

Assessing the Effect of Virtual Education on Information Literacy Competency for Evidence-based Practice of the Undergraduate Nursing Students

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Abstract

Background: Information literacy is one of the important prerequisites for an effective evidence-based practice (EBP). Therefore, it is necessary to pay attention to curricular development and use new educational methods such as virtual education to strengthen information literacy competency in nursing students. This study investigated the effect of virtual education on nursing students' information literacy competency for EBP.

Methods: This interventional study was performed with two groups of intervention and control and a pretest and posttest design. Seventy-nine nursing students were selected and assigned into the intervention or control groups by random sampling. Virtual education of the information literacy was uploaded on a website in the form of seven modules delivered in four weeks. Questionnaires of demographic information and information literacy for EBP were used to collect data before and one month after the virtual education.

Results: The results showed no significant difference between the control and intervention groups in all dimensions of information literacy competency in the pre-test stage. In the post-test, the virtual education improved some dimensions of information literacy competency for EBP including information seeking skills ($t= 3.144, p= 0.002$) and knowledge about search operators ($t= 39.84, p= 0.001$) in the intervention groups compared with the control group. Virtual education of the information literacy did not have any significant effect on nursing students in terms of use of different information resources and development of search strategy and frequency of the correct answer to the question of formulating a search strategy in intervention group ($p>0.05$).

Conclusion: Virtual education had a significant effect some demotions of the information literacy competency for EBP in nursing students. Nursing professors and educators are recommended to train information literacy by integrating virtual and face-to-face education. Researchers should also examine the effectiveness of these interventions, their barriers and facilitators.

Introduction

Evidence-based practice (EBP) is derived from the general movement toward evidence-based medicine in healthcare. EBP has been accepted as an important concept in nursing and is quickly becoming the norm for effective nursing practice globally [1]. EBP is a decision-making approach to patient care that utilizes an integration of the most current and valid research findings, the nurse's clinical expertise, the client values and preferences, and available resources in making decisions. The benefits of EBP include: improved nurses' practice knowledge, patient-centered care with better patient outcomes, reduced occurrence of adverse events, reduced care costs to patients and health facility [2].

Essential scientific evidence includes all types of study designs, depending on the clinical questions raised to generate the most suitable answer and can be obtained by systematic and structured searches in retrieval systems, bibliographic databases and clinical guidelines. This requires retrieval skills in

database searching and information literacy competency [3]. Information literacy competency is the ability to recognize when information is needed, determine the amount of information needed, to retrieve information efficiently, evaluate, classify, and store its sources [4]. We now know that information literacy competency such as development of appropriate research questions, search, appraisal of relevant literature, and evaluation of the transferability of research evidence into clinical practice are critical to apply EBP successfully [5].

Nurses should have opportunities to learn EBP competencies such as information literacy [5]. Nurse educators should develop nursing students' competency for EBP and then motivate them to deliver the highest quality of care using EBP [6]. Nurse educators must understand the effective strategies for teaching EBP competencies in theory and practice. Therefore, undergraduate nursing students should be competent in EBP and equipped with information literacy competency and nurse educators have a fundamental role in reinforcing these outcomes [2]. Unfortunately, efforts to raise nursing students' information literacy in the past years have had minimal success because experts and school faculty could not agree on effective strategies for nursing education and teaching nursing information literacy [7]. A study indicated that nursing students were not competent in almost all areas of informatics and suggested that information literacy skills had to be improved through informatics curricula [8]. Establishing information literacy skills in students is vital to plan an informatics curriculum and adequately prepare them to use information technologies and promote safe EBP [9]. Consequently, there are gaps in integration of the information literacy competency into nursing education. In addition, newly graduated nurses reported that the training they received was insufficient in clinical settings [10]. Researchers have reported that nursing schools do not have a standard for the type and complexity of computer skills required for nursing students. Integration of the information literacy into nursing education will require nursing curriculum reform and an infusion of technologies for learning and development of innovative educational programs, which improve nursing informatics competency [11]. However, researchers reported that factors and barriers affecting a student's information literacy competency including, lack of information literacy in curriculum, confused definitions of informatics, and nursing educators' lack of informatics skill all might contribute to the student's competency [12]. A systematic review reported a lack of critical appraisal and advanced literature search skills may contribute to the negative attitudes towards EBP, which may be minimized by appropriate teaching and practice of these skills [5]. Another study noted that many nurse educators strived to equip nursing students with information literacy competency in clinical settings Their instructional approaches particularly emphasized the students' understanding of research concepts and principles and generally on how the research evidence is retrieved and integrated into patients' data and organizational factors to make patient care decisions [2].

It is noteworthy that in nursing education there is an ongoing transition from traditional teaching and learning to more self-directed learning due to the development of the Internet, learning platforms and new technology [13] and from a changing student population to digital natives. However, researchers have paid less attention to teaching strategies such as online teaching/learning and blended-learning about information literacy competency in the Asian countries [7]. In addition, we are entering into a new phase

of the evolution in academia and higher education known as “online and digital universities”. Digitalization in higher education allows streaming lectures online or enables professors and students to interact through the virtual education [14]. On the other hand, some believe that with the advent of modern educational technologies, students can distance themselves from traditional approaches and move towards new learning methods. In fact, students are encouraged towards self-learning through information technologies to improve their learning experience. Virtual education is one of the most widely used technologies in recent years. Virtual education is a novel educational approach, which can facilitate simple and inexpensive access to educational resources and services through communication technologies (e.g., electronic devices), regardless of time and place [15].

Literature review showed that few studies implemented a training program to improve information literacy competency among students and reported that students’ information literacy competency increased after the training program. Liou et al. tried to develop a blended course to improve nursing students’ information literacy in Taiwan. The majority of students with positive perception of the teaching strategies expressed that they understood more about information literacy and applied information literacy skills in nursing [7]. A meta-analysis in Iran showed that virtual education was as effective as traditional education in learning transfer. Among different educational technologies, multimedia education, e-learning, and computer-mediated learning using compact discs and software packages had significant effects on medical education. The effectiveness of educational technologies was 63% higher in the virtual education groups, compared with the controls without virtual education [15]. Another study proposed various strategies for the incorporation of EBP competencies into undergraduate nursing education. Nurse educators can use strategies such as debates, social media, simulations, learning modules, game-based learning, workshops and training sessions. None of these strategies are superior to others in terms of teaching EBP [2].

Problem Statement

Health care in Iran has markedly improved over the last 25 years. The Iranian health care system aims to be evidence-based and patient-centered, which requires ongoing improvement of the quality of health care professional education. Nursing students need to be prepared for EBP competencies. Insufficient attention has been paid to teaching of information literacy competency in virtual nursing education, especially in middle- and low-income countries. Furthermore, virtual learning is a method to strengthen the traditional approaches to education, but there is no evidence of the evaluation of this method. Assessment of the students’ information literacy competency for EBP after virtual education can help adjust curricula to students’ educational needs. Regarding the importance this issue and the scarcity of the related studies in Iran, this study aimed to evaluate the impact of a training program on information literacy for EBP in the undergraduate nursing students in Iran.

Methods

Study design and setting

This interventional study with a pretest-posttest design was conducted in a Nursing School affiliated with Kerman University of Medical Sciences in southeast of Iran.

According to the academic law in Iran, the bachelor's degree includes four years of study and the curriculum is based on a semester system. As a result, students are supposed to pass theoretical and clinical credits in university and educational hospitals, respectively. The participants of this study were students who received no information literacy education. However, the undergraduate nursing curricula at the time of this study included only 1.5 credits of research in nursing (34 hours in third semester) and one credit of information technology in nursing (26 hours in the first semester). Although basic research skills and the use of computers may be taught, the demands of the nursing curriculum do not allow for more education. These credits do not include any literature searching skills in practice.

Study Population And Sampling

The target population of this study included all undergraduate nursing students (N = 136) in the sixth and eighth semesters. The sample size was 80 participants using the sample size formula. Eighty participants were divided randomly into intervention and control groups (40 students in each group). We equally selected students from each of the semesters. Inclusion criteria included the nursing students who passed credits of research in nursing and information technology in nursing and started learning in the clinical settings. The exclusion criteria included students' absence in one session, their transfers to another university, guest students, and failure to complete the questionnaires due to any reason. Finally, 79 students completed the questionnaires and one student of the intervention group did not complete the course (response rate = 98.75%).

Instruments

The instrument used in this study consisted of two questionnaires. The first one was about the nursing students' demographic information such as gender, age, so on (Table 2).

The second questionnaire was about information literacy competency for EBP that demonstrate EBP readiness. This questionnaire was part of a valid and reliable questionnaire namely "Perceptions of Nurses of EBP", which was developed by a team comprising faculty members from Nanyang Technological University, and nursing representatives from Alexandra hospital and National University of Singapore [16, 17]. The information literacy competency for EBP questionnaire was composed of two sections. The first section concerned about the use of different information resources by nurses for patient care and clinical decision-making (19 items), and how often they referred to three different types of information sources: print, electronic and human. These items could be answered on a 5-point Likert scale ranging from "never" to "always". The second section included information searching skills and use

of different search features of online databases and web search engines. Searching skills are considered critical for searching relevant research literature or documents. The participants had to answer how often they used several search features, such as headings and search operators (10 items). These items could be answered on a 5-point Likert scale ranging from "never" to "always". In addition, nurses' knowledge about Boolean /Connectors ('OR', 'AND', 'NOT' or 'AND NOT) and Proximity (e.g. W/nn; PRE/nn) operators was assessed with items. These items could be answered with yes (one point), no (zero point), and not sure (zero point). Finally, nurses were provided with a hypothetical searching topic (Effect of cigarettes on lung cancer) along with five possible search statements to assess their skills in searching database and their actual skills in developing an effective search statement by using Boolean operators for conducting a search on MEDLINE. They were asked to select the most appropriate search statement for the given topic. Item 4 was a more appropriate search statement than others (Cigarettes OR Smoking OR Tobacco) AND ("Lung Cancer" OR "Lung Tumor" OR "Lung Neoplasm").

In this study, we used Persian version of the questionnaire, which was validated in Iran [18]. The content validity of the Persian version of questionnaire was approved by experts, and also its reliability was measured with Cronbach's alpha ($\alpha = 0.87$).

Data Collection

The current study aimed to assess the effect of virtual education on the nursing students' information literacy competency. Data were collected using an anonymous, self-reported, and electronic questionnaire from March to May 2020. To collect data, the first researcher created groups for each of the intervention and control groups in WhatsApp. Informed consent was obtained from students enrolled in the course two weeks before the program. All students in this study had e-mail addresses; therefore, link of questionnaire was sent to e-mails and WhatsApp groups in pre-test (before course) and posttest stages (one month after the course). Researchers designed the e-questionnaire using Google Document software. Therefore, the questions were prepared and then sent to the students' e-mails. After the students answered the questions and pressed the OK button, the completed questionnaires were automatically sent to the researcher. The instruction of how to fill out the questionnaires was sent to participants' e-mails and WhatsApp groups. To attain the highest response rate, the first researcher spent appropriate time on data collection and determined a deadline to deliver completed questionnaires. In addition, she sent detailed information about how to learn the educational program. Moreover, she coordinated time of educational sessions with participants in the intervention group and reminded them to attend the sessions in the scheduled times. It should be noted that the participants completed questionnaires at e-campus.

Intervention Procedure

Intervention procedure

To prepare and develop the course content, the researchers reviewed the literature about information literacy competency, the link between information literacy and EBP in nursing as well as students' educational needs [7, 19–23]. They discussed the extracted topics to achieve a consensus concerning goals and contents and teaching strategies. The researchers employed the standards proposed by the Association of College and Research Libraries as a guide for information literacy competency in higher education and selected essential competencies. The curricular content and structure should include the concepts and skills of information literacy to have a holistic view of information literacy and gain those abilities [23]. The researchers also consulted with a multidisciplinary team, including two medical informatics specialists, two nursing faculty members, an expert in the field of medical education, a librarian and two nursing students. The team members provided their experiences and perspectives on required training and competencies of students concerning information literacy competency in EBP, as well as teaching-learning activities and educational programs available to informatics literacy in nursing school. In this step, the topics were developed using focus group discussion and then the team reviewed them for suitability, feasibility, applicability and relevance to the nursing education. Each item of the developed content was frequently reviewed and revised. Having agreed on the information literacy competencies, the researcher drafted the content of training program. This curricular integration also afforded many opportunities for student-centered teaching methods such as evidence-based learning, and inquiry learning. One medical informatics specialist and six nursing faculty members who were not in the research group approved the content validity of the educational content. Finally, two members, one specialized in nursing and the other in medical informatics, taught topics of the course (Table 1).

In short, educational standards (content appropriate to the level of the student, general and behavioral goals, feedback, references, a table of contents, the desired quality of audio-visual elements and compatibility of the content with the society and culture of Iran) and technical standards (connecting the table of contents to the main content, a proper guide, colors appropriate to the background, the ability to search the text, user-friendliness of the final environment, the ability to download and receive content individually) were considered carefully in designing and developing an electronic content. The educational materials were uploaded on the website dedicated to this research for four weeks. The participants of the intervention group had a username and password to use the educational content uploaded on the website. The address of the educational website was declared through the communication channels. Participants were able to access the website off line for a month at any time and place using the assigned passwords. Reminder messages were sent via WhatsApp and SMS to motivate the use of the website. In these reminders, the deadline of the course was also announced.

The communication between students and researchers was established by an internet tool, which allowed instant messaging and group meetings. The researchers designed the website materials in seven modules during four weeks. Materials were prepared in the forms of audio file, PowerPoint slides, video tutorials, and textual help, question and answer, hands-on exercise (with examples of literature search), and homework. Students were required to self-learn course materials, practice exercises, and discuss issues by E-mail or WhatsApp. Students could expand the discussion based on other students' responses. Assignments included learning journals and literature search, website critiques, discussion on literacy

issues such as academic integrity, and project focusing on search. Assignments encouraged a sense of involvement in the use of reference materials. All other assignments were submitted to the instructors and their reflections/corrections on the assignments were sent back to the students via E-mail. The assignments could be resubmitted unlimited times. Students were able to use them through a user and password-protected. Students were expected to exercise knowledge and related skills of information literacy during/upon the completion of the course. This approach shifted the students from teaching and teacher-centeredness to learning and student-centeredness and promoting self-regulation. Furthermore, students were able to share their comments and questions with the instructors and other students. They were encouraged to ask questions and to offer comments. While intervention group was provided with additional materials derived from our training course, the control group did not receive this program. In other words, the two study groups had equivalent conditions and students received the standard courses of nursing curricula with virtual tools at E-campus during the coronavirus pandemic. No academic credit was given to the participants of this study.

Table 1
Main topics presented in the course

Modules	Topics
1	<ul style="list-style-type: none"> -Familiarity with EBP and understanding of what is involved in EBP -Perception of the value and significance of EBP in nursing -Learning of level of skills required for undertaking different EBP activities -Discussing and making a possible work plan by using an example according to the steps of EBP -Understanding what information literacy and its framework are. -Explaining various terminologies related to information literacy. -Familiarity with how information technology can be used in education
3	<ul style="list-style-type: none"> -Introducing and orientating variety of information sources including hard print, electronic and human sources -Developing the skills to obtain e-books, e-journals, and other meaningful information using the library or the Internet -Demonstrating a variety of electronic search capabilities such as the ways to subscribe and receive free articles -Determining the most appropriate methods for accessing information electronically: search engines, interfaces (the database screens), and content available through a given system
4	<ul style="list-style-type: none"> -Developing skills to criticize/evaluate software, hardware and websites -Demonstrating medical and nursing databases such as Current Nursing and Allied Health Literature)CINAHL(, PubMed, Scopus,... -Using search strategies in databases such as PubMed and Scopus - Describing the available information systems (Online formulary, Up to Date, EBSCO,...) -Describing information needed through key concepts and terms -Identifying keywords, synonyms, and related terms for the information needed (Medline, etc) -Searching articles in Persian databases such as Scientific Information Database)SID(, Medlib, Iranmedex, and Magiran
5	<ul style="list-style-type: none"> -Doing simple and advanced search, and conducting limited search based on the publication year, full text, keywords, Medical Subject Headings (MeSH), and using search operators such as AND, OR, NOT and etc. -Doing practical exercises. For example, retrieving related articles in databases such as PubMed and Scopus for "Intubate Patient Care" with related keywords and providing search results

Modules	Topics
6	<ul style="list-style-type: none"> -Demonstrating abilities and gaining proficiency in search of information, management of information, and application of various technological tools in presenting information. -Determining the nature and extent of the information needed -Explaining the risks and constraints of searching the Internet for needed evidence-based information -Using appropriate search language and parameters for selected system
7	<ul style="list-style-type: none"> -Assessing the quantity, quality, and relevance of the search results to determine whether alternative information retrieval systems or investigative methods should be utilized -Evaluating information sources critically and incorporating selected information into their knowledge base and value system -Comparing various information sources to evaluate reliability, validity, accuracy, authority, timeliness, and point of view or bias -Synthesizing conclusions based upon information gathered -Using information effectively for a specific purpose individually or as a member of a team -Evaluating outcomes of the use of information

Statistical analysis

The data were analyzed using SPSS 21, descriptive statistics (frequency, percentage, mean and standard deviation) and inferential statistics (independent samples *t*-test, paired *t*-test, McNemar-test, and chi square). The Kolmogorov-Smirnov test showed that the data followed a normal distribution. The significance level was considered ≤ 0.05 .

Results

Demographic and professional information

Table 2 shows demographic and professional information of the study participants. Based on the chi-square test, no significant difference was found between the intervention and control groups in demographic and professional information (Table 2). Moreover, data analysis indicated homogeneity of the participants in the two study groups at the baseline in all dimensions of the information literacy for EBP.

Table 3

Comparison of demographic and professional information of nursing students between the intervention and control groups

Variables	Groups	Intervention		Control		Statistic) χ^2 (P value
		n	%	n	%		
Gender	Male	18	64.20	27	67.50	3.60	0.055
	Female	21	53.80	13	32.50		
Marital status	Single	28	71.80	34	85.00	2.03	0.153
	Married	11	28.20	6	15.00		
Work experience in clinical setting (yr)	None	15	38.50	18	45.00	1.10	0.57
	Student work	24	61.50	22	55.00		
Attendance at nursing research courses	Yes	16	42.1	10	25	2.56	0.109
	NO	23	57.9	30	75		
Attendance at computer skills courses	Yes	11	28.20	12	30.00	0.031	0.86
	NO	28	71.80	28	70.00		
Attendance at information literacy courses	Yes	7	17.90	7	17.50	0.003	0.95
	No	32	82.10	33	82.50		
Willingness to use electronic databases and electronic journals	Low	6	15.80	12	32.40	3.19	0.20
	Moderate	18	47.40	16	43.20		
	High	14	36.80	9	24.30		

Use Of Different Information Resources

The pretest phase showed no significant difference in the mean scores of use of different information resources between the intervention (2.70 ± 0.57) and control (2.63 ± 0.44) groups ($p = 0.17$, $t = -1.39$). However, no significant difference was observed between the intervention (2.53 ± 0.54) and control (2.71 ± 0.60) groups in the use of different information resources in the posttest ($t = -1.33$, $P = 0.18$). This showed that the educational course did not improve significantly the use of different information resources in the intervention group (Table 4).

In addition, the paired t-test showed no significant difference between the intervention and control groups in the use of different information resources in the pretest and posttest.

Table 4

Comparison of the mean scores of the use of different information resources for patient care and clinical decision-making between intervention and control groups at pre and posttest

	Time	Pre test	Post test		
Information resources	Groups	M ± SD	M ± SD	Mean difference	Statistic <i>t</i> * and <i>p</i>
Printed	Intervention	2.57 ± 0.64	2.64 ± 1.10	0.07	<i>t</i> =-0.96 <i>P</i> = 0.34
	Control	2.70 ± 0.72	2.60 ± 0.49	-0.1	<i>t</i> = 0.73 <i>p</i> = 0.47
	Statistic <i>t</i> ** and <i>p</i>	<i>t</i> =-0.81 <i>p</i> = 0.42	<i>t</i> = 0.30 <i>p</i> = 0.76		
Electronic	Intervention	2.36 ± 0.73	2.27 ± 0.74	-0.09	<i>t</i> = 0.88 <i>p</i> = 0.38
	Control	2.56 ± 0.75	2.51 ± 0.59	-0.05	<i>t</i> = 0.40 <i>p</i> = 0.69
	Statistic <i>t</i> ** and <i>p</i>	<i>t</i> =-1.19 <i>p</i> = 0.23	<i>t</i> =-1.60 <i>P</i> = 0.11		
Human	Intervention	2.66 ± 0.52	2.62 ± 0.92	-0.04	<i>t</i> = 0.25 <i>p</i> = 0.80
	Control	2.87 ± 0.68	2.84 ± 0.65	-0.03	<i>t</i> = 0.25 <i>p</i> = 0.80
	Statistic <i>t</i> ** and <i>p</i>	<i>t</i> =-1.50 <i>p</i> = 0.14	<i>t</i> =-1.54 <i>p</i> = 0.13		
Total	Intervention	2.70 ± 0.57	2.53 ± 0.54	-0.17	<i>t</i> = 0.53 <i>P</i> = 0.60
	Control	2.63 ± 0.44	2.71 ± 0.60	0.08	<i>t</i> = 0.48 <i>p</i> = 0.63

*Paired *t*-test**Independent *t*-test

	Time	Pre test	Post test
	Statistic t^{**} and p	$t = -1.39$ $P = 0.17$	$t = -1.33$ $P = 0.18$
*Paired t -test			
**Independent t -test			

Information Searching Skills

In the pretest phase, there were not significant different in the mean scores of information searching skills and using different search features between the intervention (2.33 ± 0.74) and control (2.45 ± 0.64) groups ($t = -0.68$, $p = 0.50$). However, a significant difference was observed between the intervention (2.58 ± 0.31) and control (2.17 ± 0.58) groups in terms of information searching skills and using different search features in the posttest ($t = 3.14$, $P = 0.002$). This shows that the educational course statistically significant improved information searching skills and using different search features in the intervention group. In addition to, the paired t -test showed that searching skills and using different search features statistically significant decreased in posttest compared with pretest for the control group (Table 5).

Table 5

Comparison of the mean scores of information searching skills and the use of different search features between intervention and control groups at pre and posttest

	Time	Pre test	Post test		
variable	Groups	M \pm SD	M \pm SD	Mean difference	Statistic t^* and p
Information searching skills	Intervention	2.33 ± 0.74	2.85 ± 0.31	0.25	$t = -2.40$ $P = 0.02$
	Control	2.45 ± 0.64	2.17 ± 0.58	-0.28	$t = 2.36$ $p = 0.02$
	Statistic t^{**} and p	$t = -0.68$ $p = 0.50$	$t = 3.14$ $P = 0.002$		
*Paired t -test					
**Independent t -test					

Knowledge About Search Operators

The pre-test phase showed no significant difference between the intervention (0.37 ± 0.09) and control (0.25 ± 0.08) groups in the mean scores of knowledge about search operators ($t=-1.54, p= 0.12$). However, a statistically significant improvement was observed in the intervention group (0.67 ± 0.07) compared with the control group (0.34 ± 0.17) in terms of knowledge about search operators in the posttest ($t= 8.39, P= 0.001$). This showed that the educational course statistically improved knowledge about search operators in the intervention group. In addition, the paired t-test showed no significant difference in the control group's knowledge about search operators in the pretest and posttest (Table 6).

Table 6

Comparison of mean scores of knowledge about search operators between intervention and control groups at pre and posttest

	Time	Pre-test	Post-test		
Variable	Groups	M ± SD	M ± SD	Mean difference	Statistic t^* and p
Knowledge about search operators	Intervention	0.37 ± 0.09	0.67 ± 0.07	0.3	$t=-5.08$ $p= 0.001$
	Control	0.25 ± 0.08	0.34 ± 0.17	0.09	$t=-1.21$ $p= 0.23$
	Statistic t^{**} and p	$t= 1.54$ $p= 0.12$	$t= 8.39$ $p= 0.001$		
*Paired t -test					
**Independent t -test					

Assessment Of Developing Search Strategy

The pretest phase showed no significant difference between the intervention (%41) and control (%25) groups in frequency of selecting a more appropriate search statement ($x = 2.30, P = 0.13$). In the posttest, the frequency of selecting a more appropriate search statement (41%) did not change in the intervention group, but it significantly decreased in the control group (%25) ($x = 4.12, p = 0.04$).

Discussion

This study evaluated the impact of a training program on information literacy competency for EBP in nursing student. The results of this study showed that the training program had no significant effect on the use of information resources and all its dimensions (print, electronic, and human resources) in the students of the intervention group. The researchers did not find an interventional study whose results

support the present study. However, several studies such as Hecht et al. in China [24], Ruzafa et al. in Spain [6], Keshmiri in Iran [25], and Chang et al. in Taiwan [26] showed a positive effect of the educational intervention on the use of information resources. The reasons for the ineffectiveness of our training and the difference between the present study and the mentioned studies may be the differences in the study population, educational method and lack of face-to-face interaction with participants in virtual education, data collection tools, research setting and time (our research was done at the same time as the coronavirus pandemic). Other reasons may be undergraduate students' unfamiliarity and poor understanding of EBP and the importance of using information resources and developing information search strategy in undergraduate students, no student's involvement in EBP system due to inefficiency of the educational system in the university, nursing instructors' lack of proper understanding of EBP and therefore no emphasis on EBP prerequisites.

The results showed that the control and intervention groups rarely used the electronic information resources and this educational intervention could not motivate students in the intervention group to use electronic resources more. These results mean that students in both groups used printed and human resources more and the electronic resources less to search for information on clinical decision-making and EBP. In addition, Researchers in Iran [27], Nigeria [28], and Jordan [29] showed that nurses considered their coworkers more efficient than print information sources because they were more accessible to them. They also believed that human resources would give them an opportunity to discuss clinical decisions and they would gain more confidence [29]. The reasons for the similar results of the studies are easy access to human resources, lack of skills required to use electronic resources, lack of time, lack of skills in translating English texts, insufficient skills of searching and retrieving information and lack of appropriate technology. Other reasons include the inadequate skills of professors in using electronic resources, and the age gap between educators (as Digital Immigrants) and nursing students (as native Immigrants). Onyia considered the high cost of electronic resources, lack of search skills, high cost of Internet access, insufficient library equipment, inadequate time, and slow Internet speed as the reasons for low use of online resources [28]. However, a study in Korea showed that electronic resources were the most important sources of information for providing health care. On the other hand, mass media and print materials were less popular among postgraduate students [30]. The reasons for the difference between the two studies may be the differences in the research setting, the education level of the study participants and the emphasis on the use of digital information resources and the teaching method of the education system in Korean universities. We suggest strengthening the information literacy competency of undergraduate students through competency-based applications, informatics courses and informatics-related content throughout the curricula. The researchers reported that undergraduate nursing students had different educational backgrounds and practical experiences. Thus, nursing curricula must reflect the advancement of students in informatics proficiency. Experts and school authorities must agree on effective strategies for improvement of nursing students' information literacy competency. Educators have faced challenges with a changing student population, who are mostly younger than 25 years of age and are considered as "digital natives". They respond to information technology much more sufficiently and effectively and their desire to learn with interactive means is stronger than that of the "old scholar"

(equal or older than 25 years old). Therefore, innovative teaching strategies are needed in teaching and learning to integrate information literacy into nursing curriculum [7].

The results showed that the educational intervention increased searching skills and using different search features in the intervention group compared with the control group. Previous studies also have shown the effectiveness of this educational intervention [6, 31–33]. One of the reasons for the effectiveness of such education may be the type of educational content or students' familiarity with computers from childhood that increases their motivation to learn more information search skills. Although information is increasing constantly, high levels of various information search and retrieval skills are required for EBP, e.g. the inability to undertake critical appraisal of material that is retrieved. In order for students to be successful in an information society, they first need to have sufficient knowledge about search tools and facilities in electronic environments and then, apply them by using critical thinking skills to examine the content of information, and dissemination and productivity of selective information.

A literature review reported that nurses were more confident in using Google than using bibliographic databases. PubMed or MEDLINE and CINAHL were the most commonly used bibliographic databases for information retrieval. Although there is an overall global increase in the use of electronic devices, such as computers, mobile devices and smartphones, and much information is available to the Internet or databases, the nurses' use of bibliographic databases is significantly low. Nurses still prefer searching information on resources such as Google, as well as consulting and asking coworkers, rather than searching bibliographic databases. It seems that Google and peers are the nurses' primary sources of evidence based information [3].

This study found that the educational intervention had a positive effect on the intervention group's knowledge of using Boolean and proximity operators compared with the control group. One of the reasons for the effectiveness of training is the attractiveness and novelty of the educational content for participants and practical assignments. Several descriptive studies on the use of operators, showing the weakness of users [16, 34]. Owing to the fact that information retrieval systems, including databases and search engines, hold millions of records, students should learn correct search, controlled terms, synonyms and terms related to words using Boolean, proximity operators and other search strategies. This study showed no increase in the ability of the intervention group after training how to develop an online search strategy. No interventional study has measured the items mentioned. However, Majid et al. (2012) in Singapore showed that only 13% of the nurses chose the fourth choice of the questionnaire as the correct answer. It should be noted that the questionnaire of the present study was derived from the same study [16]. Researchers in a study on nursing students showed that attending information technology classes, along with providing practical work by participants, increased their computer skills in searching for scientific resources [29]. Another reason for these results may be that the intervention was done at the same time as the coronavirus outbreak. The environmental stresses caused by the corona, the conditions governing the country, the closure of the university, life in quarantine, and the unpreparedness of students for this educational method also might contribute to the ineffectiveness of intervention, and we did not

examine them in this study. According to researchers, although digitalization in higher education allows streaming lectures online or enables professors and students to interact in the virtual environments, not everyone is ready for this. Even those young people, who spend much time on playing video games or interacting with others on social network platforms, prefer real classrooms and real universities [14].

Finally, the researchers in this study believe that we cannot achieve an effective education by only presentation of content through technology. It is impossible to achieve educational goals without paying attention to the educational design and models in various formats. Therefore, nursing instructors should achieve effective e-learning by expanding the use of educational design patterns and developing electronic courses and using effective models. It is also very important to design courses properly and pay attention to the flexibility of educational design patterns. One of the most important issues in medical education and training is to engage students in learning environment, which can be realized through a variety of educational technologies. However, it is suggested to use virtual technologies along with traditional methods or to integrate them into other educational approaches.

Limitations

The limitations of the present study were the performance of the intervention during the corona outbreak, the closure of universities, and the implementation of the study only on nursing students in one of the universities of Iran. It is suggested that longitudinal and interventional studies examine the effects of virtual education on information literacy competency in medical students at different academic levels during the coronavirus pandemic. In addition, the effects of face-to-face and virtual methods on information literacy competency should be compared during the post-pandemic period.

Conclusions

According to the results, virtual education had a positive effect on some aspects of information literacy competency. However, virtual education did not have a positive effect on other aspects such as the use of information resources. Due to the rapid spread of information, and the digitalization of the modern age, nursing students should learn information literacy to achieve accurate, effective information for EBP. Therefore, nursing professors and instructors are suggested to combine face-to-face and virtual methods according to the needs of students, to develop educational syllabus in the field of information literacy for EBP, and coordinate educational materials in theory and practice. By creating a strong link between educational institutions and clinical settings, nurses' information literacy competency in clinical settings will help enhance students' knowledge and attitudes towards using information resources and their willingness to provide EBP. Moreover, nursing educators can use the results and educational content of this study to develop a richer educational content for improving nurses and students' information literacy competency for EBP. Researchers can use the results of this study to conduct longitudinal and interventional research. In cases where the results of this study did not show a significant effect, various studies with blended strategies such as integrating virtual and face-to-face training as well as examining barriers and facilitators should be designed.

Abbreviations

EBP

Evidence-based practice

Declarations

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Availability of data and materials

The data are available upon request to the corresponding author after signing appropriate documents in line with ethical application and the decision of the Ethics Committee.

Authors' contributions

MS, PM, JF and LA contributed to conceiving and designing the research. The data were collected, analyzed, and interpreted by MS, PM, LA, JF, and FF. MS, PM, LA, JF, and FF contributed equally to writing and revising the manuscript and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Kerman University of Medical Science with the code of ethics No IR.KMU.REC.1398.115. Furthermore, the participants were explained that they could withdraw from the study at all stages with no adverse consequences. Moreover, they were ensured about confidentiality of information. At the beginning of the study, all nursing students signed the written consent forms. Upon completion of the intervention and collection of the second-phase data, participants of the control group were provided with the educational package with the same structure and topics through WhatsApp, researchers' blogs and e-mails.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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