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Critical Thinking Skills in Education: A Systematic Literature Review

Hanzalah Mohamed Nor¹, Ahmad Johari Sihes²

¹School of Education, Faculty of Social Science and Humanities, Universiti Teknologi Malaysia (UTM), 81310 Skudai Johor Bahru, Malaysia, ²School of Education, Faculty of Social Science and Humanities, Universiti Teknologi Malaysia (UTM), 81310 Skudai Johor Bahru, Malaysia

Email: hanzalah3@graduate.utm.my, p-joha@utm.my

Abstract

Many educators' goals include preparing students to think critically, which is also a quality sought by employers of university graduates. As a result, critical thinking skill is seen as a significant factor in the educational process. Many academics and researchers have recently conducted studies on the advantages and impacts of critical thinking skills in various fields, the benefits of which have been widely addressed in educational curricula. The aim of this study is to analyze the existing literature related to critical thinking in educational curricula through a systematic literature review. This paper analyses literature through electronic databases obtained primarily from Scopus. 754 publications published between the years 1944 to 2020 were retrieved for further analysis. Various tools were employed, namely Microsoft Excel, VOSviewer, and Harzing's Publish or Perish. The results of this study are presented using common bibliometric indicators like as research productivity in term of publication year, document type, subject area, keywords analysis, authorship, and citation analysis. Overall, the increase in number of works on critical thinking in teaching indicates growing awareness on its importance and specific requirements in the 21st century learning education. This paper also discusses about the critical thinking skills that are employed in the field of education. Teachers can differentiate and comprehend the critical thinking skills approach in teaching strategy in order to reduce failures and boost productivity.

Keywords: Critical Thinking Skill, Teaching, Educational Curricula, Systematic Literature Review.

Introduction

Education is now widely regarded as a critical component in developing competent societies in the 21st century. One of the most important goals in 21st century education is to empower critical thinking skills. It is said that students not only need intellectual mastery to survive, but also the capability that allows them to think critically and develop life skills (Glaze, 2018; Lindsey et al., 2014). Therefore, educational development should be able to accommodate the empowerment of students' critical thinking skill (Strauss, 2016). The development is indistinguishable from a number of studies that have sparked significant debate about how

to sustain quality improvement in the teaching procedures (Fauzi & Pradipta, 2018; Spencer-Rodgers & Cortijo-Ocaña, 2015).

This paper discusses critical thinking in the context of teaching and learning. One of the desirable outcomes of education is the capability to think critically (Facione et al., 2000). "Employers require graduate workers who can transfer their critical thinking talents to the workplace" while entering the sphere of a global market (Tapper, 2004). A wide range of academic disciplines should incorporate critical thinking into their teaching and learning (Halpern, 1998).

In light of this, it is proposed that teachers encourage students to be successful in the workplace in the future. Students' critical thinking skills must be developed in order for them to be prepared to succeed in life. If students have these skills, they will be best prepared to work collaboratively, think critically and analytically, communicate effectively, and solve problems efficiently in the workplace. In order to participate in such activities, students must be engaged in active learning, have advanced problem-solving abilities, and be able to work in groups. As a result, by developing strong leadership, communication, and teamwork skills, as well as cross-cultural and cross-national knowledge, students' confidence in their ability to contribute to the community can be developed (Kalonji, 2005).

Due to the increased interest in critical thinking in education research, there have been a few attempts to report on the literature trend, particularly those that used a systematic literature approach. Furthermore, bibliometrics is the statistical and quantitative analysis of journals. Therefore, the current state of critical thinking researches are reviewed in this paper and its future prospects are assessed. The purpose of this research is to present a systematic review on critical thinking in the classroom and compare them with the field's global development.

Methods

Scopus database was chosen because the website contains a large number of data collections, which are sufficient for conducting a comprehensive literature review. A systematic literature review begins with the aid of VOSviewer software version 1.6.11. The software simulates ris, csv and txt format from Scopus to convert into the desired form named bibliometric maps, network visualization, overlay visualization and density visualization. As such the following query has been specified in the searching process: TITLE (('critical thinking' AND "teach*")) AND (EXCLUDE(PUBYEAR, 2021)) AND (EXCLUDE (DOCTYPE, "er")). According to Chen (2010), an article's title should include information that may be used to catch readers' attention because it is the first thing they will notice. The data for this study are derived from the Scopus database on June 18th, 2021. It reflects major subjects related to the research field and the study's goal. During the systematic literature review, 693 Scopus papers were shortlisted. Table 1, shows the systematic literature review protocol.

Table 1: Systematic literature review protocol.

Description	Conditions / Results
Objective	To conduct a systematic literature review on critical thinking skills in teaching.
	To analyze the existing research on critical thinking skills in education
	To determine the gap and future research direction
Source of Data	Scopus database
Area of Interest	Critical thinking skills and teaching
Search field	Critical thinking; teaching; education; social sciences
Publication years	1944 - 2021 Scopus
Covered Period	18 Jun 2021
Preliminary Document Selected	754
Social sciences Related Papers screened	693
Documents Analysis	Information based on content analyzed with the aid of Microsoft Excel, VOSviewer and Harzing's Publish or Perish.

Results and Discussion

Based on the data obtained, the analysis considers a few factors particularly research productivity, subject area, keyword analysis, authorship, and citation analysis, among other things. The majority of the findings are reported as percentages and frequencies. VOSviewer was used to map the co-occurrence of the author keywords, and citation analysis.

Research Productivity

Research productivity is examined in this research based on the number of documents produced per year. Ahmi & Mohamad (2019), stated that examination of the documents based on the year of publication helps the researcher to observe the pattern of the chosen area. The first publication on critical thinking was published by Anderson et al., (1944) entitled 'An experiment in teaching certain skills of critical thinking'. Since then, the growth of publication was a little bit slow until 1991. The number increased year by year, and the highest number of publications on critical thinking was in 2019 with 84 papers published. Table. 1 summarizes the details statistics of annual publications on critical thinking from the year 1944 to 2020, representing a total of 693 publications. Based on Figure 1, the number of publication and total citation per year is likely to rise in 2020 as the explosion of revolution industry 4.0 (IR 4.0) which is widely debated and has a significant influence on teaching curricula.

Table 1: Document by Year

Year	Number of Published Articles	Percentage (%)	Cumulative Percentage (%)	Total Citation
1944	1	0.14	0.14	3
1945	1	0.14	0.29	0
1954	1	0.14	0.43	1
1958	1	0.14	0.58	8
1963	2	0.29	0.87	1
1964	1	0.14	1.01	3
1967	1	0.14	1.15	1
1968	1	0.14	1.30	2
1972	1	0.14	1.44	0
1982	1	0.14	1.59	1
1984	4	0.58	2.16	8
1985	1	0.14	2.31	0
1986	4	0.58	2.89	41
1987	1	0.14	3.03	7
1988	2	0.29	3.32	5
1989	3	0.43	3.75	6
1990	3	0.43	4.18	4
1991	9	1.30	5.48	117
1992	7	1.01	6.49	13
1993	2	0.29	6.78	34
1994	5	0.72	7.50	41
1995	7	1.01	8.51	178
1996	14	2.02	10.53	297
1997	13	1.88	12.41	158
1998	8	1.15	13.56	708
1999	11	1.59	15.15	334
2000	7	1.01	16.16	151
2001	10	1.44	17.60	233
2002	7	1.01	18.61	109
2003	10	1.44	20.06	294
2004	15	2.16	22.22	440
2005	11	1.59	23.81	302
2006	8	1.15	24.96	39
2007	10	1.44	26.41	331
2008	19	2.74	29.15	412
2009	25	3.61	32.76	228
2010	27	3.90	36.65	239
2011	22	3.17	39.83	331
2012	21	3.03	42.86	235
2013	17	2.45	45.31	164
2014	25	3.61	48.92	240
2015	40	5.77	54.69	301
2016	47	6.78	61.47	372

2017	46	6.64	68.11	252
2018	59	8.51	76.62	317
2019	84	12.12	88.74	290
2020	78	11.26	100.00	0
Total	693	100		

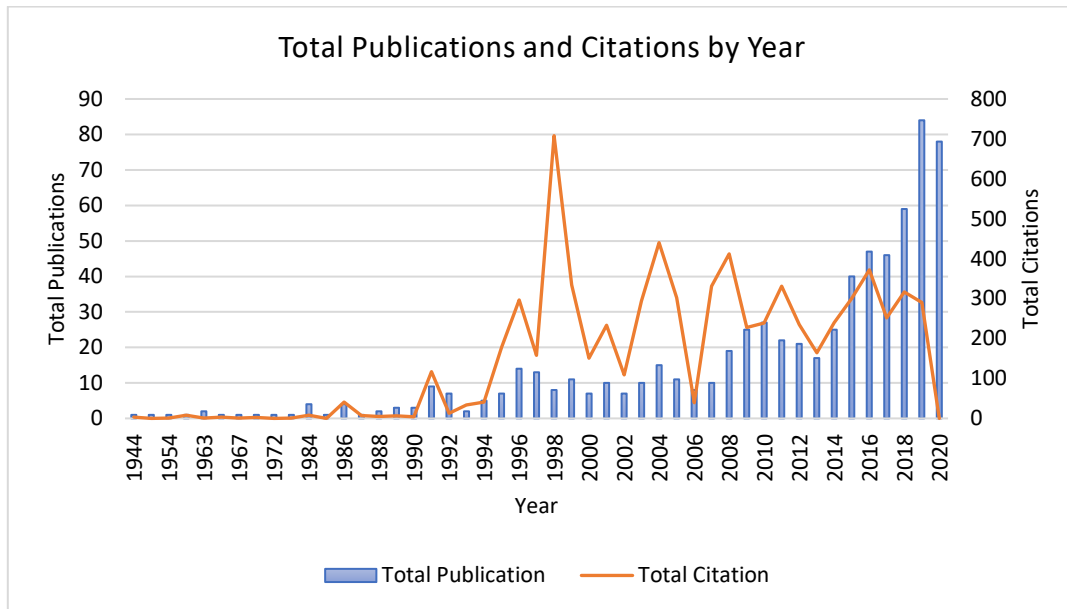


Figure 1. Publication and Citations by Year

Subject Area

Table 2 presents the total number and percentage of subjects that are published under the article title ‘critical thinking’. It was found that most of the critical thinking research are from the area of social sciences which represents (502, 48.64 %) of the total publications. Subject areas accounted for less than 10% of total publications, among other things; arts and humanities, psychology, nursing, medicine, engineering, computer science, mathematics and etc.

Table 2 Subject Area

Subject Area	Number Published Articles *	of Percentage %
Social Sciences	502	48.32
Arts and Humanities	95	9.14
Psychology	65	6.26
Nursing	55	5.29
Physics and Astronomy	54	5.20
Medicine	50	4.81
Engineering	47	4.52
Computer Science	45	4.33
Business, Management and Accounting	23	2.21
Mathematics	19	1.83
Economics, Econometrics and Finance	18	1.73
Health Professions	15	1.44
Biochemistry, Genetics and Molecular Biology	8	0.77
Chemistry	8	0.77
Environmental Science	8	0.77
Agricultural and Biological Sciences	7	0.67
Pharmacology, Toxicology and Pharmaceutics	7	0.67
Dentistry	5	0.48
Materials Science	4	0.38
Neuroscience	2	0.19
Chemical Engineering	1	0.10
Multidisciplinary	1	0.10

*Some documents are categorized in more than one subject area 1039

Analysis of abstract and title

Systematic literature review begins with the title and abstracts. An analysis of the documents was conducted with a minimum of 5 numbers of occurrences which produced five clusters involving 693 documents respectively (See Figure. 3). The VOSviewer simulated that 155 important keywords meet the threshold in form 5 clusters. In each group; humans, thinking, education, learning, students, and critical thinking have the highest frequency; which means that those 6 keywords are primarily focused on and highly related to one another.

Cluster One; 47 Items

Cluster one, which is about critical thinking, contains 47 items that are strongly linked to the keywords 'teaching', 'students', and 'critical thinking skills', all of which are linked with the objective of this research. However, the expected keywords are pedagogy, problem-based learning, critical thinking disposition which should have bigger diameter and locate closely to critical thinking. The network analyzer, on the other hand, reveals the opposite. Therefore, it is a proof that the expert still have to work hard to create awareness about the importance of infusing critical thinking among practitioners in teaching pedagogy and their disposition.

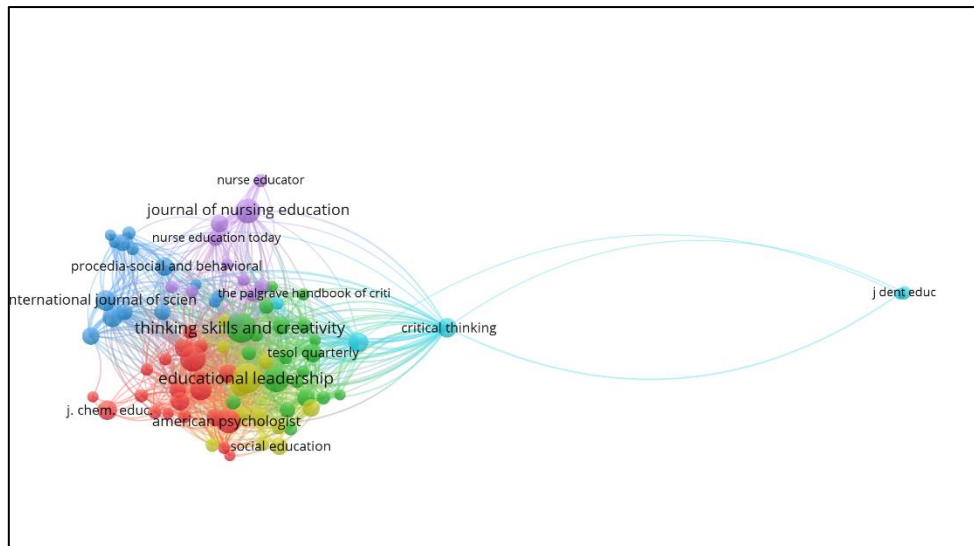


Figure 4. The analysis of co-citation and sources; clusters extracted from 693 Scopus documents.

Table 4 shows the top ten most cited papers and productive authors in the area of critical thinking in education. The document entitled “Teaching Critical Thinking for Transfer Across Domains: Dispositions, Skills, Structure Training, and Metacognitive Monitoring” by D.F. Halpern, (1998) received the highest number of citations (585 citations or an average of 25.43 citations per year) from a total of 7338 citations from SCOPUS database.

Table 4. Top 10 Cited Articles

No	Article	Authors/Year	Journal	Methodology	Total citation
1	Teaching Critical Thinking for Transfer Across Domains: Dispositions, Skills, Structure Training, and Metacognitive Monitoring	D.F. Halpern (1998)	American Psychologist	Qualitative	585
2	Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking	B. Miri, B.-C. David, Z. Uri (2007)	Research in Science Education	Quantitative	201
3	Critical thinking as a citizenship competence: Teaching strategies	G. ten Dam, M. Volman (2004)	Learning and Instruction	Quantitative	186
4	Teaching Critical Thinking: Some Lessons from Cognitive Science	T.V. Gelder (2005)	College Teaching	Qualitative	182

5	Teaching for critical thinking: Helping college students develop the skills and dispositions of a critical thinker	D.F. Halpern (1999)	New Directions for Teaching and Learning	Qualitative	151
6	Critical Thinking: Why Is It So Hard to Teach?	D.T. Willingham (2008)	Arts Education Policy Review	Qualitative	139
7	Promotion of critical thinking by using case studies as teaching method	I. Popil (2011)	Nurse Education Today	Qualitative	139
8	Look who's talking: A comparison of lecture and group discussion teaching strategies in developing critical thinking skills	C. Garside (1996)	Communication Education	Quantitative	123
9	Concept maps: A strategy to teach and evaluate critical thinking	B.J. Daley, C.R. Shaw, T. Balistreri, K. Glasenapp, L. Piacentine (1999)	Journal of Nursing Education	Quantitative	118
10	Designing the Instructional Process to Enhance Critical Thinking across the Curriculum: Inquiring Minds Really Do Want to Know: Using Questioning to Teach Critical Thinking	A. King (1995)	Teaching of Psychology	Qualitative	117

Referring to Table 4, the top ten most cited articles categorized under “critical thinking in teaching” were summarized. The top five documents were analyzed briefly in terms of content, publication, methodology and research direction. Halpern (1998) stated that the capacity to think critically has become more essential than ever before as a result of technological advancements and changes in required professional abilities. However, there is substantial evidence that many people engage in erroneous thinking on a regular basis. Several studies have demonstrated that critical thinking, which is defined as the purposeful use of skills and methods to enhance the potential of a desired outcome, may be taught in ways that facilitate transfer to other situations. To guide critical thinking education and learning, a four-part empirically based model is proposed: (a) a dispositional component to encourage students in their preparation for complex cognitive tasks; (b) critical thinking skill in teaching; (c) instruction in the structural features of issues and arguments to enhance

critical-thinking skills transfer across contexts, and (d) a metacognitive component that involves accuracy checks and tracking progress toward the objective.

As longitudinal case-study by Miri et al. (2007), in the context of science education, was conducted to see if teaching with the goal of increasing higher order thinking abilities increases students' critical thinking. By using critical thinking assessment instruments, the results revealed that the experimental group showed a statistically significant improvement on critical thinking skills components and disposition toward critical thinking subscales, such as truth-seeking, open-mindedness, self-confidence, and maturity, when compared to the control groups. The findings suggest that the students will acquire critical thinking abilities if teachers intentionally and regularly employ higher order thinking methods in the classroom, such as dealing with real-world situations in class, promoting open-ended class debates, and supporting inquiry-oriented activities.

As discussed by Ten Dam & Volman (2004), in their article about enhancing critical thinking as a crucial aspect of the competence citizens need to participate in the society. The first empirical study of teaching techniques that are "successful" in developing critical thinking is presented. The components of instruction that are considered to enhance critical thinking are as follows: fostering active learning; a problem-based curriculum; increasing student engagement; and learning based on real-life circumstances. These are all characteristics of teaching that are thought to improve critical thinking. Programs designed to increase critical thinking (higher-order) skills have been found to be ineffective in research. In the second half of this work, the different concepts for instructional approaches for critical thinking are addressed from a social constructivist perspective. Learning to think critically is defined as gaining the ability to critically engage in the communities and social practices of which one is a member. If education is to help students develop critical competence, it must give them opportunities to observe, imitate, practice, and reflect on critical agency at the classroom and school levels. Students must be provided with learning settings that they can comprehend and in which they may develop a sense of ownership over the quality of the activity in issue. Gelder (2005), derived six essential principles for critical thinking teachers from cognitive research. The lessons are as follows: developing critical thinking expertise is difficult; practising critical-thinking abilities improves skills; skill transfer must be practised; some theoretical knowledge is necessary; The ability to draw arguments (argument mapping) is enhanced. Students, on the other hand, are prone to belief maintenance. In light of these lessons, the paper offers some suggestions for teaching practise. However, Halpern (1999) concluded that critical thinking is a perennial objective of college education, but there has been little study on these abilities until recently. This chapter discusses where we have been and lays forth a four-part model for where we should be.

As a result, the above five papers clearly show the importance and impact of the critical thinking skills in teaching. Educators can create instructional methodology with intentional learning activities that encourage students to think critically in order to improve their critical thinking knowledge, abilities, and attitudes Critical thinking skills must be taught to students, and teachers must demonstrate critical thinking skills frequently and explicitly.

Finally, the citation metrics data also generated by Harzing's Publish and Perish software from the years 1944 to 2020 summarized that there are 693 papers with 7338 citations averaging at 95 citations per year of related critical thinking and teaching publications. Each paper is cited 10.59 times, and the total of h-index and the g-index is at 35 and 65 for all the publications

Conclusions

As a conclusion, a number of techniques, approaches, and processes can be used to foster critical thinking skills. In particular, it is recommended that different methods and techniques may be used in teaching to develop student's critical thinking skills. According to this paper, the goal of assisting students in improving their ability to think critically constitutes a significant transformation in the process of instruction and learning. The phrase "critical thinking" refers to the use of cognitive skills or techniques that enhance the chances of achieving a desired result. The outcomes of critical thinkers will be better than those of "noncritical" thinkers. The bibliometric network shows that the critical thinking in teaching problem can be eliminated or can be solved by analyzing the continuous data collection related to the processes. These were proven by seeing the increasing trend in the publication of statistical approach for critical thinking skills in various field. On the other hand, this study is the first to offer a bird's eye view of the current trend of critical thinking in teaching research throughout the world. This study also contributes to the expansion of the body of knowledge on critical thinking in teaching.

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