BIBLIOMETRIC INSIGHTS INTO ASSESSMENT PRACTICES IN THE MERDEKA CURRICULUM: IDENTIFYING OPPORTUNITIES FOR NEW ASSESSMENT DEVELOPMENT

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Abstract: The Merdeka Curriculum in Indonesia represents a transformative educational reform emphasizing holistic student development. However, conventional assessment methods have proven inadequate in comprehensively evaluating these desired learning outcomes. This study employs bibliometric analysis to systematically examine the research landscape surrounding the multiple assessment in the context of Merdeka Curriculum. Through data mining from the Google Scholar database spanning 2018 to 2023, the findings reveal a significant gap between the substantial academic interest in multiple assessments, as evidenced by 2,727 citations from 660 publications, and the limited number of studies (92 articles with 187 citations) explicitly focused on developing new assessment instruments. Keyword analysis further highlighted the under representation of terms like "assessment instrument" and "development," signaling a need for intensified research efforts in this domain. The study's findings underscore the urgent necessity for developing innovative assessment tools that transcend traditional knowledge-based testing methods. These new assessments hold the potential to elevate the quality of education in Indonesia, better preparing students to navigate the complexities of the 21st century global landscape.

Keywords: Merdeka Curriculum, Multiple assessment, Development, Assessment instrument, Bibliometric Analysis.

INTRODUCTION

Along with the times, the challenges faced in the world of education are becoming increasingly complex. In recent years, awareness of the importance of science education and literacy in preparing students to face the challenges of the 21st century has increased (Pratiwi et al., 2019; Teräs, et al., 2020). The role of science literacy becomes very important in a society that is increasingly dominated by the swift flow of knowledge and information because it allows an individual to make the right decisions, actively participate in science and technology issues, and adapt to environmental changes (Cornell et al., 2013; Lederman et al., 2013; Yacoubian, 2018).

Recently, the definition of science literacy has expanded to include not only an understanding of scientific practices and procedures and familiarity with how science and scientists work but also the ability to weigh and evaluate scientific results and the capacity to participate in social discussions about the value of science (Lederman et al., 2014; Mailani et al., 2022). Science has been used beyond just knowing the basics of science (Hirsh-Pasek et al., 2015). According to the National Academies of Sciences, Engineering, and Medicine (2016), science literacy is the competence to use scientific knowledge and concepts to understand and assess in the context of everyday life.

As a result, some countries are actively trying to develop a curriculum and evaluation techniques that can encourage the use of science literacy among their students (Fitria & Indra, 2020; Fives et al., 2014). Establishing the Merdeka Curriculum in Indonesia is one of the efforts made by the government to increase the use of science literacy. The Merdeka Curriculum seeks to give schools the freedom to create teaching strategies that align with student needs and are more contextualized (Kemdikbud, 2020). The program aims to provide students with the information and skills needed to understand scientific concepts, exercise critical thinking, and make informed conclusions about scientific issues. The curriculum emphasizes students' engagement in real-world problems and motivates them to think critically, creatively, and constructively. However, data shows that the science literacy level of Indonesian students has developed into a

significant issue (Pastore & Andrade, 2019). Teachers are under tremendous pressure due to accountability trends for using assessment data in decision-making (Schildkamp & Lai, 2013; Stiggins, 2017). There is also a recognition of the importance of literacy in teacher assessment as an effective and efficient way (Popham, 2018) to meet accountability standards while promoting student classroom learning (DeLuca & Bellara, 2013; McMillan, 2017; Scheerens, 2016).

Whether in a classroom or an educational institution, assessment will influence how and what the teacher has taught the learners (Baird, 2013). That particular role makes assessment one of the bases for determining a curriculum in many educational systems worldwide, including an important aspect of teachers as professionals (Cobern et al., 2014; Cochran-Smith et al., 2013).

Changes in a learning concept will naturally also change the assessment system for the learning process itself (Annandale et al., 2021). Although teachers have understood the concepts in the Merdeka Curriculum, it turns out that there are still different understandings regarding the assessment system that teachers can carry out (Annandale et al., 2021). Teachers still tend to carry out assessments that are not varied (Kirkwood & Price, 2014). Hidayah stated that current assessment tools only evaluate part of students' learning and do not examine their total capacity to independently analyze, interpret, and draw conclusions about the curriculum (Hidayah et al., 2020).

This is the basis for this research because the development of a new assessment instrument is needed. The development of a new assessment concept in the Merdeka Curriculum has great significance for advancing education in Indonesia. By integrating science literacy into the evaluation process, the new assessment instruments aim to promote a deeper understanding of science concepts and improve students' ability to think critically in the context of science. To measure effectiveness and progress in science literacy, an assessment instrument is needed to measure students' abilities holistically (Lederman et al., 2014). This underlies the importance of multiple assessment instruments, where diverse assessment methods are used to describe students' abilities more comprehensively and accurately. In this article, we will conduct a bibliometric analysis to explore research trends and gaps related to developing multiple

assessment instruments in the context of science literacy, especially in implementing the Merdeka Curriculum in Indonesia.

METHOD

Mapping research trends is done through a quantitative method in the form of bibliometric analysis taken from a collection of literature article data groups (Broadus, 1987; Donthu et al., 2021; Pritchard, 1969) that have been published in journals and indexed by Google Scholar from 2018 to 2023. This method allows researchers to find the latest updates in a particular field and explain new areas in the field (Donthu et al., 2021).

Google Scholar was used in the data mining with considerations including that it is freely accessible, indexes a large number of journals from various disciplines, provides citation data, which is an important component for bibliometric analysis, and has powerful search features that enable targeted and extensive data collection (Donthu et al., 2021; Subagja et al., 2022).

The stages in conducting this bibliometric analysis were carried out using software and applications, namely Publish or Perish 8 (PoP8) and VOSViewer (Chairani, 2023). PoP8 was used because it can collect relevant bibliographic data quickly. VOSViewer is used because it can create a research network through citations, bibliographic merging, co-citations, or co-authorship relationships. For example, this network can also contain journals, researchers, or individual articles. To create and display co-occurrence networks of important phrases extracted from a corpus of scientific literature, VOSViewer also provides text mining features.

This research uses several stages, as listed in Figure 1.

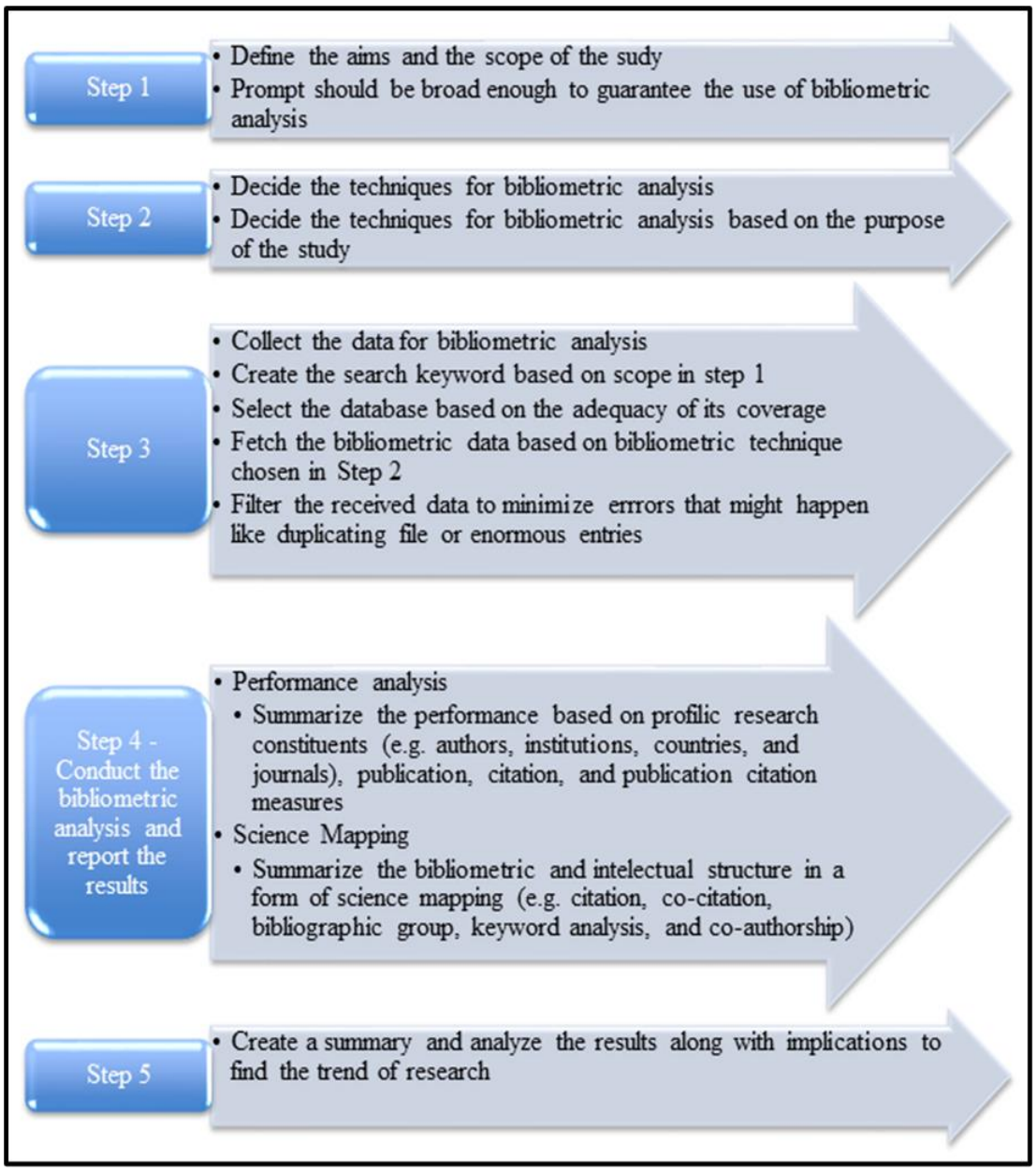

Figure 1. Bibliometric Analysis Procedure (Donthu et al., 2021; Donthu et al., 2021; Hadiastriani, 2022)

PoP8 and VOSViewer applications are used from the third to the last stage. Sample data collection for this study was carried out using the PoP8 application to search scientific publication data from the Google Scholar database with the keyword 'Multiple Assessment in Merdeka Curriculum'. The search was limited to 2018 to 2023, journal articles, and a maximum of 1.000 search results. Data collection was conducted on July 6, 2023. Scientific works on science learning materials that have been published in scientific journals, proceedings, books, other types of publications became the research population. Once obtained, the bibliographic data was then stored in the Research Information System (RIS) format.

VOSViewer software was then used to analyze, visualize, and explore patterns in the data to create and view bibliometric networks from the dataset. The analysis includes performance analysis and knowledge mapping. Performance analysis will look at the analysis of co-authorship in a journal that can be seen from the location of the points that are getting closer between authors. Knowledge mapping will look at citation analysis, co-citation analysis, bibliographic merging, and shared word analysis, which will then be visualized in the form of a map (Donthu et al., 2021).

RESULTS AND DISCUSSION

Research Trends in Assessment within the Merdeka Curriculum

The use of bibliometrics can be said to be new in the world of research, but in the last ten years, publications using bibliometrics have grown to 1021 articles and have become a new, more promising literature review method that replaces the classic review method (Tunger & Eulerich, 2018). This can be seen from the results of this study, where 660 research publication from the Google Scholar database were conducted from 2018 to 2023. After the search results were refined, the articles collected from the initial search using PoP8 provided different metric data. After filtering, 92 articles were obtained based on the standards used for analysis. The keyword "Multiple Assessment in Merdeka Curriculum" retrieved the data set from the Google Scholar database in the 2018-2023 range.

Research on the multiple assessment in Merdeka Curriculum can be said to be developing, this can be seen from the initial data which produced 2.727 citations from 660 publications, with an average of 681,75 citations per year and 1462,89 citations per author. Then, after the selection and refinement stages, 92 articles with 187 citations were obtained, with an average of 46,75 citations per year and 47,70 citations per author.

Figure 2 shows development trends and publication excerpts on the multiple assessment in Merdeka Curriculum topic in the 2018-2022 range. There are 92 documents published in scientific journals and procedures selected for bibliometric analysis. Based on the research results, the number of publications related to the topic of multiple assessment in Merdeka Curriculum has increased significantly in the last four years. The number of scientific publications has grown since 2018-2021, from 0 documents in 2018 to 92 papers in 2023. The results of this study show that multiple assessment is an important research topic in the new concept of curriculum in Indonesia, Merdeka Curriculum. The rapid development of technology has made it easier to obtain information and knowledge transfers (Xu et al., 2021).

Based on Figure 2, the number of citations consistently increased significantly in year 2021. The findings of this investigation underscore the substantial influence and widespread scholarly attention garnered by research on multiple assessment approaches within the Merdeka Curriculum framework. The citation patterns observed offer insights into the synergistic relationship between prior and contemporary studies, illuminating the pivotal topics that merit further exploration. Notably, the practice of citation serves five critical purposes: (1) establishing a comprehensive research context that enables readers to evaluate the validity of the author's conclusions, (2) providing a foundational background for the study, (3) enhancing the credibility of the research endeavor, (4) presenting alternative perspectives, data, and conclusions for comparative analysis, and (5) acknowledging the relevant preceding works that have informed the current investigation (Brun, 2019).

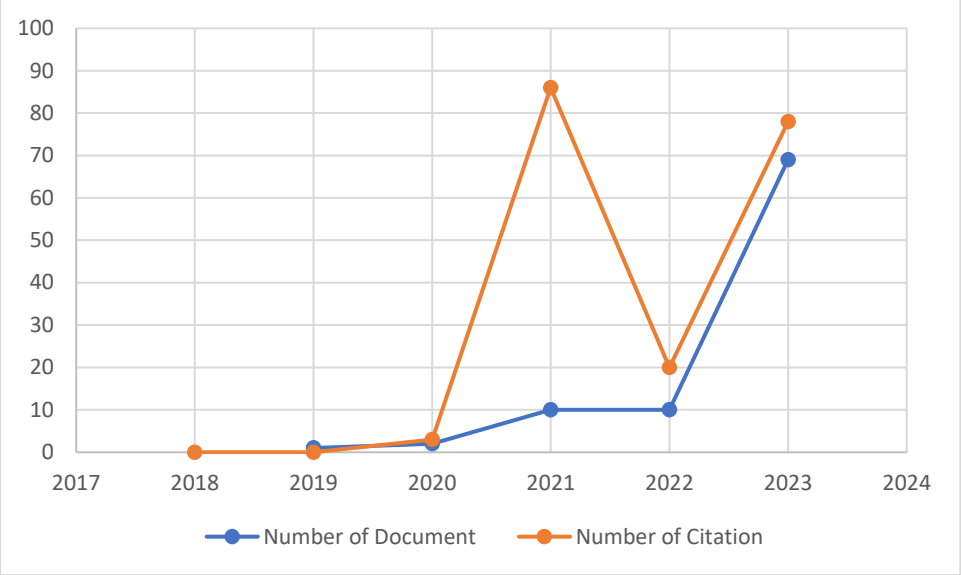

Figure 2. Trends in multiple assessment in Merdeka Curriculum publications and citations over the past five years

Identifying Gaps and Opportunities for Development

A comparative analysis of assessment practices between the 2013 Curriculum and the Merdeka Curriculum reveals several salient distinctions (Aditya, 2023). Whereas the former primarily relied on traditional assessment forms such as multiple-choice and essay questions, the latter introduces a broader array of assessment modalities, including presentations, projects, and oral assessments, catering to diverse learning styles and competencies (Iskak, Thamrin, & Cahyono, 2023). Furthermore, the Merdeka Curriculum marks a pronounced shift from the 2013 Curriculum's emphasis on summative assessment for grading purposes to a more formative approach, designed to support students throughout the learning process by utilizing assessment results to inform subsequent learning activities and make necessary adjustments (Ramadhan, 2023).

The assessment framework within the Merdeka Curriculum is distinguished by its multidimensional and student-centric approach (Lai, 2024). It embraces a comprehensive assessment methodology that transcends mere academic evaluation, encompassing skills, character development, and the

cultivation of critical thinking faculties (Dunne, 2015). Formative assessment practices are emphasized, providing ongoing feedback to facilitate continuous learning and growth rather than solely serving as a basis for grading (Shepard, Penuel, & Pellegrino, 2018). Teachers are accorded the autonomy to tailor assessment methods to suit the unique learning contexts and needs of their students, fostering a diverse array of assessment modalities such as assignments, projects, presentations, discussions, and portfolios (Kemendikbud, 2020).

Another notable divergence lies in the autonomy accorded to teachers in designing assessment methods tailored to the learning context and the specific needs of their students, enabling a more personalized assessment approach compared to the relatively standardized methods prevalent in the 2013 Curriculum (Farwati et al., 2022). Assessments within the Merdeka Curriculum are specifically geared towards nurturing students' competencies in alignment with their talents and interests, contrasting with the more uniform assessment criteria of the preceding curriculum.

This research is conducted as a preliminary to collect research data on a topic to assess field conditions and analyze the need for development (Ellegaard & Wallin, 2015; Linnenluecke et al., 2020). After obtaining data relevant to the development of the assessment instrument to be carried out, the data is then analyzed using the VOSViewer application to see intellectual interactions and structural relationships among research constituents, which, when combined in the form of a network, can present the bibliometric structure and intellectual structure of a research field (Baker, 2020). Knowledge mapping will examine the relationship between research constituents (Baker et al., 2020). The results of the knowledge mapping analysis can be seen in Figure 3.

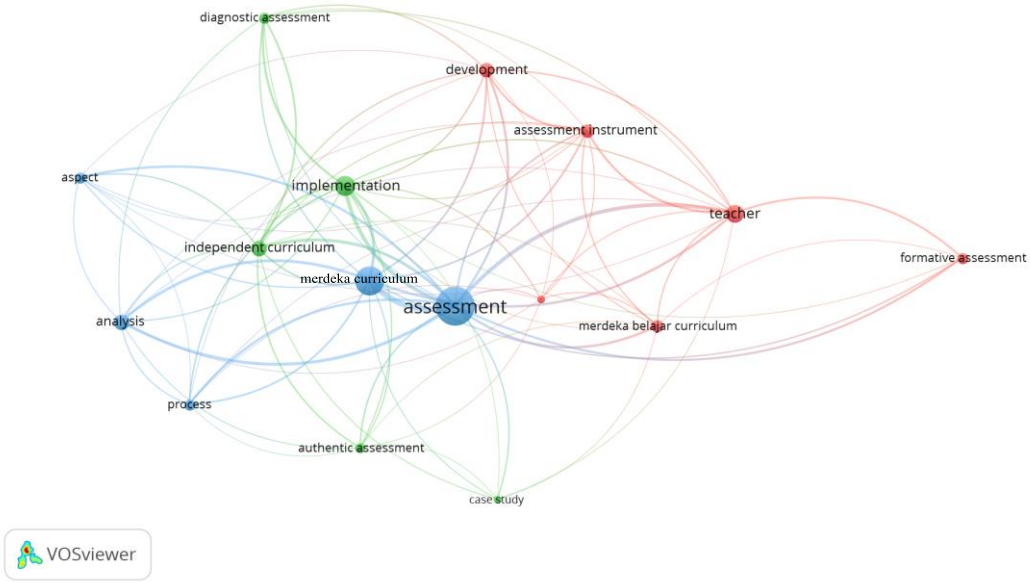

Figure 3. Topics analysis using bibliometric methods. On the map, three clusters have been identified. Assessment instrument, development, formative assessment, merdeka belajar, Merdeka belajar curriculum, and teacher are grouped in the red cluster. The blue cluster represents the assessment, merdeka curriculum, aspect, analysis, and process. Authentic assessment, case study, diagnostic assessment, implementation, and independent curriculum were included in the green cluster.

The relationship between the two circles is represented by the distance between them. The network map above was obtained from extracting titles, keywords, and abstracts from articles using the complete count method, which resulted in 589 relevant keywords. The minimum number of occurrences of keywords was then determined 5 times, and 24 keywords that often appear were obtained. Each of these keywords is then calculated for its relevance to the topic of development to be carried out. There were 16 keywords with more than 60% relevance, which were then grouped into 3 clusters.

Keywords in the same cluster show the relationship between keywords used in different publications. From the resulting map, it can be seen that research on

'Multiple Assessment in Merdeka Curriculum' is closely related to the keywords of assessment instrument, development, formative assessment, merdeka belajar, merdeka belajar curriculum, and teacher contained in the largest cluster in red. In addition, the development to be carried out is also closely related to the keywords of assessment, merdeka curriculum, aspect, analysis, and process incorporated in the blue cluster. The development to be carried out is also related to authentic assessment, case study, diagnostic assessment, implementation, and independent curriculum which is contained in the smallest cluster in green. The frequency of occurrence of these keywords in publications can be seen in Table 4 below.

Table 4. Keywords That Describe Each Cluster

No.	Cluster	Element	Link	Strength	Occurance
1	Red	assessment instrument,	11	41	12
		development,	11	43	14
		formative assessment,	5	22	9
		merdeka belajar,	9	15	5
		merdeka belajar curriculum,	10	26	11
		teacher.	13	75	21
2	Blue	assessment,	15	225	99
		merdeka curriculum,	13	152	54
		aspect,	9	25	8
		analysis,	11	53	17
		process	9	31	9
3	Green	authentic assessment,	9	22	7
		case study,	7	12	5
		diagnostic assessment,	8	31	8
		implementation	15	92	27
		Independent curriculum	11	59	16

The visualization of the text search analysis based on the research being conducted is shown in Figure. 4.

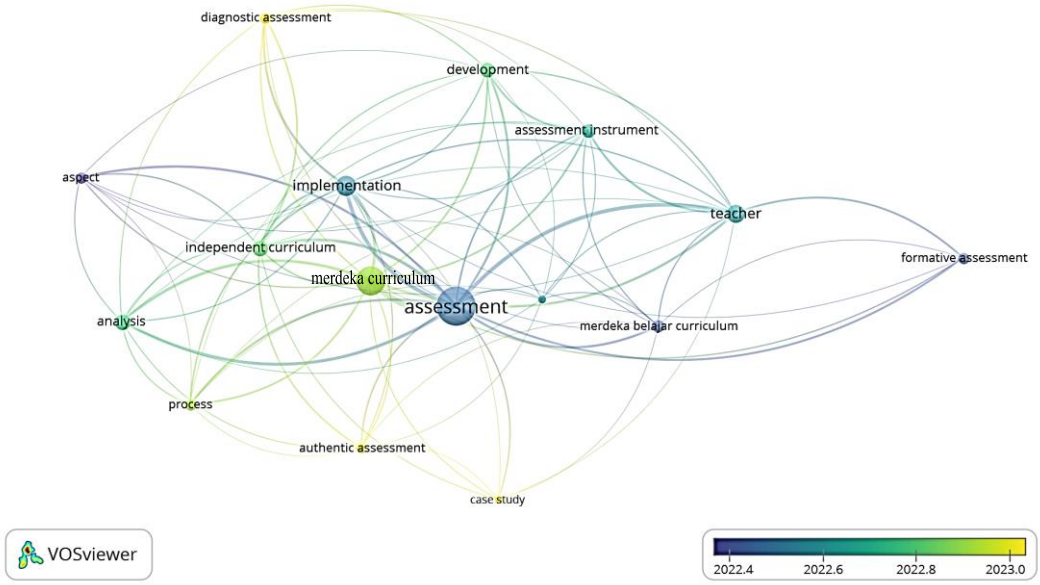

Figure 4. A network map of the trend topics based on the keywords that were used between 2018 to 2023. The indicator changes color from purple to yellow to signify which publications are currently available. The size of the circles shows the frequency of keywords' appearance.

The cluster's color indicates how much discussion occurs on that subject. It is clear that the yellow cluster, which includes diagnostic assessment and merdeka curriculum, is a topic that is being discussed frequently at the moment. The analysis of text mining by research volume is represented in Figure 5.

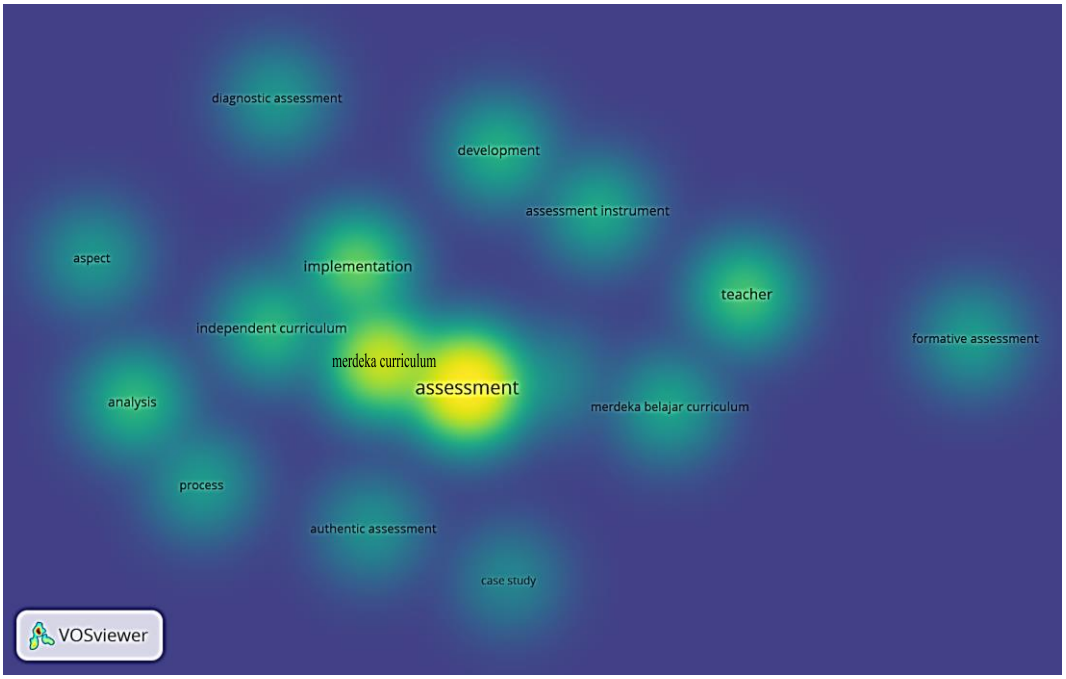

Figure 5. Density visualization clusters of article cooperation based on topics finding (minimum 5 documents) in the research field of "Development of Multiple Assessments Based on Science Literacy and Critical Thinking"

The more evenly distributed a keyword is, the more frequently it is used in the research subject. On the other hand, the more uneven the distribution of keywords, the less frequent the research topic is. This depiction is very important to identify research that has not been done so that a research update can be carried out. Figure 5 shows that the keywords assessment and merdeka curriculum have the highest density compared to other keywords. Data processing on VOSViewer from 92 media research publications published in Google Scholar indexed articles in 2018-2023 has analyzed those 193 authors contributed to developing publications on "Multiple Assessment in Merdeka Curriculum".

The analysis results show that the number of authors published at least 1 article is 192. Of this total number of authors, 9 have published at least 2 articles and analyzed their writing relationships with other authors. The analysis results can be seen in Table 5, which is visualized in Figure 6.

Table 5. Number Of Co-Authorship Networks for Research on Multiple Assessments In Merdeka Curriculum

Author	Number of Documents	Total Link Strength
astuti,sh	2	6
izanah,n	2	6
lestari,id	2	6
usman,u	2	6
jauhariyah,mnr	2	4
sunarti,t	2	4
wasis,w	2	4
mahmudah,u	2	0
trinova,z	2	0

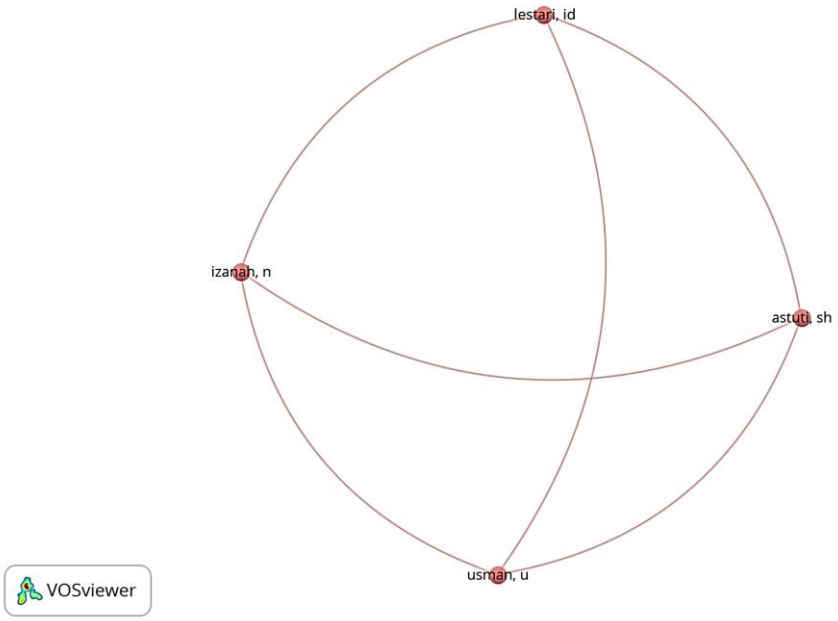

Figure 6. The summary of authors' citations. Three different color clusters were displayed on the screen. The author Mahanal, Susilo, and Zubaidah in the red cluster is the most cited;

From the figure above, it can be seen that there is only one clusters show authorship relationships. It can be seen that Izanah, Lestari, Astuti and Usman are the authors who have the most relationships with other authors.

The Need for New Assessment Development

Bibliometric analysis was used in this study to detect and locate research trends and supporting literature that contribute to the understanding that current assessment instruments may not have effectively measured students' science literacy and critical thinking holistically (Lai & Schildkamp, 2013). The bibliometric data collected showed that a number of studies on this topic have been conducted, but there is still room for innovation and improvement. The results of the bibliometric analysis in this study indicate that there is a significant need for the development of new assessment instruments in the context of science

literacy and critical thinking, especially in the implementation of the Merdeka Curriculum in Indonesia (Hadiastriani, 2022).

Based on the bibliometric data generated in this study, some important information supports the need to develop new assessment instruments. Of 660 publications identified with the keyword "Multiple Assessments Based in Merdeka Curriculum", 2.727 citations were identified. This indicates significant academic interest in this topic. However, after the data refinement process, 92 articles with 187 citations were obtained were selected, indicating that only a limited number of studies were truly relevant and focused on the topic of these new assessment instruments. In addition, keyword analysis showed that words such as "assessment," and "merdeka curriculum" had the highest density, indicating a major focus in previous research. However, words such as "assessment instrument" or "development" did not appear as the most used keywords, indicating a gap in previous research and the need for further research in this context.

The Merdeka Curriculum seeks to provide students with the information and skills needed to understand scientific concepts, develop critical thinking, and make informed conclusions about scientific issues. A significant shift in this curriculum is the focus on engaging students with real-world issues, motivating them to think critically, creatively, and constructively (Kemdikbud, 2020). This approach is believed to result in a deeper understanding of scientific concepts and improve students' ability to think critically in a scientific context.

The development of a new assessment approach in the Merdeka Curriculum was driven by several key imperatives. Firstly, there was a recognized need to support the comprehensive development of students beyond just academics, encompassing skills, character, and critical thinking abilities which traditional assessments could not adequately evaluate (Retnawati et al., 2016). Secondly, a shift towards formative assessment methods that provide feedback for continuous improvement was necessitated, moving away from summative assessments primarily serving grading purposes (Hesse-Gaweda, 2018; Crisp, 2019).

Moreover, the curriculum's emphasis on flexibility, personalization, and encouraging student independence called for assessments tailored to unique learning contexts, catering to diverse student needs, interests, learning styles while actively involving them in self-assessment and reflection (Azrai et al., 2020;

Hakim, 2022). Character development, a crucial Merdeka tenet, required assessments reflecting growth in ethics, responsibility, and social norms application (Widodo, 2020). Additionally, the new approach aimed to align with contemporary educational goals such as real-world preparedness and lifelong learning (Kemdikbud, 2020).

Bibliometric analysis further underscored this necessity, indicating significant academic interest but limited relevant focused research on developing holistic assessment instruments for science literacy and critical thinking within this curricular context (Hadiastriani, 2022). Of 660 publications on "Multiple Assessments Based in Merdeka Curriculum", only 92 articles with 187 citations directly addressed assessment instrument development. Keyword analysis revealed gaps, with terms like "assessment instrument" and "development" lacking prominence.

New assessment instruments need to be developed to more accurately and comprehensively assess students' abilities by integrating science literacy into the evaluation process so as to encourage a deeper understanding of science concepts and improve students' ability to think critically. The need for this new development is based on the new concept in the Indonesian curriculum, as conventional assessment instruments cannot comprehensively evaluate students' understanding and critical thinking skills in the context of this new curriculum. This new assessment instrument, which is based on science literacy and critical thinking, is expected to improve the quality of Indonesian education.

The Merdeka Curriculum's aim to engage students with real-world issues, motivating critical, creative, and constructive thinking for deeper scientific understanding, necessitated new assessments integrating science literacy to comprehensively evaluate these competencies (Kholisho et al., 2023; Pratiwi et al., 2022). Conventional instruments could not adequately assess the envisioned learning outcomes, prompting the need for innovative, holistic assessment development aligned with this transformative curricular vision.

CONCLUSION

The bibliometric analysis presented in this study illuminates the pressing need for developing innovative, holistic assessment instruments aligned with the transformative vision of the Merdeka Curriculum in Indonesia. By integrating dimensions of science literacy and critical thinking into the evaluation process, these new assessments aim to foster a deeper conceptual understanding among students and cultivate their ability to critically analyze and draw informed conclusions about scientific issues.

The findings underscore the urgency of this endeavor, revealing limited focused research on assessment instrument development despite significant academic interest in multiple assessments within the Merdeka Curriculum framework. Overcoming the limitations of conventional assessments that predominantly evaluate knowledge retention, the proposed multi-dimensional assessment approach holds promise for comprehensively assessing the envisioned learning outcomes and competencies emphasized by this progressive curricular reform.

As education systems worldwide strive to equip learners with the requisite skills for navigating the complexities of the 21st century, the development of assessment tools that accurately capture and nurture science literacy and critical thinking abilities emerges as an imperative. This research provides a foundation for further scholarly inquiry and innovative assessment design, ultimately contributing to the advancement of educational practices that empower students to become engaged, scientifically literate, and critically conscious global citizens.

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