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An analysis of common subjects between information literacy and critical thinking papers indexed in Web of Science Database

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Abstract

Objective: This study aimed to analyze common subjects between information literacy and critical thinking papers indexed in the Web of Science Database from 1983 to 2019.

Methods: The present study was conducted using a quantitative approach and scientometric indicators. The data in this study were extracted from 160 scholarly articles in the Web of Science citation database.

Results: A subject analysis of keywords used in the published articles showed that most keywords were the subject areas related to educational research, computer, librarianship, and information science. Furthermore, the highest number of published documents covered subject areas such as computer science and information systems, librarianship, information science, and educational research. It was also shown that 12 common subject clusters between information literacy and critical thinking were human resource infrastructure, critical information literacy, e-learning, information, and communication technology, web-based learning model, information literacy skills education, information literacy and critical thinking education, motivating factors for learning, learning threshold, digital literacy, information literacy as a skill, and poor critical thinking.

Keywords: *Information Literacy, Critical Thinking, Scientometrics*

Introduction

Information literacy refers to a set of skills, activities, and attitudes which focus on improving people's understanding of the information space. It integrates data retrieval, analysis, and application skills with information and knowledge to answer questions through ethical participation in

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educational and scientific communities and to create new questions and new knowledge (Framework for Information Literacy for Higher Education, 2016). The Association of College and Research Libraries (ACRL) published 5 key information literacy standards for higher education in 2000: (1) Identifying information needs, (2) effective access to the required information, (3) criteria for reviewing and evaluating information resources, (4) optimal use of information resources, and (5) observance of legal, ethical, and social principles of information use (ACRL as cited in Parirokh, 2007). Changes in higher education, along with the complexity of information environments, have transformed the concept of information literacy.

These skills play an important role in using information effectively and converting it into knowledge. Most indicators related to information literacy standards and the skills required for them focus on the ability to "recognize" information needs, collecting required information, evaluating, organizing, and using information by applying critical and analytical thinking skills (Parirokh, 2007).

Critical thinking is a way of thinking that doubts the nature of the existence of unknown elements and phenomena, compares them with existing knowledge and evidence, and finally draws fact-based conclusions by considering all aspects. A person with critical thinking skills compares the evidence with his/her hypotheses and comes to a logical conclusion. Such a person makes decisions and reacts based on knowledge and facts. This way of thinking enables the person to make decisions and act independently without needing to rely on others. Brookfield believed that critical thinking helps a person to engage with his or her personal and social world (Brookfield, 1991). Critical thinking skills play an important role in the effective use of information and its conversion into knowledge.

Given the definition of information literacy and critical thinking and the close relationship between these skills, is an issue of interest to find out the areas that have received much attention in studies that have addressed these two skills so far and to identify the common subjects related to information literacy and critical thinking in different fields. To this end, the subject areas related to information literacy were identified using the information literacy standards proposed by the Association of College and Research Libraries (ACRL): Identifying information needs, effective access to the required information, criteria for reviewing and evaluating information resources, optimal use of information resources, and the observance of legal, ethical, and social principles of information use (ACRL, 2016). Furthermore, the subject areas related to critical thinking will be identified using the keywords from "*Merging critical thinking and information literacy outcomes -Making meaning or making strategic partnership?*" by Robert Schroeder from Portland State University. These

keywords are *Critical Thinking, Creative Thinking, Intrinsic Motivation, Need Identification,* and *querying* (Schroeder, 2012).

A review of the literature showed that no study has yet examined the common subjects addressed in information literacy and critical thinking papers using a scientometric approach. Thus, the present study tries to identify the subjects commonly addressed in these two areas. The insights from this study can be used by information literacy and critical thinking scholars to conduct studies in educational research, knowledge and information science, and interdisciplinary fields to better understand the articles published in their fields of interest. Furthermore, the results of this study can help policymakers in educational and research centers such as colleges and universities to plan and change the content of curricula based on information literacy and critical thinking standards. This study aims to find out common subjects used in information literacy and critical thinking papers indexed in the Web of Science Database from 1983 to 2019 using scientometric indicators.

A co-word analysis study by Khazaneha et al. (2019) showed that from 2009 to 2014, most studies on information science theories were conducted in the United States, Germany, the United Kingdom, Spain, and Canada. Besides, Mostafavi et al. (2018) found that the subject studies in the field of information science were divided into 13 clusters. The main subject areas were education and learning, information literacy, information and knowledge organization, web-based information resources and social networks, professional ethics in information science, informatics, communication and health information services, information management, information systems, knowledge and innovation management, and scientometric and informatics indicators. Yekta Koushali et al. (2017) concluded that information literacy and critical thinking scores were poor for the participants in their study. Hashemi Moghadam and Moslemi (2017) found that there was no significant relationship between critical thinking skills and information literacy, and there was no significant relationship between critical thinking skills and metacognitive strategies. However, they showed a significant relationship between metacognitive strategies and information literacy. Rezaei and Pourbayramian (2015) showed that students had poor skills in terms of five information literacy standards and five critical thinking skills and the scores obtained by students for these variables were unsatisfactory. Rasouli et al. (2015) reported that information literacy and critical thinking were significantly correlated with self-regulatory strategies. There was also a significant relationship between the subscales of evaluation, inference, analysis, deductive reasoning, inductive reasoning, and self-regulatory strategies. Alinejad (2014) concluded that developing critical thinking skills is not possible without information literacy and also a person cannot have information literacy without

critical thinking. Abdolmaleki and Mirzakhani (2014) reported a relatively significant relationship between the two variables of critical thinking and information literacy. Moradi et al. (2014) found a significant relationship between the mean scores of critical thinking and information literacy. Musal Arani et al. (2014) found that students' information literacy was above average and their critical thinking was below average. Fairuz et al. (2019) concluded that critical thinking and information literacy are skills that must be developed to meet the challenges of the 21st century. Crist et al. (2017) stated that the combination of critical thinking, information literacy, and school homework improves skills and practice, thus improving students' skills. Chen et al. (2017) found that a core subject usually follows a regular pattern. Knowledge both in one subject and between different subjects is transferred through subject channels, which are differentiated to better understand the promotion of the subject. Flood (2015) assessed students' critical thinking and information literacy skills and their ability to recognize information as valid and reliable information via the Internet by an Apple application. His results showed that the effectiveness of the application in students' critical thinking skills and information literacy skills. Kong (2014) found that enhancing instructional designs in digital classrooms affects the development of information literacy and critical thinking skills among students through learning everyday knowledge in the classroom. Wertz et al. (2011) concluded that by expanding the discussion of information literacy and critical thinking, it is possible to enhance cooperation between librarians and engineering educators to achieve common goals, solve user problems, and improve the quality of service for students after graduation. Konur (2012) performed a scientific evaluation of global studies conducted by higher education institutions on education from 1980 to 2011 using a scientometric approach to assess the evolution of global research in education and concluded that incentive structures may well be used to enhance performance in educational research as well as engineering and health science studies. In a study conducted using a scientometric approach, Rorissa and Yuan (2012) addressed the retrieval co-authorship network, highly productive authors, highly cited journals and papers, author-assigned keywords, active institutions, and the import of ideas from other disciplines. Chuang (2009) found that there is a significant relationship between information literacy and critical thinking skills and that incorporating an IT-based curriculum has an effect on teachers' information literacy. It was also shown that to increase teachers' information, the information technology course had to be combined with the information literacy course. Moore (2007) also showed that information, the Internet, and critical thinking skills are correlated and that the relationship between information literacy and critical thinking varies in different disciplines. Reece (2007) found that information literacy and critical thinking skills are

interrelated, and these requirements need to be taken into account for the development of computer-aided learning tools such as web-based information literacy training. A review of the literature on studies addressing common subjects between information literacy and critical thinking suggests that a large number of studies have been conducted using a descriptive approach. Besides, a look at the studies reviewed above shows that no study has addressed this issue using a scientometric approach. This research tends to answer to the following questions:

1. What are the common subjects used in information literacy and critical thinking papers indexed in the Web of Science Database from 1983 to 2019 based on scientometric indicators?
2. How is the scientific map for countries cooperating in the fields of information literacy and critical thinking on the Web of Science database from 1983 to 2019?
3. Who are the co-authors with the greatest contributions in the fields of information literacy and critical thinking on the Web of Science database from 1983 to 2019?
4. What are the common themes used in information literacy and critical thinking papers based on the index of subject areas in the Web of Science database from 1983 to 2019?
5. What are the common themes used in information literacy and critical thinking papers based on co-word analysis in the Web of Science database from 1983 to 2019?

Research methodology

The present study was a descriptive-analytical study in terms of its methodology and an applied one in terms of its objectives. This study was conducted using a quantitative approach and scientometric indicators such as centrality index, co-word analysis, and co-authorship networks which are considered as new methods in scientometrics. The data required for this study were collected from the Web of Science citation database. The timeframe considered for data collection was from 1983 to 2019. To this end, all studies on information literacy and critical thinking indexed in the Web of Science database, were considered as the research population. To this end, a total of 160 articles that have addressed both subjects were identified by searching the database. Given the limited number of articles that have the common subjects between information literacy and critical thinking, there was no need for sampling in this study, and all collected articles were reviewed using co-word content analysis as one of the new analytical methods in scientometrics. This method assumes that the words in each document indicate its content. Therefore, the thematic structure of different fields of science can be drawn by measuring the degree of co-occurrence of concepts. In this study, co-word analysis

was performed by searching, retrieving, storing, and processing the words related to the subject areas in question in five steps:

1. First, the studies addressing the common subjects in information literacy and critical thinking were searched and identified in the Web of Science citation database from 1983 to 2019 using the following search strategy:

   o Title = ("information literacy" OR "information literacy skill*") AND Title = ("critical think*")

   o Timespan: All years. Indexes: SCI-EXPANDED, SSCI, CPCI-SSH, & ESCI.

2. Articles in the Web of Science database, regardless of other document formats, were reviewed in the form of the research sample. After searching and saving the recovered articles, the data were stored in Excel spreadsheet software.

3. After collecting the data, Ravar Premap software was used to normalize the keywords. After indexing the keywords, due to uncontrolled language problems and the large volume of keywords, the identified keywords were controlled and normalized. Therefore, to reduce the extensive range of the keywords and solve the problem of inconsistency, the subject-matter experts' opinions were used. Besides, in some cases to identify some concepts and the full form of abbreviations, the Google search engine was used. The keywords were normalized through the following steps:

   o The plural and singular forms of the keywords were normalized, and the words used in the singular form were considered singular. Besides, the words that signified a particular meaning were considered singular and the countable words were collected in the plural form.

   o The abbreviations were written in full. However, in some cases it was difficult to identify the full forms of the abbreviations and thus a specialized search strategy related to the subject in question was used.

   o The synonym words were normalized using specialized glossaries and converted into words with the highest frequency in the data. The search procedure was carried out in English.

   o The specific words with a low frequency were converted into more general words.

   o The long words and terms were divided into several shorter words and terms.

4. Since the search and retrieval operations of articles were carried out based on keywords, the identified keywords were normalized through the above steps. After searching, 160 articles

that addressed the common subjects in the fields of information literacy and critical thinking were retrieved from the Web of Science citation database and analyzed.

5. The concept maps of authors, countries and related subject areas were drawn by identifying the most frequently used words and concepts. The scientific maps were plotted based on the centrality indexes for the common subjects between information literacy and critical thinking by Ucinet, Excel, and VOSviewer software packages.

Results

Question 1: *How is the scientific map for countries cooperating in the fields of information literacy and critical thinking on the Web of Science database from 1983 to 2019?*

The highest number of articles addressing both information literacy and critical thinking were published in the United States, Canada, the United Kingdom, New Zealand, and Malaysia. Moreover, Canada, New Zealand, and Malaysia were in the centrality clusters of the highest number of published articles. It was also shown that the articles with the highest number of citations were published in the United States, Canada, China, the United Kingdom, and the Netherlands, respectively. The scientific map for countries cooperating in the fields of information literacy and critical thinking on the Web of Science database from 1983 to 2019 is shown in Figure 1:

Figure 1: The scientific map for countries cooperating in the fields of information literacy and critical thinking

Table 1: The scientific map for countries cooperating in the fields of information literacy and critical thinking on the Web of Science database from 1983 to 2019

Row	Country	The number of articles	The number of citations
1	USA	81	649
2	Canada	7	158
3	China	3	83
4	UK	7	64
5	Netherlands	1	46
6	Australia	2	32
7	Spain	2	31
8	New Zealand	4	30
9	Norway	1	23
10	Turkey	2	23
11	UAE	3	12
12	Singapore	2	12
13	Greece	1	10

14	South Africa	2	9
15	Italy	3	6
16	Malaysia	2	5

Question 2: *Who are the co-authors with the greatest contributions in the fields of information literacy and critical thinking on the Web of Science database from 1983 to 2019?*

The links between the two authors confirm the thematic connection between them. The more connections between them, the more thematic commonalities and links would exist between them, and more similar would be the colors representing them. Moreover, the larger the node drawn in the network, the more important that author is in terms of the subject in question. Clusters formed based on co-authorship analysis show the main and most frequently cited authors who have played a role in the subjects shared in information literacy and critical thinking articles. As shown in Table 2, Walton, Hepworth, Gonyea, Kuh, and Julien have published the highest number of articles. Besides, Gonyea, Kuh, Walton, and Hepworth are the most frequently cited authors. Figure 2 and Table 2 show the co-authors with the greatest contributions in the fields of information literacy and critical thinking:
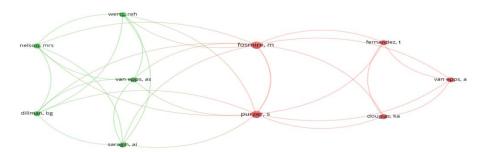

Figure 2: The co-authors with the greatest contributions in the fields of information literacy and critical thinking

Figure 2: The co-authors with the greatest contributions in the fields of information literacy and critical thinking

Row	Authors	The number of articles	The number of citations
1	Gonyea, R	2	95
2	Kuh, G	2	95
3	Walton, G	4	57
4	Hepworth, M	3	53
5	Kwon, N	2	50
6	Julien, H	2	41
7	Walter, S	2	11
8	Tagge, N	2	9

9	Spiranec, S	2	5
10	Radcliff, S	2	3
11	Fosmire, M	2	1
12	Purzer, S	2	1
13	Bezerra, AC	2	1
14	Higgina, SE	2	0

Question 3: *What are the common themes used in information literacy and critical thinking papers based on the index of subject areas in the Web of Science database from 1983 to 2019?*

To identify the common concepts and terms used in the fields of information literacy and critical thinking, 160 articles were reviewed. A thematic analysis of the most commonly used themes in both fields showed that the most frequently used themes were related subject areas including *education and educational research, computer science, information science and library science, chemistry, business and economics,* and *engineering*, respectively. This indicates that these concepts and key terms are common to information literacy and critical thinking (Figure 3).

As can be seen in the table and figure below, the themes most frequently used in both information literacy and critical thinking studies are *education, search, infrastructure, skill, student, evaluation, critical information literacy, and visual literacy*.
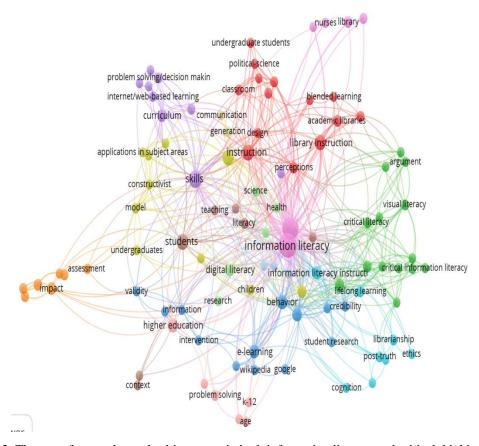
Figure 3: key terms most frequently used in both information literacy and critical thinking studies

Table 3: The most frequently used subject areas in both information literacy and critical thinking studies

Row	Subject themes	Degree	Proximity	Flow	Interdisciplinarity
1	Education & educational research	27	37	0	70.833
2	Computer science	20	45	0	0.333
3	Information science & library science	18	42	0	25.833
4	Chemistry	5	50	0	0
5	Business & economics	3	46	0	0
6	Engineering	3	50	0	0
7	Nursing	3	49	0	0
8	Science & technology	3	46	0	0
9	Social sciences	3	53	0	13
10	Arts & humanities	2	66	0	0
11	Biochemistry & molecular biology	2	50	0	0
12	Communication	2	47	0	0
13	Health care sciences & services	2	49	0	0
14	Life sciences & biomedicine	2	50	0	0
15	Psychology	1	50	0	0

Question 4: What are the common themes used in information literacy and critical thinking papers based on co-word analysis in the Web of Science database from 1983 to 2019?

To identify the themes most frequently used in both fields of information literacy and critical thinking, 160 articles were reviewed. The results showed that the most frequently used themes in terms of the centralities in the clusters are related to *computer science and information systems, information and library sciences, computer science and interdisciplinary applications, education and scientific disciplines, education and educational research,* and *computer science, theory, and methods*, respectively.
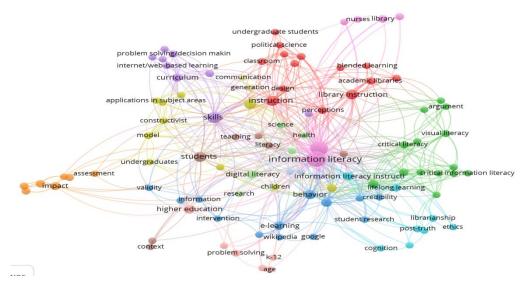

Figure 4: The scientific map of the common themes used in information literacy and critical thinking papers based on co-word analysis in the Web of Science database

Table 4: The most frequently used subject areas in information literacy and critical thinking papers based on co-word analysis in the Web of Science database

Row	Subject themes	Degree	Proximity	Flow	Interdisciplinarity
1	Computer science & information systems	26	88	0	10.333
2	Information & library sciences	21	85	0	54.333
3	Computer science ‹interdisciplinary applications	17	88	0	13.167
4	Education & scientific disciplines	17	84	0	110.5
5	Education & educational research	15	77	0	122.167
6	Computer science, theory, & methods	10	84	0	24.5
7	Business	5	102	0	0
8	Chemistry, multidisciplinary	5	105	0	0
9	Management	5	102	0	0
10	Engineering, multidisciplinary	4	91	0	0
11	Multidisciplinary sciences	3	92	0	0
12	Nursing	3	103	0	21

13	Social science, interdisciplinary	3	104	0	21
14	Biochemistry & molecular biology	2	105	0	0
15	Biology	2	105	0	0
16	Communication	2	93	0	0

Discussion

The results of this study indicated that the highest number of articles addressing both information literacy and critical thinking were published in the United States, Canada, the United Kingdom, New Zealand, and Malaysia from 1983 to 2019. Besides, Walton, Hepworth, Gonyea, Kuh, and Julien were the authors who published the highest number of articles dealing with both fields in the mentioned period. Furthermore, a thematic analysis revealed that the most frequently used themes were related subject areas including *education and educational research, computer science, information science and library science, chemistry, business and economics,* and *engineering*, respectively. It was also shown that the highest number of documents addressing information literacy and critical thinking were published in different fields including *computer science and information systems, information and library sciences, computer science and interdisciplinary applications, education and scientific disciplines, education and educational research,* and *computer science, theory, and methods*, respectively. The results also revealed 12 thematic clusters that were common in the papers published in both fields of information literacy and critical thinking as shown in Table 5:

Table 5: The thematic clusters in the papers published in both fields of information literacy and critical thinking

Row	Clusters	Row	Clusters
1	Human resource infrastructure	7	Information literacy & critical thinking education
2	Critical information literacy	8	Motivational factors for learning
3	E-learning	9	Learning threshold
4	Information and communication technology	10	Digital literacy
5	Web-based learning model	11	Information literacy as a skill
6	Information literacy education	12	Poor critical thinking skills

Cluster 1: Human resource infrastructure

One of the common subjects between information literacy and critical thinking is human resource infrastructure that covers experts in the field of information science, education, and research. An analysis of the common subjects extracted from studies that addressed information literacy and critical thinking showed that one of the most important issues is the role of information science and critical thinking professionals in libraries to provide individual and structural services to users. If this relationship is established through two-way interaction, users will feel less anxiety. Studies on information literacy and critical thinking in academic libraries have shown that there is a relationship between information literacy and the level of anxiety experienced by information professionals. This implies that library professionals with higher information literacy tend to communicate more frequently with users and analyze users' information needs more carefully. Thus, library users feel less anxiety in accessing information. Accordingly, teaching information literacy and critical thinking skills by knowledge and information science experts helps to solve users' educational and research problems in all fields (Wang et al., 2015).

Given the growing changes in information technologies, changes have been made in the policies, programs, and tasks of libraries. Most libraries have incorporated information literacy skills training in their programs based on the information literacy standards for higher education recommended by the Association of College and Research Libraries (ACRL). These training programs are also held online. Currently, due to information explosion and information overflow and spillover, libraries use critical thinking skills as one of the intellectual skills needed by their users to gain more knowledge and skills for critically evaluating the information received (Polkinghorne & Julien, 2018). This cluster shows that libraries in the past have focused on both information literacy and critical thinking in reference services, and have addressed issues such as needs analysis and access to information that require critical thinking. Currently, information literacy and critical thinking are two important issues in the scope of work of libraries, especially digital libraries.

Cluster 2: Critical information literacy

Critical information literacy is a thinking and teaching approach to examining the social structure and political aspects of libraries to produce and use the information for education and training. It is also an educational approach and an ideal method that encourages users to become regular readers. A review of studies addressing critical information literacy showed that audio-visual skills and real-time thinking along with the cognitive and emotional components of critical thinking in both fields of information literacy and critical thinking are prerequisites for teaching digital literacy skills in digital environments have been necessitated (Tewell, 2018). Critical information literacy as a

common component in both fields is used in all information literacy stages and processes including need analysis, information use, and the need to evaluate and analyze processes, resources and information found. Another reason is that information literacy and critical thinking are prerequisites for education. Critical information literacy is common to both components because in all stages and processes of information literacy from need analysis to the use of information, the need for evaluation, critique of processes, retrieved resources and information is felt.

Cluster 3: E-learning

E-learning is one of the most important elements of the information age in higher education systems. Information literacy can also be effective in improving e-learning skills, as it can improve the skills required to correctly identify and access information sources and also the ability to use information purposefully. Given that we live in the 21st century as the information age, to live better, we need to be equipped with e-learning skills as a prerequisite for learning this type of information literacy skills especially critical thinking (Chou et al., 2019). E-learning environments along with critical thinking activities affect students' academic achievement, perception, social presence, and motivation (Yilmaz & Keser, 2016). A review of the extracted studies indicated that e-learning techniques have been used more frequently in the field of health than in other fields. This can be due to the skills and abilities of health professionals and users in the use of information and communication technology that are a subset of information literacy. Given the relationship between information literacy and critical thinking, as well as the role that online education programs have in promoting users' information literacy, distance education is considered as one of the most important factors in enhancing information literacy and critical thinking, and thus some distance education features have been incorporated in library websites (Jacobs et al., 2003). Accordingly, information literacy and critical thinking are two common aspects that exist in all types of education, whether traditional, acquired, e-learning, or any other type of education.

Cluster 4: Information and communication technology

Currently, information and communication technology is used widely as a highly efficient tool and infrastructure for teaching and learning. Many professors today employ information and communication technology in learning management systems. These technologies are used as educational platforms and infrastructure. However, as they are in their infancy, they are not used universally for formal education. Information and communication technology is currently a

prerequisite for teaching information literacy and critical thinking skills. One of the applications of information and communication technology is that it can be used as educational infrastructure. These technologies provide a platform for fast access to information and sharing information for educational purposes. The use of ICT tools is also helpful in searching and retrieving data and information literacy processes. Other information literacy processes such as needs analysis, critical thinking evaluation, and use that require human context and human thinking are also performed using information and communication technology (Zaini et al., 2017).

Cluster 5: Web-based learning model

The web-based learning model facilitates teaching cognitive and critical thinking skills. People with higher levels of cognitive and critical thinking skills and greater abilities find it easier to understand the web-based learning model. A review of studies on information literacy and critical thinking showed that instructional content and materials, as well as communication media for sharing them, are increasing currently. Understanding web-based learning patterns will be ineffective if cognitive and critical thinking skills, as well as information literacy, are not formally and accurately taught. Thus, these skills must be taught to people in the community from primary school so that web-based learning becomes deeper and more accurate (Fazriyah et al., 2017). The extraction of the web-based learning model as a cluster and common subject in information literacy and critical thinking papers indicated that both information literacy and critical thinking greatly contribute to education and learning and, thus, educational and learning processes will be ineffective if one is not accompanied by the other. According to the studies reviewed, the prerequisites for web-based learning models are information and communication technology, specialized and skilled workforce in the field of technologies, information literacy and critical thinking, education and research, and the use of technologies in schools and universities (Petchtone & Sumalee, 2014).

Cluster 6: Information literacy education

Information literacy is a type of learning that is influenced by cognitive, emotional, and social processes. Applying on-site learning and cognitive principles increases the likelihood that knowledge will be put into practice in different situations and help learners apply what they have learned. The diagnosis of the situation refers to the theory which integrates the modeling of expert behavior, valid activity, training, and learning environment (Fernandez-Ramos, 2019). Matteson (2014) suggested that to access and use the information to meet users' and researchers' needs, it is essential to come up with an awareness of the problem and information literacy processes to access and use information

by employing critical thinking skills. Education will be ineffective without integrating information literacy and critical thinking into the learning process and will lead to partial knowledge of the problem. The need for knowledge is a significant part of education that is gained through three types of learning: higher-order learning, reflective learning, and integrated learning (Matson, 2014). Higher-order learning refers to a deeper understanding of the problem and means teaching information literacy and critical thinking as the basis for other types of education. Reflective learning means putting into practice what a learner has learned using critical thinking skills and information literacy. Besides, critical thinking skills for problem-solving are prerequisites for higher-order learning. Solving problem is a reflective type of learning. Integrated learning means combining information literacy and critical thinking skills in the training needed to solve life problems (Matson, 2014). This cluster addresses the importance of teaching information literacy, which is not possible without critical thinking. It also shows critical thinking as a subset of information literacy. A detailed discussion of the relationship between information literacy and critical thinking is presented in the next session.

Cluster 7: Information literacy and critical thinking education

This cluster shows the common themes between information literacy and critical thinking and these two subject areas have not been addressed separately. Some information literacy standards can be used as a platform for improving critical thinking and independent learning, which balances students' capacity for curiosity, creativity, and judgment. Some of these standards include information needs analysis, search, retrieval, and evaluation of information resources by employing critical thinking to use information (Tavares et al., 2013). Teaching critical thinking skills leads to learning motivation, problem-solving skills, decision-making, and creativity. Critical thinking is also one of the components of decision making and a criterion for assessing the efficiency of individuals in their profession and is an important factor in promoting professional independence. The five main skills of critical thinking are evaluation, inference, analysis, deductive reasoning, and inductive reasoning, which are subsets of critical thinking (Morris et al., 2019). Information literacy helps individuals build a framework for learning how to learn and improve their continuous improvement throughout their careers and their role as citizens and members of the community. Information literacy enhances students' analytical, evaluative, and management skills and increases their efficiency in applying information. It also develops "lifelong learning" in people. If a person is equipped with lifelong learning skills, i.e. if he/she has critical and cognitive thinking skills, he/she can improve learners' information literacy if he/she reinforces self-awareness that is accompanied by critical and cognitive

thinking (Tewell, 2017). Many people have little knowledge of how to search and retrieve information (information literacy). They also do not know enough about the close relationship between information literacy and learning and especially lifelong learning and self-based learning in the electronic world as an effective element of learning. Thus, creating a standard framework of information literacy can improve critical thinking and independent learning, as it balances the capacities and abilities of curiosity, creativity, and judgment in individuals. As a result, for people to acquire information literacy, they must be equipped with critical thinking skills (Williamson, 2016).

Cluster 8: Motivational factors for learning

A review of the retrieved studies showed that deep and lifelong learning occurs when a person has an intrinsic motivation to learn. Intrinsic motivation develops when individuals have the critical thinking, problem analysis, and problem-solving skills. These skills are not acquired but through teaching and strengthening information literacy and critical thinking from elementary school onwards. If these skills are developed since childhood, intrinsic motivation will also increase. Furthermore, some of the studies reviewed showed that reading is not only a factor of learning, but also includes research in behavior, information seeking, motivation, critical thinking, and familiarity with learning theories (Weiler, 2005). Teaching information literacy embedded in curricula is at odds with instructional programs in libraries. Embedded instruction in formal academic education seems to contrast with library instruction in accessing information along with information literacy and critical thinking skills. Probably there is a difference between the two types of instruction since formal education in schools and universities is acquired and resources are used only for memorizing instructed materials and formal education does not address critical thinking. Thus, learners are not intrinsically but extrinsically motivated to learn to gain higher scores (Adhikari et al., 2017). Students with stronger memory are more motivated to learn than those with weaker memory. This is probably because it is easier for the former group to memorize instructed materials and get better grades. In contrast, learners with weaker memory but higher analytical power score lower. This means that the score as extrinsic motivation is the cause of the difference between these two groups of students (Rosman et al., 2016; D'alessio et al., 2019). Other influential factors that motivate people to learn are their intelligence, ideas, and beliefs about learning. Education also plays an important role in the development of information literacy, especially when incorporated into curricula. In addition, access to and search for information becomes difficult with reduced information literacy and critical thinking skills. Therefore, the ability to use information search tools should be increased via online

and e-learning. This is achieved if the motivating factors for learning that are common between information literacy and critical thinking are taught to people in the community (Schreiber, 2017).

Cluster 9: Learning threshold

The learning threshold as one of the common clusters between information literacy and critical thinking was derived from a review of studies addressing both fields. The concepts and learning threshold and outcomes represent two different ways of thinking about teaching and learning(Hosier, 2017). A review of studies in these two fields showed that if information literacy and critical thinking are considered prerequisites for other types of education, people with higher levels of information literacy and critical thinking skills will learn more deeply and conceptually. One of the issues that have prevented all students from having equal opportunities to receive education for acquiring information literacy and critical thinking skills is the issue of the digital divide. The digital divide means that not everyone in society enjoys the same educational facilities such as information and communication technology, course curriculum updates, and specialized human resources. As a result, learning outcomes are different among different groups in the community. Those who have the necessary facilities along with information literacy and critical thinking skills have deep and cognitive learning, and those who do not have the necessary facilities, have superficial and memorized learning that is not lasting and easily forgotten (Alagozlu, 2010). Another issue that causes students to lack equal educational opportunities is the lack of training in information literacy and critical thinking skills. Learning educational materials does not make sense without thinking and contemplation. Given the large volume of information and information overflow, choosing information to use and learn requires critical thinking skills and information literacy. A review of the case studies showed that students who have information literacy with critical thinking skills would learn better than those who use rote learning techniques without using their thinking skills. This means that people who critically analyze content are successful in all educational programs and have an intrinsic motivation to learn (Cheung, 2016).

Cluster 10: Digital literacy

Digital literacy is often referred to as the "umbrella" for a wide range of educational methods that seek to empower users in the digital world. Entering the age of technology and the dominance of the Internet that lead to extensive use of information and communication technology in recent decades has affected the human life of the new age. However, not all people in different parts of the world have access equally to technological and digital facilities, and this creates a deep gap between rich and poor countries. Despite huge investments and governments' efforts to fill this gap, it is still

affecting people in some parts of the world. Digital literacy is one of the ways to bridge this gap and contains skills that help digital citizens to get familiar with security, legal, and ethical behaviors in the use of digital technologies, to be able to adapt their knowledge well to the requirements of the information age, and to make the most of the least physical facilities and equipment. Each of the types of literacy such as digital literacy, ICT literacy, basic literacy, and media literacy are platforms for information literacy. All types of literacy can contribute to lifelong deep learning with cognition if they are accompanied by critical thinking and have some critical and evaluative elements within them to analyze issues (Koltay, 2011).

Cluster 11: information literacy as a skill

In the digital age, information literacy has been defined as the ability to effectively identify information needs, access the information needed, and evaluate and use information, and is, therefore, an important skill for individuals and organizations. Thus, understanding the relationships between information literacy, creativity, and job performance can not only help organizations recognize the importance of information literacy and its impact on the workplace but also provide instructional guidance for instructors in planning training programs. Wu's study (2019) has shown that intelligent systems can enhance cognitive capacity and help learners engage in critical thinking. Developing critical thinking skills is an essential aspect of education that has been the focus of many educators over the years, as it is believed that these skills can lead to higher academic performance. Previous studies on information literacy and critical thinking have suggested that the ability to analyze and interpret information is involved in the planning process while evaluating arguments and inference is important for decision making. Both information literacy and critical thinking skills are instructed in marketing, strategy, and leadership training courses. Critical thinking skills are defined as a method for structurally solving problems and as the analysis, evaluation of a subject for decision making, and judgment to solve various problems (Kitsantas et al., 2019).

Cluster 12: Poor critical thinking skills

A review of studies related to this cluster suggested that the new generation of future leaders cannot think critically and that universities should teach information literacy and critical thinking skills to their students. It has also been shown that four factors can affect the ability of new students to think critically: (1) Teachers' teaching methods; (2) parental influence; (3) technology; and (4) emotional intelligence. The first three factors are considered as external factors and emotional intelligence is regarded as an internal factor. The findings of the reviewed studies indicated that members of the current generation have low levels of critical thinking ability and a moderate level of emotional

intelligence. Teaching methods used by teachers are one of the main factors affecting students' ability to think critically (Chova et al., 2016). Digital inequality is one of the most important issues in the information age. In rural and less developed areas, there is no guarantee that everyone will have easy and equal access to information and communication technology, and this leads to the persistence of the digital divide (Yu et al., 2017). Another issue that may lead to poor critical thinking skills is that critical thinking is not taught since childhood in the family and schools. Especially in Iran, traditional educational styles and rote learning can be the main cause of lower levels of critical thinking among individuals. As a result, poor critical thinking skills can lead to low per capita reading in the country and the lack of ability to conduct research and engage in deep learning and problem analysis and problem-solving (Zou, 2019).

Conclusion

A review of studies on information literacy and critical thinking papers published in the Web of Science database from 1983 to 2019 indicated that the highest number of articles addressing both information literacy and critical thinking were published in the United States, Canada, the United Kingdom, New Zealand, and Malaysia. Moreover, Walton, Hepworth, Gonyea, Kuh, and Julien were the authors who published the highest number of articles dealing with both fields in the mentioned period. A thematic analysis of the reviewed studies also suggested that the most frequently used themes were related subject areas including education and educational research, computer science, and information science and library science, respectively. Besides, the highest number of documents addressing information literacy and critical thinking were published in computer science and information systems, information and library sciences, computer science and interdisciplinary applications, education and scientific disciplines, education and educational research, and computer science, theory, and methods, respectively.

The results also revealed 12 thematic clusters that were common in the papers published in both fields of information literacy and critical thinking. These clusters were *Human resource infrastructure, Critical information literacy, E-learning, Information and communication technology, Web-based learning model, Information literacy education, Information literacy, and critical thinking education, Motivational factors for learning, Learning threshold, Digital literacy, Information literacy as a skill,* and *Poor critical thinking skills*. Overall, this study showed that if education is combined with information literacy and critical thinking skills, it will lead to deep and lifelong learning. It was also shown that despite the growth of new ICT tools, issues such as lack of

training in information literacy and critical thinking skills from childhood and the digital divide are factors that have influenced education and research. The availability of resource-based educational programs and rote learning techniques has increased the need for comprehensive education based on information literacy and critical thinking skills.

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