelligence leads to the birth of the concept of information intelligence. The information intelligence in the current study refers to the developed theoretical concept of Gardner's multiple intelligence under the topics of informational behavior (Spink, 2010). In all types of intelligence, the objective is to measure the ability to perceive the existing conditions and realities and use them in connection with the information and knowledge of the individual to meet the needs or solve the problems of oneself or others. In information science, a special framework of intelligence can be included in the discussion of information-seeking behavior as a basis for measuring information power. Gardner (2011) stated intelligence is the human ability to solve problems. He suggested that human intelligence should not be one-dimensional and include at least eight forms of intelligence (visual-spatial intelligence, verbal-linguistic intelligence, logical-mathematical intelligence, musical (rhythmic) intelligence), physical-kinesthetic intelligence, intrapersonal intelligence, extra personal intelligence, and naturalistic intelligence). Each of them is considered a dimension of multiple intelligence. Spink (2010) has stated that "we can develop Gardner's model of multiple intelligences to propose information intelligence as a new concept". Based on the theory of multiple intelligences, informational intelligence can be defined as follows:

"Information intelligence under the field of information-seeking behavior refers to the human ability to understand information issues. It can achieve specific information goals such as identification, collection, organization, and application of information" (Spink, 2010; Gardner, 2011)." Since human mental abilities that have an innate and acquired origin are called intelligence (Sternberg, 2020), informational intelligence can also be subject to this principle. The term "information intelligence" under the subject of information-seeking behavior was first proposed by Spink (2010) in the field of information science. With the search formula TITLE-ABS-KEY ("Information Intelligence") in Scopus, 414 documents were retrieved in the Scopus database on August 10, 2022. Figure 1 shows that the number of scientific resources published in the field of information intelligence is increasing dramatically. As information societies are developing at a high speed, the need to conduct scientific research in this field is also increasing.

Library Philosophy
and Practice
ISSN 1522-0222

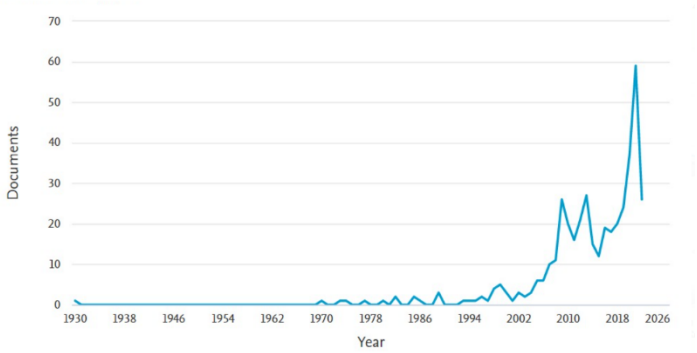

Figure 1. Published documents in information intelligence by theyear

The need to update information and communication skills measures and the weakness of information intelligence literature are some of the issues that highlight the importance of research related to information intelligence. Intelligence in recognizing the conditions of information needs depends on receiving correct data, instant organization, processing, and quick dissemination to support decision-making (Hamidizadeh, 2016). According to Gardner (2011), the value of each human ability is such that it should be included in the structure of intelligence as an effective indicator. Based on this, by linking intelligence topics with information science, a new discipline called "intelligence science" has emerged, which is offered in the form of academic courses in some universities (Zhao, 2022). Therefore, the results of such research can be used in the development of educational and research decisions and the formulation of the latest trends in information science to advance the professional status of information science.

3. Information intelligence and information-seeking behavior

Spink (2010) presents the relationship between information intelligence and information-seeking behavior in a specific theoretical framework. He believes that information-seeking behavior is based on five levels. This model is used to conceptualize information-seeking behavior (Figure 2).

Library Philosophy and Practice
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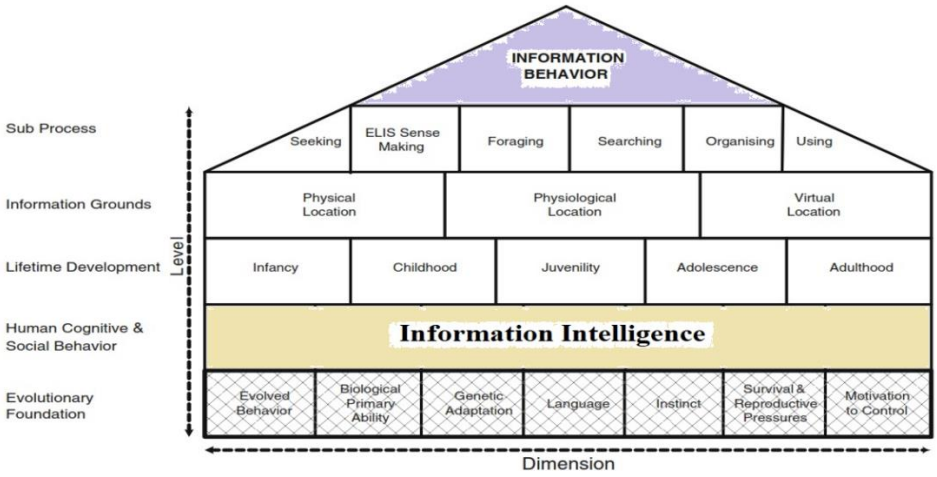

Figure 2. Information intelligence (Spink, 2010)

In other research in the field of information-seeking behavior, the studies of Spink (2010); Spink & Cole (2005; 2006; 2007), and Fisher et al (2008) provided theoretical frameworks for understanding the sub-processes that makeup information-seeking behavior. These studies show that information-seeking behavior is not only an evolved behavior with lifelong cultural, social, and instinctive characteristics, but also includes sub-processes such as information fields, information seeking, searching, retrieval, organizing, and using information. Recently, there have been studies that provide comprehensive frameworks of intelligence (Petrides, 2021). Such approaches, in case of continuation, more research, and general acceptance, are good efforts in line with the limitations of the theoretical foundations of intelligence after the theory of multiple intelligences and theories that agree with it. Such perceptions of the framework of intelligence are in line with the goals and beliefs of information science. The theoretical frameworks are a cognitive approach with growing features and broad dimensions. In previous studies, informational intelligence is an adaptation of human genes to their environment as a secondary biological ability with genetic and acquired origin. Increasing the level of information intelligence is related to the success of humans in various stages, which is a cognitive mechanism that increases the ability of humans to dominate their environment. It can be said that Informational intelligence is an instinct that grows and evolves along with thought training and is transmitted from one generation to another in a hidden form.

4. Methodology

The current research is practical in terms of its purpose because it has identified effective indices and measures for measuring information intelligence. Qualitative methods have been used to achieve specific research objectives including library studies, content analysis, and expert opinion. The research tools have been reviewing theories from related fields, analyzing the content of published articles in the category of information intelligence, taking notes, and interviewing experts. Free and axial coding was used to analyze the content of specialized resources. The research included two categories of the research community. One category included all the specialized

Library Philosophy and Practice
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resources published in the category of information intelligence and the other category included the community of experts related to the subject. To achieve the third objective of the research, an open interview was conducted with 15 experts in information science (8 experts) and psychology (7 experts). In interviews, experts' opinions were received regarding the effective indices and measures identified in the measurement of information intelligence. To achieve the fourth goal, which is to design a model to measure informational intelligence, the research continued in three stages. Table 1 shows that first a preliminary model was designed. After determining the importance of each of the dimensions, indices, and measures the final model was designed based on the opinion of experts, using the preference judgment questionnaire and the method of measuring multi-indicator criteria of decision making.

Table 1. S tepsto design the information intelligence measurement model

levels	Tools	Performance
Determining the importance of each of the dimensions, indices, and indicators effective in measuring information intelligence	A researcher-made preference judgment questionnaire and used fuzzy multi-criteria decision-making techniques	Determining the importance of information intelligence indices by information science experts and the importance of multiple intelligence indicators by psychology experts
Designing the information intelligence measurement model	Modeling and statistical techniques	The fit test of the information intelligence measurement model by appropriate statistical indicators, calculation, and design of the final model of information intelligence measurement

The study tried to increase the comprehensiveness of the targeted review, accurate data collection, prevent the entry of invalid data, use the opinions of experts, validate resources, and ensure the accuracy of the used data. In this way, the content analysis according to known methods; validity and reliability of the research reach an acceptable level.

5. Findings

The research findings in this part are divided into three parts based on the specific objectives. The first part is related to the identification of effective indices in the measurement of information intelligence. The second part is related to the identification of the measures for measuring each indicator's effectiveness in information intelligence. The third part is related to the experts' opinions about the identified indices and measures for measuring information intelligence.

5-1. Effective indices in measuring informational intelligence

In this research, to achieve the first specific objective the theoretical foundations related to information intelligence were studied, including the theoretical foundations in the field of information and communication skills. Then, by analyzing the content of related articles, fourteen effective indices are indicated for measuring information intelligence including information need, information need analysis, information search, information evaluation, information application, information combination, information extraction, information storage, information organization, Information dissemination, information presentation, information feedback,

information judgment, and information delivery. The analysis was done using open, axial, and selective coding of qualitative data according to selected articles. The findings in Table 2 show the effective indices identified in the measurement of information intelligence based on the related resources.

Table 2. Effective indicators in measuring information intelligence

Indicators for measuring information intelligence	References
Information needs	Wilson (1981) ; Burnett and White (2022) ; Jackson et al (2008) ; Kim et al (2022) ; Xie et al (2022); Anderson et al (2022) ; College and Research Libraries Association (2020); Bruce (1997); Eisenberg and Berkowitz (2003); Haring (2004); Herring, (1996); Hicks and Lloyd (2022); Santucci et al,(2022); Garcia (2022); Hicks (2022); Ogunjimi et al (2022); McCloskey (2022); Witherspoon et al (2022); Ebrahimi and Stara (2017); Ahadzadeh (1391); Ahmadi et al (2016); Ahmadi et al (2015); Imani et al (2018) Marafet et al (2017) Mahmoudi Topkanlou et al (2015); Mahmoudi and Taheri (2014); Mukhtarpour (2008); Mokhtarpo (2008); Mokhtari et al (2013); (1394); Mokhtari and Davrpanah (2011); Mokhtari and Molay (2012); Bagherinia (2017). Turki et al (2013). Jafarzadeh et al (2018); Jafarian and Saidipour (2012); Jalali Dizji et al (2018); Jamali Mahmoui (2008); Jamali Mahmoui (2013); Habibi Azar et al (2013); Hosni (2017).
Information analysis	Dervin and Nilan (1986); Vacari (2001); Wang et al (2000); Zai (2008); Costa (2001); American Library Association (1989); (2003); Doyle (1994); Chen and Ho (2007); 2020; Bruce (1997); Eisenberg and Berkowitz (2003); Herring, (1996); Svensson et al (2022); Giangrandcasigoli and Gisty (2022); Kim et al (2022); Alan (2007); Ahmadi et al (2013); Arjamand Kermani and Tirgar (2016); Yektai Koshali et al (2016); Indigo (1389); Nekozad et al (2017); Mosal Arani et al (2013); Mansourian (1391); Moradi et al (2013).
Information Searching	Spink and Cole (2005); Manzel (1964); Villar (2014); Piroli and Card, (1999); Isenberg and Berkowitz (1992); Wilson (2000), Iftikhar (2020); Lacy et al (1996); Lanning and Gerty (2022); Hossein and Al-Sand (2022); Arsen, and Jokar (1390); Li Li (2012); Svensson et al (2022); Ellis and Hagen (1997); Kriklas (1983); Kolthau (1991); Maho and Thibault (2003); Fidel and Sorgel (1983), Chu et al (2000); Costa (2001); Doyle (1994); Prague Declaration (2003); American Library Association (1989); College and Research Libraries Association (2020); College and Research Libraries Association (2020); Ahmadi et al (2013); Asadi (2013); Naderi and Mansourian (2013).
Information evaluation	Costa (2001); Doyle (1994); American Library Association (1989); Association of Faculty and Research Libraries (2020); Bruce (1997); Eisenberg and Berkowitz (2003); Herring, (1996); Alan (2007); Apoke et al (2022); Al-Zubi (2022); Young (2022); Hussain, Lee and Al-Sanad (2022); Moreau (2022); Gao (2022); Malek, Betul, and Amin (2022); Asadi (2019); Ismailzadeh and Hassanzadeh (2018); Ismaili et al (2018); Ashrafi Rizi and Kazempour (2016); Nik Kar (1378); Nazari (2005); Keshavarz (2015)
Information Application	Santucci et al (2022); Garvey (1979); Paisley (1986); Paul (1985); Marchionini (1998); Isenberg and Berkowitz (1992); Costa (2001); Doyle (1994); American Library Association (1989); Association of Faculty and Research Libraries (2020); Haring, (1996) Malik et al (2022); Hicks et al (2022); Putnis and Gala (2022); McCluskey (2022); Ebrahimi et al (2015); Nokarizi et al (2018); Majari Tabar (2019); Naderi and Mansourian (2013); Mansourian (1387).
Information Combination	Fidel (2012); Inverson and Jarvelin, (2005); Sarasvik, 2007); Costa (2001); Doyle (1994); American Library Association (1989); Association of Faculty and Research Libraries (2020); Bruce (1997); Eisenberg and Berkowitz (2003); Herring, (1996); Azad Pilehroud, (1378); Azadi Ahmadabadi and Azadi Ahmadabadi (1387); Azadi Ahmedabadi and Amraleh (2019); Ebrahimpour et al (1392); Mansourian and Sangari (2014)
Information Extraction	Doyle (1994); American Library Association (1989); Association of Faculty and Research Libraries (2020); Bruce (1997); Eisenberg and Berkowitz (2003); Herring, (1996); Burnett and White (2022); Wahhabi and others (2017)
Information Saving	Doyle (1994); Spink (2010); American Library Association (1989); Bruce (1997); Eisenberg and Berkowitz (2003); Haring, (1996)
Information Organizing	Doyle (1994); American Library Association (1989); Association of Faculty and Research Libraries (2020); Bruce (1997); Eisenberg and Berkowitz (2003); Herring, (1996); Asadi (1389)

Library Philosophy and Practice
ISSN 1522-0222

Information Dissemination	Perez-Montoro (2014); Adler (1996); Kamwa (2020), Wang et al. (2020); Pierce (2014); Griffiths (1991), Toorak and Henderson (1996), Duggan and Banwell (2004); Wang et al. (2014); Sophie and Galobe (2016); Kumar et al (2022); Azad (1387); Torpedo (1397); Esfandiari Moghadam and Zahdi (1391); Esfandiari Moghadam and Kashi Nehanji (1390); Amrai et al (1390) Mehrabi (2018); Mansourian (2011)
Information Providing	Kolthau (1991); Wellescroft (1997); Maby and Fancher (2020); Peled, 2020)., Olivera et al. 2019); Association of College and Research Libraries (2020), Eisenberg and Berkowitz (2003); Herring (1996), Bruce (1997); Eisenberg and Berkowitz (2003); Herring, (1996); Osi and Ergon (2022); Ashrafi Rizi et al (2013); Ashrafi Rizi et al (2019), Badleh et al (2017), Narmanji (2014), Mohammadi et al (2019); Maghsoudi and Esmaili Shad (2016)
Information feedback	Tang et al (2021); Chang (1956); Adomavicius et al (2012); Adomavicius et al (2013); Adomavicius et al (2009); Zhang et al (2003) ; Adomavicius et al (2022); Hashem, Kenan and Maximiano (2017); Bichler et al (2017); Mitchell and Fumos (2006); Goodest and Schmilen (2022); Nik Zaman (2018) Nasiri et al (2015)
Information judgment	Savinen (2002); Stifel (2005), Stifel (2003); Hoggs, Wareham and Joshi (2010); Azami and Salehinia (2014); Miao et al (2022).
Delivery of information	Hinze and Wissard (2003); Petochovait (2006); Mills and Lodge (2006); Jackson et al. (2008); Kirkham (1994); Sacks and others (2018); Haines and Vissard (2003); Ismail Ponki et al (2014); Webb et al (2004); Shan et al (2017); Alan (2007); Nik Kar and Sood Bakhsh (1384); Nemati Anarki et al (2019); Makizadeh and Bigdeli (2013); Vejsik (2019).

5-2. Measurement parameters of each indicator affecting information intelligence according to Gardner's multiple dimensions of information intelligence

To achieve the second specific objective of the research 101 measures were examined in the continuation of the study of theoretical foundations related to information intelligence, including theoretical foundations in Gardner's multiple intelligences, information and communication skills, and content analysis of resources. Effectiveness in measuring information intelligence was determined based on the identified indices. It was done using open, axial, and selective coding of qualitative data according to selected articles. The findings in Table 3 show the effective measures in measuring informational intelligence based on each effective indicator identified in the previous step and according to the multiple dimensions of Gardner's intelligence.

Table 3. Effective indicators in measuring information intelligence according to the multiple dimensions of information intelligence

Indices	Dimensions	Measures	References
Information needs	Visual-spatial intelligence Verbal-linguistic intelligence Intrapersonal intelligence	Linguistic association Listening skills Getting to know the different uses of vocabulary Getting to know the different uses of words Understanding the deep meanings of words Understanding deep meanings and words Ability to learn languages and related fields Ability to learn second, third, and... Thinking and revelation in issues	Binet (1904); Gardner (2011); UNESCO (2022), Webster, (2022), Atkinson and Shiffrin (1968); UNESCO (2005); Jank et al (2020); Wagner (2010); Whitespoon et al (2021)
Information analysis	Intrapersonal intelligence logical-mathematical intelligence	Thinking about the important goals of life Delve into your motivations and inner states	Gardner (2011); (Antons, 2018); Wilson and Given (2020); Afsharpour et al (2015); Basler (1986)

	Physical-motor intelligence Musical intelligence	The ability to discover logical flaws in affairs Boiling thinking during physical activities Detection of unbalanced and out-of-rhythm sounds Enjoy the music Mixing music with soul	
Information Searching	Visual-spatial intelligence logical-mathematical intelligence Extroverted intelligence Physical-motor intelligence	Curiosity Ability to locate in unfamiliar places physical activity Constant movement Interest in handicrafts Avoid being limited in a particular situation Having physical flexibility	
Information evaluation	Intrapersonal intelligence logical-mathematical intelligence	Flexibility when failures and problems occur The ability to self-identify Awareness of your weaknesses and strengths Being strong-willed and independent Ability to quantify things	Gardner (2011); Grants, Gudmundsson and Irmer (2014); Salovey (2000); Arnat (2020); Nobel (2000); Yoon (2007).
Information Application	Verbal-linguistic intelligence Intrapersonal intelligence Musical intelligence	Interest in information sources Pursue your interests Self-directed work Recognizing the rhythm and rhythm of voice, singing, and music Ability to play a music collection after listening	Gardner (2011)
Information Combination	Visual-spatial intelligence logical-mathematical intelligence Musical intelligence	clear visualization Effective drawing of lines, shapes, and images Geometric ability and spatial composition of information Visualization of objects from different spatial dimensions Ability to understand information from different infographics Interest in listening to music	Gardner (2011); King (2007)
Information Extraction	Visual-spatial intelligence logical-mathematical intelligence Extroverted intelligence Physical-motor intelligence	Ability to discover patterns, order, order, and logical sequence of objects and phenomena Interest in discovering the latest science A rational explanation of concepts, including clear, abstract, without words and images Color separation power Use of documentary information recording tools Ability to solve visual puzzles The course of bright dreams Using the senses in finding information Courage to do risky things Interest in acquiring new skills	Gardner (2011); Andretta (2004); Assyrian (2019)
Information Saving	logical-mathematical intelligence Intrapersonal intelligence Musical intelligence Natural intelligence	Mental numerical calculation ability Interested in mathematics and related sciences The habit of recording the events of your life	Gardner (2011); Basler (2004); Wollman (2001)

Library Philosophy and Practice
ISSN 1522-0222

		Ability to memorize pieces of music Ability to play at least one musical instrument nature tour A fan of nature	
Information Organizing	Visual-spatial intelligence Natural intelligence	Ability to understand natural essentials Understanding natural communication Getting to know different manifestations of nature Recognizing the differences between species Familiarity with information sources related to nature Preferring natural things to artificial things Interested in studying nature Interested in working in nature	Sisk and Torrance (2001); Won (2002); Gardner (2011); Santos (2006); Amram (2007), Wigglesworth (2013); Burba (2001); Link and Kiel (2005); Zohar and Marshall (2000); Nobel (2001); Emmons (2000); Edwards (1999)
Information Dissemination	Visual-spatial intelligence Verbal-linguistic intelligence Extroverted intelligence logical-mathematical intelligence	Understanding the characteristics of information media Knowing the stages of media production Ability to actively deal with all kinds of information media The clean vision of the media Adopting a suitable position for information Avoiding speculation in the field of information Nobles on different information channels Adhering to the step-by-step method of disseminating information Ability to use proper notification procedures	Gardner (2011), Ansaf (1985); Zhao and Austin (2022); Pereira (2018); Zhang (2015); Ma et al (2006); Koltai (2011); Garben (2011); Van Oudenhoff et al (2017); Khatri (2021); Corva Sanchez et al (2022); Osatui (2013); Samson et al (2018); Olson and Chervani (1980); Calvert (2002); Calvert (2007); Yi et al (2021); Yun and Nilan (1999); Yoon (2007); Robin (2010); Petochovait (2006); Jayakanth et al (2022); Innes and Irwin (2015); Madayl (2010); Thorpe (2017); Wojcik (2019); Yee et al (2022); Dye et al (2021); Clark (2012); Lavranos (2015); Steffel Marby (2005)
Information Providing	Verbal-linguistic intelligence Extroverted intelligence Physical-motor intelligence Musical intelligence	Appropriate use of learned vocabulary Writing effective text Verbal transfer of information effectively Social acceptability in consulting and guiding others Preferring group work to individual work Ability to do things with the participation of others The ability to make friends Using body language to convey information Ability to collaborate in team activities Ability to transfer knowledge to others Ability to lead others Feeling comfortable in the crowd Interested in doing social and professional activities Interest in moving in a group rather than moving alone	Gardner (2011); Ansaf (1985); Bar-Ann (2006); Hoggs and Bradford (2007); Golman (1995); (Arnold, 2008); Meyer et al (2002); Alan (2007); Borba (2005); Link et al (2011); Stanley (2020); Arnold (2008); Cooper (1997); Kaptari et al (2018); Bar-Ann (1997); (Arnold, 2008); Weisinger (1998); Golman (1998); Cummings (2019); Baran and Parker (2000); Almeida (2007); Islen (2019); Stasis and Brown (2000); Ansatazi (1983).

		The use of musical tools in the study of learning, teaching, and providing information Having a pleasant voice	
Information feedback	Visual-spatial intelligence Intrapersonal intelligence Extroverted intelligence	The ability to resolve ambiguity Ability to ask open questions and reveal hidden needs Continuation of communication with clients until reaching the desired result Expressing appropriate emotions in response to clients' feelings flexibility	Aghakishizadeh et al (2018), Charbono and Wardell (2022)
Information judgment	Intrapersonal intelligence Extroverted intelligence	Patience while performing information services Accept your mistakes responsibility Sympathy companionship	Steffel Marby (2003); Aghakishizadeh et al (2018)
Delivery of information	Verbal-linguistic intelligence logical-mathematical intelligence	Effective verbal communication with clients Understanding the legal issues in the delivery of information Statistical abilities in calculating two-way communication costs	Aghakishizadeh et al (2018) , Orr et al (2001); Anderson (1998) ; Gardner (2011)

5-3. Experts' opinions about the indices and measures identified to measure information intelligence

At this stage of the research, open interviews were used to fulfill the third specific goal and to receive experts' opinions about the effective indices and measures identified to measure information intelligence. In the interview, a researcher-made table was designed based on the findings in the first and second stages. All the effective indices and measures identified in the measurement of information intelligence were used according to Gardner's multiple dimensions of intelligence. The table was given to fifteen experts in the field of information science and psychology to express their opinions by writing or orally. Table 3 is based on the opinions received from experts. It included the finalized effective indices for measuring information intelligence. As this table shows, the final indices effective in measuring information intelligence were summarized in the two dimensions of information retrieval and information management. The information retrieval dimension includes 9 indices and the effective measures of each indicator in measuring information intelligence. It is included 1) Needs assessment indicator (measures: language association, listening skill, use of vocabulary, vocabulary, understanding of vocabulary, understanding of concepts, understanding of mother tongue, understanding of another language, thinking, and revelation), 2) Analysis indicator (measures: Curiosity, location, logical perception, thinking, sound recognition, musical fusion, enjoyment of music), 3) Search indicator (measures: curiosity, location, physical activity, mobility, manual work, limit avoidance, physical flexibility)), 4) Evaluation indicator (measures: mental flexibility, self-knowledge, self-awareness, music understanding, music performance), 5) Application indicator (measures: numerical calculations, interest in math, recording events, clear visualization), 6) Composition indicator (measures: interest in music, understanding information balance, multidimensional understanding, geometric

Library Philosophy and Practice
ISSN 1522-0222

understanding, drawing pictures), 7) Diffusion indicator (measures: understanding procedures, media activity, information certainty, Information position, media understanding), 8) Feedback indicator (flexibility, emotion control, continuity of communication, understanding of hidden needs, ability to resolve ambiguity), and 9) Judgment indicator (measures: empathy, companionship, responsibility Acceptance, understanding of mistakes, patience). The dimension of information management included five indices and the effective measures of each indicator in measuring information intelligence. The indices and measures are included 1) Storage indicator (measures: mental calculations, interest in math, recording events, memorization, playing music), 2) Organization indicator (measures: nature tourism, nature lover, understanding of natural necessities, understanding natural relationships, understanding natural manifestations, differences between species, understanding information sources, preferring natural things, studying nature, working in nature), 3) Extraction indicator (measures: discovering patterns, interest in new things, description rationality of concepts, color separation, information recording, visual architecture understanding, walking in lucid dreams, information senses, risk-taking, skill learning), 4) Presentation indicator (measures: use of vocabulary, text writing, the verbal transmission of information, consultative acceptability, teamwork, synergy, body language, making friends, knowledge transfer, leadership, comfort in the crowd, group mobility, melodious instruments, pleasant voice), 5. Delivery indicator (measures: statistical ability, understanding of the law, verbal communication), effective participation, social activity).

Table 4. Finalized effective indices in measuring information intelligence based on experts' opinion

Dimensions of information intelligence	Indices and measures for measuring information intelligence				
information recovery	**Need Assessment**				
	Vocabulary comprehension	words	Use of vocabulary	Listening skills	Linguistic association
		Thought and revelation	Understanding another language	language comprehension	Understanding concepts
	Analysis				
	Voice recognition	boiling thought	logical perception	location	Curiosity
				Enjoy the music	Musical fusion
	Search				
	handcraft	mobility	physical activity	location _	Curiosity
				physical flexibility	Limitation avoidance
	Evaluation				
	Music Performance	Understanding music	Self-awareness	Self-Knowledge	mental flexibility
	Application				
		Clear visualization	Record events	Interest in math	Numerical calculations
	Combination				
	Drawing pictures	Geometric understanding	Multidimensional understanding	Understanding information balance	interest in music
	Dissemination				
	Media Comprehension	informational position	Certainty of information	Media activity	Understanding procedures
	Feedback				

Library Philosophy and Practice
ISSN 1522-0222

Dimensions of information intelligence	Indices and measures for measuring information intelligence				
	Ability to resolve ambiguity	Understanding the hidden need	Continuity of communication	Emotion control	Flexibility
	Judgment				
	patience	Understanding errors	Accountability	companionship	Sympathy
Data management	**Saving**				
	playing music	to remember	Record events	Interest in math	Mental calculations
	Organization				
	Understanding natural phenomena	Understanding natural relationships	Understanding natural essentials	A fan of nature	nature tour
	Work in nature	Nature study	Preference for natural things	Understanding information sources	between species
	Extraction				
	submit information	color separation	A rational explanation of concepts	Interest in new things	Discover patterns
	skill training	Riskiness	Information senses	The course of bright dreams	Understanding the visual puzzle
	Presentation				
	Teamwork	Advisory acceptability	Verbal transmission of information	Writing text	Use of vocabulary
	leadership	knowledge transfer	making friends	The body language	synergy
		pleasant voice	Musical instruments	group mobility	Comfort in the crowd
	Delivery				
	Social activity	Effective participation	Verbal communication	Understanding the law	Statistical ability

5-4. Information intelligence measurement model

To determine the importance of dimensions, indices, and measures effective in measuring information intelligence, the fourteen indices in a fuzzy spectrum were valued by defining the range of qualitative variables in the expert's questionnaire and the form of numbers fuzzy triangulation (Table 5).

Table5. Results Calculations numbers Triangular fuzzy .

No	Question	Ave. 1	Ave. 2	MD
1	1	(8.67, 6.67, 4.67)	(8.67, 6.67, 4.67)	0
2	3	(8.67, 6.67, 4.67)	(8.83, 6.83, 4.83)	0.04
3	11	(8.38, 8.36, 8.34)	(5, 7, 9)	0.04
4	4	(8.67, 6.67, 4.67)	(5, 7, 9)	0.05
5	2	(8.5, 6.5, 4.5)	(8.17, 6.17, 4.17)	0.07
6	5	(8.5, 6.5, 4.5)	(8.83, 6.83, 4.83)	0.07
7	7	(5.5, 3.5, 1.5	(5.17, 1.17, 1.17)	0.07
8	10	(5.33, 3.33, 1.33)	(5, 3, 1)	0.08
9	14	(5.67, 3.67, 1.67)	(5.33, 3.33, 1.33)	0.08
10	13	(5.67, 3.67, 1.67)	(5.33, 3.33, 1.33)	0.08
11	8	(5.83, 3.83, 1.83)	(5.5, 3.5, 1.5)	0.08
12	12	(6, 4, 2)	(5.5, 3.5, 1.5)	11.0
13	9	(8.33, 6.33, 4.33)	(8.83, 6.83, 4.83)	11.0
14	6	(5.67, 3.67, 1.67)	(5, 3, 1)	14.0

Then, the priority of each of the effective indices in measuring information intelligence was determined using multi-criteria decision-making techniques. Table 6

Library Philosophy and Practice
ISSN 1522-0222

shows that the scores of the identified fourteen indices according to the experts are in a high and very high range. It should be mentioned that according to the threshold value and the average difference based on the opinion of the experts, the indices of information extraction, judgment and combination have a lower rank among the indices of the information intelligence model and were not considered in the design of the information intelligence measurement model.

Table 6. Order of information intelligence indices

No.	Indices
1	Understanding information needs
2	Search for information
3	Organize information
4	Information evaluation
5	Data analysis
6	Application of information
7	Dissemination of information
8	Save information
9	Delivery of information
10	Providing information
11	Information feedback
12	Extraction information
13	Information judgment
14	Combining information

Table 7 shows the matrix of pairwise comparisons ¬of the effective indices in the measurement of information intelligence for the design of this measurement model.

Table 7. Pairwise comparison matrix of multiple intelligence indices in the information intelligence model

Intelligence indices	naturalist	interpersonal	intrapersonal	physical - movement	logical-mathematical	verbal-linguistic	visual-spatial	musical
musical	(1.09, 0.990, 0.890)	(1.59, 1.97, 1.72)	(1.87, 1.30, 1.74)	(0.888, 0.791, 1.34)	(2.09, 1.67, 1.59)	(0.762, 0.917, 0.803)	(0.765 , 0.627, 0.598)	(1, 1, 1)
visual-spatial	(1.17, 0.897, 1.41)	(1.87, 2.21, 1.80)	(2.09, 0.919, 1.08)	(1.45, 1.70, 1.55)	(1.54, 1.62, 2.07)	(0.997, 0.875, 0.936)	(1, 1, 1)	(0.765, 0.627, 0.598)
verbal-linguistic	(3.23, 2.89, 2.62)	(1.90, 2.11, 1.92)	(1.33, 1.83, 1.59)	(1.46, 1.72, 1.62)	(1.87, 1.73, 1.98)	(1, 1, 1)	(0.997 , 0.875, 0.936)	(0.762, 0.917, 0.803)
logical-mathematical	(1.76, 1.99, 1.65)	(1.58, 1.13, 1.14)	(2.10, 2.35, 2.48)	(0.957, 1.76, 1.38)	(1, 1, 1)	(1.27, 1.67, 1.98)	(1.54, 1.62, 2.07)	(2.09, 1.67, 1.59)
physical movement	(1.29, 1.15, 0.789)	(0.855, 0.769, 0.549)	(1.76, 1.43, 1.43)	(1, 1, 1)	(0.957, 1.76, 1.38)	(1.46, 1.72, 1.62)	(1.45, 1.70, 1.55)	(0.888, 0.791, 1.34)
intrapersonal	(3.32, 3.31, 2.89)	(2.83, 2.55, 3.28)	(1, 1, 1)	(1.76, 1.43, 1.43)	(2.10, 2.35 ,2.48)	(1.33, 1.83, 1.59)	(2.09, 0.919, 1.08)	(1.87, 1.30, 1.74)
interpersonal	(3.45, 3.54, 3.65)	(1, 1, 1)	(2.83, 2.55, 3.28)	(0.855, 0.769, 0.549)	(1.58, 1.13, 1.14)	(1.90, 2.11, 1.92)	(1.87, 2.21, 1.80)	(1.59, 1.97, 1.72)
naturalist	(1, 1, 1)	(3.45, 3.54, 3.65)	(3.32, 3.31, 2.89)	(1.29, 1.15, 0.789)	(1.76, 1.99, 1.65)	(3.23, 2.89, 2.62)	(1.17, 0.897, 1.41)	(1.09, 0.990, 0.890)

Library Philosophy and Practice
ISSN 1522-0222

Table 8 shows the probability degree matrix of possible binary states in the information intelligence model.

Table 8. Probability degree matrix of possible binary states in the information intelligence model

Intelligence factors	naturalist _	interpersonal	intrapersonal	physical - movement	logical-mathematical	verbal-linguistic	visual-spatial	musical
	$V(S_{c8} \geq S_{ci})$	$V(S_{c7} \geq S_{ci})$	$V(S_{c6} \geq S_{ci})$	$V(S_{c5} \geq S_{ci})$	$V(S_{c4} \geq S_{ci})$	$V(S_{c3} \geq S_{ci})$	$V(S_{c2} \geq S_{ci})$	$V(S_{c1} \geq S_{ci})$
musical	0.990	1	1	1	1	0.828	0.665	
visual-spatial	1	1	1	1	1	0.936		0.665
verbal-linguistic	1	1	1	1	1		0.936	0.828
logical-mathematical	1	1	1	1		1	1	1
physical movement	1	0.725	1		1	1	1	1
intrapersonal	1	1		1	1	1	1	1
interpersonal	1		1	0.725	1	1	1	1
naturalist		1	1	1	1	1	1	0.990

Finally, Figure 3 shows the order of priority of multiple intelligence factors for the design of an information intelligence measurement model based on experts' opinions. Considering that the inconsistency index for the matrices of experts' opinions for the information intelligence model is less than 0.1, it is acceptable to accept these factors in the model (Figure 4).

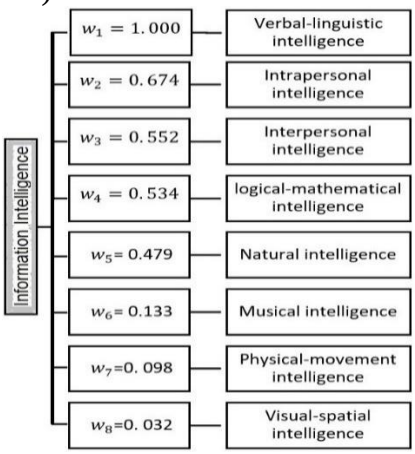
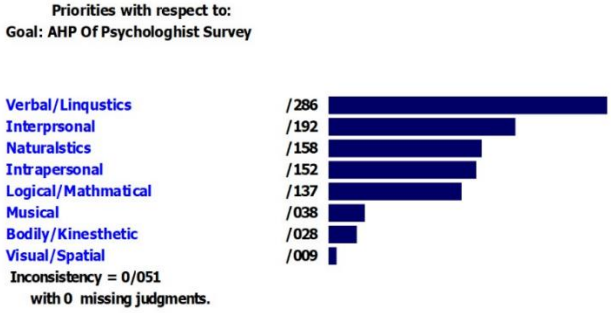


Figure 3. Priority of multiple intelligence factors to design the measurement model of informational intelligence



Library Philosophy and Practice
ISSN 1522-0222

Figure 4. The final weight of multiple intelligence indices

Figure 5 shows the sensitivity analysis of the efficiency of the effective factors in the information intelligence measurement model and the quality of the importance of the factors in general. According to the threshold value, the three indices of multiple intelligences, i.e., musical, physical-movement, and visual-spatial intelligence, are less important than other indices in the information intelligence measurement model. Therefore, the sub-indices of these three indices are not considered in the design of the information intelligence model.

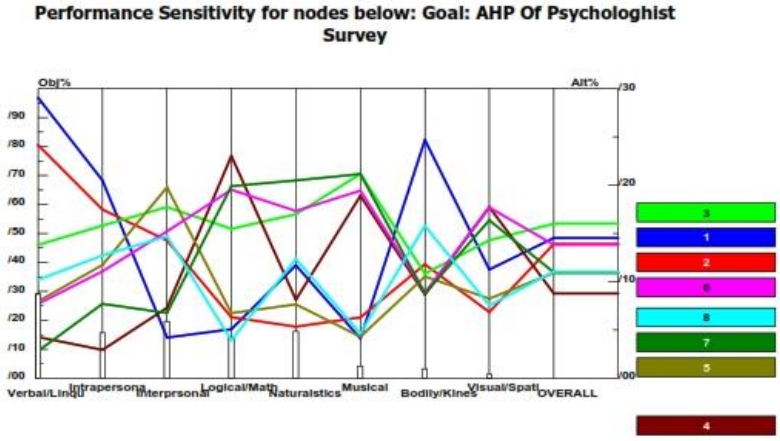


Figure 5. Diagram of sensitivity analysis of model efficiency

To design the information intelligence measurement model were determined the final dimensions, indices, and measures. Table 9 shows these items.

Table 9. Dimensions, indices, and measures of the final model for measuring information intelligence

Dimensions	Components and indicators				
Information recovery	**Need assessment**				
	Vocabulary comprehension	words	Use of vocabulary	Listening skills	Linguistic association
		Thought and revelation	Understanding another language	language comprehension	Understanding concepts
	Analysis				
	Voice recognition	boiling thought	logical perception	location Enjoy the music	Curiosity Musical fusion
	Search				
	handcraft	mobility	physical activity	location physical flexibility	Curiosity Limitation avoidance
	Assessment				
	Music Performance	Understanding music	Self-awareness	Self Knowledge	mental flexibility
	Application				
		Clear visualization	Record events	Interest in math	Numerical calculations
	Dissemination				
	Media - Comprehension	informational position	Certainty of information	Media activity	Understanding procedures
	Feedback				

Library Philosophy and Practice
ISSN 1522-0222

Dimensions	Components and indicators				
	Ability to resolve ambiguity	Understanding the hidden need	Continuity of communication	Emotion control	Flexibility
Data management	**Saving**				
	playing music	to remember	Record events	Interest in math	Mental calculations
	Organization				
	Understanding natural phenomena	Understanding natural relationships	Understanding natural essentials	A fan of nature	nature tour
	Work in nature	Nature study	Preference for natural things	Understanding information sources	between species
	Presentation				
	Teamwork	Advisory acceptability	Verbal transmission of information	Writing text	Use of vocabulary
	leadership	knowledge transfer	making friends	The body language	synergy
		pleasant voice	Musical instruments	group mobility	Comfort in the crowd
	Delivery				
	Social activity	Effective participation	Verbal communication	Understanding the law	Statistical ability

Finally, to design the information intelligence measurement model, multiple intelligence indices were considered as a reflection of information intelligence indices. It was also assumed that the experimental data can be explained or justified regarding the information and communication skills of librarians based on multiple intelligence indices. The information intelligence measurement model is based on pre-experimental information about the desired model structure. Based on this, the information intelligence measurement model was proposed (Figure 6).

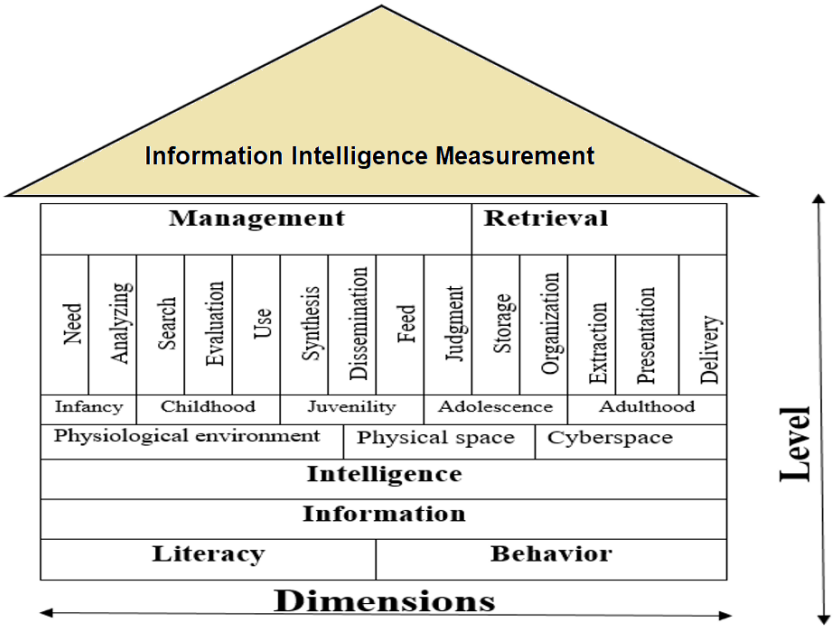


Figure 6. Proposed model for measuring information intelligence

Library Philosophy and Practice
ISSN 1522-0222

6. Discussion and Conclusion

Intelligence in Gardner's theory includes all human skills in life. The level of intelligence is important in facing life's problems and crises and learning styles based on intelligence. The theory of multiple intelligence is based on cognition and according to Gardner, learners expand their knowledge by creating a relationship between data and the latest information. The foundation of intelligence is based on the contents of the world and is independent of sensory models. For example, one can be blind but have visual-spatial intelligence; or he was deaf and had musical intelligence. It is important to respect individual differences in measuring intelligence. The low level of each of the skills cannot be an indicator of the overall intelligence of the person (Gardner, 2011). The unique features of the theory of multiple intelligences are a suitable basis for identifying indicators of informational intelligence. Therefore, based on this, it is possible to determine information intelligence measurement indicators. Here, to identify effective indicators and measures for measuring information intelligence, the first stage considered types of intelligence, information and communication skills, information literacy, and other characteristics of information-seeking behavior. It is notable that other types of intelligence, such as practical intelligence, emotional intelligence, moral intelligence, spiritual intelligence, and other types of intelligence, can also be considered for informational intelligence measurement indicators. Also, some kinds of intelligence can be considered under Gardner's multiple intelligences. For example, he placed emotional intelligence under extra personal intelligence, moral intelligence under intrapersonal intelligence, and external intelligence under logical-mathematical intelligence. Information intelligence as a new option of intelligence has an important application and there is a need for deeper studies to strengthen its theoretical and practical foundation. On the other hand, Spink, and Cole's dimensions of information-seeking behavior (2010; 2007; 2006; 2005) including information seeking, searching, giving meaning, organization, and application of information can be considered in the measurement of information intelligence. It is also noteworthy that the expansion of Gardner's multiple intelligence model by Spink to add another human intelligence as informational intelligence is a principal factor in measuring intelligence. There is a more comprehensive view of Gardner's multiple intelligence along with the combined intelligence by Petrides (2021). Based on this approach, information intelligence is related to the scope of information and a person's ability to understand the information problem and can determine information-seeking behavior. Although Spink specifically relates information intelligence to Gardner's multiple intelligences, the indices of information intelligence should be broader. Also, Spink believes that many aspects of information-seeking behavior are not known enough to justify information intelligence as a completely independent and accepted human intelligence. A model is concluded from the findings of this research, which is shown in figure 6 As this figure shows, the different dimensions of human and social perception presented in Spink's model have consolidated to create a more comprehensive view of the dimensions of informational intelligence. The human perceptual system is based on a set of perceptual-social mechanisms. It is concluded that the dimensions of Spink's (2010) social-cognitive abilities should be aggregated in informational intelligence so that the effective

dimensions and indicators in measuring informational intelligence can be separated. Then we can develop other indicators for informational intelligence, considering the types of intelligence and personality and demographic characteristics. Considering information intelligence as the first dimension of the human and social perception level of the Spink model (2010), it can be said that the cornerstone of information intelligence measurement is based on information-seeking behavior and information literacy. These two topics or skills are a subset of information, and intelligence is also based on the concept of information. The nature and level of information intelligence will be different depending on the information environment. Also, information retrieval and management, which are considered two dimensions of information intelligence, include at least fourteen indices. As mentioned before, two general dimensions can be considered for measuring information intelligence based on theoretical foundations and experts' opinions. These two dimensions include various indicators and measures. The set of indicators and measures effective in measuring information intelligence was determined after the steps of coding and extracting concepts from information intelligence indicators. Finally, fourteen indicators and ninety-seven effective measures in two dimensions of information intelligence are presented to measure information intelligence. In this research, the indicator refers to the factors that are considered the main criteria for measuring information intelligence. The meaning of the measure is the sub-criteria for measuring the main criteria. In the first level, the dimensions of information intelligence, information retrieval, and information management were determined. In the second level, effective indicators in measuring information intelligence are considered based on the theoretical foundations of information literacy and behavior. Then the effective measures in measuring informational intelligence are considered based on multiple intelligences. The initial expectation of the researchers for the final findings in this research was different based on the opinion of the experts. For example, some psychologists gave more weight to musical intelligence, and they believed that musical intelligence is very important in understanding and transmitting some information that cannot be transmitted in other ways. But the general result and the final processing of experts' opinions showed a different result and musical intelligence was not considered in the proposed model. Of course, maybe in other cultures and societies, the opinions of experts will produce different results and the model will be different. Of course, by conducting more studies, along with a better understanding of the characteristics of human information-seeking behavior, a more appropriate model for information intelligence can be provided by information-seeking behavior specialists. By adopting the integrated and multiple views of intelligence, we can reach a comprehensive framework of information intelligence. To measure information intelligence using the results of this research, each sub-criterion can be measured using different scales, including the Likert scale. The average scores obtained from the set of measurement measures of each indicator will indicate the level of information intelligence based on that indicator. The average score of all indices shows the general information intelligence of a person or organization. The measures are general and general concepts or information intelligence indicators. These concepts may be used in many other subjects, and it is possible to measure them with different scales. Some effective

measures in measuring information intelligence can also be considered effective indices. Of course, the difference they have with the indicators is that usually the indicators do not show the performance and are indicative of the result. It is notable that in information societies, officials must first determine their information strategies and then address the specific strategic goals of the information society. One of these strategic goals can be increasing the level of information intelligence of individuals, organizations, and society. For this purpose, effective and key indicators should be defined to measure and increase the level of information intelligence, and this should be one of the priorities of an information society.

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