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Research article

Towards a unified model of HCI and ISB for user interfaces

Talal Alazemi [a,*], Yun Chen [b], Maria Kutar [b]

[a] College of Basic Education, The Public Authority for Applied Education and Training, Kuwait
[b] Salford Business School, University of Salford, UK

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ABSTRACT

This study aims to identify the steps in which users of academic libraries search for information and interact with the libraries' web interfaces. The study draws on models from the disciplines of human-computer interaction (HCI) and information-seeking behaviour (ISB) to create and investigate a Unified Model. Interpretive case studies were conducted at two universities, one in the UK and one in Kuwait. Qualitative data was collected using observations with postgraduate students and analysed by a content analysis approach. The findings revealed seven steps taken in searching for information and interacting with academic libraries' web interfaces, but these steps are overlapped as users can change, move and go from one step to another based on the difficulties they encounter and the options they have.

1. Introduction

Academic library use has changed enormously with the development of Web-based interfaces, and the academic library website is now the primary way in which most users access resources. There is considerable variance in the way in which resources can be provided through the website, and understanding how library users can be most effectively supported is an important issue for the providers of library services. There are two fields which can make contributions of particular interest to this area: human computer interaction (HCI) and information seeking behaviour (ISB). HCI is the study of human interaction with computer systems, while ISB is concerned with the methods that users follow to obtain the information they require. Several studies have discussed the importance of each field of study in user interfaces and in making the information system easy to use. Hearst (2009) asserts that it is necessary to understand the human information-seeking process in order to design successful user interfaces for searches, including the strategies people employ when engaged in an information search. In each of these fields many authors have developed models of behaviour to understand the ways in which people interact with information, and it is noted that there is similarity and overlap between these.

In this study, we present a unified model of HCI and ISB, which we suggest can be used to develop understanding of academic libraries' websites use. The aim was to develop a single model in order to understand how do the users of academic libraries search for information and interact with the libraries' web interfaces. This study focuses on a discussion of the research modelling of users' behaviours and interactions and intends to make contributions to *Knowledge, Practice* and *Theory* of academic information seeking field by:

1. Clarifying and investigating in depth various models of HCI and ISB models for user interface;
2. Conducting comparative case studies between universities in two countries;
3. Creating a Unified Model for academic information seeking.

The remainder of this study is structured as follows: Section 2 discusses the significance of HCI and ISB for User Interfaces; In Section 3 we provide a review of the literature on HCI and ISB including a summary of the main models in each field; Section 4 devotes to the development of the Unified Model based on critical discussion in Section 3; Section 5 presents the study that was conducted to explore the model through practical case studies undertaken in Universities of both UK and Kuwait for the validation of the model, and Section 6 conclude the whole study by reviewing findings and suggestions for next step.

* Corresponding author.
E-mail address: tr.alazemi@paaet.edu.kw (T. Alazemi).

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2. Significance of HCI and ISB for user interfaces

Human information-seeking behaviour involves both information processing and interactions with information resources and, nowadays, technological systems. Studies of such behaviours contribute to the design of new systems and tools for organisation of knowledge and utilisation of information in academic and scientific contexts as well as in organisations (Steinerová and Šušol, 2005). Furthermore, information systems are designed to help users retrieve specific items that they require from the volume of information available. Consequently, understanding information-seeking behaviour is necessary to identify user search techniques and preferences for information resources (Rowley and Hartley, 2008). This can help design and implement convenient user-centred information systems/services (Rafiq and Ameen, 2009). In addition, Connaway and Dickey (2010) argue that information systems need to be supported by the entire process for information-seeking needs. On the other hand, Miller (2002) indicates that any improvements in HCI require a deep understanding of human behaviours and needs, which is the most helpful information with regard to evaluating any new technology. Ahmed et al. (2009) suggest that more user-centred studies with web-based systems are needed for significant improvements in the design of user interfaces for such systems.

Hearst (2009, p. 1) states that 'the job of the search user interface is to aid users in the expression of their information needs, in the formulation of their queries, in the understanding of their search results, and in keeping track of the progress of their information seeking efforts'. Undoubtedly, the user interface should be designed to recognise the users' requirements, including their goals, tasks and environment (Karpasov, 2010). Furthermore, Sommerville (2007) suggests that user interfaces should be designed to match the skills, experience and expectations of the anticipated users, and that interfaces should be designed to match the users' skills and their information-seeking behaviour.

Ferreira and Pithan (2005) have integrated the concepts and techniques of HCI (especially usability studies) and information science (in particular studies on user requirements and behaviours in seeking and using information). The constructivist model for user studies proposed by Carol Kuhlthau (section 3.2) and the criteria of usability established by Jacob Nielsen were used to analyse the usability of a digital library. Both researchers intended to identify variables that met a number of criteria, variables such as learnability, efficiency and effectiveness of the digital library; management of errors; memorability; the user's satisfaction from the perspective of cognitive and affective aspects; and the actions taken by users during the information-seeking process. They found that systems that apply and/or adopt a design which is familiar to the users' cognitive model tend to be more logical, which makes it easier to memorise its characteristics and functionalities. Users offered evidence of their previous experiences with other search systems. 'Thus, it was possible to observe that the users' actions, feelings and thoughts, as well as their experiences disclose important indications for learning components, memorisation, errors, efficiency of the digital library and mainly users' satisfaction' (p. 320). Ferreira and Pithan concluded that the results they reported are evidence of the possible synergy between HCI and ISB.

Nonetheless, several studies have shown that more research is needed to investigate the relationship between HCI and ISB models. Ferreira and Pithan (2005) suggest that there is still a need for more in-depth research integrating contributions from other fields of knowledge, in order to clarify the relationship of usability, information necessity, and the information-seeking process (ISP) with user satisfaction. Moreover, Keshavarz (2008) argues that not enough research has been carried out on the relationship between information behaviour and information system design. Much more research is needed to understand how new technologies and resources can best support user requirements in different contexts (Wang et al., 2007). A review by Ahmed et al. (2009) on research on human-computer interfaces for online information retrieval systems highlighted the need to integrate HCI technologies into information retrieval (IR) interface designs. User interface design has received limited attention from IR researchers, according to this review, and commercial database vendors and distributors have not recognised this issue; therefore, they recommend applying HCI technologies to improve the ease with which IR interfaces can be used.

Based on the aim of this research, some models including four HCI models and six ISB models were selected (section 3). A rationale for selecting these models is that they describe the steps (stages) users go through when looking for information and interacting with the system interface. None of these models, however, has been actually designed for academic library users or the academic library interface. Although models of Sadeh (see Figure 11) were created to design a user interface and improve its effectiveness, they were developed for scholars in the scientific community, who are more professional than users of academic libraries. The models used in this research were selected for investigation for various reasons:

1. They clearly identify the steps (stages) that users follow when looking for information and interacting with the system.
2. These models are assessed in terms of their popularity in information-seeking studies and interaction design.
3. These models have wide applicability and can be used in various contexts, roles, tasks and knowledge fields.
4. They are in accordance with the current study's focus on a user-centred, rather than a system-based, approach.
5. They also consider users' needs, experience and other factors that users encounter when engaged in the process of looking for information or interacting with the system.

In the following section, we examine these models in detail.

3. Review and comparison of classic HCI and ISB models

3.1. HCI models

3.1.1. Donald Norman's Execution–Evaluation cycle model

The model explains the methods users encounter when they intend to achieve a goal (Norman, 2002, 2013). When using (interacting with) something (system), they encounter two gulfs (phases): The Gulf of Execution, when they endeavour to understand how it operates (e.g. Does the system provide actions that correspond to the intentions of the user?), while the Gulf of Evaluation is when they endeavour to understand what happened (e.g. Does the system provide a physical representation that

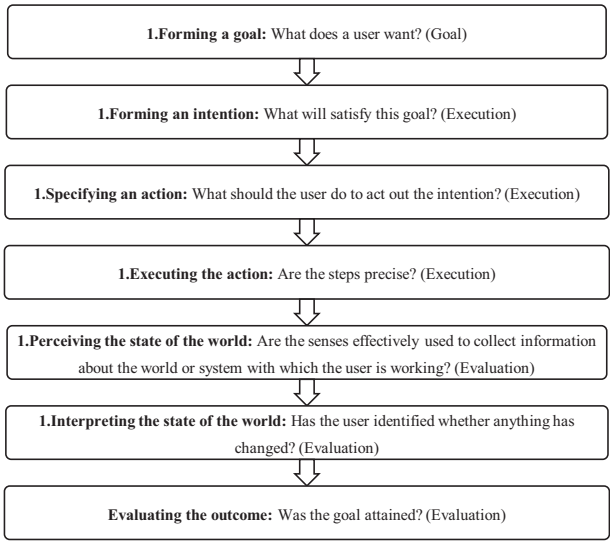

Figure 1. Stages of Action in the Norman's model (Norman, 2002).

can be directly perceived and that is directly interpretable in terms of the intentions and expectations of the user?) (see Figure 1).

3.1.2. Dix et al.'s general interaction framework

It is a general framework that describes system and user interaction in reality. It consists of four main components: system, user, input, and output (Abowd and Beale, 1991; Dix et al., 2004) (see Figure 2).

The four main translations are incorporated into the interaction phases: articulation and performance from the execution phase, and presentation and observation from the evaluation phase.

3.1.3. Shneiderman et al.'s four-phase framework

The framework identified the search process through which users interact with a system. It involves four phases that provide designers of specific systems with a good degree of independence, which are Formulation, Action, Review of Results and Refinement (Shneiderman et al., 1997) (see Figure 3).

3.1.4. Hearst model of interaction

The model explains the information access process, clarifying the interaction between users and systems when the latter are in use (Hearst, 1999) (see Figure 4).

3.2. ISB models

3.2.1. Ellis's model of information-seeking behaviour

This model was based on interviews with different groups of researchers from various academic disciplines (Ellis, 1989). Ellis et al. (1993, p. 359) argued that 'the models do not attempt to define the interactions and interrelationships between the categories or the order in which they are carried out. The nature of the relationship between the features of the models can only be described in relation to specific information seeking patterns. Therefore, although it is possible to describe relationships between the features at a general level, the exact relationship of the features of the models depends upon the circumstances associated with the information-seeking behaviour of a particular individual at a particular time'. Ellis (2005) stated that he found similarities in general and in detail between the groups of researchers, even though they were from different disciplines (see Figure 5).

3.2.2. Kuhlthau's information-search process

The model focuses on intellectual access to information and ideas as well as the process of seeking meaning. It describes the process of information seeking as one of construction, focusing on users' experience through the interaction of thoughts, feelings, and actions (Kuhlthau, 2005) (see Figure 6).

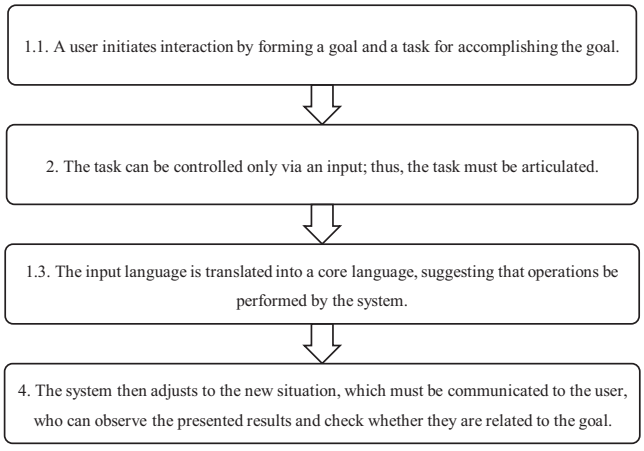

Figure 2. Stages of Action in the Dix et al.'s model (Dix et al., 2004).

3.2.3. Belkin et al.'s information-seeking strategies

Belkin et al. (1995) suggested that any single information-seeking interaction is a complex activity which can be described according to its relationship to the four identified dimensions and can also be characterised based on its values on a comparatively small number of factors or dimensions. The four dimensions can be explained as follows (see Figure 7):

- Method of interaction: This includes a range of variations, from searching for an identified item to scanning for an interesting item.
- The goal of the interaction: This involves either learning something about an item or resource or selecting useful ones for retrieval.
- Mode of retrieval: This can be divided into two modes: specification, which is seeking for identified items, and recognition, which is identifying relevant items through stimulated associations.
- Resource considered: The interaction with the items of information themselves might differ from the interaction with meta-information, which describes the structure and contents of the objects of information.

3.2.4. Marchionini's information-seeking model

The information seeking process has been described by Marchionini as both systematic and opportunistic. Marchionini argued that this process increasingly depends on the development of electronic technology. It starts with the recognition and acceptance of the problem and continues until the problem is solved or abandoned (Marchionini, 1995) (see Figure 8).

3.2.5. Wilson's model

The model invokes explicit theories at certain points, modified from other areas of study, to explain the following aspects of information seeking (Wilson, 1999; 2005): (see Figure 9)

- The theory of stress and coping, from psychology: can explain why some needs prompt information seeking more than others.
- The theory of risk and reward, from consumer research: may help clarify why individuals have a preference for using some sources of information rather than others.
- The theory of social learning, from psychology: derived from the concept of self-efficacy, helps explain why people can (or cannot) track a goal successfully, as this ability is based on their perceptions of their own efficacy (Case, 2012).
- Information processing and use: activities that happen when a person satisfies his or her information needs and begins to use the results. Wilson (1999, p. 256) argued that 'information processing and use is shown to be a necessary part of the feedback loop, if information needs are to be satisfied'.

  Case (2012) assumed that Wilson's activating mechanisms can be motivators that help and encourage an individual to search for information, but questioned how and to what extent. In addition, these motivators can be influenced by a number of intervening variables: psychological predispositions (e.g. the tendency to be curious); demographic background (e.g. education or age); role-related or interpersonal factors (e.g. acting as a manager or a mother); environmental (e.g. availability of resources); and characteristics of the sources (e.g. accessibility and credibility).

Wilson's model provides an essential perspective, recognising diverse types of search behaviour: passive attention, passive search, active search, and ongoing search (Case, 2012).

- Passive attention: information can be acquired without planning or seeking, such as by listening to the radio or watching television programmes.

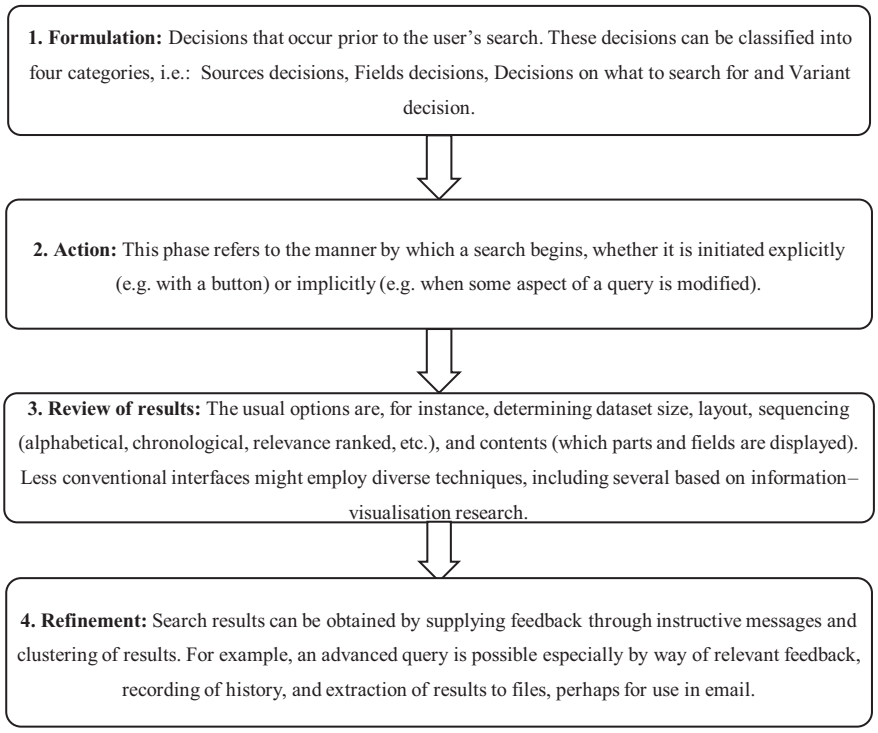

Figure 3. Stages of Action in the Shneiderman et al.'s model (Shneiderman et al., 1997).

- Passive search: indicates those occasions when one type of search (or other behaviour), such as browsing, results in the acquisition of information that happens to be related to the individual requirement.
- Active search: an individual seeks out information actively from diverse sources, such as databases, e-journals, and conferences.
- Ongoing search: the basic framework of knowledge in a particular context has been already been established by an active search, but an infrequent progressive search is carried out to update or broaden knowledge. In consumer research, Bloch et al. (1986), as cited by Wilson (1997, p. 562), defined the ongoing search 'as that which is independent of specific purchase needs or decisions and that the motives are to build knowledge for future purchase decisions and simply to engage in a pleasurable activity'.

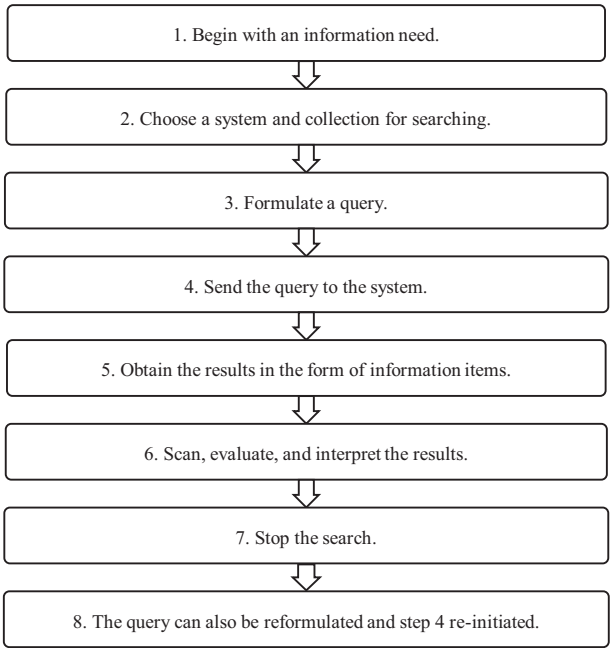

Figure 4. Stages of Action in the Hearst's model (Hearst, 1999).

3.2.6. *Sadeh's models of information-seeking and -searching behaviours*

These models leverage some existing models in terms of information behaviour, information seeking, and information searching and designed a new user interface based on the model proposed (Sadeh, 2010).

The model describes two processes of active information seeking: directed and undirected. Directed is searching for information that can be recognised, while undirected is the scanning of information with no exact information need in mind. Sadeh claimed that the nodes represent the interactions in this model as it relates to searching in automated information systems, but it can also be applied to querying a human being.

Sadeh illustrated that information searching is a directed process which is a part of the more general activity of information seeking. When the researcher has perceived an information need, searching begins as a direct process. The researcher has a concept regarding the materials required. With the purpose of querying the information system, the researcher should switch and articulate the information need. The query could be related to the researcher's assumptions about particular keywords displayed in the information or attached to it as metadata.

The undirected process begins with a receive action, and the user gains a list, whether by automated update, such as a rich site summary (RSS) feed, an e-mail, or access via a dedicated web page. The list can also be obtained from a person (a supervisor or an instructor). The references at the end of the received article can be also considered as relevant to the process. Users do not usually depend on the list of references as a solitary source of information, separated from its context. They can use the list as a route to other documents that might be interesting and exit the list of the document they are reading.

The next action is browse, in which users examine the items on the list. In most cases they are interested in the metadata, including the abstract; however, in some cases they would like to check a document closely, and they then focus on it. The focus action is at the crossroads of directed and

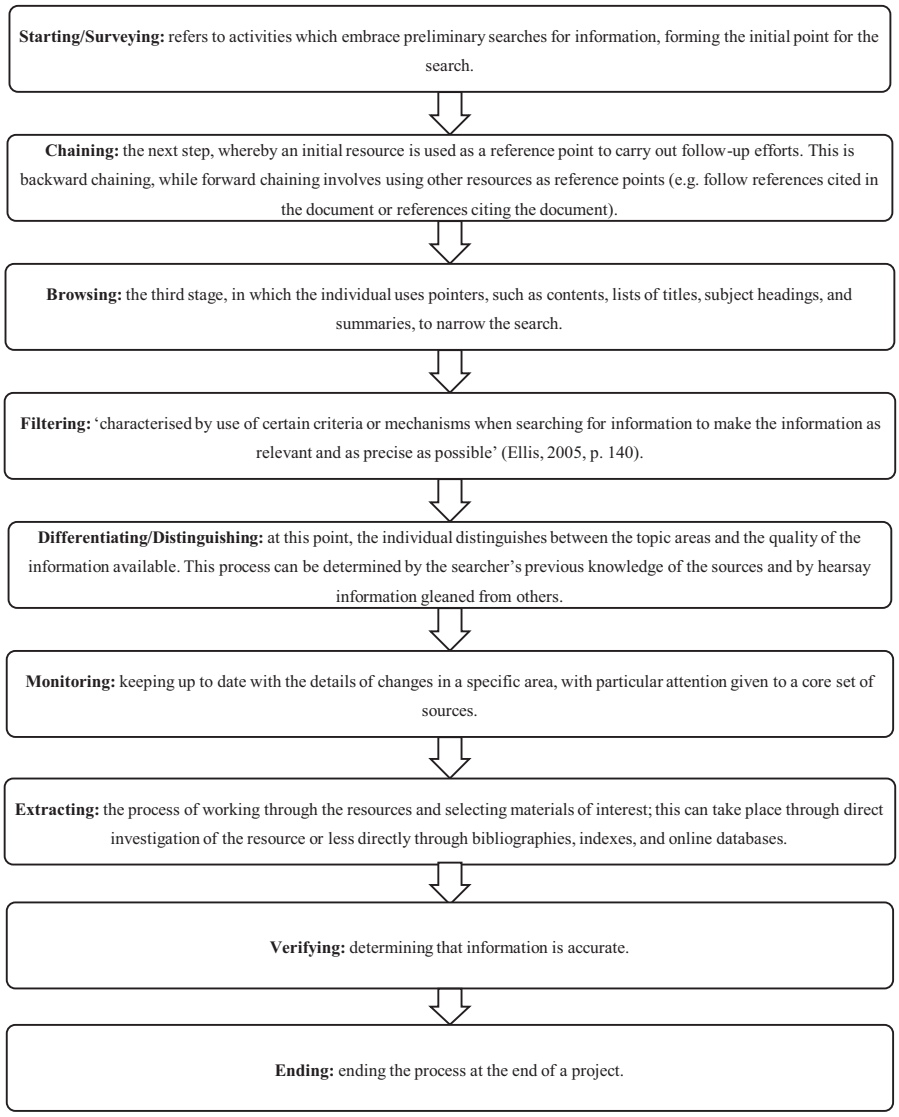

Figure 5. Main strategies of ISB identified in the Ellis's model (Ellis, 2005).

undirected information seeking. When researchers focus on a document, they might desire to examine it for more information that might be provided in textual elements and figures in the text. Conceptually, such behaviour aims to expand the document to include, for instance, an explanation, a map of a place, or a translation of a word. Different ways of expanding a document can present previous versions of the article.

At this point, the user can make a decision either to use the document immediately or to keep it for deferred use. The user might navigate other documents of diverse types by following links. In the case of navigation, the user focuses on one document at a time. The process is repeated, and the user can decide at any point to keep on navigating or to invoke a new search, probably re-using metadata elements of the material found in the focus as the search term.

A user may decide to invoke a search for other articles on an interesting topic mentioned in the primary article. When doing this, the researcher will, in all probability, use another information system—normally the library system, but possibly Google or Google Scholar—to begin a new search about their topic.

The query can be divided into three modes—explore, search, and ask for—depending on the method used in the query for the information requirement.

- **Explore:** when the researcher searches for information outside his/her field of expertise.
- **Search:** an exploratory search.
- **Ask for:** asking for a document well defined by the user.

All three modes (explore, search, and ask for) rely on system options.

Prior to taking an action, researchers usually scan the first items in a results list. When they analyse the first screen, their choice will be based on one of the following options:

- **Reformulate**: if a researcher does not find relevant items, he/she reformulates the query.
- **Focus:** if the results appear acceptable and relevant, the researcher will possibly focus on a particular item.
- **Narrow down:** if there are several results, the researcher might decide to narrow down the list to find more relevant items.

It can be seen from these summaries that the staged models of ISB and HCI include a number of common elements. This has formed the basis of our combined model, the development of which we present in the following section.

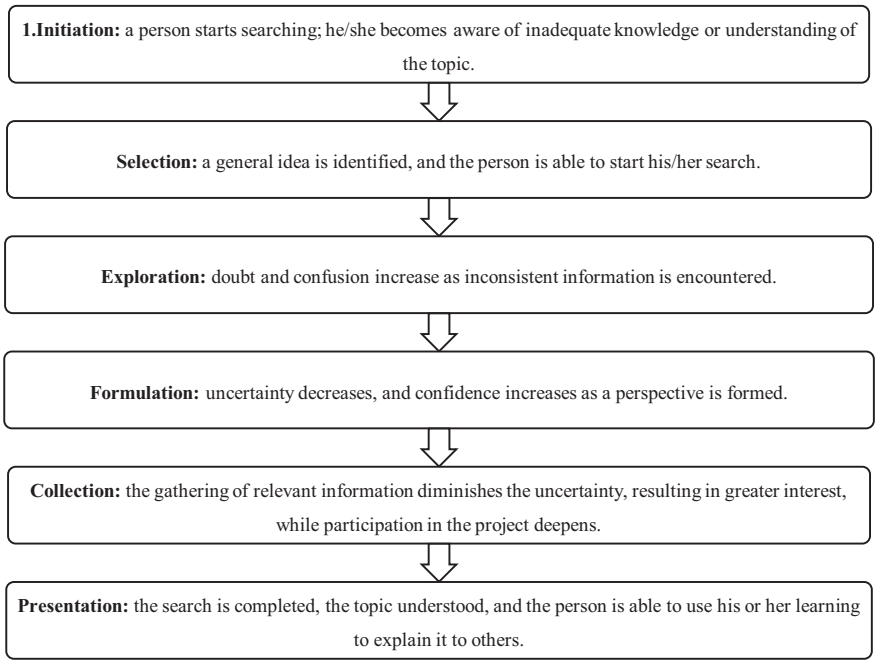

Figure 6. Main strategies of ISB identified in the Kuhlthau's model (Kuhlthau, 2005).

4. The development of the unified model of HCI and ISB

The selected models from these fields were compared in order to identify the similarities and differences between them, with regard to the steps that seekers follow when looking for information and interacting with the system (interface). In fact, these models clearly described the users' seeking behaviours and interactions in steps. Thus, based on the comprehensive descriptions of these models summarised in section 3 above, it was concluded that the steps users take to look for information or interact with system interfaces are quite similar in the HCI and ISB models, even though the concept is described differently.

The researchers grouped these models together and examined them to investigate whether there was a possibility of synergy or combination between them. It was found that these models have six common steps, as illustrated and explained in Figure 10 below.

The six steps identify the progress from commencement to conclusion of the search, and clarify how users might look for information and interact with the system. The overall mapping of these steps across the different models is displayed and clarified in Figure 11 below.

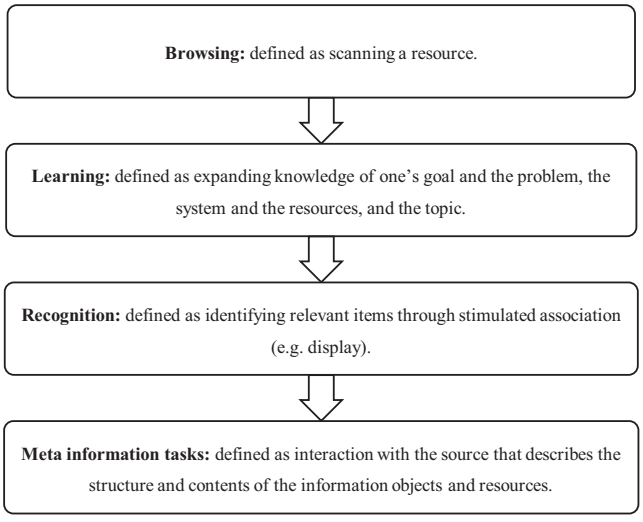

Figure 7. Main strategies of ISB identified in the Belkin et al.'s model (Belkin et al. , 1995).

In the following subsections, we provide an explanation of how our identified steps are representative the stages of the various models. An example will be presented at the end of each step to show how user (postgraduate student) formulate the step based on the models.

4.1. Commencement

This is defined as the way users take their first step when they need information, based on the models. There are some similarities and some differences between these models.

In the ISB models, users start looking for information when they need information in general, without specifying the type of information. This is Wilson's (ISB) point of view, which is similar to Hearst's opinion (HCI).

Marchionini (ISB) mentions that users start their search when they know and accept the information problem. Similarly, Sadeh (ISB) states that users start looking for information when they receive a list of (known) items to find. Shneiderman et al. (HCI) have also stated that users formulate some decisions in their minds prior to starting their search. In addition, Belkin et al. (ISB) mention that in this step, users browse to begin searching for an indentified item. Therefore, there is a specific need to search for. On the other hand, Norman (HCI) and Dix et al. (HCI) have a similar perspective with regard to the first step in interaction—forming the goal that needs to be achieved—to which Norman adds the formation of the intention to achieve it.

Ellis's (ISB) first step is starting/surveying, which aims to gain a general idea of the range of resources in a new field. Similarly, Kuhlthau's (ISB) first step is initiation, which aims to obtain information about a topic about which users have insufficient knowledge.

From the above, we can conclude that that the first step (Commencement) for users interacting and looking for information can be summarised in the four following points:

Users:

- Need information.
- Lack information about the topic.
- Look for known or identified information (e.g. items and resources) by browsing to search

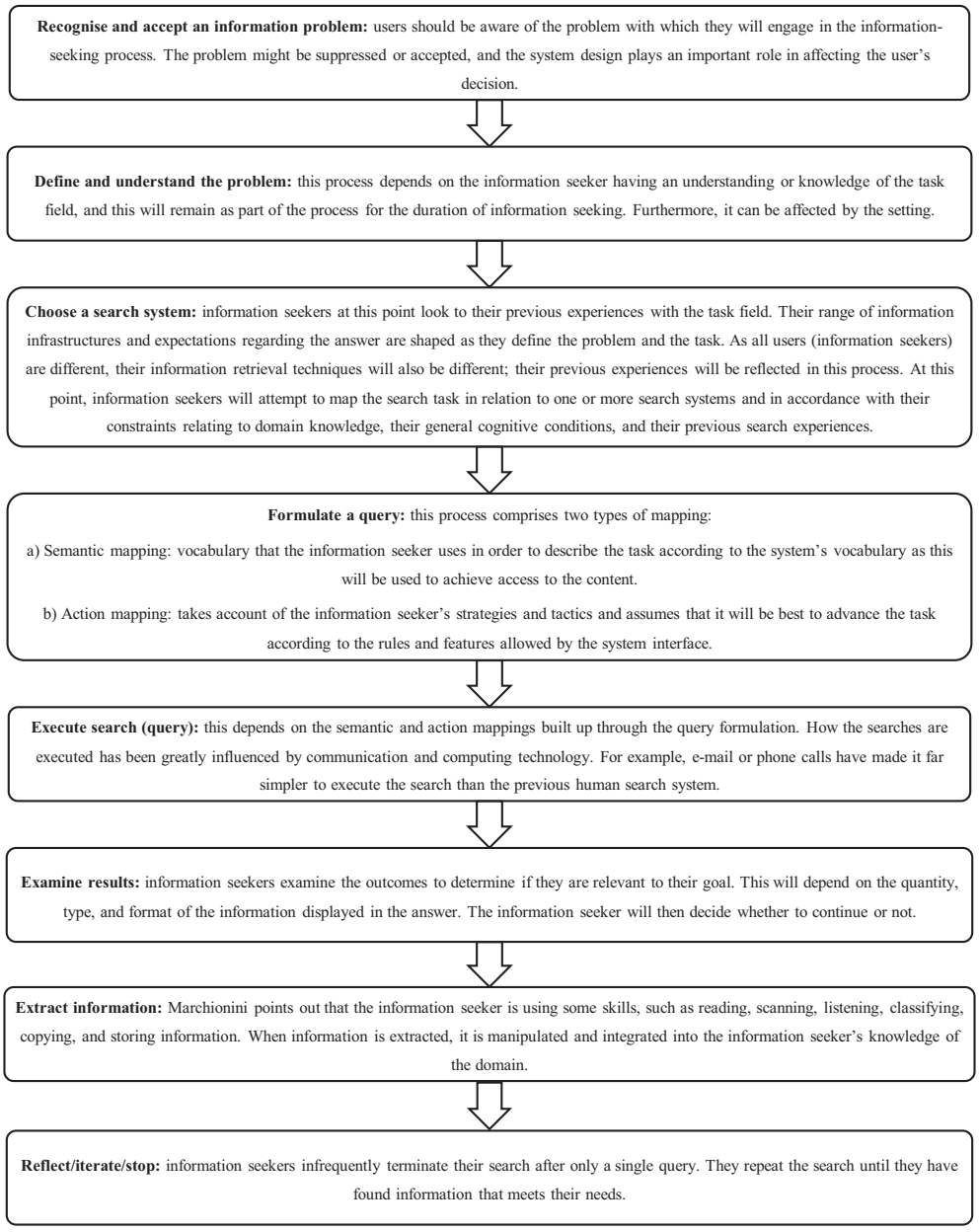

Figure 8. Main strategies of ISB identified in the Marchionini's model (Marchionini, 1995).

- Form a goal to be accomplished and decide (intend) what to do next.

For example, a postgraduate student commences with an information need, which is to locate and information (resource) about a specific topic. He/she might look for information that he/she lacks about the topic to obtain the initial information to start searching once the information problem is identified and accepted. Hence, he/she forms a goal and makes a decision about what is to be accomplished and how it can be done, and then he/she looks for a known item (e.g. article) by browsing to search for an identified item (e.g. search by articles, journals, database) to begin the search.

4.2. Exploration

This is defined as the way users start their second step when they need information. There are a number of similarities and some differences between these models with regard to this step. Kuhlthau (ISB) states that users have identified what they need to do to start searching, which might be similar to the explanation provided by Ellis (ISB), who states that users engage in "chaining" what they find in two ways: backward (following a reference cited in the current document) or forward (following the references that cite the current document). According to Ellis, users acknowledge what they want as well as are involved in chaining what they want.

Wilson (ISB) has a different point of view with regard to this step. He connects it to the discipline of psychology, pointing out that when users seek information, some needs prompt information seeking more than others. Niedzwiedzka (2003) gives a good example that explains Wilson's point of view:

'Wilson suggests [that] not all information needs make a person seek information. For example, an individual does not engage in seeking activities if he or she is convinced that the possessed knowledge is sufficient to understand the situation and make a decision. If s/he lacks such conviction, the stress connected with danger of making a mistake, trespassing social or legal norms, financial responsibility or not answering expectations of other people, occurs. The bigger the stress the bigger is

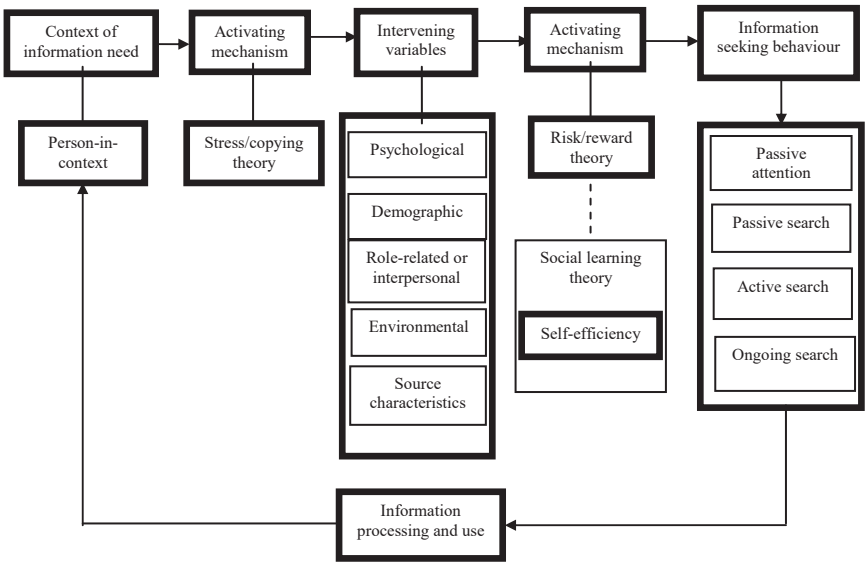

Figure 9. A revised model of information-seeking behaviour. Reproduced from Wilson (2005).

the motivation to look for information, up to a certain point where the stress paralyses such activities'.

Marchionini (ISB) points out that users explore in order to identify and understand the problem before they start. Similarly, Sadeh (ISB) states that users examine the list of items they receive to start browsing. In addition, Shneiderman et al. (HCI) point out that users will explore which source to search in, which field, what to search for, and so on. Hearst (HCI) also states that users explore in order to choose the system and collection to start searching. Belkin et al. (ISB) point out that users in this step scan an interesting item to ascertain whether to continue to the next step. Belkin et al.'s (ISB) opinion is quite similar to that of other researchers (Marchionini [ISB], Sadeh [ISB], Shneiderman et al. [HCI], and Hearst [HCI]); during the process of scanning, users encounter a number of resources, but they need to recognise which of the resources is interesting enough to be selected. Norman (HCI) and Dix et al. (HCI) have similar opinions regarding this step: that is, it involves different ways of exploration to achieve the task in mind, without indication of a specific way of accomplishing the task.

Thus, the second step (Exploration) for users interacting and looking for information can be summarised into six points as follows:

Users:

- Browse and examine the items they received.
- Explore to accomplish a task in different ways (e.g. based on their understanding of the field of work, by following footnotes and citations in an identified resource or by determining which source to search, in which field and what to search for).
- Identify what to search for.
- Browse to scan an interesting item.
- Choose the system and collection to start searching.
- They might be influenced by psychological factors.

For example, our postgraduate student examines the task in order to understand what is required to start searching, and then browses to scan an interesting item (e.g. one of the resource options available in the library interface) to explore and identify what to search for, which field and where. He/she might uses different ways of looking for information as he/she might select an option (e.g. e-journal) to start searching, then he/she might select an interesting result (e.g. document) based on his/her understanding of the topic or in order to follow references cited in the result or references that cited the result, but he/she may be affected by psychological factors such as stress associated with the danger of making a mistake.

4.3. Decision making

This is defined as the way users initiate the third step when they need information. In the ISB models, users start seeking general information to know, make sure of, and expand their knowledge as well as reduce confusion (Kuhlthau). Similarly, Sadeh (ISB) mentions that users might expand their search, and then navigate the required resources. Belkin et al. (ISB) point out that users learn something about the resources before selecting those required for retrieval. Ellis (ISB) has a similar idea, wherein users start a semi-search for possible areas of interest, but in a different way, by going to content pages, lists of titles, and subject headings, to narrow down their search. Wilson (ISB) and Marchionini (ISB) have rather similar points of view. Wilson mentions that users might be affected by a number of variables that influence their search (e.g. psychological predispositions), while Marchionini states that users are influenced by their experiences and expectations in choosing which system to search. Marchionini's opinion is somewhat different from those mentioned above, as he links this step with the previous step.

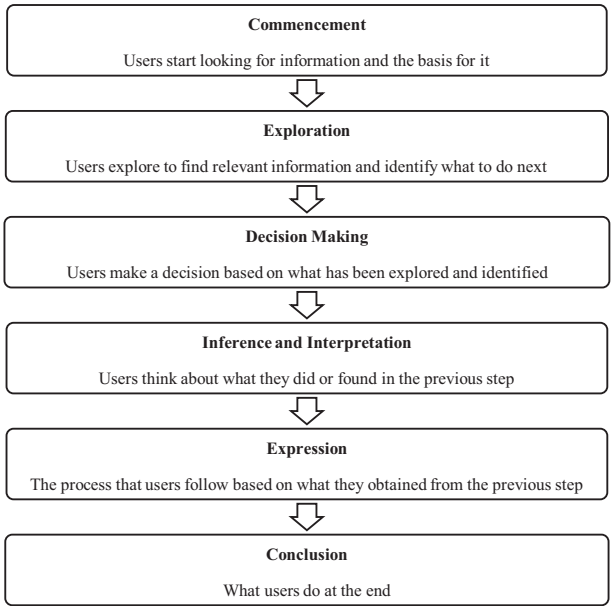

Figure 10. The unified model.

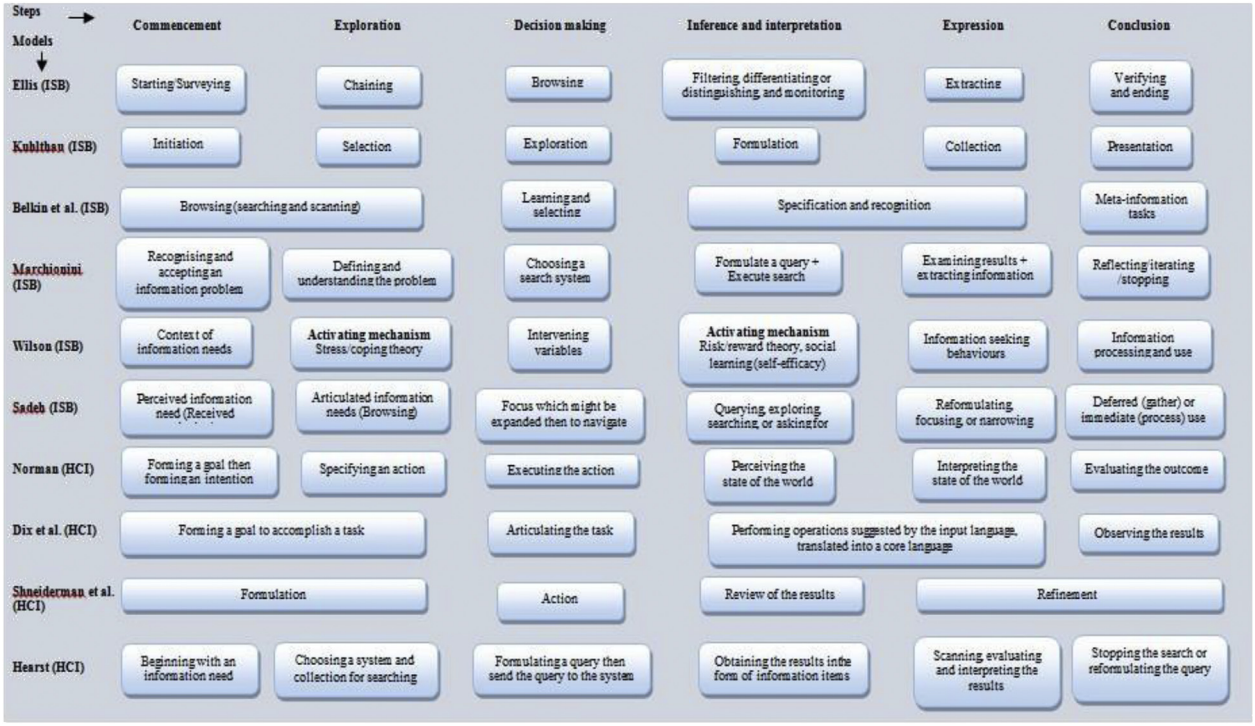

Figure 11. The steps applied in the ISB and HCI models, and the similarities and differences between the selected models.

On the other hand, Norman (HCI) argues that in this step, users execute the action by trying to find the item or the button to click on. Dix et al. (HCI) point out that users articulate their tasks based on their previous step, which is quite similar to Marchionini's (ISB) point of view. Shneiderman et al. (HCI) have mentioned that in this step, users determine how to start their search. Finally, Hearst (HCI) provides a direct step, which is sending a query to the system; users identify how to proceed by using the system to formulate their query.

Thus, the third step (Decision making) for users interacting and looking for information can be summarised into eight points as follows:

Users:

- Articulate the tasks formed and identified in the previous step.
- They might be influenced by variables, such as experiences, expectations or demography, prior to searching.
- Determine how to start their search by choosing a search system based on their experience with a particular system and their expectations from the previous step.
- Formulate their search.
- Start by searching for general information about the topic.
- Check information about their interests to learn something before they select what they want by going to contents pages or lists of titles.
- Select the items for retrieval by finding a button or an item to choose and click on.
- Expand the information they have and then navigate other types by following links.

Based on this step, in our example, the postgraduate student articulates the task formed and identified in the previous step by determining how to begin the search: he/she formulates the query to start searching for general information about the topic and check information on his/her interests to learn something before he/she select what wanted by going to contents pages, or lists of titles. Then he/she selects interested items (resources) for retrieval by finding a button or an item to choose and click on. Then he/she might follows links required to access the resource; however, he/she might be influenced by variables, such as experience, expectation, or some demographic characteristics, prior to the search, or may be affected by the previous step.

4.4. Inference and Interpretation

This is defined as the way users initiate their fourth step when they need information. In this step, there are more differences among the models than there are in the other steps, but there are still some similarities. In this step, users are more confident and their levels of uncertainty decline as they obtain information. In addition, they are now ready to solve the problem, according to Kuhlthau (ISB); however, Wilson (ISB) has a different opinion. He argues that users might use some information more than others, and may or may not be able to achieve their goal successfully as this ability is based on their perceptions of their own efficacy. Ellis (ISB) states that users filter their search to differentiate the presented data, and monitor developments by frequently following particular sources. Belkin et al. (ISB) discuss how users seek the identified items. According to Shneiderman et al. (HCI), users review the results by viewing information such as the content and dataset size.

Marchionini (ISB) mentions that users formulate their query by either semantic mapping or action mapping, and then execute their search. Sadeh (ISB) has a similar viewpoint, which is that users formulate their query, but mentions three ways by which the query to be followed is formulated: exploring, searching, and asking for (information). Dix et al. (HCI) also suggest that users formulate their query, but this is based on the suggestions of the system when they enter their query. However, Norman (HCI) states that users see what in fact has happened. Finally, Hearst (HCI) points out that users obtain information in response to their search.

Thus, the fourth step (Inference and Interpretation) for users interacting and looking for information can be summarised into six points as follows:

Users:

- Are more confident in their ability to solve the problem.
- Formulate their query and then execute the search to explore or ask for information that is already well known.

- See what has happened (e.g. displayed or through feedback) by receiving information items in response to their search.
- Review the results by viewing the data set size, layout, sequencing and contents to seek identified items.
- Filter the information sources to differentiate or distinguish between the information presented, as well as to monitor the developments in a field by frequently following particular sources.
- They might prefer some kinds of information more than others, and they may or may not be able to achieve their search goals successfully.

Based on this step regarding the example, the postgraduate student is now more confident about formulating the query for searching to explore or asking for well-known information (e.g. keywords related to the topic). Then, he/she sees what has happened (displayed) and then reviews the results by viewing the contents to seek identified items. Then, he/she might filter the results to differentiate or distinguish between the information presented. However, he/she might prefer some types of information more than other types of information, and may or may not able to achieve the search goals successfully, as this ability is based on his/her perceptions of his/her own efficacy.

4.5. Expression

This is defined as the way users follow the fifth step when they need information. In this step, the similarities among the models are strong. Kuhlthau (ISB) states that users collect the results that they focused on, similar to Ellis (ISB), who points out that users select interesting material from the resources they were working through. Furthermore, Belkin et al. (ISB) maintain that users identify relevant items. Wilson (ISB) has a slightly different point of view, which is that users might collect information in four ways: passive attention, passive search, active search, and ongoing search. Marchionini (ISB) points out that users examine their search results in different ways and then extract the relevant results. This is similar to what Wilson says regarding active searching, but Wilson states that this might happen without planning (passive forms of searching) while Marchionini sees this happening by examination. Sadeh (ISB) provides a similar opinion to Marchionini, that users scan the results and might reformulate, focus, or narrow down their search. In addition, Hearst (HCI) mentions that users scan, evaluate and interpret their results.

Shneiderman et al.'s (HCI) point of view is similar to Sadeh's, with regard to the way users refine their search. Sadeh argues that users might narrow down their search, and Shneiderman et al. mention clustering of the results. However, Norman (HCI) points out that users recognise what the state of the system is and then check if anything has changed. This is similar to Dix et al.'s (HCI) viewpoint that users will see what the system displays (translate) based on what they entered.

Thus, the fifth step (Expression) for users interacting and looking for information can be summarised into six points as follows:

Users:

- Might obtain results by undertaking passive, active or ongoing searches.
- View what the system presents to them.
- Work through the resources to identify and examine what is of interest or relevant to their goals.
- Scan, evaluate and interpret the results they obtained.
- Might reformulate the query, focus on relevant results or narrow down their search results.
- Extract relevant information they focused on, using skills such as reading, scanning, listening, classifying, copying and storing information.

In our example, the postgraduate student views the results presented by the system, and then he/she scans, reads, focuses on, identifies, examines, evaluates and interprets the results to select an interesting or relevant one. In case he/she does not find what he/she needs in the first attempt, he/she might reformulate the search, or narrow down (refine) the results to find relevant information; this can be through active searching to seek out results actively from diverse sources (e.g. databases, e-journals, and books), then he/she extracts the relevant (interested) information (result).

4.6. Conclusion

This is the last step used to search for information. The last step has many similarities between the models. Kuhlthau (ISB) mentions that users finish the seeking process by identifying whether it has failed or succeeded and then presenting and explaining this to others. Similarly, Wilson (ISB) explains this as the step wherein users use what they have found. Sadeh (ISB) similarly states that users either use what they have found immediately, or defer its use (gather). This is similar to Shneiderman et al.'s (HCI) opinion that users extract the results to files, so they might use them immediately or later on.

According to Ellis (ISB), users make sure that their findings are accurate and then end their search. This is similar to the opinion of Norman (HCI) and Dix et al. (HCI), who argue that users verify and evaluate what they have obtained before they use it. Furthermore, Belkin et al. (ISB) mention that users interact with the sources which might be different from meta-information, which describes the structure and contents of the objects of information. Marchionini (ISB) and Hearst (HCI) have a similar point of view, which is that users might either stop their search or iterate/reformulate their query.

Thus, the final step (Conclusion) for users interacting and looking for information can be summarised into four points as follows:

Users:

- Observe and evaluate the results they gained, and ensure that they are correct and relevant to their goal to end their search.
- Make sure that the information obtained is similar to what has been provided in the meta-information.
- Find results (information).
- Reflect, iterate, stop their search or reformulate their queries based on the information-seeking process itself.

Based on the last step, in our example, the postgraduate student observes and evaluates the results he/she gained and ensures that they are correct and relevant to his/her goal to end their search and this might be by making sure that the information obtained is similar to what has been provided in the meta-information (metadata). When he/she finds the required result (information), he/she extracts it (e.g. downloading it) to use them immediately or later. Finally, he/she either stops the search or iterates or reformulates his/her query it if the result is not relevant.

5. Validation of the proposed model

In order to validate the Unified Model proposed for academic information seeking, data was collected and analysed from two Universities, one in the UK and one in Kuwait. This section discusses the practical research we have undertaken for data collection and analysis, which are to be used to compare and validate the Unified Model at the end of this section.

5.1. Data collection method and process of analysis

To achieve the study's aim, two case studies were conducted at two universities, one in the UK and one in Kuwait. The use of multiple case studies helps the researcher conduct a good case study (Yin, 2013). This study used observations as its data source through a set of tasks (Appendix) given to the participants (10 postgraduate students from each university).

The observer followed several procedures before starting the tasks to ensure the tasks were performed smoothly without any problems for the participants. These procedures were as follows:

- The observer asked participants to use his personal laptop to perform the tasks, as the software used is installed on his laptop, and steps were taken to ensure that participants were comfortable using the laptop before performing the tasks. That happened with piloting 3 participants using the laptop before the real study. Based on participants' feedback from the pilot study, steps applied changed underwent for enhanced validity and reliability.
- Participants were given the option to choose the place they prefer to perform the tasks (e.g. the library, the lab or the PhD student's room). which will help them to feel free better than controlled research environment as they might be under pressure, the location they choose is closer to their nature when they are doing a real searching for information and using the library website.
- Participants were given the option to choose their preferred browser (e.g. Google Chrome, Explorer, Firefox etc…). This would help them to choose the browser they used to use to avoid any difficulties they might encounter with another browser they use it rarely or they never use. It was taken into consideration if there were differences in browser characteristics related to the task or with the libraries' websites before starting.
- Participants were given the option to skip the task they were working on and move to the next task if they encountered difficulty or did not know how to complete it. This option was given to the participants because there was a predetermined, agreed-upon session, as the observer informed them that the session would be no longer than 45 min. This was done to inform the participants that they do not need doing that in a correct way to avoid any obstacle as the observer was asking them that the aim is to perform the task normally and if they cannot do it, they can easily leave it. This helped the observer to see the participants in their nature without any attempts that they are professional, or they have good skills to do that. Also, it is an ethical issue as we told them before about the time of the participation. Therefore, this happened smoothly without any problem.

The tasks were started with pre-task questions then the observer provided the participants the eight tasks to be completed using only their respective library website. The observer asked them to think aloud while performing the tasks. Nonetheless, there are some disadvantages when using the Think Aloud technique. One of the main problems is that some users might be silent when doing some part of the task (Rogers et al., 2011). Initially, the researcher began as a nonparticipant. Later, the researcher became an active observer. Nonparticipant. means the researcher is an outsider to the group. He or she simply watches and takes field notes at a distance. The researcher records data without direct involvement. While active participant means the researcher is fully engaged. This type of observation may help the researcher establish a greater rapport with participants. According to Creswell (2013), becoming a good qualitative observer requires that a researcher change his or her role during an observation, such as starting as a non-participant and then becoming an active participant (and vice versa). Thus, which will help to minimise the disadvantages of the Think Aloud technique.

When the tasks were completed, participants were presented with a number of post-task questions intended to gather information about the positive and negative features that they experienced; the difficulties or obstacles they encountered while performing the tasks and their viewpoints and suggestions to improve their respective library's website.

Data received from pre-task and post-task questions were analysed by using content analysis. Notably, to start the process, inductive content analysis requires that the researcher first organises the data (e.g. open coding, category creation, abstraction) (Elo and Kyngäs, 2008). Regarding the tasks, task analysis was used in conjunction with content analysis. This combination stems from participants' thoughts and beliefs as they think aloud while using the academic library web interface.

The tasks were first transcribed by the researchers after watching the videos of the participation. The researchers transcribed what the participants said; each step they took to achieve the tasks; the researchers' observations of each task by all the participants. An example of task analysis is as follows:

Task one is as follows: 'Is the *International Journal of Sport and Health Science* available in the library?'

Participant K1 at Kuwait University performed this task as follows:

> *'Scanned and explored the library interface options - chose e-journals option - typed health and sport - executed search - explored the results - read their information carefully - completed the task based on the information that came with the results'.*

Participant K1. He commented as follows: *'It is slow, I used to use the databases option and it is not slow like this'.*

Participant S1 at the University of Salford performed the same task as follows:

> *'Scanned and explored the library interface options - did not find journal option to search - chose find everything - typed the whole title of the journal but with the wrong spelling - executed search - explored the results - read their information carefully - limited the results by journal title - explored the results and read the information carefully - returned to the result page - changed search option to e-journal - typed the journal title - executed the search - explored the results - read the information carefully - completed the task based on the information that came with the results'.*

Participant S1. They commented as follows:

> *'No journal option. I might start with find everything. The first two results are not from this journal. I might refine them here. Here, we have what results came in, in what journal. This only says that no entries are found. It doesn't say it's not available, but you might infer that it's not available. I think I need to click on the e-journal and search by journal title name'.*

The researcher's analysis was as follows:

After observing the participants, it became clear that they followed six steps:

1. Scanned and explored the interface options.
2. Chose an option.
3. Formulated the query and executed the search.
4. Explored the results.
5. Read and verified the results.
6. Made a decision.

It was observed that when S1 failed in the first attempt, he limited the search results, and then repeated steps 4 and 5. When he failed again, he repeated steps 2, 3, 4 and 5, and then finished the task. K1's comment indicated the slowness of searching.

5.2. Recruitment of participants

Diverse strategies played an integral role in recruiting participants. The researchers initially sent invitations by e-mail to postgraduate students; however, this method proved ineffective. None of the recipients replied. As a result, the researchers proceeded to follow three additional recruiting methods. First, the researchers went to libraries to meet with postgraduate students face-to-face, explaining the research purpose of the study and then asking whether they would like to become participants. Consequently, roughly half of the participants in the observations

joined. Second, the researchers sought the assistance of friends. This form of networking undoubtedly played a crucial role in reaching out to more students at each university. Finally, the researchers asked academics from both universities to encourage their students to participate. This method proved successful in recruiting participants.

Participants who accepted to participate, were given an information sheet including all information about the research. All participants signed a consent form prior to participation in the study. In addition, all data collected took into account confidentiality and ethical considerations. This research was undertaken with full ethical approval from the University of Salford Research Ethics Panel as attention to ethical issues is necessary in any research. Participants were given the option that they can leave or discontinue the study at any time. Participants were joined freely, and we provided some snacks to them during the participation.

5.2.1. Techniques applied to carry out the observations

The researchers used the screen capture software *Snagit* from Tech Smith.com. Snagit performed audio and video recordings of participants using the library's website as well as their attempts to complete tasks. The researcher used this screen capture software for two reasons. First, it captures how participants use the library website. According to Imler and Eichelberger (2011, p. 446) 'video screen capture technology is an inexpensive, user-friendly way to enhance electronic resource usability studies in any library'. Second, it records participants' voices, particularly useful for the Think Aloud technique. By using the Think Aloud technique, the observer can attain additional information about participants' actions and thoughts. Charters (2003) claims that Think Aloud is a research method in which participants think aloud as they complete tasks. Moreover, Rogers et al. (2011) point out that the Think Aloud technique enables the observer to better understand what is happening inside participants' heads. Nielsen (2012) defines Think Aloud in the following way: 'In a thinking aloud test, you ask test participants to use the system while continuously thinking out loud—that is, simply verbalising their thoughts as they move through the user interface'. Finally, in deciding when and where to hold each observation, the researcher followed participants' individual preferences.

5.3. Validation findings

Based on data collected outlined above, the steps that users follow when performing the tasks are as be summarised as below, with comparison of steps in the Unified Model.

Step One: Scan and Explore the Interface Options – "Commencement" and "Exploration" steps of Unified Model

All the participants were asked about the purpose of seeking information whether by using the university libraries' websites or other websites. All stated that they used the library websites or alternative websites based on the information they required. Their needs were diverse and were based on their positions and purposes. Thus, the users did not begin to search for information on the library websites until they identified what needed to be achieved.

The participants were given specific tasks (Appendix) and, therefore, knew what they were looking for. As their first step, all participants scanned and explored the interface options based on their tasks. For example, when they were asked to find a journal, they scanned and explored the interface options to find the appropriate option of locating the journal. When they were asked to find e-books, they scanned and explored the interface to find an option for e-books. This was repeated with the other tasks. Surprisingly, when the majority of the users (particularly in task four) did not find an option that was relevant to the task, they scrolled up and down the pages while scanning the library interface and exploring the options. They then went to each option, using the mouse pointer when they explored the library interface.

By comparing the first step in this study with the first step in the model, which was commencement, it can be concluded that identifying the required information, obtaining the initial information or even formulating the goal cannot be a step in looking for information on the library website, because it is used only when the users have identified the desired information. However, searching known items or browsing to search and scan an identified or interesting item to begin a search mentioned by Belkin et al. (1995) the first and second steps in the model, can be slightly similar to the first step in this study. Users were scanning and exploring the options which could be identified or interesting items to begin their searches, as they knew what they are looking for based on the task. However, none of the users in this study browsed to find identified items as they were exploring the options available in the interface.

However, the first step in this study leads to some points mentioned in the second step of the combined model—that is, users intend to accomplish a task by exploring the ways to do that (Norman, 2002; Dix et al., 2004). It also supports the point made by Shneiderman et al. (1997): users identify where to search and begin exploring based on their understanding or knowledge of the task field mentioned by Marchionini (1995), as the users in this study scanned and explored the options to identify the best one to choose based on the task.

In the first step, the users in this study were not affected by any psychological factors, as Wilson (1999) mentioned. They were confident, and when they chose the wrong option, many of them simply changed it and chose another one without encountering any problems. In addition, the users in this study did not need to follow the footnotes and citations in an identified resource, as Ellis (2005) declared. In addition, they did not need to have an idea about the topic to be able to begin their searches, as Kuhlthau (2005) declared, as they were given particular tasks to perform. They also did not need to browse or examine the items they had, Sadeh (2010) mentioned, as they had specific tasks and knew what to do.

However, none of the models indicated what users do in the cases in which they are unable to find the option they need. This study ascertained that if users did not find what they needed, they went to each option, using the mouse pointer, when they explored the library interface. Hence, this finding was not detected.

Step Two: Choose an Option – "Decision making" step of Unified Model

This study found that, in the second step, the participants chose an option. This step was based on the previous step. After scanning and exploring the interface options, they chose the option that seemed the best, based on their assessment of the options on the interface. For example, on the University of Salford's library website, there was no option for journal; therefore, most users chose "find everything". On Kuwait University's library website, there was no option for articles; therefore, most participants chose either the e-journal option or the database option, both of which contain articles. It was observed that some participants chose the wrong options because the organisation of the options was complex and because of the terminology used on the library website.

Hence, the second step of this study further supported the third step in the model, as the users in this study decided by choosing the option they believed was most appropriate. This is further supported by some points mentioned in the third step in the model. In particular, Shneiderman et al. (1997) mentioned that users determine the ways in which to begin their searches. Similarly, Norman (2002) indicates that users execute actions, such as finding a button or an item to choose and click on, as was the case with the users of this study: when they chose the option, they selected (clicked on) it. This seems similar to Marchionini (1995), who states that users choose a search system based on their experiences with a particular system and their expectations from the previous step. The users in this study chose the option based on the previous step; however, they did not choose the system, as they were using the libraries' websites (systems). In addition, the second step of this study strongly supports Wilson's (1999) view that, in the third step, the users can be influenced by a number of intervening variables (e.g. availability of resources, accessibility and credibility). The users in this study were influenced by the availability of the options provided in the libraries' interfaces, as

some of them chose the wrong option or did not know which one to choose to begin. Moreover, the second step of this study was similar to the point elaborated in the second step of the model mentioned by Hearst (1999): users choose the system and the collection to begin searching. Thus, it can be concluded that steps one and two in this study indicated that the options provided in the website interfaces affected the users' behaviours and interactions.

Step Three: Formulate the Queries and Execute the Search – "Decision making" and "Inference and Interpretation" steps of Unified Model

It was found that the third step that users performed was formulating the query and then executing the search. This step was also based on the previous step. The users did not formulate their queries to execute the search until they assumed that they chose the right option. When they failed in the first attempt because they entered a misspelled or insufficient query, they either fixed or reformulated it and then executed a search, changed the search option before they executed a search or did not complete the task.

In this study, the third step was similar to the point mentioned in the third step of the model, particularly Hearst's (1999), in which users send the query to the system, and iffails they reformulate the query. Furthermore, this step is similar to the point mentioned in the fourth step of the model, particularly by Marchionini (1995), in which a query is formulated and a search executed. Nonetheless, Marchionini pointed out that users formulated their queries according to the system's vocabulary or by using strategies and tactics based on the rules and features allowed by the system's interface. A major criticism of Marchionini's third step concerns the system's vocabulary. How do the rules or features of the system interface control the users' strategies and tactics when they formulate their queries? These do not exist on the library websites. The users of the library websites can formulate their queries without barriers or prior rules requested by the library websites or their systems. They are free to formulate their queries, and even within the advanced search, they can search according to any option they need; so, they can search by title, author, subject and so on. Users might be affected by their low knowledge of the topic when they formulate their queries or choose the keywords before executing their searches. According to one participant in this study,

> *'When I search for something, for example, at the beginning of my studies, it will be different than if I search for it again three weeks later, because the lecturer will give us more information about that topic. The lecturer will also provide us with a reading list as well [for us to] read more about that topic, and so I will have more information about the topic. I will be able to use the correct keywords. I might know about some journal that specialised in that topic or some databases that my lecturer told me about'.*

This step is also similar to the fourth step of the model, particularly in Sadeh (2010): query and then explore (i.e. search for information outside their field), search (i.e. conduct an exploratory search) and ask for information (i.e. information that is already well known by the users). Sadeh declared that users can then later reformulate, focus or narrow down their search in one step. In this study, the exploration of the results by the participants was the fourth step.

However, none of the models indicated the possibility of users formulating wrong queries or highlighted the complexity of the system, which does not support users' mistakes and which affects the search process. In addition, none of the models indicated the possibility of changing the option that the users chose to search in.

Step Four: Explore the Results – "Inference and Interpretation" step of Unified Model

It was found that the participants explored the results in general to see what was displayed for them. If no results were displayed, they either reformulated their queries or selected another option. Some participants used the advanced search but only to look for a specific name or title if they did not find it in the results. A possible explanation for this is that the participants might have thought that what they were looking for would be visible. Another possible explanation is that the participants were accustomed to seeing the keywords they entered either highlighted or bolded in the results. If no relevant results were found while exploring the results, they tended to read and verify every result, which was their fifth step.

The fourth step is consistent with the fourth step in the model presented in Norman (2002), who pointed out that users perceive what happened (feedback). Similar to what was mentioned by Hearst (1999), users receive information items in response to their searches. This step is slightly similar to Sadeh (2010) in particular in that, after sending a query, users explore in three ways (purposes):

- To search for information outside their field. This did not occur in this study because the participants searched for information determined by the observer.
- To conduct an exploratory search. The participants in this study explored the results to find information similar to the query that they formulated.
- To ask for information that was already well known by the users. This occurred in this study because the users searched for information based on the task.

Step Five: Read and Verify the Information (Metadata) of the Results – "Inference and Interpretation" and "Expression" steps of Unified Model

The findings showed that, after exploring the results, the participants tended to read and verify every result. In this step, the participants focused on each result and determined whether or not it was related to the query. It was noticed that they read and verified the results to look for words that were similar to those in their queries. Although some results were relevant to the required information, they were ignored because they did not include one of the keywords that the participants entered. If this result included words that were similar to the query they entered, they carefully read the information (metadata record) that came with the result. If the metadata record was sufficient, they finished the task based on this information. Possible explanations for this step might be that the users were not information literate or were performing tasks that were not in their subject areas. In addition, the majority of the participants did not scroll up and down the page, limit the search results or browse the results after exploring them and reading the information on the first page. Some users believed that what they were searching for should be one of the first results.

This step was similar to the fourth step in the model that was mentioned by Belkin et al. (1995), in which users learn information about an item or resource or they seek the identified item. It could also be similar to the fourth step in Shneiderman et al.'s (1997) study, in which the users review the results by examining the size, layout, sequencing and content of the data set. In addition, it is similar to Sadeh's (2010) fourth step: after formulating their query, users ask for information that is already well known to them, just as the users of this study were looking for information that was already well known to them based on the task.

Furthermore, the fifth step in this study supports several points mentioned in the fifth step in the model. Regarding the users in this study, when they ascertained that the result they examined is what they wanted, they completed the task. This is similar to Kuhlthau's (2005) position that users gather the information upon which they are focused. This is also similar to Belkin et al. (1995), who indicated that users

identify relevant items through stimulated associations, which means that users choose the results that seem relevant to their tasks. This also supports the position of Marchionini (1995), who pointed out that users examine the results that are relevant to their goals and then extract relevant information, using skills such as reading or scanning. This is also similar to Sadeh (2010), who stated that users might focus on acceptable and relevant results. Similarly, Hearst (1999) declared that users scan, evaluate and interpret what they obtain from the results.

However, the finding of this step proved that metadata plays a crucial role when users read and verify the results, as they depend extensively on this information, and they do not select any result if the metadata is sufficient, as they make the decision to finish their tasks based on this information. This finding supports study of Connaway and Dickey (2010), who suggested that high-quality metadata has become more important in the discovery of appropriate resources.

Step Six: Select (Click on) the Result to Examine and Confirm It – "Inference and Interpretation" and "Expression" steps of Unified Model

The findings showed that the participants' sixth step is to select (click on) the result to examine and verify it. The participants did not take this step if the metadata were sufficient. The participants examined the results that they selected to confirm whether or not they contained the required information. The participants used the following sequence when selecting the results:

a) Opened links if required (if the information was still insufficient) and then examined the information in that link. If they did not find what they needed in that link, they
b) limited the results. A few of them did this by scanning and exploring the results page and then Choosing one of the available limitation options, or they
c) Reformulated their queries and executed a search or they
d) Changed the search option and then formulated their queries and executed a search.
e) Utilising these methods, they repeated three steps—*explore the results*, *read and verify the information related to the results (metadata)* and *select (click on) the results to examine and verify them*—until they made the decision regarding whether to complete the task or leave it, which is step seven in this study and which will be discussed after this step.

The comparison of this step with the model showed that it was similar to the fourth and fifth steps, especially in regard to Ellis (2005), who pointed out that the users filtered the information sources to differentiate or distinguish them from the information presented. They then worked through the resources, selecting any material of interest. However, in this study, only few of the users were limited or filtered their search results at Salford. At Kuwait, none did this, because the refine option was not sufficiently visible. The sixth step could also be similar to that referred to by Sadeh (2010), which is the fifth step of the model: the users scan the results and then reformulate (if they did not find the required information), focus (on acceptable and relevant results) or narrow them down (if they find several results) to those that are most appropriate for the required information. This is also similar to Sadeh's (2010) third step: users might navigate other types of documents by following links, but the users in this study followed the links for the results they selected to ensure that these results were what they needed and were not for anything else.

Regarding the fifth step in the model, Shneiderman et al. (1997) pointed out a similar step in which the users refined their searches by using the feedback received from the system and then clustering the results. In addition, this step is similar to the third step in Belkin et al.'s (1995) model, in which the users learned about items or resources and then selected the most useful ones for retrieval. The sixth step of this study was consistent with the fifth step in Marchionini's (1995) model, in which the users examined the results that were most closely related to their goals and then retrieved the relevant information. Moreover, in this study, the users encountered difficulties when they selected items to examine. Some results that were selected did not open, or they could not access them to decide whether or not the results were relevant, and this affected the searching process. This finding is similar to Wilson (1999). In the third step, Wilson found that the users were influenced by a number of intervening variables, such as the environment (e.g. availability of resources) and the characteristics of the sources (e.g. accessibility and credibility). The users in this study were affected by the accessibility of the results they needed. As they transferred to the websites for these results, they needed to enter their username, password or Athens, and because of restricted access, some of them encountered difficulties when attempting to access the resources they selected.

However, the sixth step of this study found that the visibility of the search options or limitation options affected the users' behaviours and interactions, particularly at Kuwait, as none of them observed the refine option.

Step Seven: Make a Decision – "Conclusion" step of Unified Model

The findings showed that users make decisions in two ways:

1. They finish the task because they have succeeded and obtained the required information or fail and choose not to continue,

   Or

2. They repeat steps 2, 3, 4, 5 and 6 until they complete or do not complete the task.

These steps are similar to the final step in the ISB and HCI combined model. Nevertheless, this step is more similar to those in Marchionini (1995), who pointed out that users reflect, iterate and stop their search based on the information-seeking process. In addition, it seems similar to Hearst (1999), who declared that users either stop the search or reformulate the query.

To summarise, this study showed that users follow seven steps to search for information and interact with academic library web interfaces. These steps overlap as users can change, move and go from one step to another based on the difficulties they encounter and the options they have. Conversely, to a large extent, these steps support those identified in the combined model. However, there were some differences in the order and process of the steps in this study compared to the steps in the unified model. In addition, some findings had not been detected before and were identified above. Finally, the steps found in this study supported the significance of the HCI and ISB fields for academic library web interfaces and the synergy between the HCI and ISB models in identifying the steps that users take when searching for information and interacting with the interface is effective and efficient.

6. Conclusion

It has been shown that the models of the HCI and ISB fields included in this study shared many similarities and had few differences between them, resultantly a new model was created by combining the common steps identified in these models. This work enables us to consider how users interact with academic library interfaces taking into account both their information seeking needs and the principles of interaction which influence their usage of the interface. Academic library interfaces are continually developing and it is our belief that reliance on either a ISB or HCI model in isolation will result in only a partial understanding of the experience of the academic library user who has an information need.

Information seeking behaviours must be viewed in the context of the interface being used and therefore a model that is grounded also in our understanding of interaction provides the ability to move away from evaluation of a specific interface and provides a means to understand and the actions to be supported. The study outlined in Section 5 above indicates that the model (Unified Model) is a good indicator of the steps taken by academic library users, although some refinement is possible; this provides future direction for the work. However, the model needs to prove its validity by future studies, and it would be a good path towards such a real unified model. Finally, the steps that were identified in this study were limited to postgraduate students. Future research should consider other users of academic library websites, particularly undergraduate students to increase and examine the efficiency of the steps used to search for information and interact with web interfaces, as they constitute the largest population in universities.

Declarations

Author contribution statement

Talal Alazemi, Yun Chen, Maria Kutar: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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