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Trend of Research Visualization of Learning, Classroom, and Class Participation in Higher Education Institutions: A Bibliometric Analysis from 2001 to 2020

Dr. Muhammad Shoaib
Assistant Professor, Department of Sociology, University of Gujrat, Pakistan, shoaibsoc@uog.edu.pk

Dr. Akhlaq Ahmad
Assistant Professor, Department of Sociology, International Islamic University Islamabad, Pakistan, akhlaq.ahmad@iiu.edu.pk

Mr. Nusrat Ali
Librarian, Quaid-e-Azam Library, University of Gujrat, Pakistan, nusrat.ali@uog.edu.pk

Mr. Farooq Abdullah
Lecturer, Department of Sociology, Mirpur University of Science and Technology (MUST), Mirpur, AJ&K, Pakistan, farooq.abdullah@must.edu.pk

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First Author and Corresponding Author
Dr. Muhammad Shoaib
Assistant Professor,
Department of Sociology,
University of Gujrat, Pakistan
Email: shoaibsoc@uog.edu.pk

Second Author
Dr. Akhlaq Ahmad
Assistant Professor,
Department of Sociology,
International Islamic University Islamabad, Pakistan
Email: akhlaq.ahmad@iiu.edu.pk

Third Author
Nusrat Ali
Librarian,
Quaid-e-Azam Library,
University of Gujrat, Pakistan
Email: nusrat.ali@uog.edu.pk

Fourth Author
Farooq Abdullah
Lecturer,
Department of Sociology,
Mirpur University of Science and Technology (MUST), Mirpur, AJ&K, Pakistan
Email: farooq.abdullah@must.edu.pk

Declaration

Authors declare no potential conflict of interest for this study.

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Abstract

The main objective of this research is to inspect the classroom environment, student learning, interactive learning, class participation, higher education institutions using bibliometric analysis from 2001 to 2020. For the scientometric analysis, we extracted data from the Science Citation Index database, Web of Science (Core Collection) using a searched query. The data was extracted on February 27, 2021 (GMT-4:29 AM). Further, the period was 2001 to 2020. There were 6340 published documents were found. The study findings illustrate that the topic of higher education institutions was on top of the topic list and a major proportion of published documents was an article. The English language was used and the frequency of published documents was gradually increased as per year. The author 'Lepori B' was on the top with 13 publications and 205 citations. Further, organization Univ. Colorado and United States country was on top of the top. Furthermore, higher education was the top keyword and computer & education were the top sources of published documents. Likewise, the top funding agency was 'National Science Foundation NSF'. In the end, a conclusion was drawn.

Keywords: Bibliometric Analysis, Interactive Learning, Classroom Environment, Student Learning, Class Participation, Higher Education Institutions

1. Introduction

Higher education has been the subject of hot debate among academics, researchers, and policymakers across the globe (Dimosthenous, Kyriakides, & Panayiotou, 2020; Shoaib & Ullah, 2021b; Ullah & Shoaib, 2021; Zayed, Zguira, Souissi, & Bali, 2019). A large amount of literature has been conducted in higher education and the world over (Ashwin et al., 2020; De-Wit, 2020; Kim & Maloney, 2020). In higher education, different aspects are explored in terms of classroom activities and issues to the policy matters (Allam, 2020; Caliskan, Akin, & Engin-Demir, 2020; Stuart-Buttle, 2019). Similarly, the sphere of higher education like other public spheres has been under debate as masculine and feminine characteristics (Allam, 2020; Caliskan et al., 2020; Stuart-Buttle, 2019). Here, we use the Scientometrics analysis to examine the existing literature on higher education learning and classroom activities (Shoaib, Abdullah, & Ali, 2020; Shoaib, Rasool, & Anwar, 2021). It is aimed to measure that educational institutions benefited and facilitated through the research conducted across the globe through different data basses these databases include the

web of knowledge and e-libraries to address the issues of learning and classroom (Dehdarirad, Villarroya, & Barrios, 2015; Goyal & Kumar, 2021; Lopes, Fidalgo-Neto, & Mota, 2017; Rafique & Shoaib, 2015; Shoaib et al., 2020; Shoaib et al., 2021). Further, it makes education beneficial for the students and institutions (Earp, 2010; Gaviria-Marin, Merigó, & Baier-Fuentes, 2019; Thanuskodi, 2010). Similarly, the classroom activities extend from the teaching methods, conducive environment, teacher-student interaction, students' satisfaction, provision of the facilities and teachers while fulfilling the demands of the syllabus (Shoaib et al., 2020; Shoaib & Ullah, 2019, 2021a).

1.1 Objectives of the Study

The main objective of this research is to inspect the classroom environment, student learning, interactive learning, class participation, higher education institutions using bibliometric analysis from 2001 to 2020. Further, it is dissected into the followings;

1. Topics and types of published documents
2. Language and years of published documents
3. Top twenty results of authors' information
4. Top twenty organizations of published documents
5. Top twenty countries of published documents
6. Top twenty keywords of published documents
7. Sources of publications
8. Funding agencies or published documents
9. Citations of published documents

2. Review of Literature

In the bibliographic studies, different databases, the web of knowledge, and e-libraries are established across the world (Perdomo-Ortiz, Valencia, Durán, & Heredia, 2020; Shoaib et al., 2020; Shoaib et al., 2021; Tallolli & Mulla, 2020). This has been possible due to access to technology that further paved the way forward for the developing countries to follow the footsteps of the developed countries in developing the databases and web of knowledge and e-libraries in their countries (Baada, Ayoung, Bekoe, & Azindow, 2020; Mishra, Gupta, & Shree, 2020; Rafiq, Batool, Ali, & Ullah, 2021). The trend of bibliographic studies was initially set by the developed countries because of the steady research conducted in every sphere including higher education (Hyland & Jiang, 2020; Phelan, Anderson, & Bourke, 2000; Shoaib et al., 2021). In developed

countries, every step is taken under the shades of research. As developed nations understand and know that research is the only tool to resolve the social issues generally and educational problems in particular (Lopes et al., 2017). In higher education, the classroom and learning-related issues were well researched by researchers and academicians in the developed countries (Gherasim, Butnaru, & Mairean, 2013; Mariam, Anwar, Shoaib, & Rasool, 2021; Shoaib et al., 2020). Most of the research on classroom issues is conducted in the west including the classroom structure (Idsoe, 2016; Palmer et al., 2016). The classroom structure has been the focus of the research at all levels of education from primary to higher education (Boz, Yerdelen-Damar, Aydemir, & Aydemir, 2016; Fenzel, Dean, & Darden, 2014; Ning, Van Damme, Van Den Noortgate, Yang, & Gielen, 2015; Shoaib & Ullah, 2021a). Similarly, the issues of the classroom were also searched. It is revealed that a conducive learning environment is only possible when classroom issues are either removed or addressed (Fenzel et al., 2014; Gherasim et al., 2013; Jewitt, Clark, & Hadjithoma-Garstka, 2011). In the developed countries, every aspect of education is well searched as they strengthened their educational system by conducting research (Hirschy & Wilson, 2002; Kvalsund, 2004). To further provide the access to the students and common researchers to the bibliographic studies conducted in higher education, the web of knowledge and databases developed while manual libraries were transformed into e-libraries (Shoaib et al., 2021). The major purpose was to provide them access to the people (Johns & Shonrock, 2007).

Likewise, the databases like developed countries were either established by these countries or the international databases were linked to them (D. R. Baker, 1991; Dehdarirad et al., 2015; Ivanov, Markusova, & Mindeli, 2016). However, the libraries were transformed into the e-libraries where the old text and next research was found available for the students, researchers, academicians, experts, and other stakeholders (Lantzy, Matlin, & Opdahl, 2020; Litsey, Allen, Cassidy, DeVet, & McEniry, 2020; Sahu & Parabhoi, 2020). Owing to modern technology, the databases of developing countries reflected the classroom and learning issues on higher education that further proved helpful in restructuring higher education (Goodyear, Casey, & Kirk, 2014; Marunda-Piki, 2018; Samuelsson & Samuelsson, 2016). In most of the developing countries, the research databases are either linked with the developed countries or have partial access to these databases (Burki, 2020). However, the e-libraries were established at a large scale in higher education institutions (Channa, Manan, & David, 2020; Perez-Encinas, Rodriguez-Pomeda, & de Wit, 2020; Shahzad, Hassan, Aremu, Hussain, & Lodhi, 2020). The only major issue that has been persistent

even a developing county may have the complete transfer of the technology is quality of the research produced is higher than the developing countries (Cheng, Wang, Mørch, Chen, & Spector, 2014; Dehdarirad et al., 2015). Thus, most of these researchers are highly paid and may not be studied by the researchers of the developing countries even after the decades (Shoaib et al., 2021). Hence, this study is designed to evaluate the classroom environment, student learning, interactive learning, class participation, higher education institutions using bibliometric analysis from 2001 to 2020.

3. The Data and Methods

For the scientometric analysis, we extracted data from the Science Citation Index database, Web of Science (Core Collection) having Indexes of SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC. The searched query was used as: TI=("Classroom Environment") OR TI=("Student Learning") OR TI=("Interactive Learning") OR TI=("Class Participation") OR TI=("Higher Education Institutions"). The data was extracted on February 27, 2021 (GMT-4:29 AM). Further, the period was 2001 to 2020. It is pertinent to mention here that we used VOSviewer, Biblioshiny, and MS Excel. There were 6340 published documents were found and results based on the objective were drawn for the study.

4. Results

This section provides the results and discussion on the main objective of this research that is to examine the classroom environment, student learning, interactive learning, class participation, higher education institutions using bibliometric analysis from 2001 to 2020.

4.1 Topics and Types of Published Documents

Table 1 describes the topic and type of published documents from 2001 to 2020. It indicates that 'higher education institutions' have a percentage of 34.98 and 4.32 percent keyword 'classroom environment' is used in published documents. Further, 46.94 percent of 'students learning' is used as a keyword. Contrary to it, only 1.09 percent 'class participation is used as a keyword in the top twenty keywords list.

The second section of Table 1 presents the type of documents from 2001 to 2020. It depicts that 57.56 percent of the published documents are articles and 29.51 percent of them are proceedings paper. However, meeting abstract, editorial material, book review, review, letter, news item, correction, book chapter, and software review are also included in the type of published

documents. Among these, book chapter and software review is published in a very small in number. The total published documents are 6340 in numbers.

Table 1

Topics and Document Types

a) Topic of the documents (2001-2020)	Total Publications	Percentage
Higher Education Institutions	2218	34.98
Classroom Environment	274	04.32
Student Learning	2976	46.94
Class Participation	69	01.09
Interactive Learning	803	12.67
Grand Total	6340	100.00
b) Type of the documents (2001-2020)	Total Publications	Percentage
Article	3649	57.56
Proceedings Paper	1871	29.51
Meeting Abstract	397	06.26
Editorial Material	150	02.37
Book Review	126	01.99
Review	94	01.48
Letter	26	00.41
News Item	12	00.19
Correction	9	00.14
Book Chapter	4	00.06
Software Review	2	00.03
Grand Total	6340	100.00

4.2 Language and Years of Published Documents

Table 2 presents the language and years of published documents. Data in the first section of the table show that 92.713 percent of the published documents are published in the English language. Similarly, 2.634 percent of the documents are in the Spanish language, 1.530 in the Portuguese language, 0.962 percent are in Russian, and 0.631 percent of the published documents are in the Czech language. Similarly, a very small number of published documents are also found in

Swedish, Slovak, Italian, Arabic, Ukrainian, Korean, Latvian, and Malay. The documents in German and Turkish are reported as 18 and 17 respectively. It is important to mention here that all the published documents are published in 23 different languages.

Table 2

Language and Years of Published Documents

a) Published documents by their language (2001-2020)

Languages	TP*	Percentage	Languages	TP*	Percentage
English	5878	92.713	Bulgarian	3	0.047
Spanish	167	2.634	Latvian	3	0.047
Portuguese	97	1.530	Afrikaans	2	0.032
Russian	61	0.962	Japanese	2	0.032
Czech	40	0.631	Korean	2	0.032
German	18	0.284	Lithuanian	2	0.032
Turkish	17	0.268	Ukrainian	2	0.032
French	14	0.221	Arabic	1	0.016
Polish	10	0.158	Italian	1	0.016
Croatian	9	0.142	Slovak	1	0.016
Chinese	5	0.079	Swedish	1	0.016
Malay	4	0.063	TP* = Total Publication		

b) Published documents by their years (2001-2020)

Years	Publications	Percentage	Years	Publications	Percentage
2001	78	1.230	2011	327	5.158
2002	65	1.025	2012	360	5.678
2003	68	1.073	2013	367	5.789
2004	92	1.451	2014	378	5.962
2005	144	2.271	2015	421	6.640
2006	140	2.208	2016	482	7.603
2007	163	2.571	2017	611	9.637
2008	241	3.801	2018	608	9.590
2009	234	3.691	2019	638	10.063
2010	322	5.079	2020	601	9.479

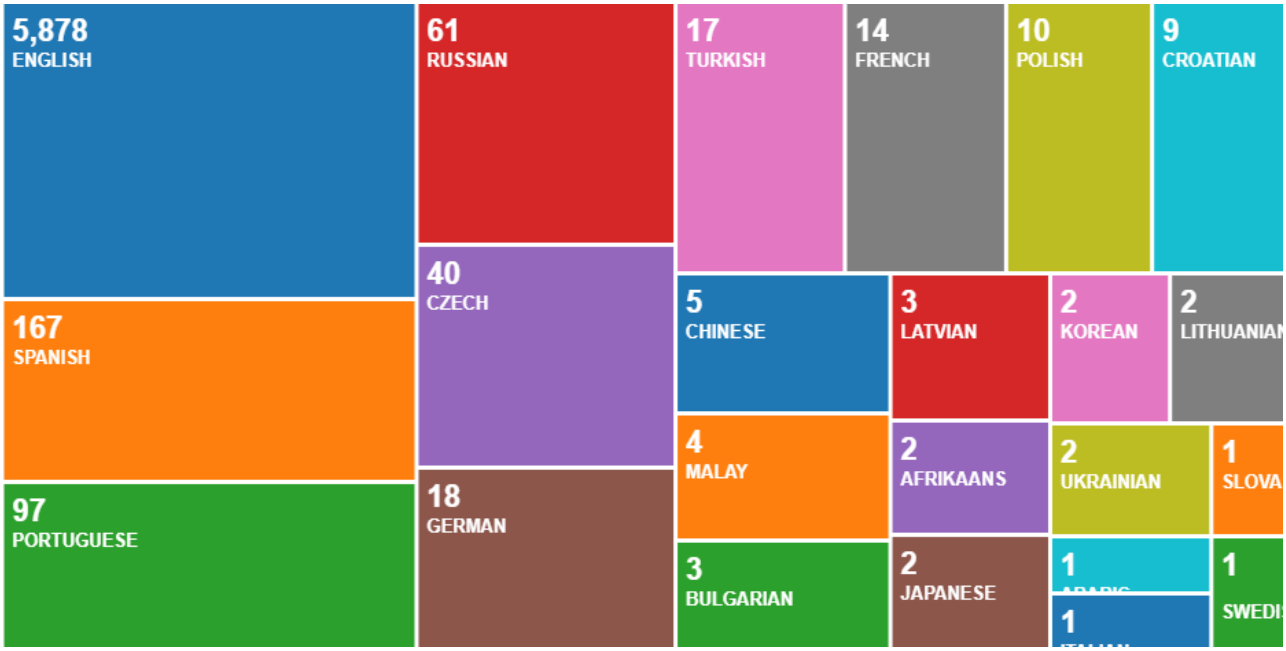

Figure 1. Published documents by their languages (2001-2020)

The second section of the table presents the years of published documents from 2001 to 2020. It is stated that 1.2 percent of the documents are published in 2001 and 2.3 percent of the documents were published in 2005. Similarly, 5.1 percent of the documents are published in 2010 and 6.6 percent of them are published and available in 2015. Further, 10.1 percent of the documents are published in 2019, and 9.5 percent documents in 2020. It is asserted that the trend of data indicates that the number of published documents increases with time. Therefore, it is concluded that published documents are increased as per the years from 2001 to 2020.

4.3 Top Twenty Results of Authors' Information

Table 3 describes the top twenty results of authors' information who published their work on the subject underhand from 2001 to 2020. Data reflect that author name 'Leopori B' is at the top in the list of top twenty authors' information with 13 publications, 205 citations, starting the year 2007, 13 g_index, and 9 h_index. Similarly, the name in the authors' list as 'Bolkon S' is securing the second position in the authors' list with 9 publications, 100 citations, starting the year 2015, 9 g_index, and 5 h_index. Contrary to it, the name 'Soon NK' is at the bottom of the top twenty authors' list with 6 publications, 7 citations, starting the year 2015, 2 g_index, and 1 h_index. Thus, it is asserted that Lepori B is at the top of the list with 205 citations and 13 publications. It is important to highlight here that there are 15062 total authors, 17166 author appearances, 1514 authors of single-authored documents, and 13548 authors of multi-authored documents. Similarly,

it is reported that there are 1616 single-authored documents, 0.421 documents per author, 2.38 authors per document, 2.71 co-authors per document, and 2.87 collaboration index.

Table 3

Top Twenty Results of Authors' Information

Author	TP*	TC*	h_index	g_index	m_index	PY*_Start
Lepori B	13	205	9	13	0.600	2007
Bolkan S	9	100	5	9	0.714	2015
Goodboy AK	9	105	5	9	0.625	2014
NA	8	180	1	8	0.048	2001
Ahmad A	7	10	2	2	0.154	2009
Carvalho T	7	112	5	7	0.313	2006
Fang N	7	25	4	4	0.286	2008
Leal W	7	50	4	7	1.333	2019
Seeber M	7	111	4	7	0.400	2012
Case JM	6	134	5	6	0.357	2008
Chan TW	6	77	3	6	0.150	2002
Dorman JP	6	41	4	6	0.190	2001
Hwang GJ	6	149	5	6	0.263	2003
Lee J	6	156	3	6	0.214	2008
Leithwood K	6	456	4	6	0.286	2008
Lozano R	6	211	5	6	0.714	2015
Prathap G	6	25	4	5	0.400	2012
Rothmann S	6	152	4	6	0.222	2004
Salvia AL	6	49	4	6	---	2019
Soon NK	6	7	1	2	0.143	2015

TC* = Total Citations, TP* = Total Publication, PY* = Publication Year

4.4 Top Twenty Organizations of Published Documents

Table 4 indicates the top twenty organizations of published documents from 2001 to 2020 on the subject under the hand. It is described that Univ. Colorado is at the top twenty organizations with 42 total publications and 895 citations. Similarly, Purdue Univ. secures the second position with

37 publications and 390 citations. However, the Univ. of Michigan and Wisconsin has a similar number of publications i.e., 35. It has also been observed that Univ. Illinois and Minnesota have a similar number of publications from 2001 to 2020 on the subject under consideration. On the other hand, Univ. Melbourne and Penn State Univ. are at the bottom of the top twenty organizations with 23 publications. It has been observed that there are 4420 organizations in total during the said period.

Table 4

Top Twenty Organizations of Published documents

Organization	TP*	TC*	TLS*	Organization	TP*	TC*	TLS*
Univ. Colorado	42	895	37	Univ. Pittsburgh	26	671	24
Purdue Univ.	37	390	23	Indiana Univ.	25	927	17
Univ. Michigan	35	1463	43	Ohio State Univ.	25	423	25
Univ. Wisconsin	35	570	21	Univ. Maryland	25	756	10
Univ. Illinois	32	322	30	Monash Univ.	24	240	16
Univ. Minnesota	32	287	28	Univ. Hong Kong	24	423	18
Michigan State Univ.	31	1139	33	Univ. Toronto	24	606	33
Univ. Queensland	30	451	13	Griffith Univ.	23	451	18
Univ. Aveiro	29	275	30	Penn State Univ.	23	360	9
Univ. N Carolina	27	524	22	Univ. Melbourne	23	166	11

TP* = Total Publication, TC* = Total Citations, TLS* = Total Link Strength

4.5 Top Twenty Countries of Published Documents

Table 5 depicts the top twenty countries of the published documents from 2001 to 2020 on the phenomena under discussion. It describes that United States (US) is at the top of the top countries list with 2085 published documents and 26071 citations in total. Similarly, England secures the second position with 422 published documents and 5645 citations. However, Netherlands is at the bottom of the top twenty countries list with 66 publications and 1631 citations. It is significant to mention here that the name of Spain, Brazil, Canada, South Africa, Mexico, India, Taiwan, Indonesia, and the Czech Republic is in top twenty countries having published documents. There are 127 countries in total number based on the published documents from 2001 to 2020.

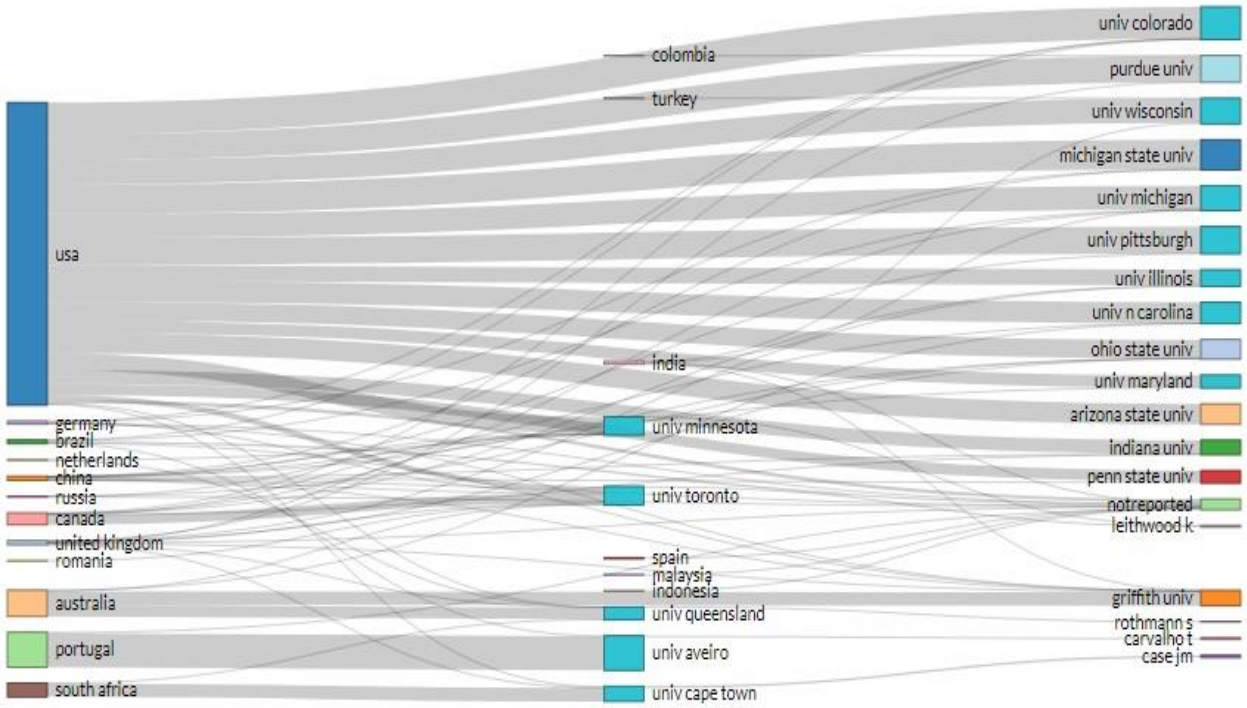

Figure 2. Tree Fields Plot by Top Productive Organizations (2001-2020)

Table 5

Top Twenty Counties of Published Documents

Country	TP*	TC*	TLS*	Country	TP*	TC*	TLS*
USA	2085	26071	271	Portugal	154	902	61
England	422	5645	223	Germany	150	1809	106
Australia	332	3209	106	Russia	115	137	9
Peoples R China	317	1916	85	Taiwan	105	1185	21
Spain	220	1110	85	India	102	332	50
Malaysia	190	490	74	Romania	99	225	19
Brazil	183	459	91	Turkey	87	472	14
Canada	179	2008	90	Mexico	76	182	27
South Africa	167	889	31	Czech Republic	71	95	8
Indonesia	157	82	21	Netherlands	66	1631	51

TP* = Total Publication, TC* = Total Citations, TLS* = Total Link Strength

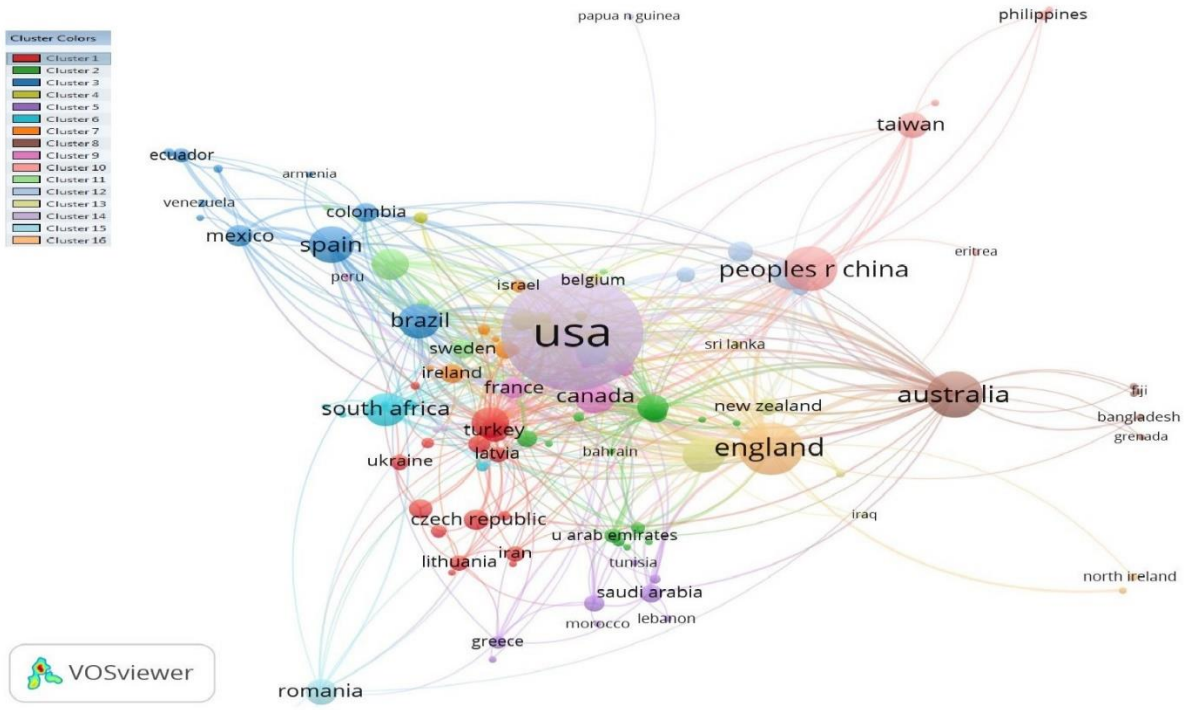

Figure 3. Published Documents by Top Country Collaborations (2001-2020)

4.6 Top Twenty Keywords of Published Documents

Table 6

Top Twenty Keywords of published Documents

Keywords	*f*	TLS*	Keyword	*f*	TLS*
Higher Education	586	928	Sustainability	63	128
Higher Education Institutions	352	469	University	63	134
Assessment	168	348	Students	61	124
Student Learning	165	236	Active Learning	59	106
Learning	133	251	Technology	58	101
Education	118	222	Learning Outcomes	56	98
Interactive Learning	105	114	Innovation	55	103
E-Learning	90	156	Evaluation	53	114
Universities	70	142	Teaching	53	109
Higher Education Institution	63	78	Classroom Environment	51	52

TLS* = Total Link Strength

Table 6 illustrates the top twenty keywords of the published documents from 2001 to 2020. The keyword 'higher education' is used 586 times and 'higher education institutions' is appeared 352 times in the published documents. Similarly, the keyword 'sustainability' and 'university' appears similar times i.e., 63 in the available documents. However, keywords 'evaluation' and 'teaching' are also used at a similar time in the published available documents from 2001 to 2020. Contrary to it, the keyword 'classroom environment' appears only 51 times in the published documents and secured the last position in the top twenty keywords. It is worth mention to indicate here that there are 13481 total keywords, 11368 total author's keywords, and 3352 total keywords plus (id).

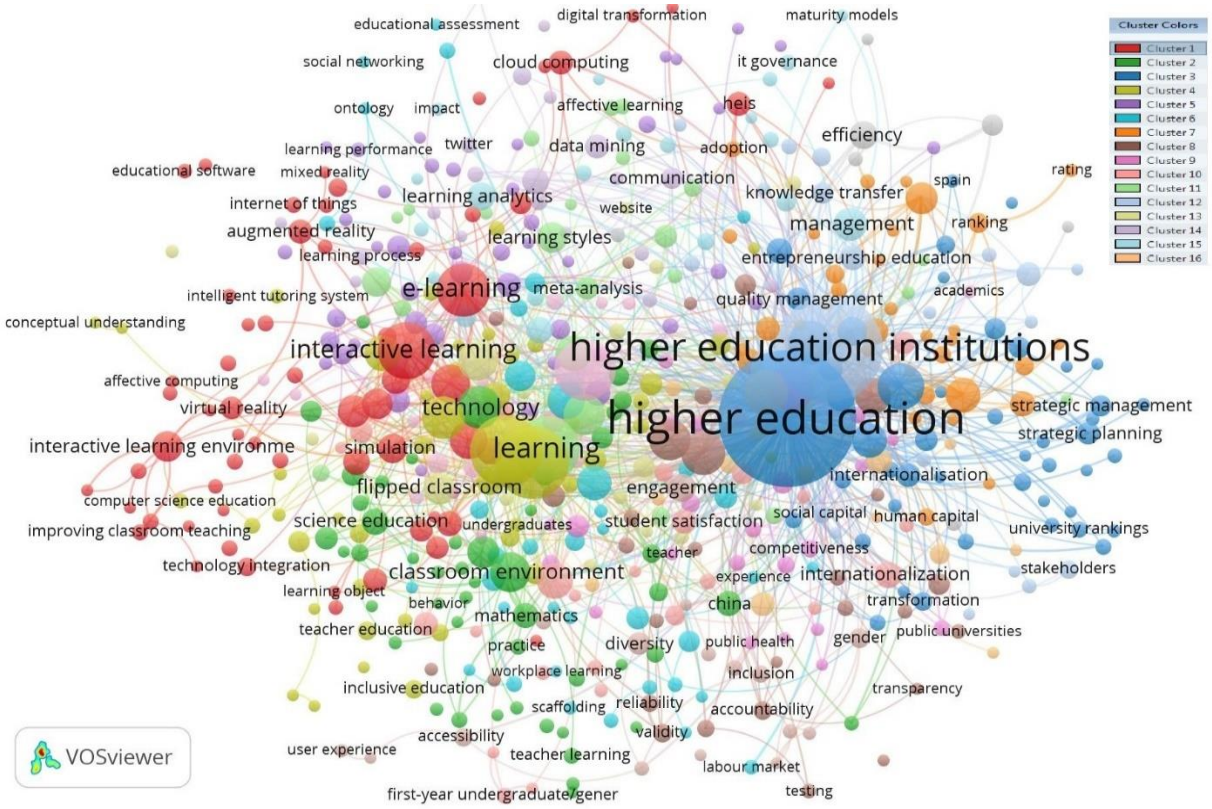

Figure 4. Word Cloud of Author Keywords (2001-2020)

4.7 Sources of Publications

Data highlight the source of published documents in *Figure 4 & Appendix A* (Table 7). The source 'Computers & Education' is at the top of the top twenty sources of publication list with 35 publications, 35 g_index, 23 h_index, 1676 citations, and 2001 year of the start of publications. Similarly, the source 'Higher Education' secures the second position in the top twenty sources of the published document list with 49 publications, 33 g_index, 19 h_index, 1161 citations, and 2001 year of the start of publications. Opposite to it, the source 'Journal of Education for Business' is at

the bottom of the top twenty sources of published documents with 21 publications, 16 g_index, 9 h_index, 284 citations, and 2001 year of the start of publications. There are 2716 total sources including journals, books, etc. for the published documents from 2001 to 2020 on the subject under consideration.

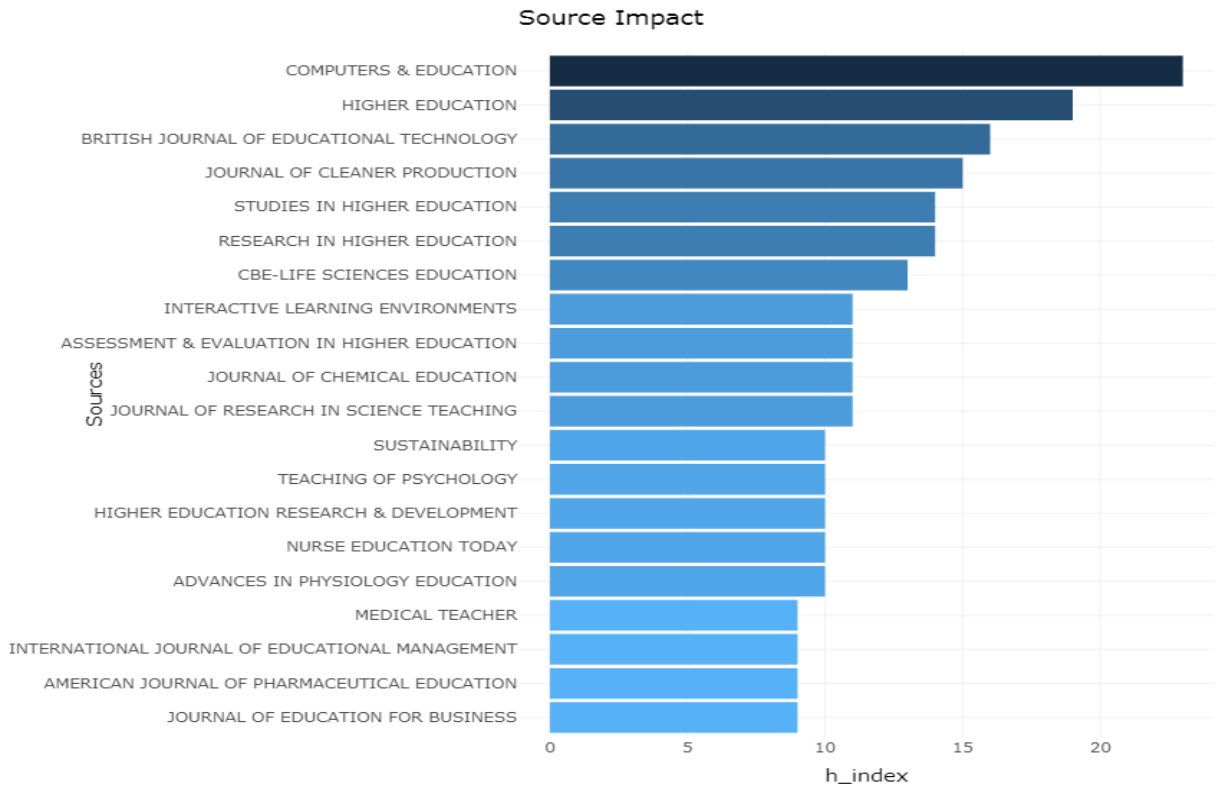

Figure 4. Top Twenty h-index Sources of Publications (2001-2020)

4.8 Funding Agencies or Published Documents

Data indicated in *Appendix B* (Table 8) that the top funding agency is 'National Science Foundation NSF' in the top twenty list with 140 publications out of 6340 and 'European Commission' secures the second position with 56 publications. On the other hand, 'Social Sciences and Humanities Research Council of Canada SSHRC' is at the bottom of the top twenty funding agencies with 9 publications.

4.9 Citations of Published Documents

It is stated in the *Appendix C* (Table 9) that the article title 'A review of research on the impact of professional learning communities on teaching practice and student learning is at the top of the list of top twenty articles published from 2001 to 2020 with the authors' name of 'Vescio, V; Ross, D; Adams, A', 737 citations, and starting year of publication is 2008 [ISSN-0742-051X, Vol./No.-24(1)]. However, the article title 'Testing a Conception of How School Leadership Influences

Student Learning' is at the bottom of the list of top twenty articles published from 2001 to 2020 with the authors' name of 'Leithwood, K; Patten, S; Jantzi, D', 234 citations, and starting year of publication is 2010 [ISSN-0013-161X, Vol./No.-46(5)].

5. Discussion

It is indicated that the researchers have researched the domain of sociology of education (D. R. Baker, 1991; Macauley, Evans, Pearson, & Tregenza, 2005; Phelan et al., 2000). Similarly, it covers all the aspects of problems experienced by the students regarding the conducive teaching environment (Shoaib et al., 2021). By the same token, different research scholars have researched the teaching method used in the institutions (Phelan et al., 2000). Further, it compared and suggested the remedies to revisit the traditional teaching methods and more influential for the students in the class (Gaviria-Marin et al., 2019; Healy, Hammer, & McIlveen, 2020; Julia et al., 2020). In the same fashion, the research has also focused on the provision of facilities and a large body of research has explored the issues in the provision of basic amenities to the students (Shoaib et al., 2020). Likewise, the student-teacher interaction has a great role in making a conducive environment for the learning (Sakale, 2019; Zayed et al., 2019). It is pertinent to mention that doing research highlighted the issues of the classroom and learning in higher education. In the developed countries, the research is taken seriously by the governments and covers serious issues emerging in education in general and students in particular (F. Baker, 2014; Fenzel et al., 2014; Younger & Cobbett, 2014). In this way, the governments and institutions also revisit the policies to restructure the educational system. Despite the research conducted by the researchers, academicians, and other stakeholders, institutions and governments also take initiative to conduct the studies if they consider that issues are to be resolved in higher education (Shoaib et al., 2021). Thus, this knowledge is accumulated by the institutions and governments in the shape of the web of knowledge, databases, and e-libraries that were not previously available to the people. This stock of knowledge is utilized by students, researchers, organizations, institutions, governments, and other stakeholders to further explore the phenomenon, revisit the policies, and restructure the institutions.

The developing countries followed the footsteps of the developed in the field of higher education (Healy et al., 2020; Hernández-Torrano & Kuzhabekova, 2020). In the same way, looking at the progress of the developed nations, research was also focused on the developing countries to enhance learning activities (Shoaib et al., 2021). Most of the countries practiced the western

models in their countries and these were nevertheless successful (Garrigos-Simon, Botella-Carrubi, & Gonzalez-Cruz, 2018). Ultimately, these few countries emphasized indigenous research in higher education (Thanuskodi, 2010). Further, the issue of technology was also a hurdle as these countries were deficient in technology to provide a better classroom environment (Brown, 2009; Khong, Saito, & Gillies, 2019). As mentioned, that few of the countries managed the technology and focused on producing the local research with their researchers, academicians, and experts (Auten, Croxton, & Tingelstad, 2020; Baada et al., 2020). In doing so they were able to produce a large body of knowledge on issues of classroom and learning (Hughes & Coplan, 2018; Ma, Du, Hau, & Liu, 2018). Aftermaths, these studies were utilized to revisit and restructure higher education (Earp, 2010; Heberger, Christie, & Alkin, 2010).

A considerable research evidenced that higher education institutions are using the bibliometric analysis for the studies across the globe (Shoaib et al., 2020; Shoaib et al., 2021; Ullah & Shoaib, 2021). This stock of research comprises the studies on virtualization of interactive learning, classroom environment, students learning and classroom participation in higher education (Ullah & Shoaib, 2021). It is easily available to the students and researchers through e-libraries mainly (Shoaib et al., 2021). As the higher education institutions now prefer the electronic stock of data in terms of the either web of knowledge or subscriptions to these stocks of knowledge (Ali, Shoaib, & Asad, 2021). However, it is not equally available to all the institutions in the world. As the developing countries still lag behind in utilizing the modern technology in provision of the stock of knowledge to the students (Shoaib & Ullah, 2021a). Although some of the countries developed e-libraries but could not reach the benchmarks set by the higher education institution in the developed countries (Shoaib & Ullah, 2021b). Similarly, this stock of data is not being utilized by the developing countries as compared to the developed nations. In developed countries, the stock of data is further undergone the bibliometric analysis that primarily shows the frequency of publications in different fields with the indexes country and subject wise (Ahmad, Ur Rehman, & Ashiq, 2021). Similarly, this data reveals the area of research explored within the defined time frame. For example, one may find the studies conducted year wise and decade wise. It also unpacks the exploration of the research area. Similarly, it also shows the trend of the research in the specific field of virtualization of interactive learning, classroom environment, students learning and classroom participation in higher education (Karisiddappa, Gupta, & Kumar, 2020; Kuzhabekova, 2021). It is important to mention here that bibliometric analysis is important to know the frequency

and trend of the research in all the fields. The research reveals that a large number of bibliometric researches has been conducted across the globe on virtualization of interactive learning, classroom environment, students learning and classroom participation in higher education (Chen, Hwang, Majumdar, Toyokawa, & Ogata, 2021; Dehdarirad et al., 2015; Hernández-Torrano & Kuzhabekova, 2020; Peng, Zhu, & Wu, 2020). However, the research is mainly conducted in the developed nations while developing nations are still in the transformation phase (Ullah & Shoaib, 2021). In developing countries, the trend of bibliometric analysis is a new phenomenon and stock of research is either manual or not up to the mark. On the other hand, those countries who adopted the modern technology are contributing towards the research through bibliometric analysis. However, several studies has also been conducted employing quantitative and qualitative study design to draw results and conclusions (Anwar, Shoaib, & Javed, 2013; Shoaib & Abdullah, 2020, 2021; Shoaib, Khan, & Shaukat, 2012; Shoaib, Khan, & Ashraf, 2011; Shoaib, Khan, & Khan, 2011; Shoaib, Latif, & Usmani, 2013).

6. Conclusion

We concluded that this scientometric method enabled researchers to gain more in-depth insights into the selected topic and support recognizing variables that were used during research on the classroom activities and learning in higher education institutions. The study was mainly based to examine classroom environment, student learning, interactive learning, class participation, and higher education institutions-oriented published documents indexed in Web of Science from 2001 to 2020. We concluded based on the study findings that the topic of higher education institutions was on top of the topic list and a major proportion of published documents was an article. The English language was used and the frequency of published documents was gradually increased as per year. The author 'Lepori B' was on the top with 13 publications and 205 citations. Further, organization Univ. Colorado and United States country was on top of the top. Furthermore, higher education was the top keyword and computer & education were the top sources of published documents. Likewise, the top funding agency was 'National Science Foundation NSF'.

7. Limitations of the Study

The present bibliometric study was based on publications in the Web of Science only and we did not use other databases agencies. Further, it only focussed to look at the classroom environment, student learning, interactive learning, class participation, higher education institutions using

bibliometric analysis from 2001 to 2020. Thus, we did not use other related topics including the role of teacher, type of institution, academic facilities, previous grades, curriculum, etc.

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Appendix A

Table 7

Top Twenty Sources of Publications (2001-2020)

Sources	h_index	g_index	m_index	TC*	TP*	PY*_Start
Computers & Education	23	35	1.095238095	1676	35	2001
Higher Education	19	33	---	1161	49	2001
British Journal of Educational Technology	16	26	0.761904762	1002	26	2001
Journal of Cleaner Production	15	25	1.363636364	655	30	2011
Studies in Higher Education	14	32	---	1070	40	2001
Research in Higher Education	14	18	0.666666667	1456	18	2001
CBE-Life Sciences Education	13	29	0.928571429	1096	29	2008
Interactive Learning Environments	11	20	---	426	34	2005
Assessment & Evaluation in Higher Education	11	18	0.785714286	369	29	2008
Journal of Chemical Education	11	17	0.578947368	305	21	2003
Journal of Research in Science Teaching	11	13	0.578947368	849	13	2003
Sustainability	10	14	1.111111111	282	49	2013
Teaching of Psychology	10	16	0.476190476	284	24	2001
Higher Education Research & Development	10	13	---	205	23	2008
Nurse Education Today	10	19	0.526315789	385	23	2003
Advances in Physiology Education	10	20	0.476190476	470	20	2001
Medical Teacher	9	21	---	450	27	2002
International Journal of Educational Management	9	15	---	238	26	2007
American Journal of Pharmaceutical Education	9	15	0.428571429	250	25	2001
Journal of Education for Business	9	16	0.529411765	284	21	2005

TC* = Total Citations, TP* = Total Publications, PY* = Publication Year

Appendix B
Table 8
Top Twenty Funding Agencies (2001-2020)

Funding agencies	TP*	% of 6340
National Science Foundation NSF	140	2.208
European Commission	56	0.883
Portuguese Foundation for Science and Technology	30	0.473
United States Department of Health Human Services	30	0.473
National Natural Science Foundation of China NSFC	27	0.426
National Institutes of Health NIH USA	26	0.410
Ministry of Science and Technology Taiwan	24	0.379
Grants in Aid For Scientific Research Kakenhi	21	0.331
Japan Society for the Promotion of Science	21	0.331
Ministry of Education Culture Sports Science and Technology Japan MEXT	21	0.331
US Department of Education	20	0.315
Economic Social Research Council ESRC	16	0.252
European Commission Joint Research Centre	15	0.237
CAPES	14	0.221
NSF Directorate for Education Human Resources EHR	14	0.221
UK Research Innovation UKRI	14	0.221
Federal Ministry of Education Research BMBF	09	0.142
National Council for Scientific and Technological Development CNPQ	09	0.142
Social Sciences and Humanities Research Council of Canada SSHRC	09	0.142

TP* = Total Publication

Appendix C
Table 9
Top Twenty Journals Articles by Citations (2001-2020)

Article title	Authors	ISSN	Vol./No.	PY	TC
A review of research on the impact of professional learning communities on teaching practice and student learning	Vescio, V; Ross, D; Adams, A	0742-051X	24(1)	2008	737
Student engagement and student learning: Testing the linkages	Carini, RM; Kuh, GD; Klein, SP	0361-0365	47(1)	2006	541
Perceptions of classroom environment, achievement goals, and achievement outcomes	Church, MA; Elliot, AJ; Gable, SL	0022-0663	93(1)	2001	436
Using hypermedia as a metacognitive tool for enhancing student learning? The role of self-regulated learning	Azevedo, R	0046-1520	40(4)	2005	377
Faculty do matter: The role of college faculty in student learning and engagement	Umbach, PD; Wawrzynski, MR	0361-0365	46(2)	2005	340
Linking teacher and student learning to improve professional development in systemic reform	Fishman, BJ; Marx, RW; Best, S; Tal, RT	0742-051X	19(6)	2003	327
The conscientious consumer: reconsidering the role of assessment feedback in student learning	Higgins, R; Hartley, P; Skelton, A	0307-5079	27(1)	2002	325
The classroom environment and students' reports of avoidance strategies in mathematics: A multimethod study	Turner, JC; Midgley, C; Meyer, DK; Gheen, M; Anderman, EM; Kang, Y; Patrick, H	0022-0663	94(1)	2002	321
Patterns in student learning: Relationships between learning strategies, conceptions of learning, and learning orientations	Vermunt, JD; Vermetten, YJ	1040-726X	16(4)	2004	320
The relation of kindergarten classroom environment to teacher, family, and school characteristics and child outcomes	Pianta, RC; La Paro, KM; Payne, C; Cox, MJ; Bradley, R	0013-5984	102(3)	2002	304
Parallel and interactive learning processes within the basal ganglia: Relevance for the understanding of addiction	Belin, D; Jonkman, S; Dickinson, A; Robbins, TW; Everitt, BJ	0166-4328	199(1)	2009	298
In-class laptop use and its effects on student learning	Fried, CB	0360-1315	50(3)	2008	286

Article title	Authors	ISSN	Vol./No.	PY	TC
Metacognitive strategies in student learning: Do students practise retrieval when they study on their own?	Karpicke, JD; Butler, AC; Roediger, HL	0965-8211	17(4)	2009	281
Help seeking and help design in interactive learning environments	Aleven, V; Stahl, E; Schworm, S; Fischer, F; Wallace, R	0034-6543	73(3)	2003	269
Self-regulation empowerment program: A school-based program to enhance self-regulated and self-motivated cycles of student learning	Cleary, TJ; Zimmerman, BJ	0033-3085	41(5)	2004	259
Biology in Bloom: Implementing Bloom's Taxonomy to Enhance Student Learning in Biology	Crowe, A; Dirks, C; Wenderoth, MP	1931-7913	7(4)	2008	254
Digital storytelling: a meaningful technology-integrated approach for engaged student learning	Sadik, A	1042-1629	56(4)	2008	243
Collaborative leadership and school improvement: understanding the impact on school capacity and student learning	Hallinger, P; Heck, RH	1363-2434	30(2)	2010	242
The educational effects of portfolios on undergraduate student learning: A Best Evidence Medical Education (BEME) systematic review. BEME Guide No. 11	Buckley, S; Coleman, J; Davison, I; Khan, KS; Zamora, J; Malick, S; Morley, D; Pollard, D; Ashcroft, T; Popovic, C; Sayers, J	0142-159X	31(4)	2009	239
Testing a Conception of How School Leadership Influences Student Learning	Leithwood, K; Patten, S; Jantzi, D	0013-161X	46(5)	2010	234

TC* = Total Citations, PY* = Publication Year