Information Science as an Interdisciplinary Science

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Abstract

The purpose of this study is to examine what kind of science information science can be and whether the information science is interdisciplinary in nature. The key finding demonstrates that the field of information science has close relationships with the fields of computer science, information technology, human computer interaction, and other fields. With the advent of information communication and technology, the information science has shifted towards user-centered approach and it has played an important role in human information interaction. Therefore, information science would be defined as the interaction between users, information, communication, and technology.

Key words: Information science, Interdisciplinary, User-centered approach, Information Communication and Technology, Information Theory

บทคัดย่อ

วัตถุประสงค์ของบทความนี้เพื่อศึกษาว่าสารสนเทศศาสตร์จัดเป็นศาสตร์ประเภทใดและวิเคราะห์ว่าศาสตร์นี้มีความเกี่ยวข้องกับสาขาวิชาต่าง ๆ ในลักษณะเป็นสหวิทยาการ จากการศึกษาและวิเคราะห์พบว่า สาขาสารสนเทศศาสตร์เป็นศาสตร์ที่มีความสัมพันธ์ใกล้ชิดกับวิทยาการด้านคอมพิวเตอร์ เทคโนโลยีสารสนเทศ

* อาจารย์ ภาควิชาบรรณารักษศาสตร์; ประธานหลักสูตรปริญญาโทสาขาบรรณารักษศาสตร์และสารสนเทศศาสตร์; รองผู้อำนวยการบัณฑิตศึกษา คณะมนุษยศาสตร์ มหาวิทยาลัยรามคำแหง

ปฏิสัมพันธ์ระหว่างคอมพิวเตอร์และมนุษย์ และรวมถึงสาขาวิชาอื่นๆ โดยเน้นเกี่ยวกับระบบสารสนเทศ แต่สารสนเทศศาสตร์ยุคสารสนเทศและเทคโนโลยีสื่อสารมีการเปลี่ยนแปลงบทบาทที่สำคัญโดยเน้นการศึกษาด้านพฤติกรรมผู้ใช้สารสนเทศเป็นจุดศูนย์กลาง ดังนั้น สารสนเทศศาสตร์อาจจะถูกกำหนดให้เป็นศาสตร์ที่เกี่ยวข้องกับการปฏิสัมพันธ์โต้ตอบระหว่างผู้ใช้ สารสนเทศ การสื่อสาร และเทคโนโลยี

คำหลัก: สารสนเทศศาสตร์, สหวิทยาการ, สารสนเทศและเทคโนโลยีสื่อสาร, วิธีการที่ผู้ใช้เป็นศูนย์กลาง, ทฤษฎีสารสนเทศ

1. Introduction

Firstly, I would like to provide general definitions of information and science. Both definitions of information and science have broad concepts because they are subjective opinions depending on person, situation and environment at a specific time. Next, I will provide concepts of what information science is and what kind of science is information science. Finally, I will discuss history of the information science and how it has developed, information science as an interdisciplinary science including summary and perspectives concerning information science.

2. Definition of information

There are a plethora of definitions for information because this depends on how people see and perceive the world, including their environment, situations, and contexts, differently. Our interactions with our surroundings are interpreted and can generate the meaning of information. Therefore, information defined by people in a particular situation is rather subjective, but should have meaning, usefulness and accuracy. For instance, I watched the television warning about tornado. As a result, I had to buy some materials to protect my house or I need to move into a shelter. In this situation, “information is a power.”

However, the term information has many concepts and meanings, which many researchers have discussed and attempted to explain. Because information is tangible and intangible, Buckland (1991, p.352) classified its entity as thing and knowledge and its process as process and information processing. Information-as-thing includes “data, text, documents, objects, and events.” Information-as-process is “the act of informing and what one knows is changed,” while information-as-knowledge is “intangible that one cannot touch it or measure it in any direct way,” but it can be perceived in “information-as-process” and can reduce uncertainty.

Therefore, these three concepts of information can give a clear picture of what information is and how each concept is related in terms of entity and process. Barlow states that information is a phenomenon with three properties: an activity, a life form, and a relationship (as cited in Borgman, 2000). This shows that Barlow’s definition conflicts with that of Buckland. However, O’Connor, Kearns, and Anderson state (2008) that the terms of information can be used in a manner consistent with Shannon and Weaver (1949).

A very formal definition of information comes from information theory. It also provides a precise definition of information. This theory not only focuses on the measurement of information but also copes with the quantitative of bits and signal of messages that could be transmitted through in electronic communication (Littlejohn, 1989). According to Shannon and Weaver (1949), they create a model of information theory to represent the flow of information between senders and receivers as show in Figure 1.

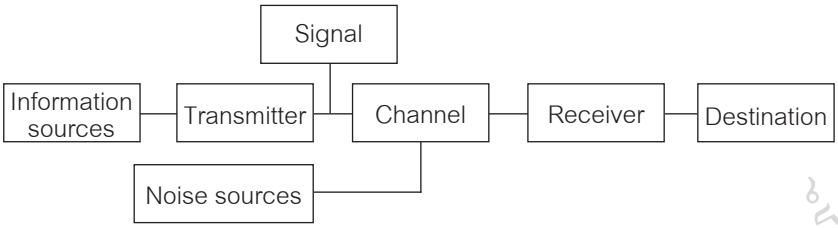

Figure 1. Shannon and Weaver's model of communication (1949)

A model of this information theory can apply for computing information quantities. Therefore, Shannon and Weaver define information in mathematical terms as below:

$$Information = H = \sum_{i=1}^{n} p_i \log p_i \quad \text{.....(1)}$$

Where Pi is the probability of occurrence of a symbol in a message system and the summation is over the number, n, of all possible symbols in a language or system of codes in use (Meadow, Bouce, & Barry, 2007, p. 38), information is a measure of uncertainty, or entropy, in a situation. The greater the uncertainty, the more the information (Littlejohn, 1989, p. 42).

Let me explain the formula (1) by rules of probability first. There are two rules: 1) the sum of probabilities of all events in a sample space equals 1, and 2) the value of the probabilities of sample has value from 0 to 1 (StatTrek, 2013). Therefore, I would like to take these rules to calculate an amount of the uncertainty presented in a message of Shannon and Weaver's model. Let H = an amount of the uncertainty presented in a message, and let H´= events of the certainty or redundancy.

By means of the rules of probability, P (H) is equal to 1- P (H´). Substitute .5 into this equation and subtract 1 from .5. The result is P (H) = 1-.5 = .5. Therefore, the entropy or information of in this situation is = .5 or 50%. The other example, let P (H) = .7; then, P (H) = 1- P (H´). Let substitute .7 into this equation and subtract 1 from .7. The result is P (H) = 1-.7 = .3. Therefore, the entropy or information of in this situation is = .7 or 70%.

This evidence indicates that the amount of information in Shannon and Weaver's model depends on the amount of freedom of choice, in selecting a message in any situation. That is, the greater the uncertainty, the more the information. This model is useful for the computer science to design system computer for sending messages and to measure the binary digits (bit) of information that could be transmitted in any message in quantified terms (Weller, 2008). Therefore, the measurement of the information in terms of bits is a system aspect.

On the other hand, Shannon and Weaver's model can be applied in for other fields such as behavioral and social sciences, often metaphorically (Littlejohn, 1989). In context of communication activities in human, people can receive information from many sources that have the power to "affect, reduce, or supplement a state of uncertainty to allow decisions to be made or communication to occur. Uncertainty has many circumstantial definitions, but in the context with which we are concerned, it can be construed as the probable amount of information available. The greater the uncertainty, the less information is available" (Borko, 2000, p. 41). Therefore, the meaning of this uncertainty opposes to Shannon and Weaver's uncertainty. This means that the uncertainty in terms of information seeking behavior refers to users lack knowledge, vagueness, and have the anomalous of states of knowledge (ASK) (Belkin, 1980).

On the other hand, the amount of presented uncertainty in Shannon and Weaver's model means that one has an amount of freedom of choice, in selecting a message in any situation (O'Connor, Kearns, & Anderson, 2008).

3. Definitions of science

Science is defined as an approach for generation of knowledge by using the systematic process of the scientific method. It also includes any systematic action that is carried out to answer research questions or meet other needs of developing a research domain, such as describing things, exploring, experimenting and predicting. However, philosophers and historians of science claim that science can also include other methods and activities that are carried out by researchers. Generally, they assume that there is a world out here that can be studied. Researchers will study many phenomena that are internal to people such as cultures, attitudes, and beliefs, as well as institutions that are either connected to people or external to them, such as universities and other physical environments. However, science has changed over time; science is dynamic and open new ideas and theories (Johnson & Christensen, 2004, pp. 14-17).

4. Definition of information science

Information science is a science that deals with information and human who use information and interact with it and technology to generate knowledge and activities. Borko (2000, p.22) defines information science as the following statements:

> *The discipline that investigates the properties and behaviors of information, the forces governing the flow of information, and the means of processing information for optimum accessibility and usability. It is concerned with that body of knowledge relating to the origination, collection, organization, storage, retrieval, interpretation, transmission, transformation, and utilization of information. This includes the investigation of information representations in both natural and artificial systems, the use of codes for efficient message transmission, and the study of information processing devices and techniques such as computers and their programming systems.*

Another definition of information science is “the study of the gathering, organizing, storing, retrieving, and dissemination of information” (Bates, 1999, p. 1044). Belkin and Robertson (1976, p. 202) state the basic phenomenon of information science as “the text and its associated information and the relationship of these to the sender and recipient.” The three basic phenomena are “information,” “the image structure of the recipient” and “the image-structure of the sender”. They define information science as “a specific concern with information in the context of human communication” (Belkin & Rolaertson, p. 198). Zins (2007, p. 336) quoted one interesting definition given by a scholar in the Critical Delphi study that information science should take “the phenomenon of message as its core perspective” because message and information are related concepts in the communication process when a message is coded and transmitted from the sender to the receiver. Focusing on the phenomena of data, information, knowledge, and message, he concludes the six models with a map of conceptions of information science that constitutes hi-tech, technology, culture/society, human world, living world, and living and physical worlds (Zins, 2007, p. 341).

5. What kind of science is information science?

Saracevic (1999, p. 1052) believes that information science is interdisciplinary in nature and has “a strong social and human dimension, above and beyond technology”. Moreover, it is concerned with a scientific knowledge. Information science is also related to fields like history, philosophy and sociology of science, as well as cognitive science. Hjorland (2002, p. 268) presents epistemology and dimension of cognitive science view information science (IS). He states that “epistemology knowledge from an interdisciplinary foundation for general theories about knowledge organization, information retrieval, and other basic issues in IS”. I agree with

Hjorland because epistemology is the theory or science of knowledge, “a broad and high-level outline of the reasoning process by which a school of thought performs its empirical and logical work” (Lee, 2004, p. 6). Moreover, epistemology studies the nature of knowledge and its significance in society. It attempts to explain the nature of the human information processing system, which is involved in the creation of knowledge by using scientific method. The more researchers understand about the representation of knowledge and how people use it, the better they can fulfill their key role in the information transfer process that created the relational systems of scientific facts, testing hypotheses and theory. Then, epistemology could be a science because it informed by the results and methods of science.

6. History of information science and its development

Information science is a young discipline dating back to more than 50 years ago when Institute of Information Scientists (IIS) was established in the United Kingdom (Ingwersen, 1992, p. 1). The phenomenon of “information explosion” that drove a scientific and technical revolution in the mid 20th century and this produced a huge growth of scientific and technical publications and information records of all literature (Saracevic, 1999, p. 1052). The 1945 article by Vannevar Bush is a milestone publication that he proposed a machine called Memex, which is “a prescient anticipation of information science and artificial intelligence” (Saracevic, 1999, p. 1053). In the 1950s, Saracevic (1999, p. 1057) comments that information science as a profession grew from research and applications in information retrieval. IR became the only approach in information science research for more than two decades. In addition to the IR system approach, since the 1980s, the research in information science has shifted to the user-centered approach with focuses on users, use, situations, context, and interaction with systems.

The period of 1977 to 1980 was a turning point for information science as a discipline. This period led the discipline more mature and well-defined since several significant publications profound analyses (Ingwersen, 1992, p. 9). Ingwersen raised some examples of publications: Belkin's analysis on the concept of information for information science in Journal of Document of 1978, and Brookes's foundation of information science in Journal of Information Science of 1980. In 1983 the most significant publication, another information science's milestone, is Machlup and Mansfield's The study of information. This book provides in-depth interdisciplinary analyses of approaches to information, as well as foci and scope with respect to various disciplines, such as cognitive science, computer science, library and information science, linguistics, cybernetics, information theory and systems theory. With the advent of the Internet and the World Wide Web in the 1990s, another phenomenon of information explosion has had an impact on information exchange between users and IR systems in terms of relevance (Saracevic, 1999).

Other developments of information science are the growth of the association, a scholarly journal, and schools in the field. The American Society for Information Science was founded in 1937 with its former name, the American Documentation Institute. ASIS has played a strong role in developing information science in the United States. The Journal of the American Society for Information Science (JASIS), the leading journal in this field, has published scholarly articles back to more than sixty years ago. Technology was added to the society and to the journal in the new millennium and now it is known as The Journal of the American Society for Information Science and Technology (JASIS & T).The name of schools of library science" or schools of library and information science" have been changed to ischool for some universities such as College of Information, University of North Texas, the iSchool at Drexel, School of Information Studies at Syracuse, to name a few.

7. Information science as an interdisciplinary science

Information is a science concerning all aspects of information (DeBons, & Otten, 2000, p. 36). This can link information science to relate itself to several disciplines. One of the three characteristics that Saracevic (1999) categorized information science is interdisciplinary in nature. According to Bates's basic definition of information (2005) as the pattern of organization of matter and energy, it can be implied that information is concerned with everything in the world. This can link information to "a variety of connotations in different fields" (Saracevic, 1999, p. 1054). For example, psychology used information as a variable for sensory perception or comprehension, while physics and biology have explored information as a basic property of the universe. Rayward (1998) concluds that the history of information science is an historical interdisciplinary. Norton (2000) states that information science has roots in a variety of disciplines. Therefore, the study of the information science is an interdisciplinary field ranging from library, computer, and cognitive sciences to sociology, economics, and statistics. Borko (2000) points out that either information science or interdisciplinary science derived from and related to such fields as mathematics, logic, linguistics, psychology, computer technology, operations research, the graphic arts, communications, library science, management, and other similar fields. More than that, the Information Science Abstract (ISA) defined information science as follows:

> *An interdisciplinary field concerned with the theoretical and practical concepts, as well as the technologies, laws, and industry dealing with knowledge transfer and the sources, generation, organization, representation, processing, distribution, communication, and uses of information, as well as communications among users and their behaviorc as they seek to satisfy their information needs (as cited in Hawkins, p. 49).*

Librarianship and information science have strong interdisciplinary relations as librarianship deals with how to organize, preserve, and use graphic records in print and other media, whereas information science is aware of the process of generation, representation, management, retrieval, and use of information (Ingwersen, 1992). DeBons and Otten (2000) conclude that "information science in the library science sense represents primarily a technology, with some science-oriented aspects that can be considered as sub-fields of the postulated metascience" (p. 36). Saracevic (1999) notes that research on OPACs tend to be more IR features that bring the two fields in closer relations. The name of "library and information science" is now commonly used. Information science is related to computer science in terms of "the application of computers and computing in IR, and the associated products, services, and networks" (Saracevic, 1999, p. 1060). In addition to library science and computer science, DeBons and Otten (2000) map other sciences and disciplines that are related to information science, namely, mathematics, linguistics, psychology, and engineering sciences.

8. Summaries and perspectives concerning information science

The scope of information science expands at present into digital society, and the discipline is reaching user-centered and system-centered approach in its evolution, with related fields such as computer science, cognitive sciences, psychology, education, communication, information technology, social science, and human computer interaction (Ingwersen & Jarvelin, 2005). Trends demonstrated in the information science literature such as JASIS&T, as well as the recent conferences such as ASIS&T annual conference, iConference, pointing to the future are as follows:

1. More interdisciplinary research in geographic information science, health informatics, social informatics, bioinformatics, and digital ecosystem.

2. More user-oriented issues in human computer interaction, taxonomy, and relevance.

3. The use of social networking such as Twitter for information sharing, Weblogs, Facebook, etc.

4. Information retrieval in Web searching and mobile phone search.

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