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TEN YEARS' DEVELOPMENT OF TEACHER ASSESSMENT RESEARCH: A BIBLIOMETRIC ANALYSIS

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ABSTRACT
This study aims to demonstrate a detailed knowledge map of teacher assessment research via a 10-year data set from the Web of Science (WoS) database. A bibliometric analysis was employed for analyzing the articles published between 2012 and 2021 to show the status of teacher assessment research in the past ten years, research topics on teacher assessment, and future research directions. Using the keyword "teacher assessment and teacher evaluation" and filtering data by selecting articles and early access in teaching and education, 847 articles were retrieved. Through production, content, and citation analysis with the help of a bibliometric tool, this article present an overall knowledge map about teacher assessment research, and We found that teacher assessment remained a popular research theme in the academic field over the past ten years, and its booming production involved many authors, institutions, and sources, and countries. Furthermore, "assessment," "formative assessment," "teacher education," and "students," "knowledge," "education," and "performance" are popular topics in teacher assessment research, and fundamental issues, including "impact," "accountability," "feedback," "technology," "formative assessment," "knowledge," and "achievement" keep good topics to be explored in future research. In the end, we argue that more detailed analysis on specific topics on teacher assessment by integrating quantitative and qualitative methods.

Keywords: ten-year development, teacher assessment, teacher evaluation, bibliometric analysis

Introduction

Assessment plays an essential role in the field of education (Ainscow, Beresford, Hopkins, Southwoth, & West, 2012), because the philosophy that assessment impacts how and what teachers teach and students learn (Baird, 2013; Hattie & Timperley, 2007; Shepard, 2000; Volante & Fazio, 2007) has gained widespread recognition and has influenced assessment practices. As a concept first introduced by Stiggins(1991), assessment literacy contains both assessment knowledge and skills related to teacher practice (Popham, 2009; Stiggins, 1995), and use and interpretation of assessment to give insight into instruction, generate feedback, enlighten student learning, and report student achievement (Stiggins & Duke, 2008; Webb, 2002). Before 1993, assessment literacy was identified with standardized measurement and classroom testing. After that, the focus has been shifted to the construct of assessment literacy and evaluation of its level so that we can distinguish novice teachers from expert teachers (Ogan-Bekiroglu & Suzuk, 2014; Siegel & Wissehr, 2011).

Measuring and supporting teachers' assessment literacy has been a focus of educational policy and research since the early 1990s (Gotch & French, 2014; Plake et al., 1993; Popham, 2013; Stiggins, 2004). Many researches has been done on the models of assessment literacy. For instance, DeLuca,LaPointe-McEwan and Luhanga(2016) conducted a thematic analysis of 15 assessment standards and an examination of 8 assessment literacy measures of five English-speaking countries and results indicated that there are great shifts in assessment standards over time yet early conceptions of assessment literacy still dominate the majority of measures. Pastore and Andrade (2019) discussed three-dimensional model of teacher assessment literacy, that are conceptual knowledge dimension, praxeological dimension and socio-emotional dimension and hope that the model can inform curriculum to ensure adequate attention to contextual and socio-emotional dimensions of assessment literacy. Ladson-Billings discussed culturally relevant approaches to teacher assessment and proposed that culturally relevant teachers should develop academical, cultural competence, and socio-political consciousness in their students. Xu and Browna (2016) proposed a new conceptual framework of teacher assessment literacy in practice (TALiP), which consists of a basic mastery of educational assessment knowledge, an internalized set of understanding and skills of the interconnectedness of assessment, teaching, and learning and a self-directed awareness of assessment processes and one's own identity as an assessor.

Teaching assessment research is an overarching research topics of great importance in education field because of its impact on how and what teachers teach and students learn. And it involves a wide range of research contents, including teacher assessment literacy, different models of assessment, the relation between teacher assessment and student's performance. Currently, there is a booming trend in the investigation of issues in the teacher assessment research and much more achievements has been gotten. However, it is more difficult for scholars and researchers to find the information they need most and to find the literature that has greatest value in this field, because literature is increasingly hard to be arranged in an organized and transparent way for its great volume. Therefore, this paper intends to adopt a bibliometric analysis tool to analyze development of teacher assessment research during past 10 years quantitatively. We believe that this paper has its value in that it may benefit early researchers by presenting the most influential authors, documents, institutions and the most relevant research topics so that they can begin their research as soon as possible. Moreover, this paper may shed light on research gaps and research trends so that experienced scholars can fill the gap and follow popular trends to contribute more to the research of teacher assessment. Besides, the results showed by bibliometric tool can help scholars and researchers to find potential cooperator in the topics they are interested in. Last but not least, this paper has potential to help rating agency evaluate performance of institutions, individuals and countries by presenting

various statistics, including number of papers, index and citation scores.

Bibliometric analysis tool

Studies are scattered and hard to be arranged in an organized and transparent way because of booming literature. Consequently, quickly and accurately finding out the critical literature closely related to the research topic has always been perplexing (Aria & Cuccurullo, 2017). Bibliometric analysis, characterized by a quantitative analysis of articles published in a specific field (Baker et al., 2019), is one of the literature reviewing approaches to accumulate knowledge and organize previous findings. It is a particularly prevalent method when investigating various aspects of science and how institutions and universities are ranked worldwide (Ellegaard & Wallin, 2015). Bibliometric analysis is based on the Bibliometrix package in R, an open-source ecosystem encompassing statistical algorithms, mathematical functionality, and visualization capabilities (Derviş, 2019). At present, bibliometric analysis is applied in a vast range of research fields, including tsunami research (Chiu & Ho, 2007), in the management and organization (Zupic & Čater, 2015), in tourism (Koseoglu, Rahimi, Okumus and Liu, 2016), tuberculosis research (Nafade et al., 2018), Economics in Latin America (Bonilla et al., 2015), COVID-19 pandemic (Gautam et al., 2020). The bibliometric method in the study has significantly powerful functions and plays an increasingly important role in research thanks to its scalable and reliable statistics. Compared with other approaches, it has the potential to introduce a systematic, transparent, and reproducible review process based on the statistical measurement of science, scientists, or scientific activity (Diodato, 1994; Pritchard, 1969). As a particularly suitable method for science mapping, it adapts to the time when the emphasis on empirical contributions produces voluminous, fragmented, and controversial research streams (Aria & Cuccurullo, 2017). The increasing number of publications applying bibliometric analysis in all fields indicates that it fulfills the need of policymakers, researchers who demand valuable and exact research based on massive literature. In addition to benefit to researchers, the overall result produced by bibliometric tool also benefits policymakers by helping them access the performance of scholars and institutions.

This study contributes to teacher assessment research by providing a knowledge map of this field. By employing a bibliometric analysis, we hope that this knowledge map will serve as a valuable tool for early researchers to find out knowledge and research findings so that they can begin their research as soon as possible. We also hope that this paper serves as an effective way for experienced researchers to understand the development of teacher assessment research during the past 10 years, find research gaps that they can fill in the future, and help them find out potential cooperators. Furthermore, we expect that this paper will serve as a reliable measure for some rating agencies to evaluate the performance of authors, institutions sources, and countries in teacher assessment research effectively and quickly.

Research Method

2.1. Research questions

The current study aimed to identify and substantiate the state and impact of teacher assessment research during the past 10 years. The study analyzed the research topic, publication pattern, research area, authors, highly cited articles, journals, and institutions that contributed most to teacher identity research during the past 10 years. The following questions were designed to guide the review of articles about teacher assessment and evaluation in the WOS database: 1) What was the research status of teacher assessment and evaluation research during the past 10 years. 2) What were research topics on teacher assessment and evaluation research during the past 10 years. 3) What are future research directions in teacher assessment and evaluation research. This paper offered productivity, citation, and content analysis to answer these questions, such as the number of documents published and citations, co-occurrence of keywords, most relevant sources, authors and institutions, collaboration network, word cloud, and trend topics.

2.2. Data Sources

In this study, all data were retrieved from the Web Of Science core collection database [including the citation Index Social Sciences Citations Index (SSCI) and Arts and Humanities Citation Index (AHCI]. The data was retrieved on November 25th, 2021, and the research term was "teacher assessment," and "teacher evaluation" with a published timespan from 2012 to 2021. The literature types were mainly restricted to papers and early access. The literature data obtained included the complete records (the author's title, source year, abstract, keyword, DOI number, citation frequency, etc.) and the references cited in the article.

2.3. Data collection and data analysis

This research selected the Web of Science that contained the data from 2012-2021, filtered the core document set according to the title of the paper, and exported the 853 data from the selected database. Data collection was divided into three sub-stages. The first was data retrieval. This research chose Web of Science as a source of bibliographic information, and we selected the articles and early access stored in the SSCI and AHCI to analyze research questions. The second sub-stage was data cleaning. We checked papers to avoid repetition of the data. The third sub-stage was downloaded and compressed files. We downloaded 500 references the first time and downloaded 408 references the second time. And then, the two paper files were compressed for employing bibliometric tools.

Nowadays, different tools are available to perform bibliometric studies, including CiteSpace, HistCite, VOSviewer, CitNetExplorer, etc (Moral-Muñoz et al, 2020). In this paper, we adopted a biblioshiny program to acquire a general picture of teacher assessment research in the past 10 years. Biblioshiny was developed by Massimo Aria and Corrado Cuccurullo from the University of Naples and the University of Campania's Luigi Vanvitelli. It is powered by Bibliometrix and its web-based graphical interface based on WoS, Scopus, and Dimensions data (Aria; Cuccurullo, 2017). In an up-to-date review on software tools for conducting bibliometric analysis in science,

Moral-Muñoz et al. (2020) have already given an introduction on biblioshiny. According to them, the interface of biblioshiny is intuitive and well organized, and the main menu has divided according to the SMA (Science Mapping Analysis) workflow (Moral-Muñoz et al. (2020). This menu will conduct performance analysis from source, author, and document dimensions, and conceptual, intellectual, and social structures of knowledge also will be done through this menu. The analysis options are mainly subdivided into eight categories: 1) Dataset, 2) Sources, 3) Authors, 4) Documents, 5) Clustering, 6) Conceptual structures, 7) Intellectual structure, and 8) Social structure. Several kinds of file formats can be exported, maps can be exported to Pajek and Html, and Tables can be copied to the clipboard or saved as Excel, pdf, or printed.

The retrieved data in this paper was analyzed for bibliometric indicators using Rstudio software with bibliometric Rx64package v.4.1.2. Firstly, the bibliometric analysis was activated in the R environment using the R language "install. packages ("bibliometrix," dependencies=TRUE)." The command code opened a biblioshiny web interface on the google chrome browser. Raw data in WoS was imported into the biblioshiny and analyzed. And then, the author described and interpreted the findings indicated by statistics and pictures. This study applied relevant authors, institutions, countries, papers, and top high cited publications, keyword co-occurrence, word cloud, thematic map, trend topics, conceptual structure to answer three different research questions.

Results and Discussion

The Status of Teacher Identity Research in the Past 10 Years

For the first question: what was the research status of teacher assessment in the past 10 years? In this study, a productivity analysis was performed. Main information about data, most relevant authors, institutions and documents, countries dominating the teacher identity study, and the co-citation of authors and sources were presented to show the status of teacher assessment research in the past 10 years.

Main information about data

As can be seen from Figure 1, the timespan of data ranges from 2012-2021. There are 853 documents involving 191 sources in total. The average years from publication, average citations per documents and average citation per year per document is 4.29, 10.36 and 1.808 respectively. The data is mainly restricted to articles. Teacher assessment is an overarching research topics involving a wide range of research contents indicated by 1090 keywords plus and 2109 author's keywords. There are 1933 authors who devoted themselves to the field of teacher assessment research. And the authors of multi-authored document account for largest part of authors. The publication about teacher assessment largely is largely owned to cooperation between researchers and scholars indicated by the fact that there are merely 204 single-authored documents. The documents per author, authors per document, co-authors per documents and collaboration index is 0.441, 2.27, 2.59 and 2.68 respectively, which again reprove that the

teacher assessment research during past 10 years involves intensive cooperation between different researchers and scholars.

Annual Scientific Production

From the Figure 2, we can conclude that teacher assessment remains a popular research topic in Education field indicated by its lasting high productivity. The overall trend in researches related to teacher assessment during past 10 years increase and its annual scientific production is relatively stable. It can be inferred that the teacher assessment generally gains more attention in recent years, particularly in 2018, and it has potential to continue to develop in the future around the world. From the Figure 3, we can acquire the information that the average article citations per year increase generally, which coincides with the Figure that the overall productivity of teacher assessment increase as well. The average article citations per year reached summit in 2015 shows that the research of teacher assessment in 2015 gained wild recognition.

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2012:2021
Sources (Journals, Books, etc)	191
Documents	853
Average years from publication	4.29
Average citations per documents	10.36
Average citations per year per doc	1.808
References	32080
DOCUMENT TYPES	
article	847
article; book chapter	2
article; proceedings paper	4
DOCUMENT CONTENTS	
Keywords Plus (ID)	1090
Author's Keywords (DE)	2109
AUTHORS	
Authors	1933
Author Appearances	2207
Authors of single-authored documents	196
Authors of multi-authored documents	1737
AUTHORS COLLABORATION	
Single-authored documents	204
Documents per Author	0.441
Authors per Document	2.27
Co-Authors per Documents	2.59
Collaboration Index	2.68

Figure 1: Main Information about Data

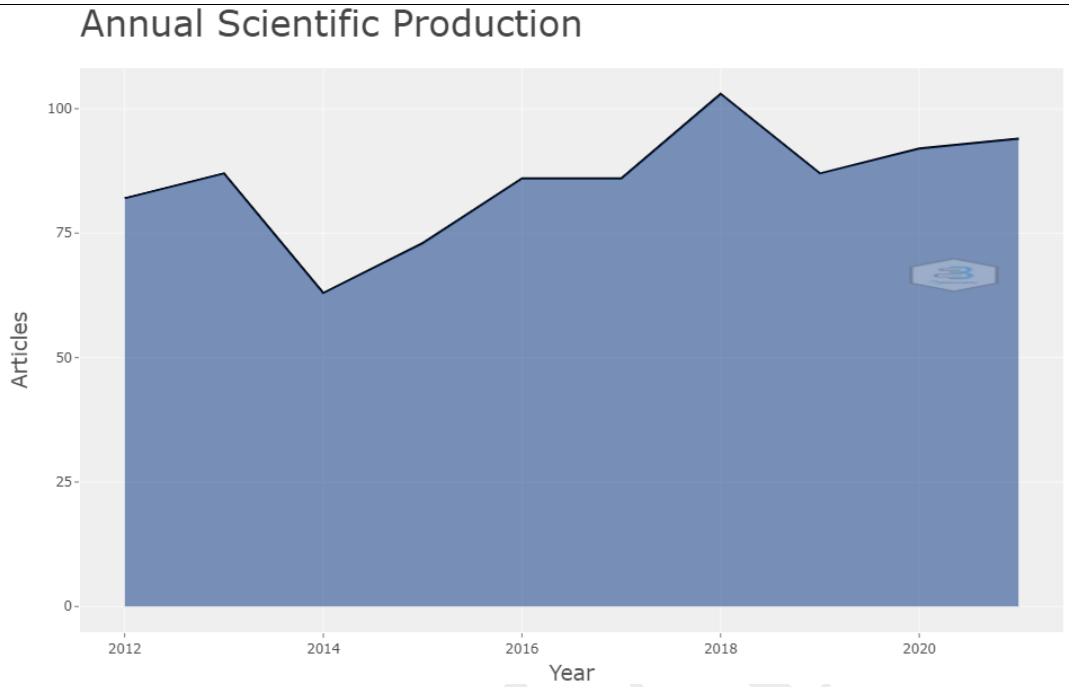


Figure 2: Annual Scientific Production

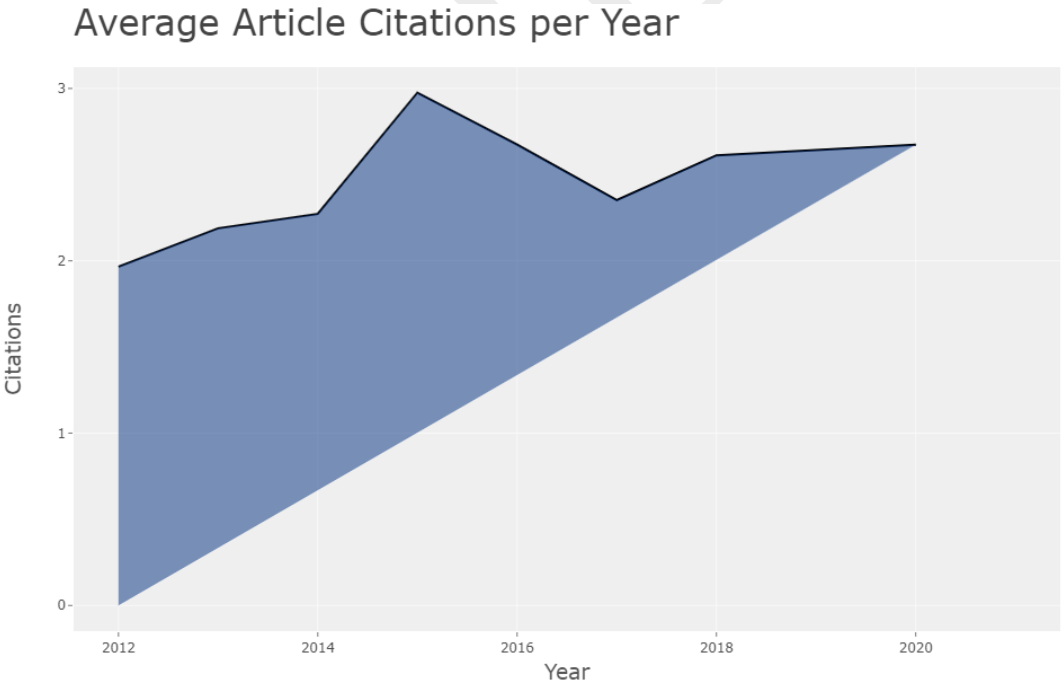


Figure 3: Average Article Citations per Year

Most relevant authors

The Figure 4 presents 10 most relevant authors by their productivity. Generally, there are no huge productivity gap between different authors. The productivity between top 10 relevant authors ranges from 8 to 4. The top most relevant and prolific authors are Christopher DeLuca and Gavin T. L. Brown by publishing 8 articles related to teacher assessment. During the past 10 years, Christopher DeLuca mainly focuses on teacher's assessment literacy, classroom assessment and assessment in teacher education. For instance, he explored a pedagogy for slow and significant learning about assessment in teacher education (Deluca et al., 2021), offered a review of national standards and measures about teacher assessment literacy (Deluca et al., 2016), introduced approaches to classroom assessment inventory (Deluca et al., 2016) and did a large-scale survey about teacher's approaches to classroom assessment (Deluca et al., 2018). Gavin T. L. Brown has strong interested in the research on teacher's perception on assessment. Over the last decade, he explored the impact of conception of assessment on assessment literacy in teacher education program (GTL Brown et al., 2016) and Chinese teacher's perception on assessment of and for learning. He also directed his focus on student's self-assessment. He reviewed the know unknows and potential directions for the future of student self-assessment (GTL Brown et al., 2016), proposed that reframe self-assessment as core competency in the future of self-assessment in classroom practice (GTL Brown et al., 2014) and pointed out directions and cautions for research on accuracy in student self-assessment (GTL Brown et al., 2015). Morgaen Donaldson is the top two most prolific authors with 7 publications. He mainly focues on the research on teacher evaluation. He explored teacher's perspective on evaluation reform (ML Donaldson, 2012), district leader's framing on educator evaluation policy (ML Donaldson et al., 2016), what district leader can do to strengthen teacher evaluation (ML Donaldson et al,. 2012）and teacher's evaluation for accountability and development (ML Donaldson et al., 2014). Timothy Teo is the top three most prolific author, he pays more attention to assessment of teacher's and student's acceptance and perception on technology. For instance, he introduced an initial development and validation of a Digital Natives Assessment Scale (2013) and conduct an assessment pf pre-service teachers' technology acceptance in Turky by applying a structural equation modeling approach (T Teo et al., 2012). These most prolific authors focus on different topics related to education and contribute a lot to the development of teacher assessment and evaluation. And there are other scholars and researchers who also delve into issues in teacher assessment and evaluation and do contributions to the progress of research field of education

Most relevant countries by corresponding authors

The teacher assessment and evaluation is a global research topic and attract wide attention indicated by the Figure 5. According to Figure 5, it can be known that a large number of authors who publish

documents about teaching assessment and evaluation comes from USA and Turkey and China. There are 264, 80 and 63 corresponding authors from USA, Turkey and China respectively. From Figure 5, we can know that the three top most cited countries are USA, Australia and China with 3086, 1036 and 716 respectively. There is no doubt that USA plays a dominant role in the research of teacher assessment and evaluation and contributes most to the development of education field concerning teacher assessment and evaluation. And Turkey, China and Australia also play important roles in this research field. This research landscape link to the national policy that encourage the research on related issues and to the common awareness that the research on teacher assessment and evaluation benefits to the improvement of many fields, such as student's learning, teacher's professional development, and teacher education program. Also, it can't be denied that there are more countries who have interests on teacher assessment and evaluation they do contributions to this field.

Most global cited documents

The most global cited documents are globally well-known documents cited in other works related to education assessment or teacher education. According to the Figure 6, the top three most global cited documents are Personalising learning: exploring student and teacher perceptions about flexible learning and assessment in a flipped university course, Teacher assessment literacy in practice: A reconceptualization and Evaluating teacher evaluation with 146, 135 and 130 total citations respectively. Personalising learning: exploring student and teacher perceptions about flexible learning and assessment in a flipped university course is written by Thomas Wanner in 2015. This paper is situated in the current debates about flexibility of teaching and learning, personalising learning, the flipped classroom and more flexible assessment for students. The research about "flipped classroom" found that a majority of students enjoy and are more engaged in a flipped classroom, prefer a blended learning that combine online and face-to-face learning and strongly value flexible assessment through more choices and control. This paper argued that assessment needs to become more student-driven and more flexible in order to adapt to the change of learning and teaching modes and there needs to be a move away from the traditional model of assessment where the lecturer/teacher decides when and how students are to be assessed. However, the study also reveals that providing flexible assessment is one of main concern of higher education teachers in "flipped classroom". To address this challenge, this paper suggested that teachers/course coordinators and students can engage in the establishment of assessment model. For instance, teachers and course coordinators need to adjust the assessment format and students can decide what kind of assessment pieces they would prefer in a democratic group. Evaluating Teacher Evaluation was written by By Linda Darling-Hammond, Audrey Amrein-Beardsley, Edward Haertel, and Jesse Rothstein in 2015. In this paper, these authors presented a number of problems with VAM models as accurate measures of teachers' effectiveness that have been documented by other researchers. For instance, Value-added models of teacher effectiveness are

inconsistent, Teachers' value-added performance is affected by the students assigned to them. It is proposed that value-added measures of student achievement tied to individual teachers should be used only in a low-stakes fashion when they're part of an integrated analysis of teachers' practices. Teacher assessment literacy in practice: A reconceptualization, written by Yueting Xu and Gavin T.L. Brown in 2016 contributes to the theoretical development of assessment literacy. In this paper, these two authors reconceptualized teacher assessment literacy (AL) by connecting research fields educational assessment and teacher education. By synthesizing and analyzing 100 studies on teacher AL, a new conceptual framework of teacher assessment literacy in practice (TALiP) that interrelates the knowledge and skill components of teacher AL with known characteristics of effective pre- and in-service teacher education, and the details of sociocultural contexts in which assessment is implemented was proposed. This framework consists of six components, they are the knowledge base, teacher conceptions of assessment, institutional and socio-cultural contexts, TALiP: the core concept of the framework, teacher learning, and teacher identity (re)construction as assessors. This paper concluded with the theoretical contributions of the framework, a working definition of TALiP, and implications for policy and practice of assessment education. In terms of practical implications, this paper suggested that the TALiP framework may be helpful in terms of resource allocation for policy development, it may shed light on the content and structures of assessment education for pre-service teacher education, and reminds school administrators of both the cognitive and emotional support that teachers need for in-service teacher education. These most relevant documents boast great academic value since they are always give implications to the future research and enlighteh the practice.

Most relevant source

As can be seen from Figure 7, the top three most relevant sources are Studies in Educational Evaluation, Teaching and Teacher Education and Assessment in Education-principles Policy/Practice, We can draw a conclusion that they play leading roles and have greatest influence on the publication pf articles about taecher assessment and evaluation, and they are also essential research fronts of this research field. Besides, Assessment/Evaluation in Higher Education, Teachers and Teaching and Educational Assessment Evaluation and Accountability also devote themselves to the development of this research field.These relevant source give implication to the scholars to submit their paper to the most relevant sources.

Most relevant affiliation

According to Figure 8, the most relevant affiliations who contribute most to the research of teacher assessment and evaluation in education field are Michigan State University, Arizona State University, University of North Carolina, Vanderbilt University and University of Olso in terms of number of articles during past ten years. The publication ranges from 27-24 which indicates that these universities pay a lot attention to the quality of education and teacher's and student's development. And

there are many scholars in these university who are interested in the research topics of teacher assessment and evaluation. The achievement of these affiliations attributes to the support of macro and micro level, including national and school support for educational reseach, scholar's effforts, and teacher's and student's collaboration.

Most relevant words

Most relevant words can reveal what research topics has been wildly explored in the field of teacher assessment and evaluation. Indicated by Figure 9(a), "Education", "knowledge" and "students" are top three most relevant words in terms of author's keywords plus. It can be shown that teacher assessment and evaluation is an important topic in education field for the progress of education quality and teacher education program and reform of education. And the purpose of exploration of issues in teacher assessment and evaluation always involves how teachers teach knowledge more efficiently and how students better learn knowledge. Furthermore, students are central role in measuring the strengthens and weakness of teacher assessment and evaluation. According to 9(b), "assessment", "teacher evaluation" and "formative assessment" are three most relevant words in terms of occurrence of author's keywords,. These words are corresponding to the search term on WOS in our study. It also can be explained that the related topics in teacher assessment and evaluation always take "assessment" and "evaluation" as central theme and there is a trend to value formative "assessment" at the core of effective teaching and learning, therefore, there are more studies exploring teacher's formative assessment, including student's self-assessment in education.

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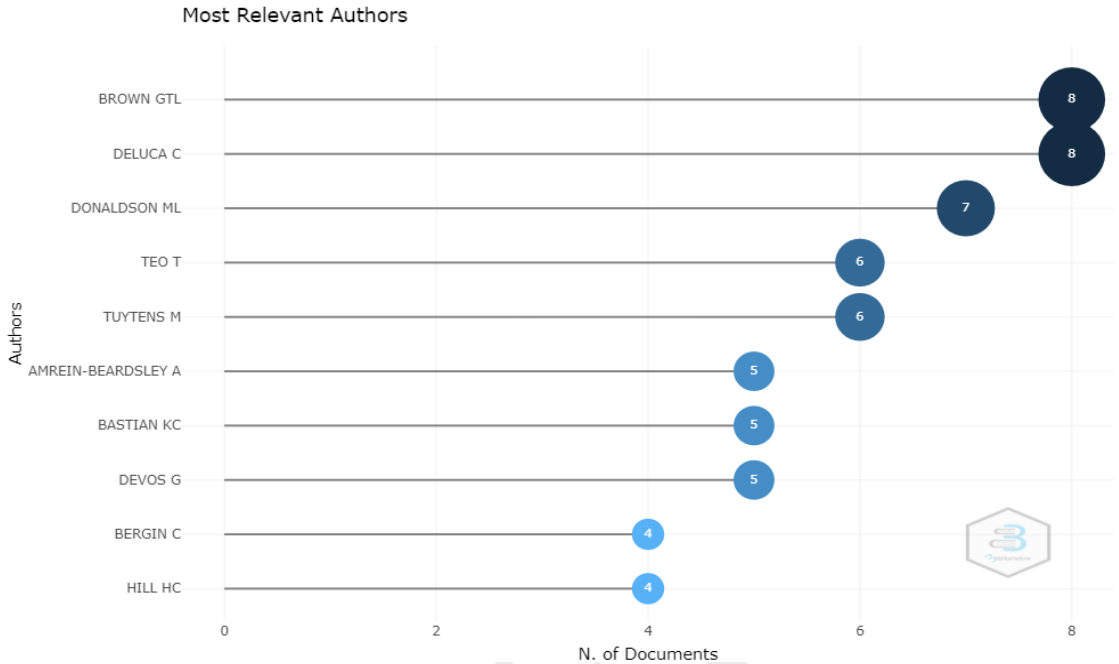


Figure 4: Most Relevant Authors

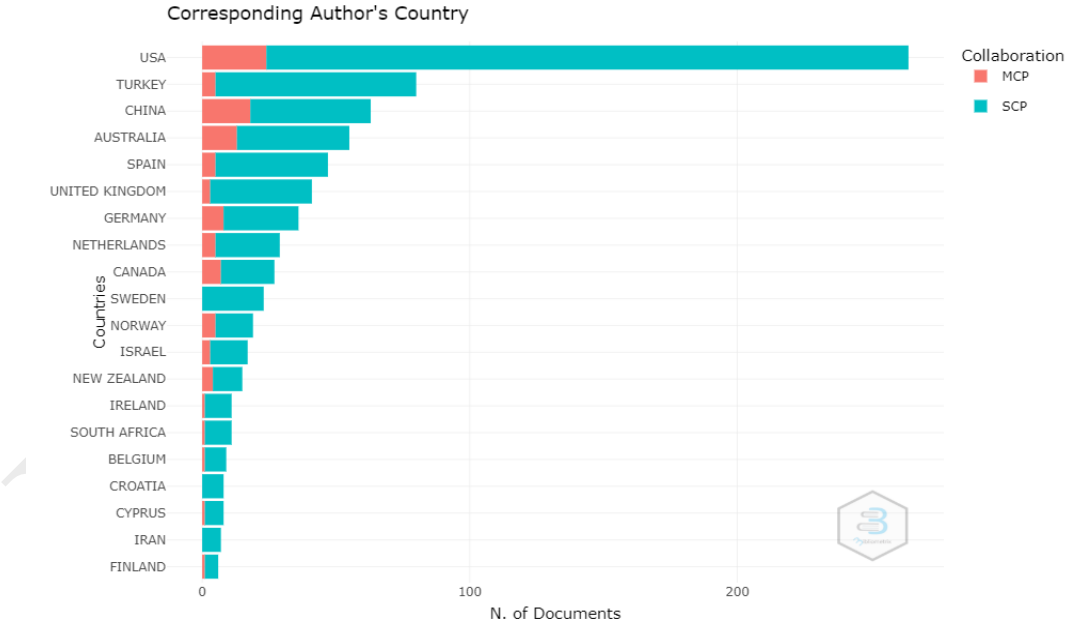


Figure 5：Most Relevant Countries by Corresponding Author's Country

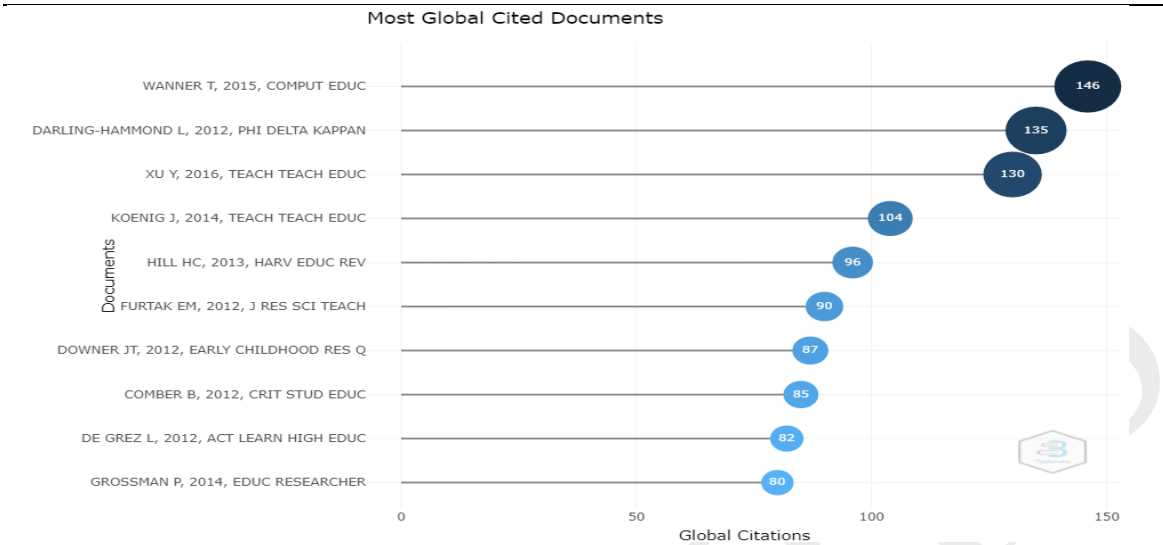


Figure 6: Most Global Cited Documents

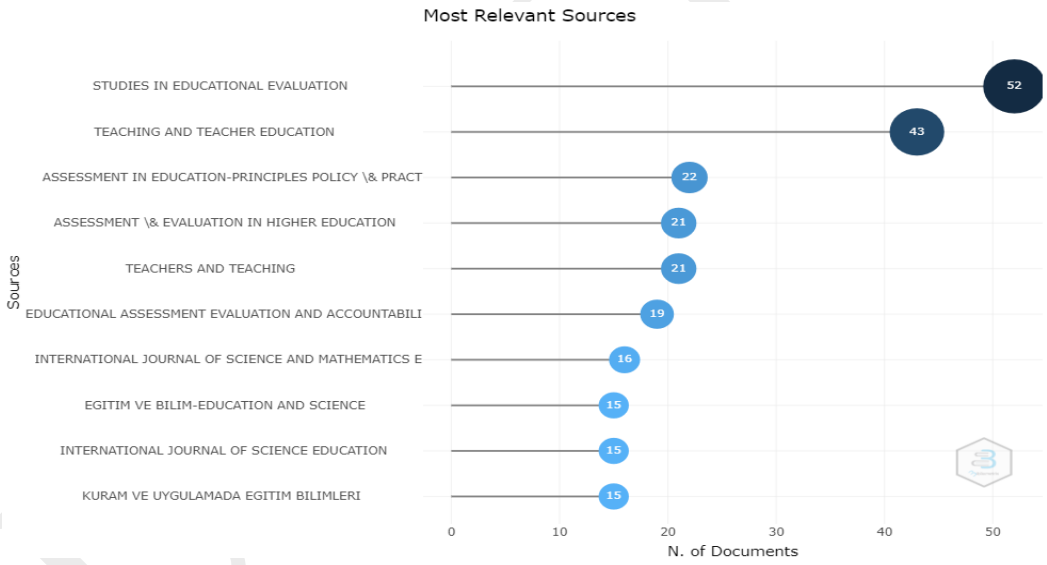


Figure 7: Most Relevant Sources

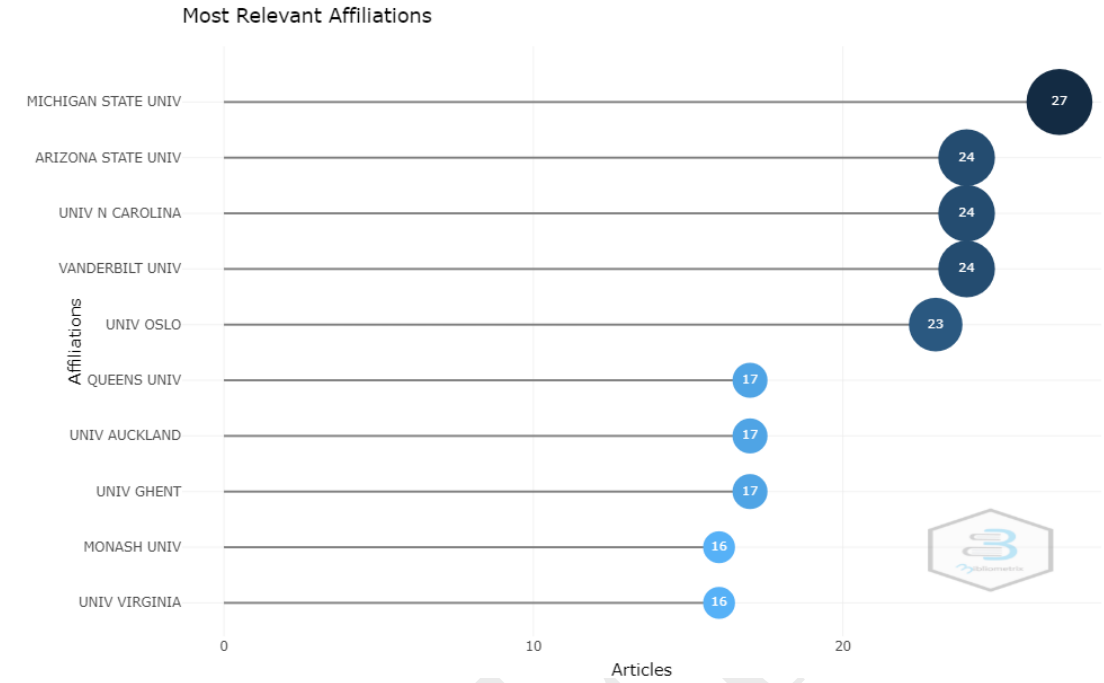


Figure 8: Most Relevant Affiliations

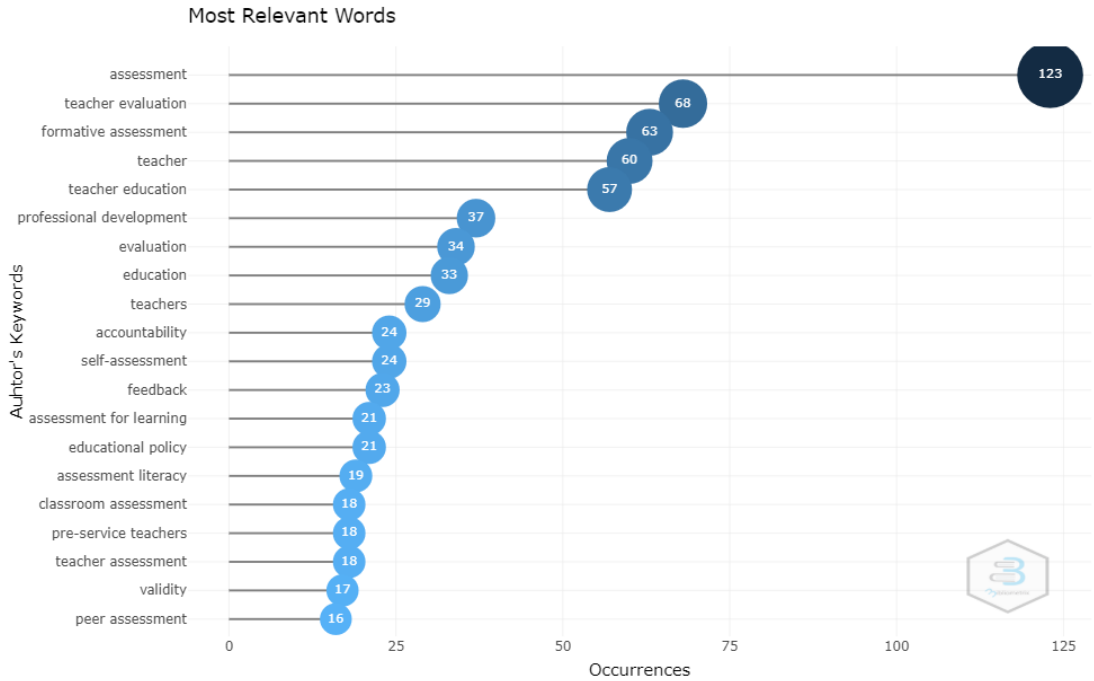


Figure 9(a): Most Relevant Words by Author's Keywords

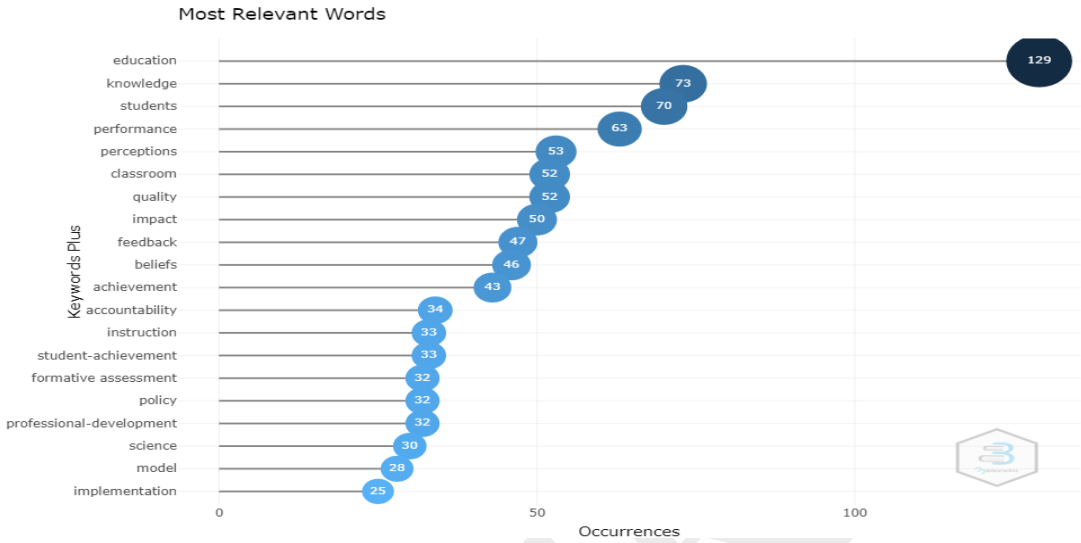


Figure 9(b): Most Relevant Words by Keywords Plus

Collaboration network analysis

The cooperative relationship among these countries is demonstrated in Figure 10 (a). The relationship between the countries is shown by clusters of color equations and lines between one name and another. Each point represents one country/territory and the thickness of interconnecting lines represents the strength of collaboration. As can be seen, The United State (USA) plays a central role in global cooperation network. Meanwhile, the USA and Canada have close collaborations with each other. Besides, Australia has a close cooperative relationship with China and United Kingdom, and Norway is a good partner for German. Many solid cooperation networks are formed between different institutions indicated by Figure 10(b). Among them, University of Virginia cooperate with Stanford University and Brown University most frequently, Arizona state University has most solid cooperation with University of Calif Berkeley, Vanderbilt University cooperate with Hong Kong Institution of Education frequently, University of Auckland has strong cooperation relation with University of Hong Kong. Furthermore, Figure 10(c) shows that there are as well as strong cooperation networks between authors. Among them, Christi Bergin has strong cooperation with Stefanie Wind in the research of teacher evaluation, Margaret Brown, Shivaun O'Brien, Gerry McNamara and Joe O'Hara has cooperated frequently in the field of teacher assessment and evaluation research. There are close relationships between Tuytens, Melissa and Geert Devos in the research of teacher evaluation policy. DeLuca, Christopher and Coombs, Andrew cooperate frequently in the research of classroom assessment. Consequently, we can conclude that the exploration of issues related to teacher assessment and evaluation

involves intensive cooperation among many countries, institutions and authors who has interest in this field, and the development in the research of teacher assessment and evaluation is a result of common efforts among a lot of parties.

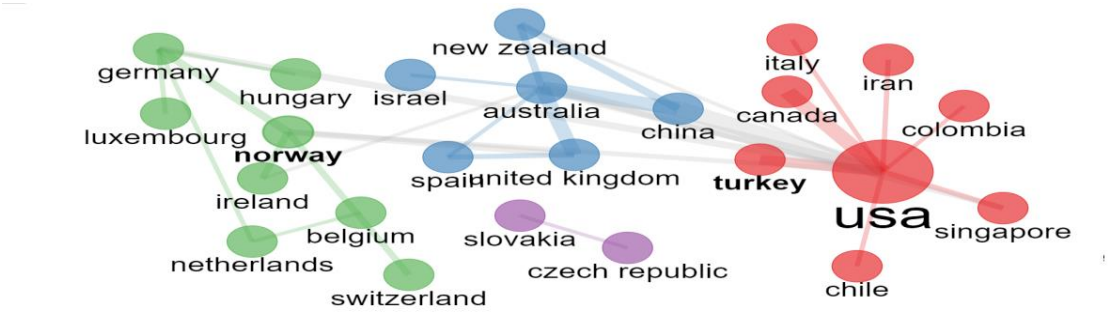


Figure 10(a): Collaboration Network of Countries

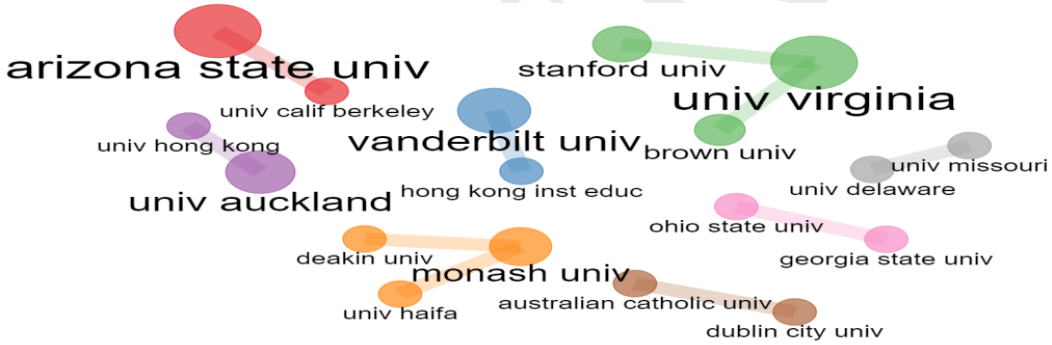


Figure 10(b): Collaboration Network of Institutions

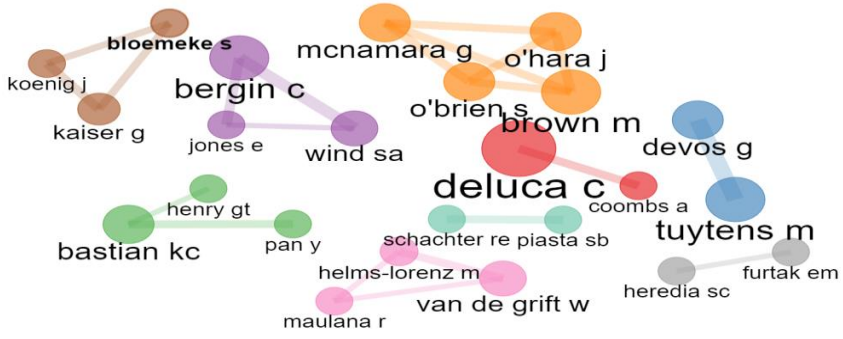


Figure 10(c): Collaboration Network of Authors

Co-citation source network analysis

As can be seen in Figure 11(a), there are two clusters indicated by two different colors. There are numerous journals in red clusters, such as the journal of Teaching and Teacher education, the Journal of Educational Research, the journal of Assessment in Education-principles Policy & Practice, the journal of Tesol Quarterly, the journal of Review of Educational Research and so on, The journal of Teaching and Teacher Education dominates the co-citation network and there is a strong co-citation network among Teaching and Teacher Education, Review of Educational Research and Assessment in Education-principles Policy & Practice. In the blue clusters, there are American Journal of Education, Educ Researcher, Teachers and Teaching, American Educational Research Journal, Education Finance and Policy and so on. Among them, Educ Researcher and American Educational Research Journal has most intensive co-citation network. Overall, these journals devote themselves to the research of teacher assessment and evaluation and they are major research fronts

Co-citation author network analysis

As can be seen from Figure 11(b), we can know that three clusters are shaped. The red cluster is dominated by Paul Black, which can revel that he is wildly cited by other scholars and researchers. And Paul Black has close co-citation network with Dylan Wiliam, Gavin T.L. Brown, Lorrie A. Shepard. This coincide with the fact that there are some cooperation between some of them and their paper are wildly cited in other works related to the teacher assessment and evaluation. The blue cluster is dominated by Linda Darling-Hammond, which in line with fact that she is one of top three most relevant authors and her paper is wildly cited. She is frequently co-cited with many authors, such as Weisberg Daniel, Julie Cohen and so on. The green cluster contains relatively few authors, including Bandura Albert, Marilyn Cochran-Smith and Andy Hargreaves, which represent that the co-citation network among them has already been shaped.

Co-citation paper network analysis.

Co-citation was put forward by Henry Small, an American intelligence scientist, in 1973 (Small, 1973). The necessary condition for two articles to form a co-citation relationship is that both articles appear in the references of a third article. The colors represent different clusters; distance implies the relatedness; vertex is represented by words and the size of the node is proportionate to its co-citation. In the Figure11(c), "papers" are the words extracted by a computer algorithm based on commonly found words in the paper and in the reference list of documents. They are preferred as they capture document's content with multiplicity. As it can be seen in Figure 11(c) , three clusters indicated in Red, Blue, Green emerged from the data. In the red cluster, the paper titled "Assessment and classroom learning" written by Paul Black and Dylan Wiliam in 1998 has most frequently cited in other references. It is not difficult to find that Paul Black's works plays important role in red clusters, such as his papers titled "Redefining assessment? The first ten years of development of assessment in education" and "Teachers develop assessment for

learning: impact on student achievement" which was co-written with Partricia Broadfoot, and with Dylan Wilian, Clare Lee and Christine Harrison respectively in 2004, and his paper titled "Development theory of formative assessment", which was written with Dylan Wilian in 2009. This also prove that there is relatively strong cooperation between Paul Black and Dylan Wilian, and their works are high-qualified and have great impact on the publication of other works in the research of teacher assessment and evaluation. Besides, Gavin T.L. Brown's work titled "Teachers conceptions of assessment: implication for policy and professional development" in 2004, and paper of joint authorship titled "Queensland teachers' conceptions of assessment: The impact on policy priorities on teacher attitudes" are also prominent in red cluster. This coincide with the fact that Gavin T.L. Brown is one of prolific authors in the research of teacher assessment and evaluation and proves that his work is valuable in this research field. In the green cluster, we can get that a lot of papers contribute a lot to the research of teacher assessment and evaluation and has close co-citation network. For instance, there is a co-citation network between Linda Darling-Hammond's co-author's work titled "Evaluating teacher evaluation" in 2012 and Weisberg Daniel's co-author's work titled "The Widget Effect: Our National Failure to Acknowledge and Act on Differences in Teacher Effectiveness. Second Edition" in 2009. In blue cluster, Lee S Hulman dominant in the co-citation network. And his work titled "Those Who Understand: Knowledge Growth in Teaching" in 1986 and his work titled "Knowledge and Teaching: Foundations of the New Reform" in 1987 has the closest co-citation network.

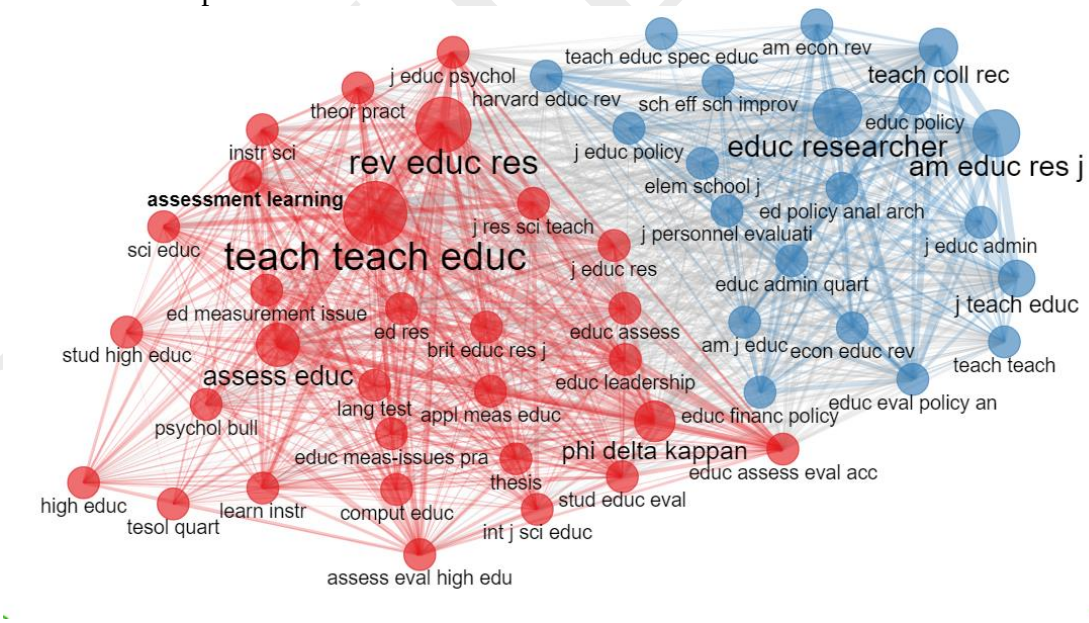


Figure 11(a): Co-citation Network of Sources

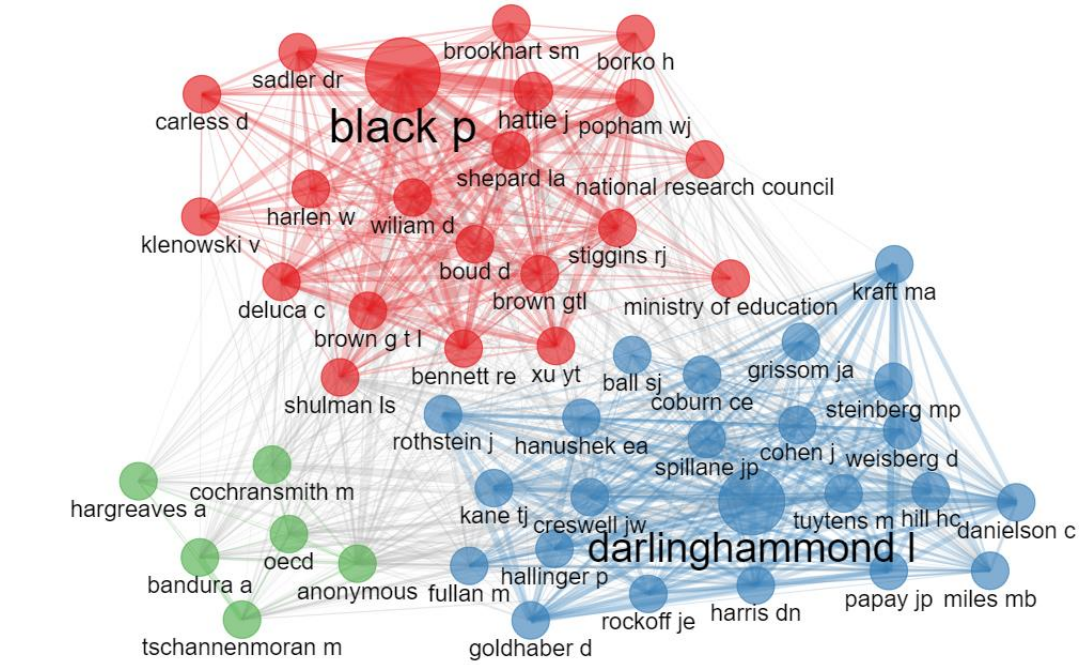


Figure 11(b): Co-citation Network of Authors

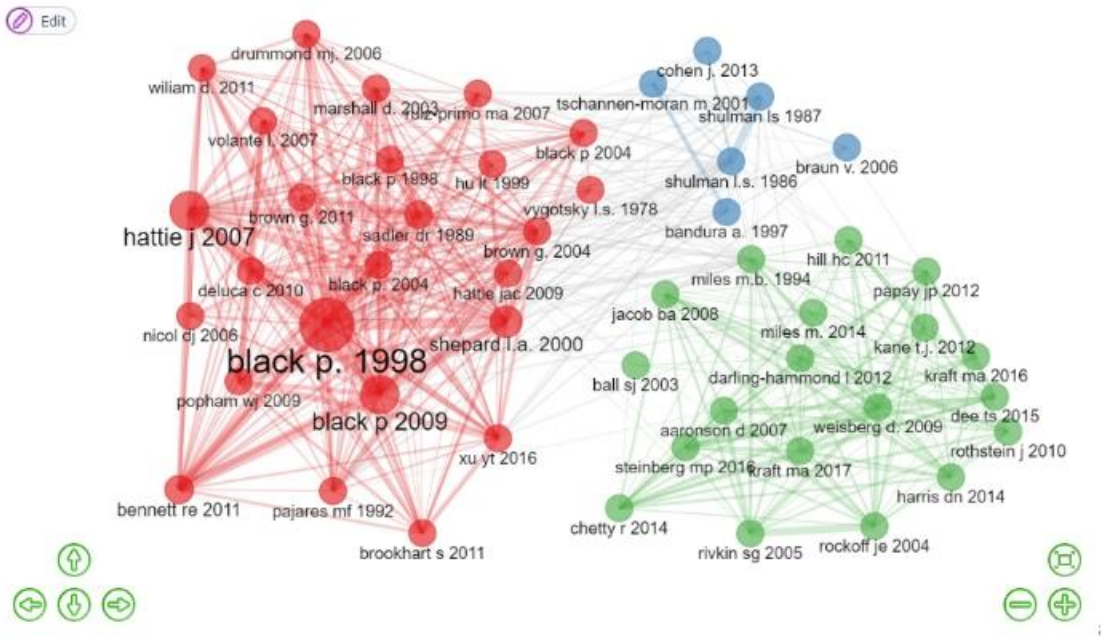


Figure 11(c): Co-citation Network of Papers

Research Topics in Teacher Assessment Research in the Past 10 Years

For the second question: What were the research topics on teacher identity in the past ten years? This study intended to answer it through content analysis. Thematic map,and co-occurrence of author's keywords were used to present research topics in teacher assessment research in the past 20 years.

Thematic Map

Thematic map reveals the status of research topics. According to different centrality and density, a thematic map is divided into four theme quadrants. The upper right quadrant contains motor themes characterized by high density and centrality, so it needs to be developed and it is important to be studied in further research. In this Figure 12, we can get that "impact," and "accountability" are important research topics and have promising development prospects. Furthermore, high density but low centrality in the upper left quadrant shows niche themes. These themes have good development, but their development trends are not certain. These theme in this quadrant are "validity," "instrument," "perceptions," "children," "performance," and "quality." Furthermore, low centrality and low density in the lower left quadrant indicate that these themes are emerging topics or declining topics that have experienced a downturn. The research topics in this quadrant are "model" and "efficacy." Finally, high centrality but low density in the lower right quadrant means that these research themes are basic in teacher assessment and evaluation research. Themes in this quadrant are "education,"

"knowledge," "students," "feedback," "classroom," and "achievement."

Co-occurrence network analysis

To picture the research hotspots in teacher assessment and evaluation field, the co-occurrence of keywords Plus was analyzed. The size of the circle associated with the number of occurrences of the signified keywords plus. The larger the circle, the more the keyword plus had been co-selected in teacher assessment and evaluation. Different colors of the circles are assigned to separate keyword plus clusters. The network in Figure 13 shows four separate clusters, indicating four subfields of the study areas in the teacher assessment and evaluation. The links between specific keywords plus showed the number of papers in which the keyword plus co-occurred. As can be seen, there are four subfield clusters, namely red cluster shaped mainly by "education", "beliefs" and "knowledge", blue cluster dominated by "students", "impact", "perceptions" and "feedback", green cluster dominated by "Performance" and "quality" and purple cluster dominated by "classroom" and "achievement". Among keyword plus of these four clusters, "education", "students", "performance" and "classroom" are central topics in the subfield research of teacher assessment and evaluation. This can prove that the research of teacher assessment and evaluation is characterized by multi-layer and multidimensions.

Thematic evolution

Thematic evolution can be used to analyze the growth of research topics related to teacher assessment and evaluation during the past ten years and can somewhat be sued to predict the research directions in the future. The evolution of the theme is shown in the image above. Although this research is teacher assessment and evaluation, this data shows several sub-themes that are widely used. The left section shows some of the themes widely used from 2012 to 2017, and the right section shows popular themes from 2018 to 2021. According to Figure 14(a), we can know that "assessment," "teacher," and "teacher evaluation" remain popular research topics from 2012 to 2021, and "assessment" has been paid more attention to during 2018-2021. In the latest three years, "formative assessment," "feedback," and "technology" are emerging topics that attract more attention from scholars and researchers, and they deserve continuous attention. According to the Figure 14(b), we can know that the research on teacher assessment and evaluation is always a research focus in "education" and stakeholders' "performance" and "perception" on it continue to consist of a significant part of relevant research. "Knowledge," "achievement" and "accountability" are relatively new research topics and have potential to develop in the future.

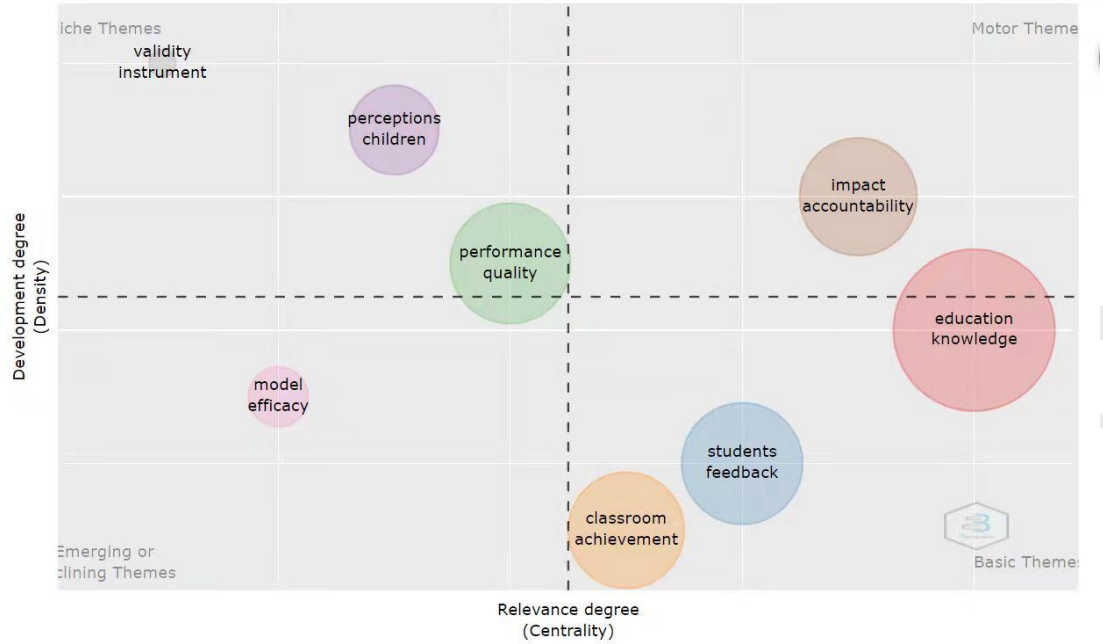


Figure 12: Thematic Map

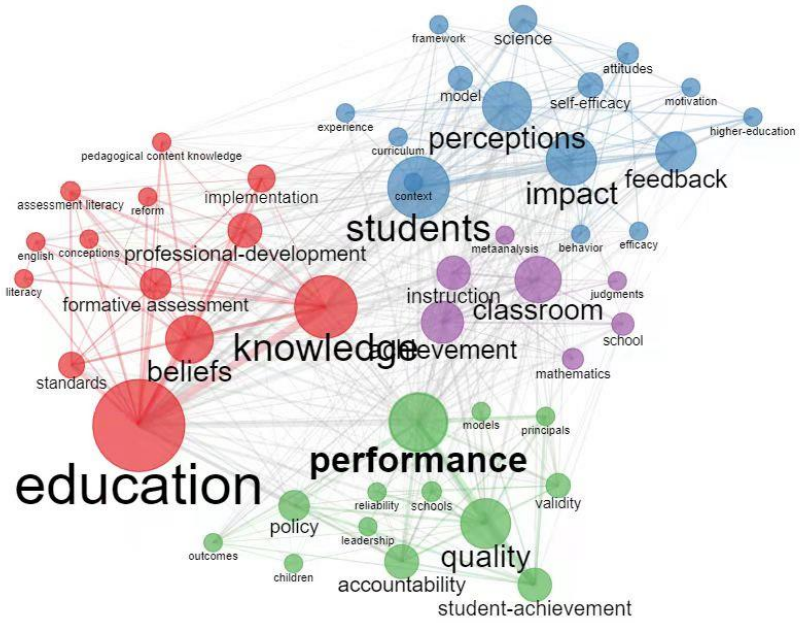


Figure 13: Co-occurrence Network of Keywords

Future Research Direction in Teacher Assessment Research

For the third question: What are the future research directions in teacher identity? With the help of the bibliometric tool, this article used Thematic Evolution and Thematic Trends to predict future research directions.

Trend topics

Trend Topics has the potential to let people know when a specific topic has attracted the most attention and which topic is most popular among many topics at a definite time. It is also able to see the development of research topics through time. More importantly, future research directions can be predicted according to its productivity in recent years. According to Figure 16, we can indicate that research topics about "assessment literacy," "classroom assessment," "thinking," and "scores" and "integration" are popular in recent years, because their productivity reached about 25 in 2020, In particular, "assessment literacy" has excellent opportunity to develop in the future indicated by the blue line. The development of the research topic on "principles" reached its climax in 2018, and there is still research focusing on "principles" of teacher assessment and evaluation despite the fact its productivity is fewer than before. However, they may continue to enjoy popularity in the future

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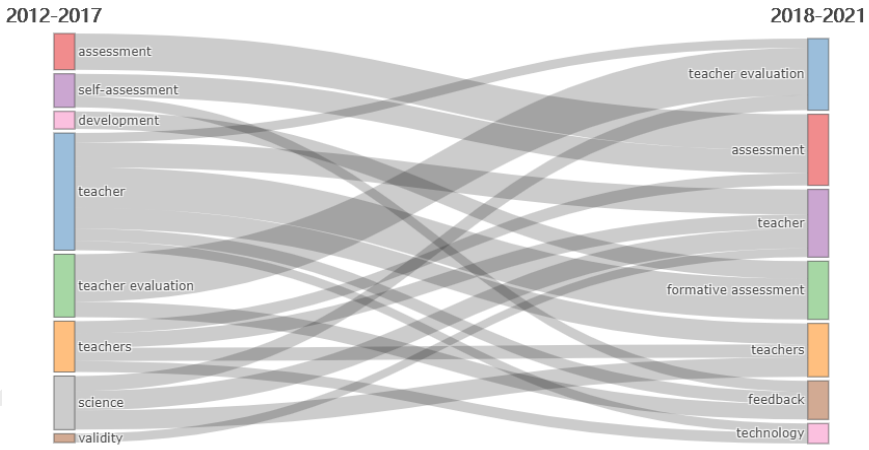


Figure 14(a): Thematic Evolution by Author's Keywords

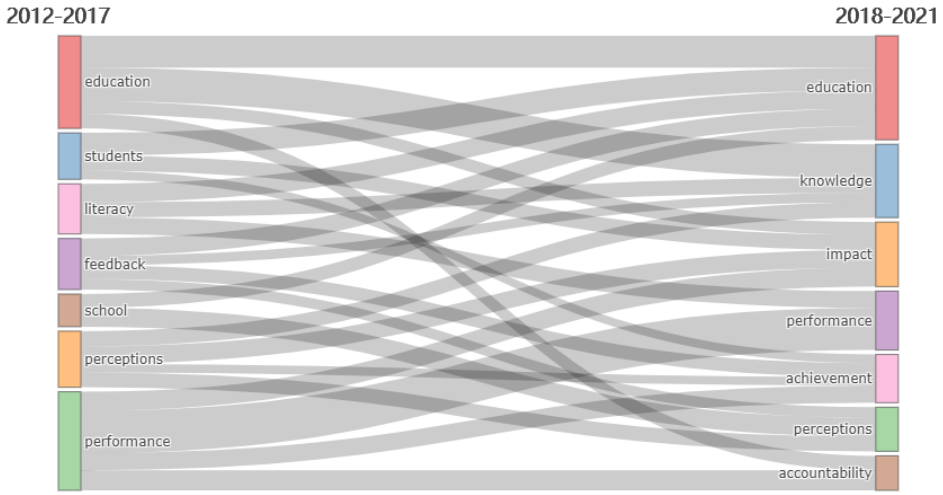


Figure 14(b): Thematic Evolution by Keywords Plus

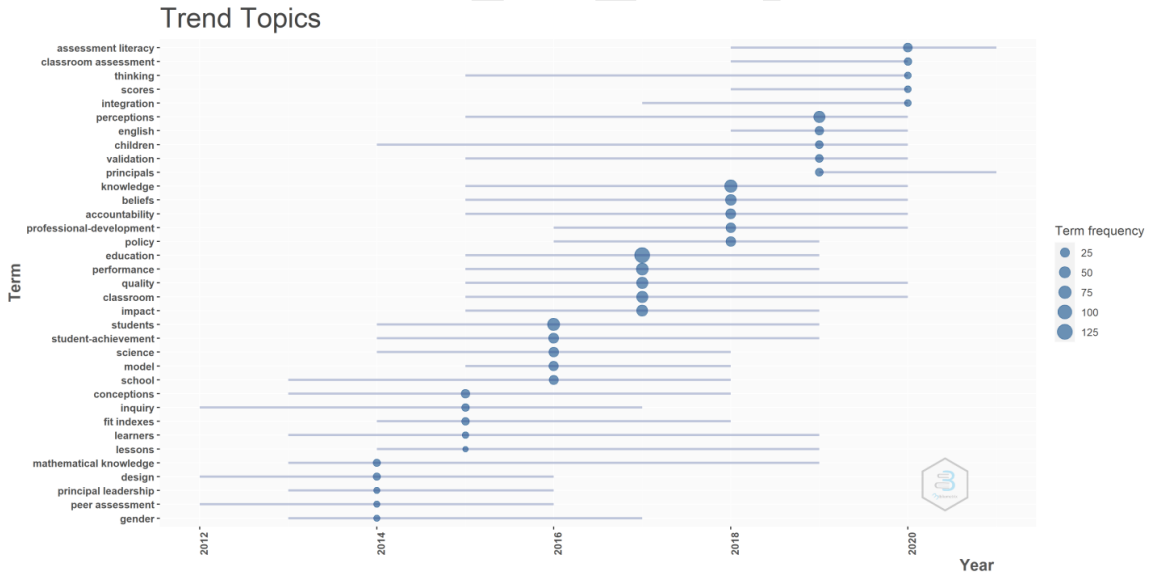


Figure 15：Trend Topics

Conclusion

This paper used a bibliometric tool to analyze the overall situation of teacher assessment and evaluation research during the past ten years. Through productivity analysis, content analysis, and citation analysis, this paper convincingly offers a detailed knowledge map about research status, research topics on teacher assessment, and evaluation research during the past 20 years. It points out research directions in the future analysis of this field.

Firstly, through productivity analysis and some parts of citation analysis, this paper can conclude that the study of teacher assessment and evaluation remains popular and relatively stable and has the potential to enjoy increasing popularity in the coming years. The development of teacher assessment and evaluation research results from a more significant number of authors, documents, sources and institutions, and countries. Among massive documents, Personalising learning: exploring student and teacher perceptions about flexible learning and assessment in a flipped university course, Teacher assessment literacy in practice: A reconceptualization and Evaluating teacher evaluation are the most widely cited documents. It can be inferred that these works may provide theoretical or experimental implications and guidance for other scholars and researchers who conduct research related to teacher assessment and evaluation. In terms of source impact, the top three most relevant sources are Studies in Educational Evaluation, Teaching and Teacher Education, and Assessment in Education-principles Policy/Practice in terms of the number of documents they published. Assessment/ Evaluation in Higher Education, Teachers and Teaching and Educational Assessment Evaluation and Accountability also devote themselves to the teacher assessment and evaluation research. Teaching and Teacher Education plays a leading role and has the most significant influence on publishing articles about teacher assessment and evaluation. And Studies in Educational Evaluation, Assessment in Education-principles Policy/Practice, and Educational research are also essential to research fronts of teacher assessment and evaluation. The most relevant and prolific authors are Christopher DeLuca, Gavin T. L. Brown, Morgan Donaldson, and Timothy Teo. They focus on proper teacher assessment and evaluation research issues and have produced many articles, and their documents are frequently cited in other works.

To conclude, they play an essential role in this research field. The most relevant affiliations who contribute most to teacher assessment and evaluation research in the education field are Michigan State University, Arizona State University, University of North Carolina, Vanderbilt University, and Olso University. During the past ten years, these universities have paid much attention to the development of teachers and students, and they devote themselves to improving education quality. The countries that contribute most to teacher assessment and evaluation research are the USA, Turkey, China, and Australia. Among them, the USA plays a leading role in its productivity and citation.

The development of teacher assessment and evaluation research involves

intensive cooperation among different parties. The United States (USA) plays a central role in the global cooperation network. Meanwhile, a solid collaboration between other countries has been formed, such as between USA and Canada, between Norway and Germany, and among Australia, China, and the United Kingdom. This cooperation network is also formed between different institutions. For instance, the University of Virginia, Stanford University and Brown University, Arizona State University and the University of Calif Berkeley, Vanderbilt University and Hong Kong Institution of Education, University of Auckland, and the University of Hong Kong cooperate frequently. In terms of cooperation networks between authors, Christi Bergin and Stefanie Wind, Margaret Brown, Shivaun O'Brien, Gerry McNamara, and Joe O'Hara, Tuytens, Melissa, and Geert Devos, DeLuca, Christopher and Coombs, Andrew have close cooperation in different research topics. Consequently, we can conclude that teacher assessment and evaluation research has gained wide recognition, and a solid cooperation network has been formed among many parties.

Secondly, there are many research topics in teacher assessment and evaluation research. For instance, "education," "assessment," "knowledge," "students," "teachers," "performance," "teacher evaluation," "teacher education," "formative assessment, "policy," "feedback," and "teacher evaluation." "Assessment" and "evaluation" are central themes around which all branches of research are derived. Education is a field that embraces all relevant research topics. Also, it can be inferred that teacher assessment and evaluation are overarching research in the education field, and it influences many stakeholders, including teachers, students and policymakers, and school administrations. The exploration of issues in the Teacher assessment and evaluation field is a lasting theme in the education field, and it has a close relation to the development and progress of education in human society. It plays an essential role in the individual product, including teachers, students, and educators. Thus, it is not difficult to predict that teacher assessment and evaluation research can enjoy continuous popularity in the future.

Thirdly, with the help of Thematic Map, Thematic Evolution, and Trend Topics. Future research directions in the teacher assessment and evaluation research can be predicted. To conclude, "assessment," "formative assessment," "feedback," and "technology" are emerging topics that attract more attention from scholars and researchers, and they deserve continuous attention. Besides, we can know that the research on teacher assessment and evaluation always a research focus in "education" and stakeholders' "performance" and "perception" on it will continue to consist of the significant part of relevant research in the future. "Knowledge," "achievement" and "accountability" are relatively new research topics and have potential to develop in the future. As indicated by Trend Topics, we can predict that the development of "assessment literacy," "classroom assessment," "thinking," "scores," and "integration" has good prospects. Besides, the "principles" also have the opportunity to thrive in the future.

To conclude, the field of teacher assessment and evaluation research remained popular and enjoyed growth during the past ten years. And the productivity of literature involved many documents, authors, sources, institutions, and countries, and the development of teacher assessment and evaluation research resulted from both individual contributions and cooperation among different parties. Furthermore, there are many research topics in teacher assessment, and evaluation research is a broad field in which massive research topics were explored, and these topics may experience growth or downturn during ten years, and different issues thrive at other times. Last but not least, teacher assessment and evaluation research have the potential to enjoy continuous popularity and recognition in the future, and some topics will be paid more attention to in the coming years.

Limitation

Adopting bibliometric analysis, this paper gives a comprehensive knowledge map about teacher assessment and evaluation research during the past ten years. However, we do not delve into any one specific research topic on this field to give a factual investigation. Besides, by adopting the qualitative method to produce statistics and pictures, we focus on presenting statistics and images and a summary of its content, but the exploration of underlying causes behind the phenomenon is lacking. In the future, more detailed analysis on smaller topics on teacher assessment and evaluation by integrating quantitative and qualitative methods is necessary for the progress of teacher assessment and evaluation research.

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