Mahdi Zeynali-Tazehkandi* and Mohsen Nowkarizi

A Dialectical Approach to Search Engine Evaluation

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"All things immovable and in motion"
Plato on knowledge in the Sophist (about 249 CE)

Abstract: Evaluation of information retrieval systems is a fundamental topic in Library and Information Science. The aim of this paper is to connect the system-oriented and the user-oriented approaches to relevant philosophical schools. By reviewing the related literature, it was found that the evaluation of information retrieval systems is successful if it benefits from both system-oriented and user-oriented approaches (composite). The system-oriented approach is rooted in Parmenides' philosophy of stability (immovable) which Plato accepts and attributes to the world of forms; the user-oriented approach is rooted in Heraclitus' flux philosophy (motion) which Plato defers and attributes to the tangible world. Thus, using Plato's theory is a comprehensive approach for recognizing the concept of relevance. The theoretical and philosophical foundations determine the type of research methods and techniques. Therefore, Plato's dialectical method is an appropriate composite method for evaluating information retrieval systems.

Keywords: information retrieval systems, system-oriented approach, user-oriented approach, dialectical method

1 Introduction

Traditionally, libraries and information centers were considered the only places where information resources were available to allow users to meet their information need. With the advent of modern information and communication technologies (ICTs), especially the World Wide Web, significant changes were made in the production, distribution, and access to information resources. In other words, the Web turned into one of the most important sources of information.

People around the world search information retrieval systems to fill a variety of their information needs. Thus, developing such systems that can make users meet their information need has become an important issue, both in popular and professional settings. However, not all information retrieved by information retrieval systems is relevant to users' information need. In this regard, the studies on the effectiveness of evaluation of information retrieval systems have been in focus for a long time, and have become even more important today. Effectiveness refers to the concept of "relevance". Thus, numerous scholars have tried to explain it, and various articles have been authored on the relevance and methods of evaluating information retrieval systems. Early research on the evaluation of information retrieval systems was published by the Royal Society Scientific Information Conference in 1948. A number of experiments have been reported in the UK, the US, and the Netherlands. In 1962, Cleverdon began conducting a series of experiments on the evaluation of information retrieval systems, known as Cranfield's experiments in which attention was drawn to the correspondence between the queries and the documents, known as the system-oriented approach (Saracevic 1975). After a while, this approach was criticized by a number of information retrieval researchers (Taube 1965; Vickery 1959), which led to the formation of the user-oriented approach. In the user-oriented approach, user satisfaction is the focus of the evaluation of information retrieval systems (Hjørland 2010; Saracevic 2007). Finally, the latter was identified as an appropriate approach. In recent years, the user-oriented approach to relevance has also been challenged by a number of researchers (Budd 2004; Dick and Weckert 2003; Hjørland 2010). In the view of Bates (2002), layers of understanding include spiritual, aesthetic, cognitive, social and historical, anthropological, biological and chemical, physical, geological, and astronomical. She concluded that a more thorough understanding of information seeking behavior in relation to information searching requires attention not only to several levels of human existence but also to the social and/or

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***Corresponding author: Mahdi Zeynali-Tazehkandi**, Department of Library and Information Science, Ferdowsi University of Mashhad, Mashhad, Razavi Khorasan 54391-59543, The Islamic Republic of Iran, E-mail: ma.zeynali@mail.um.ac.ir
Mohsen Nowkarizi: Department of Library and Information Science, Ferdowsi University of Mashhad, Mashhad, Razavi Khorasan 54391-59543, The Islamic Republic of Iran

individual perspectives. Hence, some researchers have proposed a mixed approach. In this way, while referring to these approaches and expressions of relevance, they introduced the cognitive approach which is an appropriate one (Hjørland and Christensen 2002). Capurro and Hjørland (2003) have proposed a hermeneutic approach which they believe is an approach that appropriately embodies both pragmatic and social approaches. Saracevic, as a prolific researcher in the field of relevance, described the relationship between logic, philosophy, and communication. He also referred to the dynamic and dualist models of relevance (Saracevic 2007). He believes that both the system- and user-oriented approaches have failed, and the success of research in information retrieval assessment lies in considering both approaches.

Hjørland (2010) analyzed the philosophical foundations of relevance. He initially analyzed two approaches to the study of relevance and identified each one's weaknesses. This study is one of the first researches in which the user-oriented approach is criticized. He eventually discussed the organization of his knowledge.

In another study, Huang and Soergel (2013) tried to explain the factors that affect relevance. They considered "topic relevance" as the core of relevance. It is also believed that the two existing approaches are not contradictory, but complementary. Consequently, an approach should be used in the study of relevance that is comprehensive in the two approaches.

Against this backdrop, in research on evaluation of information retrieval systems, attention to both objective and subjective approaches to relevance as well as using an integrated approach is increasingly felt. In other words, in assessing the relevance of the documents to the information need, both system- and user-related factors should be taken into consideration. A cursory look at the literature review demonstrates that both types of factors and both approaches are in progress. In this regard, Saracevic (2015) emphasizes that relevance is timeless and concerns about relevance will always be timely. Therefore, the question addressed in the present study is which approach involves both objective (system-oriented) and subjective (user-oriented) approaches.

Research in all fields follows a series of epistemological foundations (the researcher may not refer to its epistemological basis or may be unaware of it). Strictly speaking, ontological assumptions are the basis of epistemological assumptions and underpin the emergence of methodological considerations, which in turn describe the rules that deal with practical techniques of research. Therefore, research methods deal not only with the technical rules such as sample selection, data collection, and data analysis but also with an understanding of the world, the researcher's goals, and strategies shaped by his worldviews. The present study investigates critically two approaches in the field of relevance. These are system-oriented (objective) and user-oriented (subjective) approaches. The philosophical and theoretical foundations of the two approaches are identified, and, as a result, a composite method is suggested for assessing information retrieval systems (especially search engines), based on the philosophical foundations.

1.1 Relevance

The concept of relevance plays an important role in information retrieval. While we all perceive this concept intuitively, it is still difficult to provide a precise definition of it. More than 160 researchers have tried to explain the concept of relevance (Lavrenko, 2008). It could be said that there are as many different definitions of relevance as the number of researchers. In the following, several sources of differences in attitudes toward relevance are explained (Mizzaro 1997):

1.1.1 Changing the Meanings of Object and Subject in Philosophy

During the nineteenth century, the existence of mind apart from the body was challenged and the concept of mind was transformed into a new and completely radical one (monism) (Olafson 2017). It seems that this change had an impact on the field of library and information science. While Park (1993) regards the topic relevance—the relationship between the citation's subject and the question's subject—as subjective relevance because users interpret the documents in their own way and select the relevant ones, Saracevic considers it as objective relevance (Saracevic 2007).

1.1.2 Differences in Philosophical Schools

Differences in philosophical schools lead to differences in attitudes toward relevance. While Foskett (1972) considers the sociological and positivist approach as an appropriate paradigm for defining relevance and refers to the notion of society, Bookstein (1979) has an existentialist tendency and refers to the individual. For Schamber, Eisenberg, and Nilan (1990), situation is an appropriate alternative to Foskett's society and Bookstein's individual. Goffman and Newill (1966) have a pragmatic attitude. In their view, documents may be pertinent but not relevant. Huang and

Soergel (2013) argue that a document is pertinent only if it is relevant.

1.1.3 Difference in the Attitude Toward Relevance or the Mixture of Relevance and Relevance Judgment

Just as Jaspers who makes a distinction between truth and truth-recognition (Brun 1998), Bookstein (1979) and Mizzaro (1998) differentiate between relevance and relevance judgment. Relevance is a matter of ontology while the relationship between the subject (relevance judger) and the object (relevant documents) is a matter of epistemology. Although epistemology and ontology have an ineluctable relationship, they are independent entities. Ontology deals with the nature of knowledge and objects, while epistemology deals with the relationship between knowledge and subjects.

1.1.4 Difference in Attitude Toward Information Need

The two concepts of relevance and information need are interrelated. Relevance is directly related to the cognizer who articulates the query (again objectivity and subjectivity) and information need, as Schamber, Eisenberg, and Nilan (1990) put it, is directly related to the concept of relevance, and users pay attention to their retrieved results according to their information need. Type of attitude toward the information need has a significant impact on the type of relevance. While many researchers, among them Wilson, consider information need as a secondary need evolved from a primary one (Naumer and Fisher 2010), others with an existentialist orientation consider information need as a primary one (Ma 2012). Furthermore, debates on information need and query are related to information seeking processes.

Against this backdrop on differences and attitudes toward relevance, studies on relevance have elaborated the two system-oriented and user-oriented approaches as shown below.

1.2 System-Oriented Approach

A system-oriented approach has been used in many information retrieval evaluations. The main studies on information retrieval (from the Cranfield studies in the 1950s and the 1960s to the evaluations of the Text Retrieval Conference (TREC) in the 1990s) are based on this very approach (Saracevic 1996) and are rooted in a physical (mechanical) philosophy (Capurro and Hjørland 2003; Cooper 1971). In mechanical philosophy, one must remember the famous philosopher of the School, Parmenides, who presented the philosophy of being (Fitt and Freeman 1983; Nehamas 2017).

In Parmenides' philosophy, one who exists is existing and cannot be non-existent, and one who does not exist is non-existent and cannot be existing; for Parmenides, existence has an absolute meaning; an object either exists or not (Fitt and Freeman 1983; Guthrie 1962). In a similar way, in the judgment of relevance for which this approach is used, each document is either relevant or not (Bookstein 1979; Borlund 2003; Lavrenko 2008). According to Parmenides, one who exists can also be thought about, known, expressed or named, what cannot be done for the non-existent. True, what is known and expressed exists, but this is revealed to him by a goddess (Cornford 2014). As such, in information retrieval evaluations of the Cranfield and TREC experiments, a number of experts were assigned to identify the relevant documents (Harter 1992).

The third case, which is very important for Parmenides, is that everything is stable and unchangeable (Guthrie 1962). Information need is viewed as stable (Borlund 2003). With little connivance, it can be said that Aristotelian logic is similar to this philosophy. What matters to Aristotle is reason and cognition (one may like to note his *Categories*); he used a deductive method to achieve recognition and obtain the truth, and did not pay much attention to induction (Groarke 2016). In deductive logic, there are two premises to reach a logical conclusion; in other words, a rational individual concludes through understanding two premises. However, this idea has adverted attention only to the output in the evaluation of information retrieval systems, using a one-way strategy for searching and ignoring the interactive process (Saracevic 1996). To use the deductive method, it is necessary to have access to both the information need and the retrieved documents, which should be submitted to the experts to assess.

In a system-oriented approach, a concept is defined rigorously, logically, and mathematically, and a concept may be defined in a mathematical way. This can be said to be the job of a reductive method. For ease of understanding, a complicated concept, known as "the whole unit", can be divided into its components (Chen 1975). In this context, the information need is considered equal to a query, and a query is specified in a written expression of the information need. That is, the information need is equal to a request (Swanson 1986). In studies on information retrieval for which this approach has been used, the information need is initially converted into queries which are entered into the system. The retrieved documents (or their

bibliographic records) are stored, and then the requests and the documents (or their representations) are submitted to experts to assess their relevance.

In a system-oriented approach, information retrieval is viewed only from the vantage point of the system and the user is relegated to a secondary position. This approach is based on the experimental and traditional information retrieval models in which the ways the documents are processed and the extent to which they match the query are important (Saracevic 2007). Therefore, relevance is considered as an attribute of the system, and much attention has been paid to the acquisition, representation, organization, and the matching of the documents and the requests (Saracevic 1996). As such, what is meant by relevance is the relationship between a query and a document, implying that relevance has an objective and independent nature and is operationally constant because it is independent of the conditions of retrieval or the knowledge of the person posing the query.

The system-oriented approach has been criticized. Some researchers believe that information can never be objective, that is, the truth and meaning of information are always subject to free impressions of the text. It is suggested in this view, along with other concepts, that any expert's advice is questioned (Case and Given 2016). In addition, according to Swanson, anyone who opposes the user's judgment is absolutely making a mistake (Swanson 1986). Some researchers (Harter 1992; Ingwersen 1992) argue that the information need is not stable, but rather a kind of momentary mental situation which, in fact, is renewed momentarily.

Mizzaro (1998) mentioned a drawback in the system-oriented approach. He argued that in information retrieval evaluation, information need is not equivalent to the need entered into the system. The approach is further criticized in that the users are represented only by their query, and their other aspects are not considered (Saracevic 2007).

According to Swanson (1986), the relationship between a document and a request is not objective (whether a person considers it relevant or not); it is subjective because both the document and the request are the products of the human's mind. In addition the system-oriented approach ignores the users' mental state flux when they interact with the system (Borlund 2003; Hersh 1994). Consequently, it seems that this approach is very unrealistic in nature (Harter 1992).

Another line of criticism is that Hjørland and Christensen (2002) addressed questions from the exact sciences, such as the medical sciences, and the abstract sciences were neglected. In fact, information need is not limited to exact or objective sciences. Swanson (1986) pointed out this issue when he stated that the idea of objective relevance would be clearer when it comes to the question of the physical world. The system-oriented approach is also criticized because it adopts a simple binary perspective of being or not being, relevant or not relevant (Borlund 2003).

1.3 User-Oriented Approach

In 1959, Vickery initiated discussing the appropriate definitions of relevance when he differentiated between subject relevance and user relevance (Mizzaro 1998), and especially when a shift of paradigm occurred from the Cranfield's physical and mechanical paradigm to the Belkin's cognitive "Anomalous State of Knowledge", as well as Ingwersen's cognitive perspectives (Capurro and Hjørland 2003).

In the user-oriented approach, the overall purpose of information retrieval systems is to provide relevant documents or their substitutes to the users. Thus, the user is the focus of attention. As suggested in this approach, information retrieval systems should be designed appropriately for the users. As such, relevance is what the users perceive in their procedure of information behavior (Park 1993). In this approach, relevance is related to the users' psychological states (Harter 1992), social dimensions (Saracevic 2007), and individual status (Bookstein 1979). Different authors have described this approach to relevance as pertinence, utility, usefulness, and psychological relevance (Swanson 1986). In the user-oriented approach, relevance is inherently related to the mental process (Park 1993; Saracevic 2007).

The origin of the user-oriented approach traces back to the philosophies of Heraclitus and Protagoras. Heraclitus' philosophy of nature is commonly synthesized by variations of the statement "No man can enter twice in the same river because the river's water is always flowing" (Stace 2010, 91). In other words, everything is transient and evolving (Nehamas 2017).

By the same token, information need is transient. In other words, if a person needs some information in time A, he will need other information in time B; it is a kind of cognitive and emotional state of mind that an individual has at any moment, and, in fact, is renewed instantly (Harter 1992). During the interaction with the system, the individual's information need changes (Saracevic 2007). Some researchers have gone beyond this. For example, Swanson (1986) believes that the main value in the information retrieval process is not in the use of documents, but rather in re-designing a query; therefore, the information retrieval process is an endless iterative one. On the other

hand, if the basis of the information retrieval is re-questioning, the aim of the system will be to discover the users' information need – a one-way look. The user-oriented approach argues that an individual's information need is not solved by a single or set of documents, but rather throughout the search process. In fact, it is the interaction with the system that serves to meet the user's information need. Here, the critique is that relevance is not the main problem of human-computer interaction, but the problem of human interaction with recorded knowledge (Hjørland 2010). It should also be added that interaction is not relevance, but rather relevance involves interaction.

In this study, the pre-Socratic philosophers' perspectives are employed to explain this topic. Heraclitus and Parmenides are famous pre-Socratic philosophers (frequently categorized as Sophists). In Heraclitus' philosophy, cognition is related to perception. Therefore, the users use the documents considered relevant based on their own recognition. To illustrate the issue, suppose a user needs information and three documents. First, he is asked to identify the relevance of the documents, and he identifies A as irrelevant and B and C as relevant. After reading the documents, he is asked to re-identify the relevance of the documents; but this time, he identifies A as relevant. This is the same flux of relevance pointed out by Borlund (2003). According to this approach, what is important is our perception and cognition, and not the existence of relevance. There are different phenomena in the world; according to this approach, if we do not identify them, it is implied that they do not exist, and they come into existence with our perception.

According to the user-oriented approach, rooted in Protagoras' human-centered philosophy, only the users can judge the relevance of the documents to their information need (Bookstein 1979; Borlund 2003). According to Protagoras, man is the measure of all things (Fitt and Freeman 1983, 118). However, Hjørland (2010) believes that this statement is a superficial logic (cheerful and bad), the development of which puts more risks on information science.

In the user-oriented approach, information need is considered equal to the demands and opinions of the individuals, but the demands of individuals may not correspond to the truth. In fact, need is not always equal to demand, because people may wish for something while they do not need it and vice versa (Derr 1983; Naumer and Fisher 2010). An economic view of information need is not suitable for evaluating relevance. In this approach, it is believed that the users' satisfaction should be the cornerstone of designing and evaluating the information retrieval systems (Cooper 1971), a view criticized by Huang and Soergel (2013). Hjørland and Christensen (2002), in their critique of this approach, took non-interactive relevance into consideration and demonstrated that when a person has a reason for accepting a particular proposition, the correctness of the reason is not due to his success in the discussion. The reason may be correct, even if it does not convince him, or incorrect, even if he thinks it is correct.

According to the user-oriented approach, humans have a wide range of structures in mind that constructs their model of the world (Ingwersen 1992). Therefore, two different viewpoints about a single topic require different information and, at a deeper level, different relevance criteria. Thus, recipients at varying levels may perceive a single text and message differently (Spink and Cole 2005). It is possible that a document and a text are considered as relevant by one user and irrelevant by another. It is only the user who can judge the relevancy (Harter 1992), i.e. whether the document is relevant to one user and irrelevant to another; this refers to Heraclitus' relativity of the unit (Nehamas 2017), which can be pleasant for one individual and painful for another. This argument leads to the fact that truth is also relative. In other words, relativism is represented as a substitution for certainty and is expressed as a strong view in which no truth is independent of mind. However, this view has been rejected by Budd (2004) and is not an appropriate perspective for information science and the issue of relevance.

2 Relevance: Stable, Flux or Both?

The system-oriented (objective and stable) and user-oriented (subjective and flux) approaches to relevance are discussed in several studies (among them Bookstein 1979; Borlund 2003; Budd 2001; Hjørland 2010; Spink and Cole 2005). In his studies on relevance, Saracevic (2007) states that advocates of each approach have failed in their challenge with the other. In particular, he argues that Dervin and Nilan have gone astray by choosing merely the user-oriented approach, and the proponents of the system-oriented approach have gone astray by ignoring the side of the user-oriented approach. In support of Saracevic's arguments, Hjørland (2010) states that the system-oriented experiments of Cranfield cannot be viewed as an effective approach to relevance. He also discusses contradictions and disagreements in the user-oriented approach. Indeed, the two approaches are not contradictory. The main problem is how we may use them integratively for both to become effective (Saracevic 2007). Huang and Soergel (2013) also agree that both approaches are complementary. In philosophical studies (including Annas 2003; Brookes 1980; Sorabji 1974), the dualist

philosophers have paid attention to both stability and fluctuation; for them, not only these two approaches are not contradictory but also are complementary.

3 Plato: A Dualist Philosopher

It was mentioned earlier that the system-oriented approach emanates from Parmenides' mechanical philosophy, and the user-oriented approach is rooted in Heraclitus' flux philosophy. By reviewing the related studies (Annas 2003; Brookes 1980; Sorabji 1974; Stannard 1959), it can be concluded that Plato accepts the Heraclitus multiplicity, but restricts it solely to the tangible (sensible) world – the realm of existence and corruption – and interprets Heraclitus' arguments in this range of tangible (sensible) knowledge. On the other hand, Plato accepts Parmenides' unity, but restricts it to the realm of reason – the real world, or the world of forms – and connects Parmenides' arguments which imply stability and unity of "existence" to the existence of ideas. In addition, Plato believes "the philosopher, who pays the highest honor to knowledge, must necessarily, as it seems, because of them refuse to accept the theory of those who say the universe is at rest, whether as a unity or in many forms, and must also refuse utterly to listen to those who say that being is universal motion; he must quote the children's prayer, all things immovable and in motion, and must say that being and the universe consist of both" (Plato 1914). Therefore, Plato is a dualist philosopher whose theory includes both Heraclitus' flux and Parmenides' stability.

Typically, every school of philosophy consists of three components of ontology, epistemology, and methodology. Ontology discusses the nature of the truth. What is the absolute truth? What is the nature of the truth? Epistemology, the theory of knowledge, deals with how the world can be identified, and what is the relationship between the researcher and the research findings. Methodology is a set of processes and rules that guide the researcher in order to find answers to the research questions (Connaway and Powell 2010). Among the existing philosophical schools, Platonic philosophy has been identified as an appropriate one for evaluating information retrieval (judgments of relevance); thus, the methodology proposed by this school is believed to provide more comprehensive results than other methodologies do.

Moreover, due to the insufficiencies of quantitative and qualitative research methods, the mixed-method has been proposed (Creswell and Clark 2017; Greene and Caracelli 1997). Mixed-method research integrates the qualitative and quantitative methods in one study to improve the quality of the research (Creswell and Creswell 2017; Ma 2012). Fidel (1993, 2008) analyzes the characteristics of quantitative and qualitative methods in information retrieval studies. There, he has attributed the system-oriented approach to the quantitative, and the user-oriented approach to the qualitative method. The dialectical method is an appropriate method to evaluate information retrieval because, first, it offers mixed method research (Creswell and Clark 2017; Greene and Caracelli 1997), and, second, it is suggested by the researchers in the field of information retrieval (Thornley 2012; Thornley and Gibb 2007) for evaluating information retrieval systems. For the purpose of the study, the use of Plato's dialectical method is offered to evaluate information retrieval systems which is elaborated in more detail below.

4 Dialectical Method

The term "dialectics" consists of "dia-" which means "dual" or two (Online Etymology Dictionary 2001; Runes 1948, 78), and "-lectic" (or "-legein") which means "speech" or words (Runes 1948, 78; Wiktionary 2019). Dialectics is a method of philosophical reasoning that involves some sort of contradictory process between opposing sides (Anderson 1997, Online Cambridge Dictionary 2020; Runes 1948, 78). Hence, dialectics refers to two opposites, and in this way two quantitative and qualitative methods, also called opposites, are placed and composed together (Hegel and Marx have, more recently, represented dialecticians). Accordingly, a dialectician is a person who can see unity in plurality, and plurality in unity.

A dialectical method includes two stages: collecting and dividing (Murray 1988; Stannard 1959). Reviewing the related studies (for example, Anderson 1997; Murray 1988; Runes 1948; Stannard 1959) shows that the first stage (collection) is tagged with different labels such as gathering, collection, composition, aggregation, and ascending dialectic, and the second stage is commonly referred to as division. In the aforementioned studies, more attention is given to the second stage (division). In other words, the first stage can be called induction and the second stage deduction.

In Platonic dialectics, both the objects of sense and the objects of intelligence are considered (Anderson 1997; Annas 2003). Plato's philosophy is based on the existence of the universe, and the sense of objects has been included and the examination of sensible objects was the starting point for his philosophical research.

It may be concluded that Plato was committed to the dialectical method until the end of his life. He pointed out that in any particular research; there was no more clear and no more precise method than accessing a single form

through numerous examples and setting all examples in the same way as that single form. In other words, in a dialectical method, the individual's knowledge is used to move up from the details of the multiplicity and dispersion to the unity (the form), i.e. stage of collection, and then to move back from the unity to the multiplicity (stage of division).

5 The Dialectical Method for Evaluating Information Retrieval Systems

5.1 How to Select the Search Engines

First, identify and prepare a list of search engines. Then, visit their webpages and examine them for various characteristics, including their history, accessibility, information retrieval facilities, number of indexed webpages, non-promotional activities, and methods for retrieving relevant results.

Previous investigations on search engines can also be used as a selection criterion. The rank of each search engine on ranking websites such as Alexa may also be considered as a selection criterion.

In quantitative research, the theory is often confirmed or rejected, so they are called conservative, while in qualitative research, new theories are formed and new variables are known, so they are called progressive and innovative (Kothari 2004).

As the suggested method in the present study is of a dialectical type, both quantitative and qualitative methods serve for selecting the search engines. Selecting search engines (based on the previous studies and their ranking on Alexa ranking website) and visiting their webpages to examine their characteristics form the quantitative and qualitative phases of the study, respectively.

5.2 How to Select the Subject Headings (Formulating the Simulated Work Tasks)

As stated above, the system-oriented studies are rooted in Parmenides' philosophy. Parmenides believed in the stability of the world. Therefore, in the system-oriented studies, there is no change during the process of converting the information need into a query, and information need is equal to the query or the query phrase. This is so, while in the user-oriented studies, the information need is different from the query. Thus, in system-oriented studies, the query is used to evaluate information retrieval. By contrast, in user-oriented studies, information need is used to evaluate information retrieval.

In the dialectical method, due to the belief in stability and flux, both system-oriented and user-oriented approaches are considered. It should be noted that the users are in a difficult situation and need information for some form of solution: this, in the field of information retrieval, is called "information need" or what Mizzaro (1998) called "real information need" because it is stable. The users perceive the real information need and build the Perceived Information Need which implicitly represents (in the mind of the users) that challenging situation. Moreover, the users may not perceive correctly their real information need. It may be possible that the users' perception of the challenging situation changes over time. As such, the perceived information need is in flux and changeable. As a result, in a dialectical method, simulated work tasks (SWTs) are used. SWTs are work, profession, or occupation-related tasks that are performed to achieve a goal, such as tasks related to education, travel, parenting, etc. (Byström and Järvelin 1995). These tasks are performed to create information need close to real-life situations.

Lewandowski (2012) suggested selecting 30–35 subject headings or keywords from a subject heading list or thesaurus for the SWTs selection not to be arbitrary. In this regard, divide the subject heading list or thesaurus into an equal number of classes previously considered and then specify one page from each class, using the Rand Corporation's "A Million Random Digits" Table (Connaway and Powell 2010, 121). Open the specified pages in the subject heading list and blindly select one Preferred Subject Heading (PSH). Depending on the selected subject headings, formulate the SWT in consultation with experts in the field of information science. The following is an example:

5.3 An Example of an SWT

Assume that you have graduated. You may like to write and submit your resume in response to a recruitment ad or to a job-seeking agency, but you do not know how. Thus, you need to study the appropriate resources on how to write a resume and proceed with subsequent steps.

> **Guidance**: Copy the URLs that help you write the resume in a word document.

5.4 How to Select Judgments (Participants)

In quantitative studies, the sample size is calculated using specific formulas such as the Cochran formula. Accordingly, for a population of more than 20,000, a sample of 375

people is suggested. In qualitative studies, the sample size ranges from five to 20 people (Connaway and Powell 2010). As the population of the users of search engines is over 20,000 people and the suggested method is a dialectical one (Creswell and Clark 2017), it is suggested to select, via random stratified sampling, 150–200 people with different educational levels, in different fields, in a range of ages and genders. A stratified sample is suggested because factors such as age and gender (Vakkari and Järvelin 2005), educational level (Huang and Wang 2004), and field of study (Davidson 1977) are believed to affect the process of information retrieval.

5.5 Research Implementation Process

After preparing SWTs, two tasks should be specified in each search form and submitted to the participants along with search instructions. Participants should be asked to go through the SWTs so as to formulate the information need they have in mind. They should then be asked to search the target search engines to meet the information need, read the retrieved websites, copy the URLs from any websites, and record them in an electronic search form. Finally, the participants should be asked to send the completed form to the researchers' email address which has already been provided to them.

5.6 Sorting URLs (Excel Data Entry Forms)

After collecting the search forms, it is suggested that the researcher create an Excel file with three columns (participant-selected URLs, the related search engine, and the frequency of each URL). For each of the SWTs, an Excel worksheet (PSH) should be created. As such, the retuned search forms are checked, and then each participant-selected URL and the related search engine's title are copied into the appropriate columns.

While inputting the participant-selected URLs into the Excel file, they should be ordered alphabetically so that the frequency of each URL can be easily calculated. In so doing, the frequencies in every worksheet can be calculated.

5.7 Determining the Relevance of the URLs

In order to estimate measures such as precision, recall, and normalized discounted cumulative gain (NDCG), etc., the relevancy of each URL should be calculated on a range from 0 to 1. To rescale our data, we can simply calculate using the following formula (Jain and Bhandare 2011; Jain, Nandakumar, and Ross 2005):

$$z_i = \frac{x_i - \min(x)}{\max(x) - \min(x)}$$

where x (x_1,…, x_n) and z_i are now our ith rescaled data. As the relevance score of a URL may be zero, the following formula can be used:

$$\text{Relevance score of } n \text{ URL in } A \text{ SWT} = \frac{\text{The frequency of } n \text{ URL in } A \text{ SWT}}{\text{The highest frequency in } A \text{ SWT (of a URL)}}$$

For example, if the URL "*n*" for the SWT "*A*" has been selected five times by participants and the URL "*m*" which was selected 15 times had the maximum frequency of selection, then we would have:

$$\text{Relevance score of } n \text{ URL in } A \text{ SWT} = \frac{5}{15}$$

In this way, the relevancy of URLs is determined and it is possible to calculate the measures and compare the effectiveness of the search engines.

6 Discussion and Conclusion

Before designing a research and deciding on its methods, it is necessary to determine its sample size and strategies, the basic assumptions of our epistemological and ontological definitions.

Epistemology is the basis of assumptions which, in turn, is the basis of the methodologies used for collecting, analyzing, and interpreting data (Connaway and Powell 2010). In line with this, Wilson (2002) claims that research carried out without philosophical inquiry is merely doing things, rather than robust research. On the other hand, Hjørland (2010) states that the understanding of the relevance concept without a philosophical foundation is limited. Saracevic (1996, 1975, 2007) has always tied the notion of relevance to epistemology. This is why the philosophical understanding behind doing research in the relevance area is of increasing importance and why in this paper initially the two approaches to information retrieval – system-oriented and user-oriented – were examined from a philosophical perspective.

The system-oriented approach has its origins in Parmenides' mechanical philosophy in which the world is seen as stable and unified. In this approach, the information need is equal to the questions fed into the system, but the mental change of the users and their knowledge structure is almost ignored. In contrast, the user-oriented

approach is rooted in Heraclitus' flux philosophy which states that "you could not step twice into the same river" and everything is transient. In this approach, the world is moving and everything is in flux and changing. In line with this, Mizzaro (1998) proposed four levels of need in which changes are taken into consideration when the information need changes into the query. Furthermore, based on the user-oriented approach, any document may sometimes be relevant to an individual and sometimes irrelevant. This brought us to the conclusion that these two approaches oppose each other. Nevertheless, according to Hjørland (2010); Huang and Soergel (2013); Saracevic (2007), in the field of relevance only the studies which use a composite approach are successful. Thus, the use of theory in the field of information retrieval is recommendable, provided that both the system-oriented (Parmenides's stability) and the user-oriented (Heraclitus's flux) approaches are used.

As Plato accepts Heraclitus' view of absolute flux and change and connects it with the sensible world in which nothing is constant and permanent, it is an ongoing flow. At the same time, he defers to Parmenides' unity, but confines it to the world of intellect, the real world, or the world of forms, and connects Parmenides' arguments about the stability and unity of "existence" with the existence of ideas. Therefore, using the Platonic theory is a comprehensive approach.

In applying the theories of Heraclitus, Parmenides and Platonic theory to the evaluation of information retrieval systems, it can be concluded that reading the documents changes the participants' worldview and knowledge structures. A change in their knowledge structures results in a change in their criteria for judging the document's relevance; in a similar way, the document's relevance to the information need will also change over time. Moreover, situating the same person in the same position (the situation before creating the need) after reading a series of documents will create an information need different from the one perceived at the time (t_1). In other words, the change in the experience and type of a participant's perspective can be interpreted within the framework of Heraclitus' theory of flux. Furthermore, while the documents remain the same, the participant's judgment changes over time; put it another way, a document may be recognized as irrelevant at the time (t_1), while it may be judged as relevant at another time (t_2) after reading several other documents. However, there is no change in the document and this lack of change in the document is Parmenides' "stability". As a result, Plato's dualist theory can resolve the contradiction between the two approaches, i.e. system-oriented and user-oriented.

The issues related to the concept of relevance are interwoven with the essence of cognition. Thus, Plato's theory is a comprehensive one involved with the essence of cognition (the concept of relevance). However, merely investigating the concept of relevance is not enough; the main concern is what method is more comprehensive for evaluating the information retrieval systems. Since epistemology and methodology are interconnected, the type of attitude towards knowledge determines the way of attaining knowledge. Plato's theory helps the concept of relevance to be recognized as a comprehensive approach; by way of deduction, using his method of attaining knowledge is also a comprehensive one. Plato proposed the dialectical method to attain knowledge. As a result, it can be argued that a dialectical method is a comprehensive approach as long as it addresses all aspects of the information retrieval process. The dimensions of information retrieval are storing, indexing or coverage (crawling), information retrieval capabilities (user interface), posing questions (recommending system), information retrieval algorithm, and document displaying and ranking method.

Based on the dialectical method, the participants are provided with SWTs and are asked to search for their information need arising from SWTs in information retrieval systems (such as search engines), and then to copy and paste the relevant document links into the search form. The more a document is considered relevant by the participants, the more the relevance assigned to the document is, and any information retrieval system which can retrieve more relevant documents is recognized as a more efficient system. In the dialectical method, participants in the natural environment carry out the search; thus, a successful information retrieval system will actually recognize the users' information need and retrieve relevant documents. Hence, in this method, all the characteristics of the information retrieval process are seen in relation to each other. In other words, the two approaches (system-oriented and user-oriented) are not seen as contradictory, but rather are complementary.

References

Anderson, A. A. 1997. *Universal Justice: A Dialectical Approach*, Vol. 47, Amsterdam: Rodopi.

Annas, J. 2003. *Plato: A Very Short Introduction*. Oxford: Oxford University Press.

Bates, M. J. 2002. "Toward an Integrated Model of Information Seeking and Searching." *The New Review of Information Behaviour Research* 3 (1): 1–15.

Bookstein, A. 1979. "Relevance." *Journal of the American Society for Information Science* 30 (5): 269–73.

Borlund, P. 2003. "The Concept of Relevance in IR." *Journal of the American Society for Information Science and Technology* 54 (10): 913–25.

Brookes, B. C. 1980. "The Foundations of Information Science: Philosophical Aspects." *Journal of Information Science* 2 (3–4): 125–33.

Brun, J. 1998. *Socrates*. Paris: Presses Universitaires de France.

Budd, J. M. 2001. *Knowledge and Knowing in Library and Information Science: A Philosophical Framework*. Lanham, MD: Scarecrow Press.

Budd, J. M. 2004. "Relevance: Language, Semantics, Philosophy." *Library Trends* 52 (3), 447–62.

Byström, K., and K. Järvelin. 1995. "Task Complexity Affects Information Seeking and Use." *Information Processing & Management* 31 (2): 191–213.

Capurro, R., and B. Hjørland. 2003. Foundations of Information Science: Review and Perspectives. http://arizona.openrepository.com/arizona/html/10150/105705/ethikskript/tampere91.htm (accessed July 20, 2016).

Case, D. O., and L. M. Given. 2016. *Looking for Information: A Survey of Research on Information Seeking, Needs, and Behavior*, 4th ed., Bingley: Emerald Group Publishing.

Chen, G. K. 1975. "What is the Systems Approach?." *Interfaces* 6 (1): 32–7.

Connaway, L. S., and R. R. Powell. 2010. *Basic Research Methods for Librarians*. Santa Barbara, CA: ABC-CLIO.

Cooper, W. S. 1971. "A Definition of Relevance for Information Retrieval." *Information Storage and Retrieval* 7 (1): 19–37.

Cornford, F. M. 2014. *Plato and Parmenides*. Abingdon: Routledge.

Creswell, J. W., and J. D. Creswell. 2017. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Los Angeles, CA: Sage Publications.

Creswell, J. W., and V. L. P. Clark. 2017. *Designing and Conducting Mixed Methods Research*. Los Angeles, CA: Sage Publications.

Davidson, D. 1977. "The Effect of Individual Differences of Cognitive Style on Judgments of Document Relevance." *Journal of the American Society for Information Science* 28 (5): 273–84.

Derr, R. L. 1983. "A Conceptual Analysis of Information Need." *Information Processing & Management* 19 (5): 273–8.

Dick, A. L., and J. Weckert. 2003. "A Philosophical Framework for Library and Information Science." *The Library Quarterly* 73 (1): 73–7.

Fidel, R. 1993. "Qualitative Methods in Information Retrieval Research." *Library and Information Science Research* 15: 219.

Fidel, R. 2008. "Are We There Yet?: Mixed Methods Research in Library and Information Science." *Library & Information Science Research* 30 (4): 265–72.

Fitt, M., and K. Freeman. 1983. *Ancilla to the Pre-Socratic Philosophers: A Complete Translation of the Fragments in Diels, Fragmente der Vorsokratiker*. Cambridge, MS: Harvard University Press.

Foskett, D. J. 1972. "A Note on the Concept of Relevance." *Information Storage and Retrieval* 8 (2): 77–8.

Goffman, W., and V. A. Newill. 1966. "Methodology for Test and Evaluation of Information Retrieval Systems." *Information Storage and Retrieval*. 3 (1): 19–25.

Greene, J. C., and V. J. Caracelli. 1997. "Defining and Describing the Paradigm Issue in Mixed Method Evaluation." *New Directions for Evaluation* 74: 5–17.

Groarke, L. 2016. "Aristotle: Logic." In *Internet Encyclopedia of Philosophy*. https://www.iep.utm.edu/aris-log/#H11 (accessed July 8, 2016). https://doi.org/10.1016/b978-0-12-803581-8.04142-4.

Guthrie, W. K. C. 1962. *A History of Greek Philosophy: Volume 2, The Presocratic Tradition from Parmenides to Democritus*, Vol. 2. Cambridge: Cambridge University Press.

Harter, S. P. 1992. "Psychological Relevance and Information Science." *Journal of the American Society for Information Science* 43 (9): 602–15.

Hersh, W. 1994. "Relevance and Retrieval Evaluation: Perspectives From Medicine." *Journal of the American Society for Information Science* 45 (3): 201–206.

Hjørland, B. 2010. "The Foundation of the Concept of Relevance." *Journal of the American Society for Information Science and Technology* 61 (2): 217–37.

Hjørland, B., and F. S. Christensen. 2002. "Work Tasks and Socio-cognitive Relevance: A Specific Example." *Journal of the American Society for Information Science and Technology* 53 (11): 960–5.

Huang, M.-H., and H.-Y. Wang. 2004. "The Influence of Document Presentation Order and Number of Documents Judged on Users' Judgments of Relevance." *Journal of the American Society for Information Science and Technology* 55 (11): 970–9.

Huang, X., and D. Soergel. 2013. "Relevance: An Improved Framework for Explicating the Notion." *Journal of the American Society for Information Science and Technology* 64 (1): 18–35.

Ingwersen, P. 1992. *Information Retrieval Interaction*, Vol. 246. London: Taylor Graham.

Jain, A., K. Nandakumar, and A. Ross. 2005. "Score Normalization in Multimodal Biometric Systems." *Pattern Recognition* 38 (12): 2270–85.

Jain, Y. K., and S. K. Bhandare. 2011. "Min Max Normalization Based Data Perturbation Method for Privacy Protection." *International Journal of Computer & Communication Technology* 2 (8): 45–50.

Kothari, C. R. 2004. *Research Methodology: Methods and Techniques*. New Delhi: New Age International.

Lavrenko, V. 2008. *A Generative Theory of Relevance*, Vol. 26, Berlin: Springer.

Lewandowski, D. 2012. "A Framework for Evaluating the Retrieval Effectiveness of Search Engines." In *Next Generation Search Engines: Advanced Models for Information Retrieval*, 456–79. IGI Global.

Ma, L. 2012. "Some Philosophical Considerations in Using Mixed Methods in Library and Information Science Research." *Journal of the American Society for Information Science and Technology* 63 (9): 1859–67.

Mizzaro, S. 1998. "How Many Relevances in Information Retrieval?" *Interacting with Computers* 10 (3): 303–20.

Mizzaro, S. 1997. "Relevance: The Whole History." *Journal of the American Society for Information Science* 48 (9): 810–32.

Murray, J. S. 1988. "Disputation, Deception, and Dialectic: Plato on the True Rhetoric ("Phaedrus" 261–266)." *Philosophy & Rhetoric* 21 (4): 279–89.

Naumer, C., and K. E. Fisher. 2010. "Information Needs." In *Encyclopedia of Library and Information Sciences*, 4, edited by Marcia J. Bates, 2452–8. London: Taylor and Francis.

Nehamas, A. 2017. "Parmenidean Being/Heraclitean Fire." In *Presocratic Philosophy*, 61–80. London: Routledge.

Olafson, F. A. 2017. *Philosophical Anthropology*. Encyclopedia Britannica. https://www.britannica.com/topic/philosophical-anthropology (accessed June 29, 2017).
Online Etymology Dictionary. 2001–2020. "Dia." https://www.etymonline.com/word/dia- (accessed July 5, 2016).
Online Cambridge Dictionary. 2020. "Dialectic." https://dictionary.cambridge.org/dictionary/english/dialectic (accessed May 5, 2020).
Park, T. K. 1993. "The Nature of Relevance in Information Retrieval: An Empirical Study." *The Library Quarterly* 63 (3): 318–51.
Plato. 1914. "Plato with an English Translation: Theaetetus Sophist." Translated by H.N. Fowler. William Heinemann.
Runes, D. D. 1948. *The Dictionary of Philosophy*. New York: Philosophical Library.
Saracevic, T. 1975. "Relevance: A review of and a Framework for the Thinking on the Notion in Information Science." *Journal of the American Society for Information Science* 26 (6): 321–43.
Saracevic, T. 1996. "Relevance Reconsidered." In *Proceedings of the Second Conference on Conceptions of Library and Information Science (CoLIS 2)*, 201–18. New York: ACM.
Saracevic, T. 2007. "Relevance: A Review of the Literature and a Framework for Thinking on the Notion in Information Science. Part III: Behavior and Effects of Relevance." *Journal of the American Society for Information Science and Technology* 58 (13): 2126–44.
Saracevic, T. 2015. "Why Is Relevance Still the Basic Notion in Information Science." In *Re: Inventing Information Science in the Networked Society. Proceedings of the 14th International Symposium on Information Science (ISI 2015)*, 26–35.
Schamber, L., M. B. Eisenberg, and M. S. Nilan. 1990. "A Re-examination of Relevance: Toward a Dynamic, Situational Definition." *Information Processing & Management* 26 (6): 755–76.
Sorabji, R. 1974. "Body and Soul in Aristotle." *Philosophy* 49 (187): 63–89.
Spink, A., and C. Cole. 2005. "A Multitasking Framework for Cognitive Information Retrieval." In *New Directions in Cognitive Information Retrieval*, 99–112. Dordrecht: Springer.
Stace, W. T. 2010. *A Critical History of Greek Philosophy*. Auckland: The Floating Press.
Stannard, J. 1959. "Socratic eros and Platonic Dialectic." *Phronesis* 4 (2): 120–34.
Swanson, D. R. 1986. "Subjective versus Objective Relevance in Bibliographic Retrieval Systems." *The Library Quarterly* 56 (4): 389–98.
Taube, M. 1965. "A Note on the Pseudo-mathematics of Relevance." *American Documentation* 16 (2): 69–72.
Thornley, C., and F. Gibb 2007. "A Dialectical Approach to Information Retrieval." *Journal of Documentation* 63 (5): 755–64.
Thornley, C. 2012. "Information Retrieval (IR) and the Paradox of Change: An Analysis Using the Philosophy of Parmenides." *Journal of Documentation* 68 (3): 402–22.
Vakkari, P., and K. Järvelin. 2005. "Explanation in Information Seeking and Retrieval." In *New Directions in Cognitive Information Retrieval*, 113–38. Dordrecht: Springer.
Vickery, B. C. 1959. "The Structure of Information Retrieval Systems." *Proceedings of the International Conference on Scientific Information* 2, 1275–90.
Wiktionary. 2019. "Lectic." https://en.wiktionary.org/wiki/lectic (accessed May 5, 2020).
Wilson, T. D. 2002. "Alfred Schutz, Phenomenology and Research Methodology for Information Behaviour Research." *The New Review of Information Behaviour Research* 3 (71): 1–15.