Bibliometric Analysis of Research Trends in PISA Scores: Themes, Evolutions, and Collaborative Networks

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Abstract. *This study aims to conduct an in-depth bibliometric analysis of research trends regarding PISA scores. The main focus of the research is to identify the main themes that dominate the literature, analyse how the research focus has evolved, and explore collaborative networks between researchers and institutions that contribute to this research. The research method is bibliometric analysis with data analysis using the R studio biblioshiny package. The results showed that the production of scientific papers with the theme of PISA analysis began to be widely produced in 2012 and experienced an increase until 2020. The evolution of the theme shows keywords such as "large-scale assessment", "mathematic education", 'STEM', "academic achievement" and "socioeconomic status" are the most used keywords by researchers on this theme. There are other elements such as gender socioeconomic conditions, and conditions related to immigrants that have become the focus of studies related to PISA results data which are also shown in the conceptual mapping framework. The collaborative character of this research effort demonstrates PISA's global significance as a tool for educational assessment, enabling information exchange and cross-border sharing of best practices.*

Keywords: PISA, Bibliometric analysis, Evolution, Thematic, Trends.

1   Introduction

The Programme for International Student Assessment (PISA) [1] has become an important cornerstone in understanding the quality of education worldwide. PISA provides data on the academic achievement of 15-year-old students in different countries, making it a crucial source of information for educators, policymakers and researchers [2], [3]. The increased interest in PISA scores aligns with the complexity of global education challenges and the need to approach education issues with an evidence-based approach [4]. Along with this increased interest, the literature related to PISA continues to grow [5]–[10].

Through his research, Kucherenco stated that educational research and research conducted by students can contribute to forming professional competence in general

[11]. Educational research using data from the Program for International Student Assessment (PISA) has a strong relationship with progress in education [12]. PISA provides an important foundation for evaluating the performance of education systems in different countries, enabling in-depth and objective comparisons of how countries perform in the global education context [12]–[14]. Using PISA, education research can identify global education trends [14], look for factors that influence student achievement [7], evaluate the effectiveness of education policies and develop further research in various aspects of research [15], allowing countries to learn from each other and share best practices to improve their education systems [16]. Thus, education research using PISA data not only provides a deeper understanding of education performance but also contributes significantly to progress and improvement in education as a whole [17].

This manuscript aims to conduct an in-depth bibliometric analysis of research trends on PISA scores. The main focus is to identify the main themes that dominate the literature, analyze how the research focus has evolved over time, and explore the collaborative networks between researchers and institutions that contribute to this research.

This study has an important contribution in helping education and research stakeholders to understand the development of research so far, identify key trends, and highlight collaborations that can be improved. The results of this study will hopefully be a valuable source of information for those with an interest in improving the education system and directing future research in the context of PISA scores.

2 Method

The methodology used in this bibliometric analysis uses several stages including the data collection stage which is carried out based on the theme, namely "PISA analysis". The second stage is the data visualization process using VoS Viewer software [18], [19], and the third stage is bibliometric data analysis using R studio biblioshiny package [20]–[22]. In summary, the bibliometric analysis method in this study is shown in figure 1.
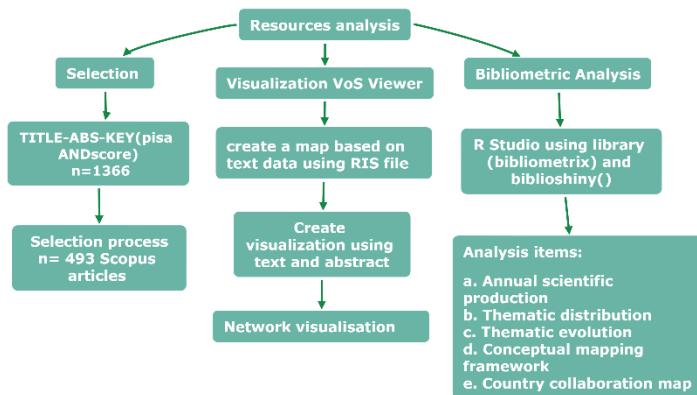

Fig. 1. Methodology

2.1   Data Collection

The data collection process was carried out by collecting data from the Scopus database (Scopus, n.d.). The search process began by using the TITLE-ABS-KEY (pisa AND score) data search coding obtained 1366 data. Next, a systematic search selection was carried out using inclusion and exclusion criteria using a codification system.

(pisa AND scores OR program AND for AND international AND student AND assessment AND scores) AND (science AND proficiency OR mathematic AND proficiency OR reading AND proficiency OR reflection AND skills);AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA,"PSYC")) AND (LIMIT-TO(DOCTYPE,"ar")   OR   LIMIT-TO   (DOCTYPE,"re"))   AND (LIMIT-TO(PUBSTAGE,   "final"))   AND   (EXCLUDE(EXACTKEYWORD, "Humans") OR EXCLUDE (EXACTKEYWORD, "Child") OR EXCLUDE (EXACTKEYWORD, "Human Experiment") OR EXCLUDE (EXACTKEYWORD, "School") OR EXCLUDE (EXACTKEYWORD, "Sex Difference")OR EXCLUDE (EXACTKEYWORD,   "Turkey")   OR   EXCLUDE   (EXACTKEYWORD, "Socioeconomics") OR EXCLUDE (EXACTKEYWORD, "Migration") OR EXCLUDE   (EXACTKEYWORD,   "Language   Test")   OR   EXCLUDE (EXACTKEYWORD,   "Immigrants")   OR   EXCLUDE   (EXACTKEYWORD, "Immigrant Students") OR EXCLUDE (EXACTKEYWORD, "Immigrant Children"))

Through this process, 493 articles were obtained to be continued to the next stage.

2.2   Data Visualization with VOS viewer

Data which were selected then continued to visualization stage with VOS viewer software [18], [19], [23] to visualize the co-occurrence network against the relationship strength among keywords and abstracts from the collected resources.

2.3   Data Analysis

Data analysis has been done using R studio software with the utilization of bibliometric dan biblioshiny package [21], [22], analysis process using the R studio protocols [24].

3   Result and Discussion

Fugure 2. Show data visualization using the VoS Viewer. A total of 277 terms with at least 10 occurences were detedted out 10.469 terms. 60 % of these terms, or 166 terms, are thought to be relevant to the PISA analysis theme. These relevant terms resulted in four grouping of relationships, acluster 1 (red) had 68 linked terms. Cluster 2 (green) had 44 interconnected terms, cluster 3 (blue) had 30 interconnected terms, and cluster 4 (yellow) had 24 interconnected terms.
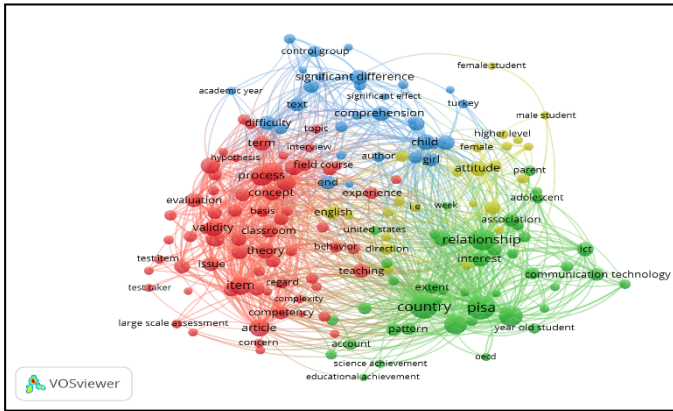
Fig. 2. Visualization using VoS viewer

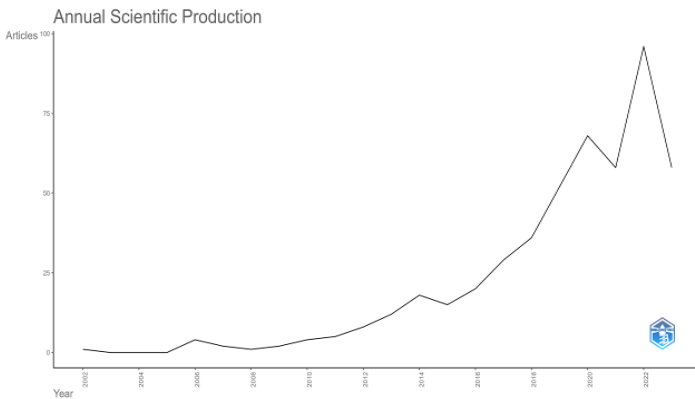Data nalysis using R studio-biblioshiny shown as follows:

Fig. 3. Annual scientific production

Numbers of scientific production over years are shown in Figure 3. It describes the annual publication of scientific papers [22], the results of the analysis show that the number of scientific papers with the theme of PISA analysis began to be produced in 2012 and increased until 2020. In 2021, the number of articles with this theme decreased and peaked in 2022 with almost 100 articles. Moreover, the number of keyword developments and the distribution of topics show variations from year to year, indicating that research topics with the scope of PISA data analysis remain of interest to researchers.

The results of thematic distribution shownin figure 4 analysis related to research trend topics using PISA scores obtained niche themes of assessment, process data, empirical models and empirical studies. Emerging themes articulated as newer themes that just starting to catch attention, this are include computer testing, pedagogical issues testing, and reading comprehension. Basic themes are surveys, level characteristics, and socio-economic status. Motor themes according to figure 4 are

themes which might be rapidly developing and gaining relevance, including digital dominated, namely computer aided analysis, data mining, electronic assessment in one cluster. Student, human capital, and socioeconomic conditions in one cluster. Student, education, educational computing in one cluster. Positive attitude, leisure, and science learning are in one cluster near the theme relevance line. The academic performance, and mathematics clusters are between the motor and basic theme quadrants, themes which located in the middle of the quadrant might represent well-established and moderately relevant topics. As its positioned in the middle of the quadarant, hence themes under this quadarant thought have a consistent development of topics in that field. One of the important part is the niche themes, it is seems specialized, however these themes gaining importance.
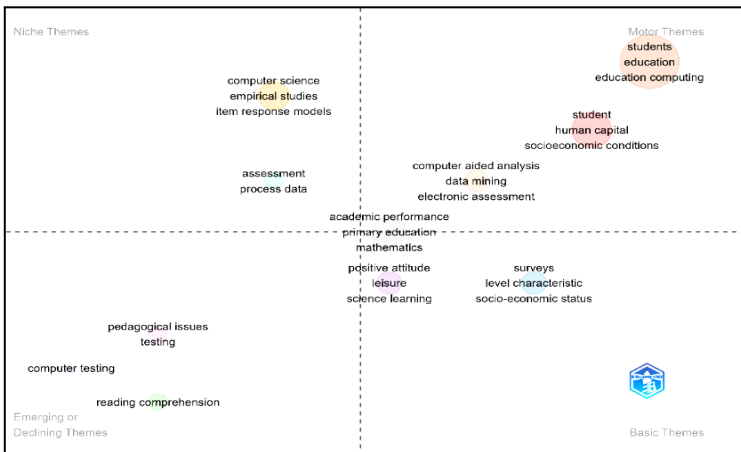

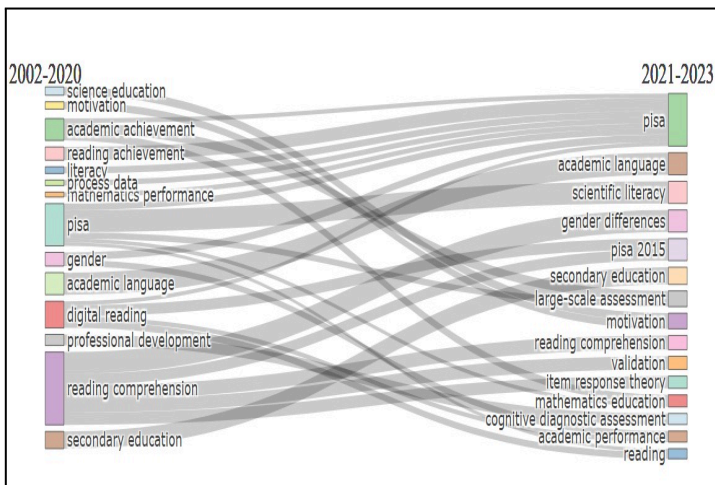**Fig. 4.** Thematic distribution

Fig. 5. Thematic evolution

The evolution of the theme as shown in Figure 5 indicates how frequently keywords are used by authors researching themes related to PISA data analysis. As a result, keywords such as "large-scale assessment", "mathematic education", 'STEM', and "academic achievement" "socioeconomic status" are the most used keywords by researchers on this theme. PISA is already known as a large-scale test, especially in science and mathematics [25], [26]. However, there are other elements such as gender, socioeconomic conditions, and conditions related to immigrants that have become the focus of studies related to PISA.
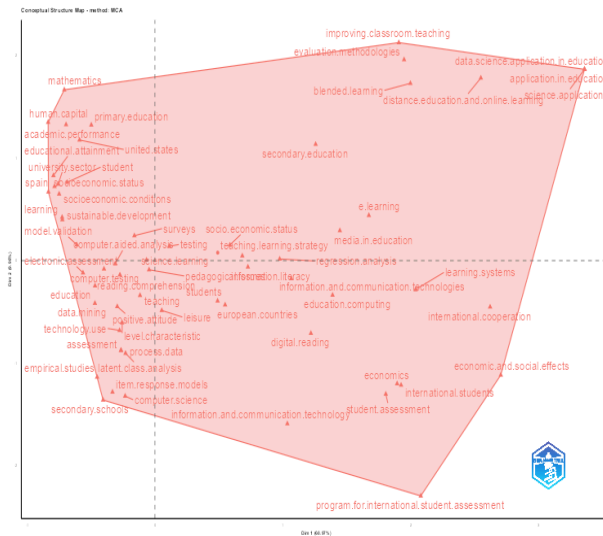

Fig. 6. Conceptual mapping framework

As presented in figure 6. through factor analysis and conceptual structure dynamics in relevant subjects, conceptual structure mapping enables researchers to uncover the conceptual structure of a field. In addition, conceptual structure mapping leads researchers to gather information on related issues and, as a result, select which keywords they should focus on [21]. The mapping results indicate that keywords such as "socioeconomic status", "academic performance", "educational attainment", and "evaluation methodologies" are the keywords in the conceptual framework loop. "socioeconomic status" is one of the indicators contained in the PISA test which serves to assess how much influence students' proficiency in science, mathematics, and reading has in terms of different social and economic backgrounds [26].

The theme of analyzing PISA results initiated a network of author collaborations between countries as shown in Figure 7. Dominated by authors from countries such as the USA, Germany, Canada, UK, Australia. In addition, there are many collaborations between authors from Indonesia and authors from Malaysia (n=3), Jordan, Peru, Romania, Sri Lanka (n=1), and Saudi Arabia (n=2).
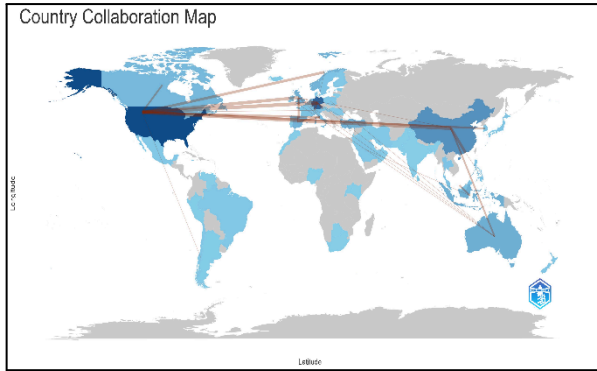
Fig. 7. Country collaboration map

Figure 7 implies that the examination of PISA data has resulted in a network of author collaborations between countries, this relationship illustrates collaborations. The participation of authors from other nations adds wide set of perspectives to the examination of PISA findings, resulting in a more thorough knowledge of educational outcomes. Overall, the collaborative character of this research effort demonstrates PISA's global significance as a tool for educational assessment, enabling information exchange and cross-border sharing of best practices.

4   Conclusion

To conclude, the analysis of PISA test data inspires researchers from time to time to conduct in-depth explorations. PISA results provide space for researchers to study aspects related to factors that affect students' achievements in the learning process in the fields of math, science and reading. From 2012 to 2020, the study found an increase in interest in PISA-related research, showing the importance of this worldwide examination in the academic community. This study covers a wide range of issues, from examining variation in PISA accomplishment scores to investigating the assessment's impact on many areas of education, intellect, and economic well-being. Furthermore, the analysis of research trends and collaborative networks provides valuable insights into the evolution of the academic discourse on PISA, indicating that it remains an important subject for investigation and discussion among educators, policymakers, and researchers worldwide aiming to improve student achievement and educational and educational outcomes.

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