



Research article

Evidence-based information-seeking behaviors of nursing students: Concurrent think aloud technique

Modi Al-Moteri*

Nursing Department, College of Applied Medical Sciences, Taif University, POB 11099, Taif 21944, Saudi Arabia



ARTICLE INFO

Keywords:
Information Seeking Behavior Cognition Nursing Ellis-model Students

ABSTRACT

Background: With the expansion of scientific information, and the beginning of evidence-based practice (EBP), embracing “evidence-based information-seeking behaviors” is essential to provide effective up-to-date nursing care. To better support students’ evidence-based information-seeking behaviors, this study explores how nursing students actually search and identify evidence-based information.

Methods: A concurrent think aloud technique was employed in which 12 nursing students were asked to verbalize their thoughts whilst using search engines to find EBP to inform their practice. **Results:** In general, searching literature per se is complex and many different searching activities are employed, including triggering, recalling, scanning, linking, accessing, retrieving, relating, extracting, evaluating and referencing. The search behavior may involve some iteration of the cyclical activities of scanning, linking and accessing. It is believed that background (recalling pre-existing knowledge), assessing relevancy, evaluating and referencing are pertinent to evidence-based practice information-seeking behavior. In view of this, the study proposes a new model of evidence-based information-seeking behaviors.

Conclusion: This study presents an evidence-based information-seeking behavior model based on a number of identified searching features. Results may have important practical implications for nursing educators.

1. Introduction

Evidence-Based Practice (EBP) is essential to provide effective up-to-date nursing care [1–3]. EBP refers to the incorporation of the findings of best research evidence in daily nursing care and practices [2]. The importance of acquiring EBP skills at the undergraduate level is widely acknowledged. This includes ‘search for’ and ‘selection of’ information [4]. In several studies conducted globally however, inconsistent implementation of EBP was reported [5–8]. In the United States (US), while the first set of EBP skills for nurses was released in 2014 [9], a great need to improve nurses’ EBP skills was reported in 2018 [10]. Some studies have stressed the need to integrate instruction on information-seeking processes into nursing programs [11,12].

As is the case worldwide, educational institutions and agencies in Saudi Arabia have engaged in a shift to the EBP framework, demanding synchronized emphasis on EBP in nursing education. In 2018, the Saudi Commission for Health Specialists (SCHS) re-devised the Nursing National Competencies to include a “Information and Communication Technologies (ICTs)” skill [13]. To this end, the College of Nurses at Taif University has launched a program to prepare nursing students to be information seekers.

* Taif University, P.O. Box 888, Hawiyah, Taif, Saudi Arabia.
E-mail addresses: m.motairy@gmail.com, m.motairy@tu.edu.sa.

<https://doi.org/10.1016/j.heliyon.2023.e15549>

Received 12 November 2022; Received in revised form 7 April 2023; Accepted 13 April 2023

Available online 17 April 2023

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Specifically, the College of Nurses at Taif University states “Value research and ‘evidence-based practice’ to determine the effective course of action for safe care delivery” [14]. Therefore, assessing students’ EBP information-seeking behaviors is essential, and an international requirement [15]. Indeed, the practice of doing searches for EBP is not only important for nursing students during their study time, but also to prepare them for their professional practices [16]. EBP provides the context to manage, repossess, examine, and use current information efficiently [12].

The concept of information seeking behavior can be defined as the process of identifying and fulfilling the need for information. Cognition and information search skills are used to complete the searching task [16,17]. The information-seeking behavior of nurses and nursing students has been the focus of many researchers for decades [12,18–23]. Numerous studies underscored individual and organization related factors that hamper or enhance information-seeking activities. For instance, confidence learning styles, perception toward EBP, searching skills, available free time, computer accessibility, information resources and technology infrastructure are the variables impacting the success of searching behavior [20,24,25]. In fact, confidence was found to influence nursing students’ use of knowledge sources for the first two years of employment post their graduation [26]. Few investigations, however, explored the searching behaviors of nursing students per se, using an investigation of the actual search actions [19,27,28].

Searching for information is a process in which inner mental activities and observable physical actions of an individual interact with each other to guide the search behavior [17]. This requires in-depth investigation. However, studies of information-seeking behaviors of nursing students, tend to be more descriptive using surveys and questionnaires to collect data [29]. This implies that the current nursing literature may not contain more than a partially detailed picture of information-seeking behavior [30]. Ellis [31], argued that using observation and/or unstructured interview or combining both techniques better adds itself to the investigation of information-seeking behavior. Case and Given [32], confirmed Ellis’ claim and stated that if researchers are looking for more insight or in-depth information about information seeking behavior, they might consider observing or interviewing a small number of individuals. Think-aloud technique serves as a mirror for the internal thoughts and helps to gain insight into an individual’s mental processes [33,34]. This technique is mainly used for assessing processes and understanding how people perform certain activities [35]. Unlike other forms of interviews that may rely on many interpretations and assumptions, think-aloud technique allows participants being studied to express their beliefs, thoughts and feelings in a way that may reflect some aspect of the regular cognitive processes. Thus, the technique can help to reveal what underlies the behavior being investigated, and this is a cornerstone in the technique validity [33].

For a more in-depth investigation, and for generating models of information-seeking behaviors of nursing students that contribute to the existing knowledge and support the current changes in the educational requirements, it is advisable to consider embedding a theoretical model within the study’s procedure. The theoretical model presents an articulated lens for the way the researcher will see results [36]. One of the greatest theoretical models of this kind of in-depth investigation can be found in the works of David Ellis [37].

Ellis’s model is based on experiential studies conducted with different groups and subgroups of users including social sciences researchers [38], academic researchers [31] and engineers [39]. Ellis demonstrated that there are some common features of the information seeking behavior of users in these all disciplines. These features are: (1) start—the searching process for information; follow (2) the chains of citations by consulting references cited in sources (backward chaining), or consulting references that cites those sources (forward chaining); (3) browse and scan areas of potential interest; (4) differentiate and filter the information sources by judging their quality, relevance and other characteristics; (5) monitor and maintain the awareness of developments in a field of interest and; (6) extract the needed information by searching through a source to identify relevant material.

Other globally used models have been proposed relevant to information seeking behavior including, “information search process” by Kuhlthau [40], and “problem-solving model” by Wilson [41]. In these models’ information seeking behavior occurs within a context as a linear iterative process consisting of stages [42]. Kuhlthau [40] proposed a search process model of information seeking behavior relying on the fact that individual uncertainty is the basic motivator of searching for information. The model includes six stages in which every stage of these stages relates with the emotional state of information seeker. These stages are: (1) ‘initiation’ which is triggered by feelings of uncertainty; (2) ‘selection’ of a general topic; (3) ‘exploration’ in which a decrease in the feelings of uncertainty about the topic takes place; (4) ‘formulation’, in which encountered information is associated with feelings of confidence; (5) ‘collection’ the topic is analyzed by selecting and evaluating information; and finally, in Stage (6) ‘presentation’ positive or negative feeling that depend on how useful are the findings. Wilson [41] proposed a problem solving model in which the searching behaviors are linked to the different phases of a goal-directed problem-solving process. These stages are: (1) problem recognition, (2) problem definition, (3) problem resolution. Wilson indicates that both Ellis’s features and Kuhlthau’s stages can be linked to the problem solving model.

Some degree of integration of different frameworks is now taking place, the significance of Ellis’s framework [43], is heightened by the fact that it has many similarities with the dominant frameworks of Kuhlthau [40] and Wilson’s [41], specifically in terms of the process used to seek for information. Further, Ellis’s model was described by other researchers as being flexible in application [44]. Indeed, most of the information-seeking activities in Ellis’ framework are now being supported by features available in Web browsers. It seems important to investigate if there are new searching activities that are being brought about by the rapid expansion and change in nursing knowledge, and information technology [45], and if so, what these activities are and what implications they hold for the enhanced strategies of information seeking behavior of nurses. This study explores nursing students’ evidence-based information-seeking behaviors.

2. Methods

A concurrent think aloud technique study was conducted from April to May 2021 among nursing students at a university in Saudi

Arabia.

2.1. Participants

Nursing students were considered eligible if they were in the fourth year and undertook a nursing research course. In total (N = 150) nursing students were eligible and invited to contribute in this study. Based on university policy, no direct contact with the student database was permitted. Alternatively, the university made the contact with the students through their email accounts. An invitation email message with a URL embedded survey, explanatory statement to explain the purpose of the study and an ethical approval statement were all attached and sent to the university Information Technology Department (ITD). Potential participants were instructed to click on the link, select the suitable date, time and place, if they were interested in participation, however, they are free to withdraw at any point by sending a withdrawal email request. Four weeks were allocated for collecting the responses. Initially 19 participants showed interest and clicked on the link, of which seven participants didn't show up at the predetermined time and date of data collection and 12 completed the interview. According to Hennink and Kaiser [46], nine to seventeen (9–17) interviews or four to eight (4–8) focus group discussions are adequate to achieve saturation, particularly in qualitative studies with a relatively homogenous population and defined objective.

2.2. Procedural

The library hall was set as a preferred place for participants to conduct the study. Interested participants visited the researcher on the predetermined date and time. Participants were instructed to bring the equipment they use to conduct a data search, including their own laptop, tablets or other technical equipment. The study purpose, procedure and data collection were all reviewed verbally with participants. Privacy regulations were maintained and participants were asked to sign a consent form. Participants were also asked to provide brief description about their demographic data. As searching datasets to find EBP to inform their practice is not a frequent task of nursing students, the researcher used a simulated search task inspired by Jocelyn Chew et al. [47] to create a simulated but authentic task. The researcher provided participants with the following task instructions “You need to search and identify scientific evidence on “turning frequencies of adult bedridden patients”. The researcher provided participants the following definition of “scientific evidence”: information/data that is generated from peer reviewed studies.

The researcher also instructed the participants to verbalize their thoughts during the search task. Participants were informed that during the search task, they are free to drink, eat, leave the room and take as much time as they needed. The sessions of the search task were audio recorded and were transcribed later.

2.3. Ethical approval

Ethical approval was granted by the University Ethics Review Committee. Informed consent was obtained. Participants were informed that their participation was entirely voluntary and that any information resulting from the study would be treated with confidentiality.

3. Data analysis

3.1. Qualitative analysis

All participants' recorded sessions were transcribed and separately transformed into Word files and printed out. The amount of data produced from their thought processes was around 17,241 words. For the researcher to better understand the participants' evidence-based information-seeking behaviors, a hybrid thematic analysis approach was carried out [48]. The approach integrated deductive and inductive analysis techniques. The researcher started the first round of analysis by reading and rereading the printed files to familiarize herself with the data. Similar segments, statements and words were categorized. The initial codes were then identified, organized and similar codes were grouped. Saturation was reached after approximately eight transcripts. Patterns and themes

Table 1
Deductive analysis.

Initial study codes	Ellis's six information-seeking model	Final codes	Final themes
Obligation	Starting,	Triggering	Starting
Recalling pre-existing knowledge	X	Background	
Exploring available resources	Browsing	Scanning	Searching
Keywords	Chaining	Linking	
Accessibility	Monitoring	Accessing	
Documenting the resources in a list	Differentiating	Retrieving	
Examining appropriate information	X	Relating	Selecting
Organizing information in a table	Extracting	Extracting	
Evaluating the quality of information	X	Evaluating	Closing up
Referencing to the source	X	Referring	

produced from completing the inductive coding process were not intended to be final. Indeed, the inductive phase was followed by another deductive coding process [48], to facilitate an in-depth examination of findings in line with the existing knowledge. In the deductive analysis the emerged codes were linked with Ellis’s six information-seeking dimensions [43] presented in literature. Ellis’s six information-seeking dimensions have guided the presentation of themes and codes and their interrelationships (Table 1).

Prior to accepting the final findings, the consistency of applying the coding system was checked. Two masters’ students were invited to be coding checkers. Random samples from the printed files were selected and were given to the masters’ students as well as the with code system and the description. The masters’ students were requested to recode based on the code system developed by the researcher. Inter-agreement between the researcher and the masters’ students was calculated and was satisfactory. Once the credibility was checked, then the generation of the model for nursing students was begun.

4. Findings

A total of 12 participants of nursing students participated in this study. Participants were eight male and four female.

4.1. The emerged themes

The emerged codes with similar patterns were grouped to create a specific category (theme). In this process, four themes and ten subthemes emerged from the open-ended questions analysis. These themes were (1) starting (2) searching, (3) selecting and (4) ending. The following section will include representation of themes and related subthemes.

4.1.1. Starting

Two aspects related to the starting theme have emerged as subthemes from participants answers: trigger and background. These two subthemes reflect the initial thoughts prior to initiation of the task of searching for information.

4.1.1.1. Trigger. At this stage, a student becomes aware about the need for information. It seems that feelings of obligation and uncertainty are the most common triggers that lead to initiation of the process of searching for information. The qualitative answers noted that much of the search behavior is mainly a response to a task as shown in the answers below:

Verbatim	Key findings
“... I’m quite aware about the importance of EBP ... but we often not seek for EBP if we are not required to do that ...”	Obligation
“... I only seek for scientific information if I have an assignment or research project ...”	Obligation

4.1.1.2. Background (recalling pre-existing knowledge). Participants verbalized sometimes, recalling information from their courses or reflecting on previous experiences that helped them in starting their search, as they commented below:

Verbatim	Key findings
“... you see ... I’m trying hard to remember what I took in my courses ... we learned a lot about bedridden patient in meds [medical] and funda [fundamental of nursing] ... knowing information about the topic sometimes help in identifying the starting point ...”	Previous knowledge
“... I had a similar experience last semester while I was doing my geriatric assignment ... my instructor taught us a good trick in how to start searching for any subject ...”	Previous experience

4.1.2. Searching technique

Several subthemes representing specific search behaviors have emerged within the theme of searching which were similar to those in Ellis’s model.

4.1.2.1. Scanning. As in Ellis’s model, participants beginning the activity of undertaking a search for information do not know where to start. This stage is an exploration of available resources and participants visit various resources related to the topic of interest. They scan resources to obtain an overview of their content. It appears that this stage is used by participants before arriving at a specific direction about where to go or what source to select.

Verbatim	Key findings
“I start with a broad search and sometimes I start with no specific direction”	Broad search
“... You see me googling different websites until I find sources which are related to bedridden or immobile patient [topic of interest].”	Different websites
“At the beginning I’m searching plenty of places”	Plenty of places
I inspect the sources I found during my search, in order to detect something, help me in expanding my search	Inspecting
“... Google is my choice”	Google search

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Verbatim	Key findings
"... I know there is lots of search engine but Google is the best ..."	
"... (Google) easy to use and very friendly ..."	

Participants viewed information (sources) they found with no specific target in their mind. This step is similar to browsing in Ellis's model. It is possible that sources of data are found, and screened. Their aim is to screen the sources they retrieved during their search activity in order to find information that attracts their attention or meets their needs.

4.1.2.2. Linking. As in Ellis's model, participants use keywords from a source that is relevant to their topic of interest. They also use the keywords in their topic of interest to search.

Verbatim	Key findings
"I'm using different words from the topic and instructions to start the search"	Search word—topic and instructions
"I use keywords from the first source I found during my search and that is highly relevant to my search aim. ..."	Search word—resource
"..... I use 'plus' to connect the search words ... you could use (bedridden + turning) there is other tricks to connect words but I can't remember them now ..."	Connect search words
".... If search keywords are not helpful, I do another broad search ... this what I'm doing now ..."	Do broad search again

The techniques used by participants are similar to forward and backward chaining.

4.1.2.3. Accessing. Participants will try to read and view some content of the identified resources to form an idea, however, access is not always granted.

Verbatim	Key findings
"... this article require purchase I'll just read the summary .. sometimes summary is more than enough ... I mainly avoid those websites that require purchase to access ..."	Read summary
"... I read the material if I can only access the source"	Access permitted
".... the abstract seems helpfulbut it require registration to read the full article But you know ... I can still be able to read it through SDL (Saudi Digital Library) you need only to copy the title and paste it there ..."	Alternative access
".... if I couldn't reach the full article ... I use Google scholar to click "Cited by" to show me other articles that have cited this article"	Alternative work

4.1.2.4. Retrieving. After scanning different resources, participants begin to determine and collect the relevant information from a collection of resources. This includes documenting the resources in a list to revisit later.

Verbatim	Key findings
"... During my search I looked at their contents I sometimes save the related materials ... I copy the link of the article on page in word ... so I can return back to them later"	Manual retrieving
"... one of my friends recommended me to download Mendeley ... it helps in storing and organizing research data, ...I'm using it since then ..."	Retrieving tool

4.1.3. Selecting

Two subthemes related to the selecting theme have emerged from participants' answers:

4.1.3.1. Relating. Participants start to select the most appropriate information. In this activity participants sort through the collected information and select the most relevant. Participants prioritize that information based on the topic of interest.

Verbatim	Key findings
"I go through the articles, back and forth until I select those that are highly relevant to the topic"	Back and forth
"I divided the information into most relevant and less relevant...this save a lot of time"	Divide
"I start to categorize articles to find those which provide more in-depth coverage of the task, then I print them all ..."	Categorize

4.1.3.2. Extracting. As in Ellis's model, data that has been collected from more than one source will be extracted. Participants locate

each piece of information needed within each source and prepare it for evaluation. Extracting allows different types of information to be combined either for further evaluation or utilization.

Verbatim	Key findings
"I read the collected information many times then I organized the necessary information in a table "	Read and organize

4.1.4. Closing up

Two subthemes related to the closing up theme emerged from participants' answers. The following verbatims were obtained:

4.1.4.1. *Evaluating.* Participants evaluated the quality of the collected information as not all relevant information will be used. Some participants ignored information that would not meet their quality criteria. Two types of quality judgments were reported in participants' answers: source quality and source content quality.

Verbatim	Key findings
"I examine the information I'm interested on whether it builds on scientific argument"	Examine the information
"I carefully examine the website before I download anything"	Examine the source

4.1.3.4. *Referencing.* At this step participants use and report the information that was found through the above process and refer to the resource.

Verbatim	Key findings
"I use the information and I reference to the source in my written assignment ..."	Referencing

5. Discussion

Many conceptual models have been proposed by cognition scientists to describe individuals' information seeking behavior [44,49]. These models mainly serve a specific context but share a similar perspective on information seeking behavior [50]. Indeed, information technology science models have focused mainly on the "information user", while communications science models have focused on "communicator activities" [51]. Hence, many of these models have been revisited by researchers and new conceptual context related models have been developed [27,52].

In the nursing field, nursing education and healthcare are going through radical changes [53]. It is therefore recommended as being important to conduct new studies into information seeking behavior [12]. However, the number of reports conducted specifically on undergraduate nursing students with respect to information behavior is still small and several have focused on registered nurses [20, 22,54,55]. Further, while information seeking behavior in the human behavioural sciences includes different sets of skills [17], studies



Fig. 1. Evidence-based information-seeking behaviors conceptual model.

in the nursing literature tend to focus their investigation on a sub-set of information-seeking behavior such as using libraries [56], electronic information access [28] retrieving information [19] rather than the broader concept of information seeking behavior.

The findings of the current study support and are matched with the Ellis's theoretical model. Beside the six information-seeking activities of Ellis's model, there were an additional four activities that nursing students employed. The new activities are: background (recalling pre-existing knowledge), relating, evaluating and referencing. Further, similar to what Kuhlthau [40] confirmed, findings of the current study go beyond the simple observable physical actions of the process of information seeking. The study findings incorporate certain cognitive strategies such as linking, scanning retrieving, relating and evaluating.

In general, the ten information-seeking activities that nursing students follow are—triggering, background (recalling pre-existing knowledge), linking, scanning, accessing, retrieving, relating, extracting, evaluating and referencing—which are not necessarily always sequential. These ten activities are categorized under four main interrelated stages that encompass: (1) starting, (2) searching technique, (3) selecting the most related information, and (4) closing up. In view of that, the study proposes a new model (Fig. 1).

5.1. The emerged model

Participants in the current study searched information resources in response to a specific given task. The task mainly determines the search topic and triggers the search activities. The tasks in the current study were mainly about carrying out an assignment and/or research project. However, in nursing practice, evidence-based information can be triggered in response to making a nursing practice change or to answer a clinical question [57]. Starting was identified as a distinct activity in Ellis's model, however, in this study and among nursing students, the starting activity comes as a stage that is triggered by a given task and includes recalling for previous knowledge and experiences. This activity (triggering) is associated with the attempts to initiate the search process, and therefore should be added to David Ellis's information-seeking model. This finding is aligned with what was noticed in social science studies [27], particularly, what is presented in Kuhlthau [40] model.

In the current study Google was the most used search engine. This is possibly because participants use it as a starting point to initiate the search as well as to find open-access websites and platforms as an alternative to “pay-walls or sign-up restrictions” [27].

The next two stages bridge between the starting and closing up stages. These two stages are where most of the searching activities take place. As shown in Fig. 1, in each of the two stages (i.e., scanning, linking, accessing, retrieving, relating, extracting), a number of activities could take place. Participants scanned the materials, however, the depth of scanning and the type of items within the resource scanned were not revealed by the qualitative data. Further studies are required to clarify this area. Because searching in general does not necessarily always lead to a direct source of information, scanning is mainly broad. Indeed, participants reported that they start by initiating a general and unspecific search to find interesting information or resources. During the linking activities, all participants use keywords obtained from a task title or instructions. In subsequent searches, different keywords are obtained from the identified searched material. Once interested materials were identified, retrieving these materials becomes the next step.

Accessing some electronic sources requires permission either through registration or purchasing. In the current study participants' response revealed that they prefer direct, easily accessible sources. This may be because students avoid spending time creating or logging into an account. Indirect availability and accessibility of sources were noticed as barriers in the search process [27]. Participants continue searching for information and form a result list for a given question. In the current study participants saved information for later relevance assessment. It appears that the formed search list acts as an “anchor” for later visit. The activity which follows is assessment of relevance of information acquired. During the relevance assessment, participants mostly assess information fitness with the topic of interest or query at hand. Upon closer inspection to assess relevancy, information suited to answer the query at hand, is determined and organized. It is believed that organizing is a helpful step to assess information relevance.

The last stage relates to the utilization of the information being assessed for relevancy. Participants' response revealed that an evaluation of information quality was undertaken. Some studies showed that the quality of information is mainly evaluated based on the source quality [58]. Finally, participants in the study tend to use a referencing system and in-text citation. This finding is of interest since student adherence to academic integrity values is of concern [59]. Perhaps this is because participants in this study were fourth-year undergraduates. Indeed, the literature shows that the freshman often lacks citation skills [60]. Students' referencing skills mainly developed progressively during their period of studies [61]. A clear instruction about referencing remains essential when teaching students EBP.

5.2. Implications

The study results may provide insight for decision makers, librarians and nursing educators to become more active by devising strategies to enhance information seeking behavior and skills. This study's results may present important practical implications for the future research to investigate information-seeking activities — triggering, starting, linking, scanning, accessing, listing, relating, extracting, evaluating and referring — as well as the development of more effective training programs that will empower information users to develop and enhance information literacy. With the increasing availability of electronic resources, it is essential to teach nursing students how they can evaluate and access reliable and trustworthy information sources.

5.3. Study limitation

This study has some limitations. First, this is a limited scale study, as the study findings were drawn from a defined population of nursing students in a specific geographic area. Hence, the study findings cannot be generalized to wider populations. Secondly, the

sample might be homogenous in term of having the same program, school and study year, and this could affect the study outcomes. Thirdly, the technique used to recruit participants may produce sampling bias, although this limitation was managed by trying to reach all eligible participants; however, bias is expected. Although the methodology used in the current study was found to be very effective and could readily be replicated to study other groups, the length of the interview may have limited their interest to participate. More studies should be considered in which different groups such as medical doctors, nurses, or nursing academics are studied. Indeed, there is still a need for more research to verify the findings reported in this study.

6. Conclusion

The findings of this study confirm many activities as identified by Ellis's information-seeking model. However, the information-seeking behaviors of nursing students searching for EBP should include four additional steps—background (recalling pre-existing knowledge), assessing relevancy, evaluating and referencing—alongside those listed by Ellis. These four new steps are believed to be pertinent to evidence-based practice information-seeking behavior. Even though considerable work has been published in the literature about the information-seeking behavior of nursing students, there is still a room for more investigations to confirm the results demonstrated in this study.

Ethical approval

Ethical approval was granted by University Ethics Review Committee (UERC). Informed consent was obtained. Participants were informed that their participation was entirely voluntary and that any information resulting from the study would be treated with confidentiality.

Summary Points

1. Embracing "evidence-based information-seeking behaviors" is essential for health professionals to provide effective up-to-date nursing care.
 2. Evidence-based information-seeking behaviors of nurses are not adequately investigated
 3. Searching literature per se is complex and including many different searching activities
 4. The search behavior may involve some iteration of the cyclical activities
 5. Background (recalling pre-existing knowledge) and experience, assessing relevancy, evaluating and referencing are believed to be pertinent to evidence-based practice information-seeking behavior.
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Author contribution statement

Modi Al-Moteri: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Declaring of interests

The author has no conflict of interest to declare.

Acknowledgement

The author would like to acknowledge Deanship of Scientific Research, Taif University for funding this work. The author wishes also to express her gratitude to the participants for their significant contribution. She also wishes to express her thanks for all master students who review the coding system.

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