

Development of Affective Attitude Instruments: Bibliometrics on the Scopus Database 2014 – 2023

Suyono^{1,*}, Nuryani Dwi Astuti¹, Heri Retnawati², Syarief Fajaruddin¹, Ari Setiawan¹, Mohd Kasturi Nor Abd Aziz³, & Satrian Suhendar¹

¹Postgraduate Education, University Sarjanawiyata Tamansiswa Yogyakarta, Indonesia

²Graduate School, Universitas Negeri Yogyakarta, Indonesia

³Faculty Business & Communication, University of Malaysia Perlis, Malaysia

*Corresponding email: suyono@ustjogja.ac.id

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Abstract: This study aims to map publication trends, knowledge structures, and research gaps in the development of affective attitude instruments indexed in Scopus during 2014–2023. This study uses bibliometric analysis. A literature search was conducted in the Scopus database using the keywords “Development of Attitude Instruments” OR “Attitude Instruments” OR “Affective Attitudes” OR “Students’ Attitudes Towards Learning”. From 1,033 initial documents, after a screening process based on inclusion criteria (period 2014–2023, open access, English language, journal/conference paper/review article type) and manual review, 689 documents were obtained and analyzed using Biblioshiny (R) for thematic mapping and VOSviewer for other analyses. The results show three main findings. First, the COVID-19 pandemic became a turning point, shifting the focus from classical attitude measurement to adaptive instruments for online learning, with a surge in publications in 2021–2022 in response to the need to measure students’ anxiety, adaptation, and mental health. Second, there is a systematic geographical imbalance in which developed countries (the US, the UK, and Canada) dominate as centers of psychometric theory, while Indonesia presents strategic opportunities; demographic bias is also evident in the dominance of binary gender variables, which reduce pedagogical complexity. Third, the thematic map reveals the most pressing missing link: the disconnection between the validity and reliability themes and the e-learning system, indicating that the validation standards for attitude instruments remain oriented towards face-to-face learning and have not adapted to the era of Society 5.0. This study concludes that the development of affective attitude instruments has transformed from classical psychometrics to the digital era and commercialization. The most strategic future research agenda is to develop an attitude instrument validation framework that integrates with digital learning platforms, bridges the gap between student intentions and behavior, and simultaneously supports character education and digital transformation.

Keywords: bibliometric analysis, attitudinal instrument, scopus-indexed journals (2014–2023) R and VOSViewer software.

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■ INTRODUCTION

Education plays a fundamental role in achieving various development goals, across social, political, and economic dimensions. Quality education not only catalyzes improvements in individual quality of life and economic growth but also serves as a foundation for realizing equality and social justice. In the

intensively connected and rapidly changing digital era (Society 5.0), the urgency of character education is increasingly prominent. Character education plays a central role in shaping children’s attitudes and behavior, serving as a role model, contributing to individual career success, and equipping them with moral knowledge and positive attitudes, which are vital aspects of social

life (Rasmuin & Widiani, 2021; Karimah et al., 2023).

Neglecting character formation in the educational context can trigger various social problems stemming from student behavior. Juvenile delinquency, such as brawls, bullying, high rates of absenteeism, lack of respect, and serious problems like drug abuse, continues to be reported (Ferrara, 2019; Goss & Holt, 2014). In fact, negative behaviors in the school environment, such as bullying peers, difficulty controlling emotions, provocative behavior, rude language, and violating school rules, are still common (Agboola & Tsai, 2012). All of these challenges demonstrate that efforts to build character and instill positive values from an early age face complex obstacles.

To ensure the success of character education, reliable attitude measurement instruments (affective instruments) are needed. Ideally, these instruments should provide results that closely reflect the actual conditions of the subjects being measured, and a thorough analysis of the factors influencing their performance in school is crucial (Kholis et al., 2020). Affective instruments play a crucial role in accelerating the achievement of learning objectives, especially when used in supportive learning models (Lusiana & Lestari, 2013). However, field practice demonstrates a serious crisis in the development and implementation of these instruments.

Preliminary studies and various empirical reports indicate a significant gap between curriculum demands and realities on the ground. Research at an elementary school in Bandung (June 2022) revealed that although teachers had a good conceptual understanding of affective assessment, assessment documentation was still largely conducted verbally and on a situational basis, without consistent use of formal instruments such as rubrics or observation sheets. The high teacher-student ratio and workload were major obstacles to implementing measurable

assessments. A similar finding was found at SMKN 6 Bandung, where knowledge assessments still dominated over attitude and skill assessments, indicating that attitude assessments had not been implemented in accordance with the requirements of authentic assessment (Nurrahman et al., 2022).

At the secondary level, research identified systemic non-compliance: teachers at SMA Negeri 1 Teluk Gelam neglected required 2013 Curriculum assessment procedures, providing final assessments without reviewing the eight-instrument process (Mawardi, 2019). At the tertiary level, the specific reliability challenge is well-documented: development of affective instruments for physics laboratory assistants achieved item reliability of 0.93 (good quality) but person reliability of only 0.39 (weak consistency in subject responses) (Hadiati & Pramuda, 2020). This discrepancy, strong item quality paired with weak respondent consistency, demonstrates that without standardized, validated instruments, character assessments risk remaining superficial rather than reflecting authentic student conditions.

Ma & Hui (2023) analyzed 173 SCOPUS articles on attitudes in STEM education (2008-2022), revealing “an upward trend in research publications” with notable increases in 2013, 2018, and 2018-2022. Yan et al. (2021) employed bibliometric and science mapping analyses on emotional intelligence in education, finding that “publication counts surged between 2012 and 2021.” More comprehensively, Ho et al. (2021) systematically reviewed 175 studies on affective computing in education (2010-2023), documenting “an increasing trend in publications within this domain,” with learning domains “mainly associated with STEM courses.” Additionally, Ramos-Quispe et al. (2022) analyzed 553 documents on emotional intelligence in education, revealing “a consistent upward trend in publications from 2004 to 2024.”

These studies collectively demonstrate that bibliometric analysis is the predominant methodology for mapping affective research trends, with consistent evidence of publication growth across multiple domains.

The 2024 bibliometric analysis of healthcare students' empathy, using Scopus and VOSviewer, reported a rapid rise in publications from 2014 to 2023 and identified the United States as the leading contributor. Recent Scopus- and VOSviewer-based bibliometric studies suggest that bibliometric mapping is useful for tracking publication growth, collaboration patterns, and thematic clusters, as well as for identifying gaps in emerging education-related topics (Ejaz et al., 2022).

Based on the background of the crisis in the implementation of affective instruments in the field and gaps in current research trends (state-of-the-art), the problem formulation of this study is: 1) What are the publication trends and developments in research on the development of affective attitude instruments indexed by Scopus during the period 2014–2023?; 2) How can we map the knowledge structure of affective instrument development research, including mapping by keywords, most prolific authors, and contributing countries and institutions?; 3) How can we visualize bibliometric developments on this topic, including identifying research gaps that can be recommended for future follow-up studies?; 4) How has the evolution of psychometric theory been reflected in the shifts and changes of keyword patterns in the field of affective attitude instrument development over the past decade (2014–2023)?

■ **METHOD**

Research Design

This study employed a bibliometric analysis approach to systematically map the intellectual, conceptual, and social structure of the literature on affective attitude instrument development. Bibliometric analysis is defined as the application

of mathematical and statistical methods to written communication, enabling quantitative evaluations of publication patterns, citation networks, and thematic evolution within a scientific field (Agboola & Tsai, 2012; Nyström, 2010; Pehar, 2010; Purnomo, 2019). This design was chosen because it is particularly suitable for identifying research trends, influential works, key topics, and emerging gaps in a given body of literature (Agirkan & Ergene, 2020; Carlos et al., 2022; Maghfiroh & Soebagyo, 2022). In this study, bibliometric analysis was utilized to provide a comprehensive overview of the development of affective attitude instruments over the past decade, based on publications indexed in the Scopus database from 2014 to 2023. The resulting analysis offers a macroscopic view of the field, including author productivity, collaboration networks, keyword co-occurrence, and thematic mapping, which collectively inform future research directions in educational measurement.

Search Strategy

The literature search was performed on October 7, 2023, using the Scopus database. Scopus was selected for its reputation as the largest abstract and citation database, offering extensive, high-quality coverage of peer-reviewed literature across various disciplines. The search strategy employed Boolean operators to combine key concepts relevant to the research focus. The following keyword string was applied to the title, abstract, and keyword fields: ("Development of Attitude Instruments" OR "Attitude Instruments" OR "Affective Attitudes" OR "Students' Attitudes Towards Learning").

This keyword combination was formulated to balance sensitivity (retrieving a broad range of relevant documents) and precision (excluding irrelevant materials). The rationale for each keyword is as follows: (1) "Development of Attitude Instruments" and "Attitude Instruments" were used to capture documents detailing the

construction, validation, and psychometric properties of attitude scales; (2) “Affective Attitudes” was included to specifically target studies on the affective domain in education, distinguishing it from cognitive and psychomotor aspects; and (3) “Students’ Attitudes Towards Learning” was added to narrow the scope to educational contexts, ensuring that the retrieved literature is directly relevant to student populations and learning environments (Krathwohl, 1964; Mendo-Lázaro et al., 2017). The search was initially limited to the 2014–2023 period, open-access publications, and English-language documents using Scopus filters before the manual screening process began. The complete step-by-step document selection process is illustrated in the PRISMA 2020 flow diagram (Figure 1), which details the number of records identified, screened, excluded, and included at each stage (Mehra & Omidian, 2012).

Inclusion and Exclusion Criteria

To ensure the relevance and quality of the selected documents, a set of inclusion and

exclusion criteria was established prior to the screening process. These criteria are presented systematically in Table 1. The publication period was restricted to 2014–2023 to capture research trends over the most recent ten-year span. Only open-access documents were included to ensure accessibility and transparency, while English-language publications were prioritized as the international standard for scientific communication. Regarding document type, only journal articles, conference papers, and reviews were included, as these represent primary research and synthesized literature; other formats such as books, book chapters, editorials, notes, and retracted documents were excluded. The topic suitability criterion required that documents explicitly address the development of attitude instruments, affective measurement, or students’ attitudes toward learning; documents that merely mentioned “attitude” in passing were excluded. Finally, only documents with complete metadata (e.g., author, affiliation, abstract, keywords, year) were retained to facilitate accurate bibliometric analysis.

Table 1. Inclusion and exclusion criteria

No	Criteria	Inclusion	Exclusion
1	Publication Period	2014 – 2023	Before 2014
2	Access Type	Open Access	(Subscription / Closed Access)
3	Language	English	Besides English
4	Document Type	Journal articles, Conference papers, Reviews	Books, book chapters, editorials, notes, letters, retracted documents
5	Topic Suitability	Discussing the development of attitude instruments, affective instruments, or students' attitudes towards learning	Does not discuss attitude instruments at all; only mentions the word "attitude" in passing.
6	Metadata Completeness	Complete data available (author, affiliation, abstract, keywords, year)	Data is incomplete or cannot be exported

Data Analysis

The data analysis was conducted in three stages following the PRISMA 2020 protocol: (1) Identification, (2) Screening, and (3) Eligibility and Inclusion.

1. Identification Stage: The initial search in the Scopus database using the predefined keywords yielded 1,033 documents. These records were exported to Mendeley reference management software to identify and remove

duplicates. No duplicates were found, as the search was performed directly from Scopus with initial filters applied.

2. Screening Stage: The 1,033 documents were then screened based on the inclusion criteria (publication period, open access, and language) using Scopus's built-in filtering features. This process excluded 350 documents that did not meet these criteria, leaving 683 to proceed to the next stage.
3. Eligibility and Inclusion Stage: The remaining 683 documents were manually assessed for eligibility through a thorough review of abstracts and keywords to confirm topical relevance to the development of attitude instruments. At this stage, no additional documents were excluded, as the prior automated screening was sufficiently rigorous. However, 5 documents were later excluded during the analysis phase due to incomplete metadata (missing author keywords). Consequently, the final dataset comprised 678 documents for bibliometric analysis (Link Database). The complete selection process is illustrated in the PRISMA 2020 Flow Diagram (Figure 1).

For the bibliometric analysis, the metadata of the final 678 documents were exported in CSV, RIS, and BibTeX formats. The analysis was performed using two complementary software tools: (1) Biblioshiny (the web-based interface of the R-package *bibliometrix*), which was used to analyze intellectual and conceptual structures, including most relevant authors, affiliations, thematic maps, thematic evolution, annual topic trends, and global collaboration networks; and (2) VOSviewer, which was employed to map relationships between keywords through co-occurrence analysis using the full counting method. A minimum threshold of 10 occurrences per keyword was set to ensure the inclusion of sufficiently frequent terms. VOSviewer generated network, overlay, and density visualizations to highlight current trends, research clusters, and emerging topics in affective attitude instrument development. (Rasmuin, 2022). This combined analytical approach enabled a comprehensive and multi-dimensional exploration of the research landscape.

PRISMA 2020 Flowchart: The complete document selection process is presented in Figure 1, which follows the PRISMA 2020 standard template (available for download from prisma-statement.org).

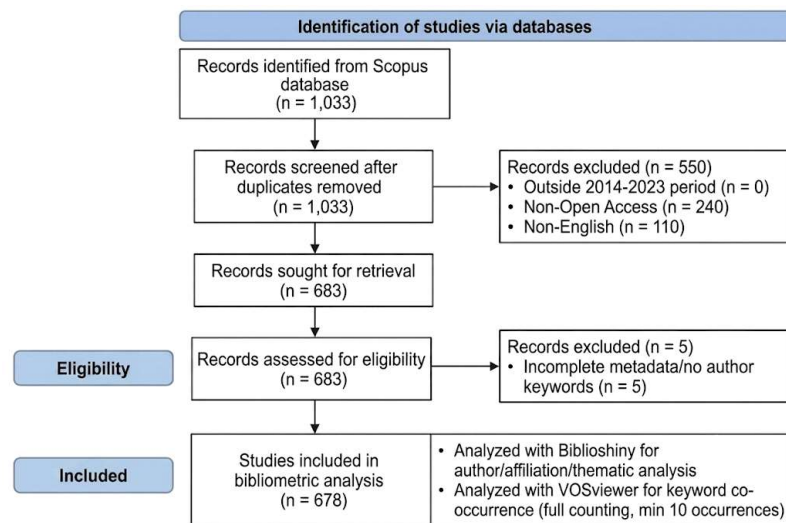


Figure 1. PRISMA 2020 flow diagram

■ RESULT AND DISCUSSION

The data obtained in this research will be described at the beginning, regarding the output or plot produced by Scopus. These outputs include information on documents by year, subject area, affiliation, country or region, and year-by-source. Meanwhile, the bibliometric analysis results include key information such as the most frequent keywords, a treemap, a word cloud, the most relevant authors and affiliations, and the most frequently cited countries. In

addition, bibliometric analysis includes document-related data, such as citations per year, thematic maps, thematic evolution of author keywords, topic dendrograms for author collaboration networks, and global collaboration maps. Next, the discussion of the results from the VOSViewer tool includes visualizations of the network, overlay, item density, and cluster density.

The first graph produced by Scopus displays document data by year (see Figure 2). This research uses the period from 2014 to 2023.

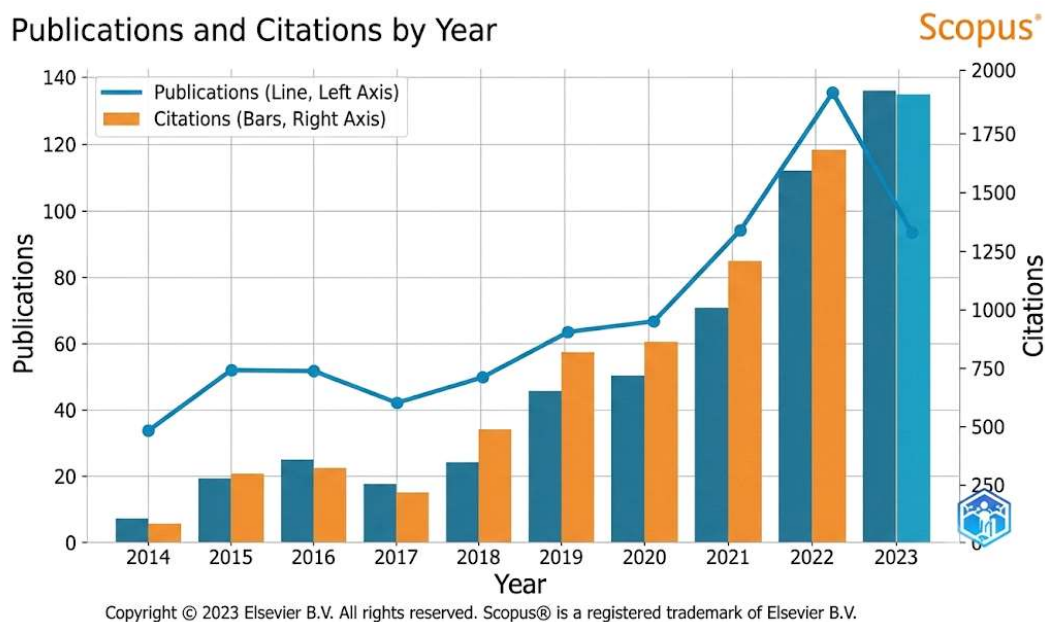


Figure 2. Documents publication and citations by year

Based on the graph, the number of documents increased from 2014 to 2023, but it decreased in 2017 and fell again in 2023. However, it should be noted that the 2023 data was retrieved on October 7, 2023, so it does not yet represent a full year. Therefore, the observed decline in 2023 should not be interpreted as a real downward trend. The number of documents then increased significantly in 2021 and 2022. 2021 and 2022 were pandemic years, so many researchers were developing attitude instruments. In 2022, it peaked with almost 140 documents. There will be a decrease from 2022 to 2023. It is hoped that it will increase again after 2023. Overall, there was a significant increase in the number of documents from 2018 to 2022.

Publications on attitude instrument development are highly unequal globally, with the United States dominating absolutely (>80 papers, double the number of second-placed publications). The US's dominance is due to: (1) a long tradition in psychometrics (Thurstone, Likert, Messick) and infrastructure such as ETS; (2) data-driven education policies (No Child Left Behind, ESSA) that encourage attitude assessment; and (3) the advantage of English as the language of scientific publication. Indonesia ranks seventh (>20 papers). Its productivity remains low due to: (1) language barriers and cross-cultural adaptation processes; (2) the 2013 Curriculum policy stimulated interest, but the results are still mostly published in national

journals; (3) opportunities for international collaboration, cross-cultural instrument development, and increased funding. China (fourth place, >40 papers) is estimated to have higher productivity than the data indicate because the open-access criteria in this search exclude many Chinese subscription journals. The Netherlands (with a small population) is able to match Malaysia due to its strong tradition of English-language research, the presence of major publishers (Elsevier, Springer), and a leading psychometrics center. Implications: Western dominance has the potential to create cultural bias in attitude instruments. Language barriers and open access need to be addressed by promoting open access journals in Southeast Asia and strengthening South-North and South-South collaboration.

The third result from SCOPUS illustrates documents by affiliation (please see Figure 4). Ten universities had the most documents in this picture. The first rank is occupied by the University of Victoria, which has more than 30 documents. The University of Leeds was ranked second with more than 20 documents. Third place is The University of British Columbia, with more than 10 documents and almost 15. The fourth position, with more than 10 documents, is held by the University of Alberta. Meanwhile, positions five, six, and seven (Universiteit van Amsterdam, The University of Manchester, and Dalhousie University) have the same number of documents: 10. The University of Sheffield, Iowa State

University, and The Hong Kong Polytechnic University have the same number of documents, namely more than 5 documents, in eighth, ninth, and tenth place.

The development of attitude instruments is no longer the exclusive domain of the social sciences, but has expanded across various disciplines, with increasingly strong multidisciplinary intersections. Social Sciences (22.1%) continue to dominate across education, national values, and religion. The main intersection occurs in the fields of Medicine (14.4%) and Psychology (13.7%), which focus on measuring the attitudes of patients and healthcare workers and on detecting depression, anxiety, and stigma. The Arts and Humanities (9.0%) contribute to measuring art appreciation, ethical attitudes, and cultural heritage preservation. Meanwhile, Computer Science (7.5%) and Business Management (6.6%) reflect the trend toward instrument digitalization through LMS and artificial intelligence, as well as the measurement of job satisfaction, loyalty, and consumer attitudes. Although smaller fields such as Engineering, Nursing, and Environmental Science contribute only 2-5%, their presence remains significant for measuring professional and ecological attitudes. The implications are that future researchers are required to have cross-domain competencies (clinical, arts, business, environmental), that cross-faculty collaboration is essential, and that instrument development methods from education need to be adapted to these new contexts.



Figure 3. Main information

The average number of citations per document was calculated as the total number of citations across all 678 documents in the dataset, divided by the total number of documents (678). This calculation includes documents with zero citations, providing a comprehensive overview of citation impact across the dataset rather than only considering documents that have been cited.

Figure 3 shows the main data from the database that we have entered into the bibliometric software. The database comprises 678 documents from 497 sources relevant to the development of attitude instruments. Another indicator is the annual growth rate, which shows that the number of documents grew by 11.83% compared to the previous year. In this study, 2172 authors were involved, of whom 94 were sole authors. International/country collaborations account for approximately 25.92% of all collaborations. There are also 2136 keywords/themes related to developing attitude instruments. Apart from that, another important metric is the average number of citations per document, which reached 13.08. This figure was calculated from all 678 documents in the dataset, including those with zero citations, thereby reflecting the overall citation impact across the dataset rather than representing only cited documents.

An analysis of the top 50 keywords revealed that “female” (8%), “male,” and “human” (7% each) dominated the keyword mapping. This finding indicates that gender variables are frequently examined in attitude instrument development research. This prominence can be attributed to several factors: first, the influence of the developmental psychology tradition that considers gender a significant differentiating variable in attitudes and morals; second, researchers’ assumption that certain attitude constructs (such as attitudes toward violence or cooperation) may differ between men and women; and third, the relative ease of operationalizing gender compared to other

demographic variables such as socioeconomic status or learning styles.

The frequent appearance of the keywords “female” and “male” in the bibliometric mapping reflects the common practice of including gender as an analyzed variable in this research area. However, it is important to note that keyword frequency in bibliometric analysis does not directly measure the pedagogical quality or content validity of the instruments themselves. Nevertheless, this pattern suggests that future research could benefit from considering a more nuanced approach to demographic variables, including: (1) examining intersectionality how gender interacts with race, social class, disability, or religion to produce richer contextual data; (2) being cautious about reinforcing gender stereotypes in learning contexts; (3) considering non-binary gender identities (agender, bigender, genderfluid) to enhance instrument inclusivity; and (4) expanding the focus beyond gender to include other pedagogical factors such as the quality of teacher-student relationships, classroom climate, and teaching methods. Therefore, future research is advised not to automatically treat gender as the primary variable without strong theoretical justification, to accommodate diverse gender identities, to shift the focus to richer contextual analysis, and to report Differential Item Functioning (DIF) analyses ensure the developed instrument is fair across demographic groups.

Presenting different authors’ keywords can be achieved using a Word Cloud. Font size and word weight reflect the frequency of these keywords in the database. As shown in the following word cloud (based on the previous graphic), the term “female” stands out the most, indicating it is the most frequent keyword in the database. The next keywords are “male” and “human”. These keywords are closely related to student attitudes. Other interesting keywords found in the word cloud include “attitude”, “article”, “humans” and “adult”. Authorship

Table 2. Name of author and number of articles

Authors	Articles
Rhodes Re	31
Conner M	11
Beauchamp M R	7
Lithopoulos A	7
Williams D M	7
Blanchard C M	6
Liu Y	6
Anwar S F	5
Courneya K S	5

The information in Table 2 presents the author's most relevant details in this context. Based on the results, several authors have the most significant relationships with frequently searched keywords related to the development of attitude instruments. In sequence, the authors are RHODES RE with 31 articles, CONNER M with 11 articles, then BEAUCHAMP MR, LITHOPOULOS A, and WILLIAMS DM wrote the same number of articles, namely 7. Meanwhile, BLANCHARD CM and LIU Y also have the same number of articles, namely 6. ANWAR SF and COURNEYA KS with 5 articles each.

The results based on the most relevant affiliations show that the University of Victoria has the largest number of articles, namely 31. Followed by the University of Leeds with 24 articles. Furthermore, the University of British Columbia had 19 articles. The fourth and fifth positions are held by the University of Manchester and the University of Alberta, with 16 and 14 articles, respectively. Dalhousie University and the University of Amsterdam each have 13 articles. In 8th, 9th, and 10th place are Iowa State University, United International University, and the University of Nottingham, with 12, 11, and 9 articles, respectively.

Additional data we obtained regarding the most frequently cited countries. The following information explains the ranking of the most frequently cited countries. The United Kingdom

ranked first with 1883 citations. Then, the USA is in second place with 1,235 citations, 500 citations behind the United Kingdom. Meanwhile, Canada ranks third with 881 citations. In fourth place is Australia, with 346 citations, followed by Ireland in fifth with 278 citations. China ranked sixth with 245 citations. Furthermore, Germany had 236 citations, placing it seventh. Italy, Greece, and Hong Kong rank eighth, ninth, and tenth with 229, 176, and 176 citations, respectively.

The next data concerns topic trends from 2014 to 2023. Discussions about males, Females, humans, surveys, articles, and psychology began to appear around 2018 and ended in 2021. Meanwhile, education topics remained relevant from 2014 to 2023 and beyond.

The blue color depicts the SCP (Single Country Publications) value, which reflects the number of articles produced by researchers from the same country. In contrast, the red color represents the MCP (Multiple Country Publications) value, which indicates the number of articles produced by researchers from multiple countries. In terms of author countries of origin, the top three countries are the USA (with SCP: 54 and MCP: 13), which produced a total of 67 articles, then the United Kingdom (with SCP: 36 and MCP: 16), which produced 52 articles, and Canada (with SCP: 35 and MCP: 12), which each produced 47 articles.

Thematic mapping using Callon's centrality and density framework reveals four quadrants in attitude instrument development research. Quadrant I (Basic Themes) is dominated by gender demographics (female, male, human) that are highly connected across studies but internally shallow, suggesting a need for more in-depth exploration of these variables. Quadrant II (Niche Themes) displays e-learning, online, and information systems themes that are internally mature but appear separately from validity and reliability themes in the keyword co-occurrence analysis. This separation indicates that the

literature rarely combines these two sets of keywords simultaneously, suggesting that validation practices in online learning contexts may not be explicitly captured through bibliometric keyword mapping rather than confirming an actual absence of such practices in the field. Quadrant III (Emerging/Declining Themes) shows that student attitudes, behavioral attitudes, and cognitive attitudes have low connectivity and development, indicating fragmented definitions of attitudes and weak theoretical links between attitudes and behavior in the literature. Quadrant IV (Motor Themes) provides a mature, well-connected core foundation encompassing validity, reliability, factor analysis, and survey methodology.

The observed separation between e-learning themes and validity/reliability themes in the keyword mapping highlights a potential gap in how validation research is reported and indexed, rather than a definitive lack of validation practices in digital contexts. In the Society 5.0 era, instruments developed for face-to-face learning contexts may require additional consideration when applied to asynchronous online environments. However, this does not necessarily imply that such validation is absent from the literature. Therefore, future research is recommended to go beyond simply repeating classic tests (Cronbach's alpha, EFA) without a digital context, to develop inter-rater reliability measurement methods for online observations, and to redefine student attitudes by differentiating between attitudes toward learning content, technology platforms, and virtual social interactions.

An analysis of the evolution of attitude instrument research themes over four periods (2014-2023) reveals a paradigm shift reflecting responses to global policies, technology, and social crises. In the 2014-2017 period, cognitive attitudes, females, and students dominated, reflecting the legacy of classical psychometrics

(Likert, Thurstone) as well as the influence of the third wave of feminism and post-PISA 2012 global education policy discussions. The 2018-2020 period marked a behavioral turn, with the emergence of behavior and perception as new themes, in response to criticism of the attitude-behavior gap and the influence of self-determination theory; globally, the implementation of SDG 4 encouraged the measurement of safe school climates and the periodic reporting of student character. The 2021-2022 period (COVID-19 pandemic) witnessed the elimination of cognitive attitudes due to mass online learning, with the focus shifting to shorter measures of perception, self-reported behavior, and responses to the global student mental health crisis, as recommended by WHO. The 2023 period witnessed the rise of affective attitudes (as distinct from cognitive attitudes) driven by the integration of affective computing (emotion-detecting AI) into education systems, as well as the sudden emergence of the buzzword *commerce* signifying the commercialization of attitude instruments by ed-tech platforms (Quizizz, Kahoot, paid LMS) as premium features, in line with UNESCO's policy on AI ethics in education. Most importantly, the significant increase in the use of the keyword *attitude instrument development* in 2023 indicates that this field has become a standalone field of study, no longer simply part of psychology or educational methodology. Overall, this evolution reflects the journey from classical psychometrics (2014-2017) to the behavior-based paradigm (2018-2020), adaptation to the pandemic crisis (2021-2022), and the era of digital affective commercialization (2023 onwards), demonstrating that attitude instrument research dynamically responds to global policy needs, international crises, and technological innovation.

A topic dendrogram showing the hierarchy and relationships between keywords resulting from hierarchical clustering. The results of this

topic dendrogram show two clusters. The first cluster includes keywords such as women, men, humans, adults, articles, and others. Meanwhile,

the second cluster focuses more on learning topics, such as attitudes, affective attitudes, surveys, perceptions, behaviors, and students.

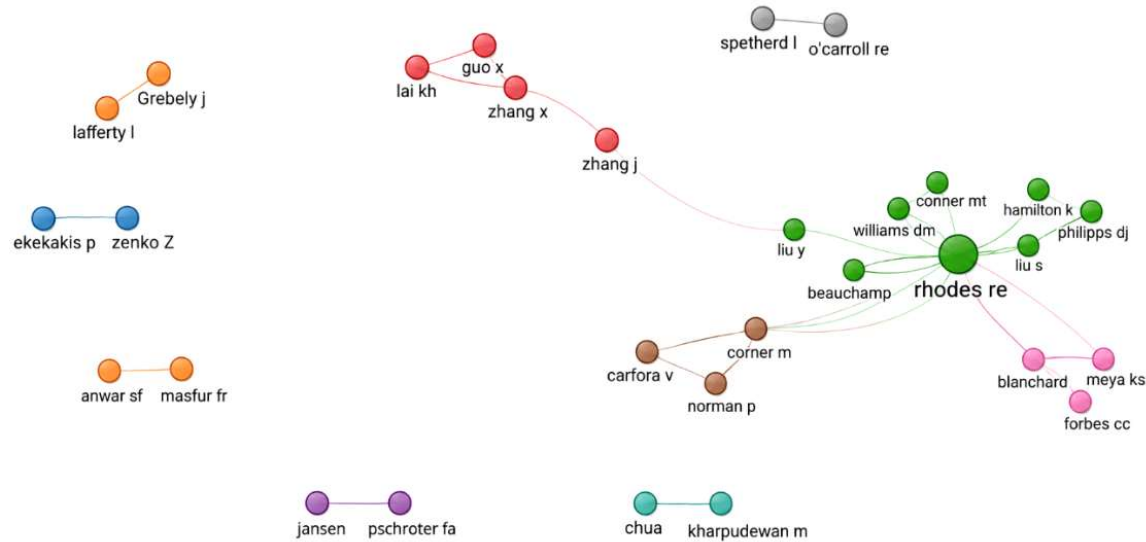


Figure 4. Author collaboration network

Figure 4 illustrates the author collaboration network, which provides insights into the structure of research communities in the field of attitude instrument development. The network reveals several distinct collaboration clusters, each representing groups of researchers connected by co-authorship patterns.

The pink cluster, consisting of Lai KH collaborating with Zhang X, Guo X, and Zhang J, likely represents a research group focused on measurement and validation studies in educational or psychological assessment, as suggested by their frequent co-authorship patterns. The brown cluster comprises Carfora V, Corner M, and Norman P, whose collaboration appears to center around health-related attitude measurement, possibly reflecting shared institutional affiliations or thematic research interests in behavioral health. Another pink subgroup includes Blanchard, Forbes CC, and Meya KS, indicating a concentrated research network in physical activity or exercise psychology. The green cluster is the largest, encompassing Liu Y, Beauchamp, Warburton DER, Williams DM, Conner MT,

Hamilton K, Philipps DJ, Liu S, and Aukiner G. This extensive collaboration network suggests a well-established research community with strong institutional ties or shared theoretical frameworks, likely focusing on the intersection of physical activity, health behavior, and attitude measurement. Additionally, cross-cluster collaborations are evident among researchers from the red, brown, pink, and green groups, indicating interdisciplinary connections that bridge subfields within attitude research.

The identification of these collaboration clusters has important implications for the field. First, the existence of distinct thematic groups suggests that attitude instrument research is not monolithic but rather comprises specialized subdomains, such as educational measurement, health psychology, and physical activity research. Second, the presence of multiple clusters with limited cross-collaboration highlights potential opportunities for greater interdisciplinary exchange, which could enrich the field by integrating diverse methodological approaches and theoretical perspectives. Third, the large

green cluster indicates that certain research areas, particularly those related to health behavior and physical activity, have more established collaborative networks, potentially serving as models for fostering collaboration in other sub-domains. Overall, the collaboration network underscores the importance of scientific

partnerships in advancing the development and validation of attitude instruments, while also revealing the thematic and institutional structures that shape the field.

As shown in the global collaboration map, article authors collaborate not only with fellow affiliates or countries but also across national

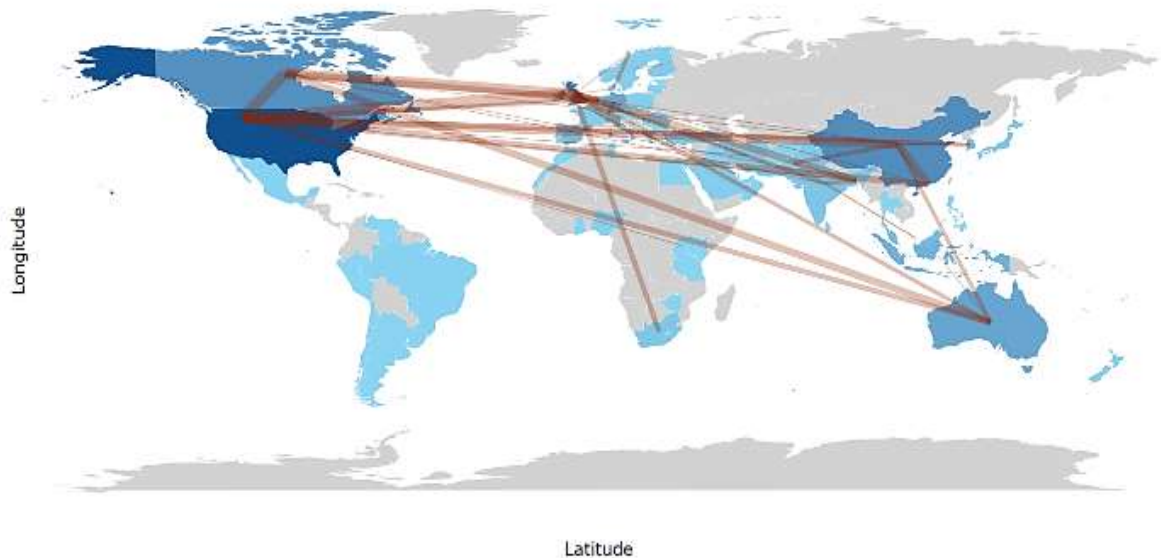


Figure 5. Collaboration world map

borders. This collaboration even spans continents. Many authors from Australia collaborate with Belgium, Bulgaria, Finland, Hong Kong, Indonesia, Israel, Malaysia, the Netherlands, and Norway. USA collaborates with several countries: Australia, Bangladesh, Bhutan, Canada, Chile, China, Cyprus, Czech Republic, Egypt, Finland, France, Germany, Ghana, Hong Kong, India, Iran, Italy, Korea, Malaysia, Netherlands, New Zealand, Pakistan, Saudi Arabia, Singapore, Sri Lanka, Switzerland, Turkey, Uganda, United Kingdom. Furthermore, the United Kingdom collaborates with writers in Australia, Bahrain, Bangladesh, Belgium, Canada, Denmark, Egypt, Finland, France, Germany, Ghana, India, Iran, Ireland, Italy, Japan, Malaysia, Morocco, Netherlands, New Zealand, Norway, Poland, Portugal, Qatar, South Africa, Spain, Sweden, Uganda, Zimbabwe. Canada also

collaborates with writers in various countries, including Australia, Bangladesh, China, Finland, France, Germany, Ghana, India, Iran, Ireland, Morocco, the Netherlands, and New Zealand. China also collaborates with various countries and regions, including Australia, Bangladesh, Finland, France, Germany, Hong Kong, India, Iran, Iraq, Korea, Malaysia, New Zealand, Norway, Pakistan, Saudi Arabia, South Africa, and Switzerland. All this shows that geography is not an obstacle to the development of science.

Analysis results using VOSViewer

Co-occurrence cluster analysis using VOSviewer revealed a strong theoretical relationship between “student visualization” and “intention” within the same cluster, along with “acceptability,” “intervention,” and “group.” This close relationship is explained by three theoretical

foundations. First, the Theory of Planned Behavior (Ajzen, 1991) explains that visualization of learning progress in learning analytics dashboards serves as formative feedback that creates a discrepancy between the current and desired states, thereby triggering students' intentions to change their behavior. Second, the theory of self-regulated learning (Zimmerman, 2002; Winne & Hadwin, 1998) suggests that visualization serves as a metacognitive monitoring tool during the performance phase, allowing students to compare actual behavior with set goals, and thus visualization itself is often designed as a pedagogical intervention to improve self-regulation. Third, the Technology Acceptance Model (Davis, 1989) explains that the perceived usefulness and perceived ease of use of 3D

visualization and Augmented Reality directly influence students' behavioral intentions, forming a causal chain of visualization → attitude → intention → behavior. The presence of this cluster has important implications for the development of affective instruments going forward, namely the need to shift from static attitude measurement to dynamic intention-behavior tracking, as research indicates an intention-behavior gap that needs to be detected. Therefore, the ideal affective instrument should be integrated with the learning visualization system and be able to predict and respond to the dynamics of students' intention-behavior in real-time.

Figure 6 depicts the overlay visualization, where the color gradient indicates the average publication year of documents associated with

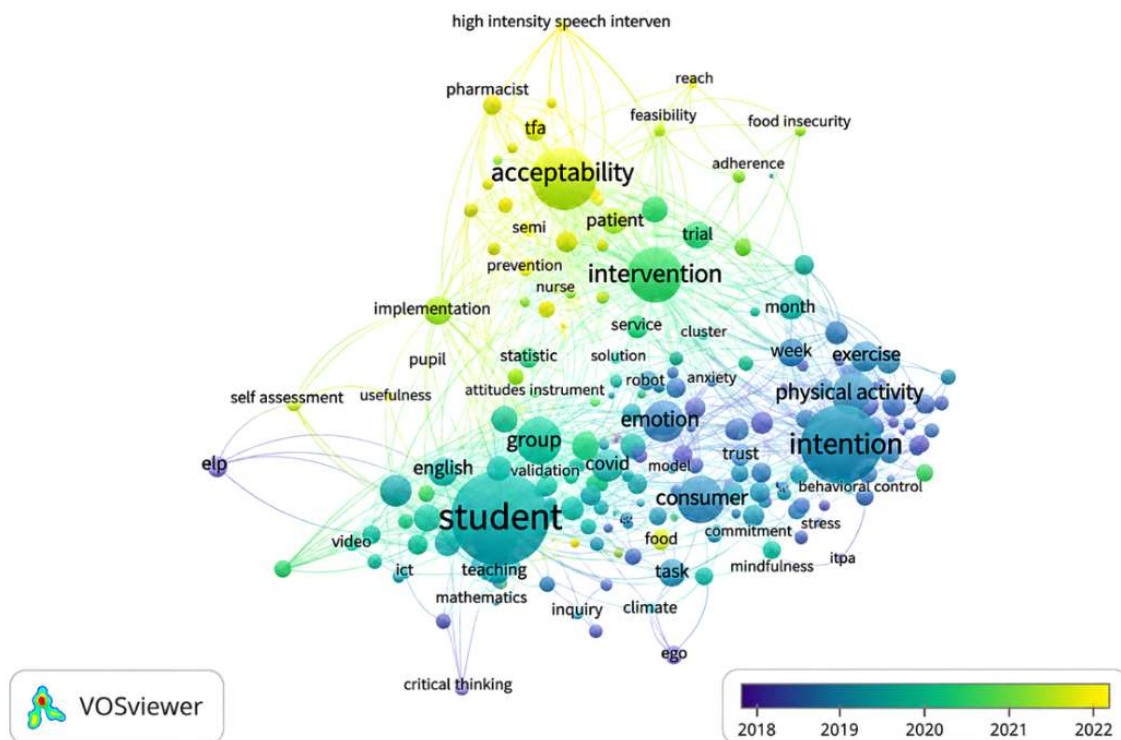


Figure 6. Overlay visualization

each keyword, ranging from 2018 (darker/earlier) to 2022 (lighter/more recent). Based on this visualization, it can be observed that topics such as students, education, validation, teaching, mathematics, critical thinking, groups, video, ICT,

CFA, inquiry, attitude instrument, and intention appear with colors corresponding to the earlier part of the period, suggesting that these themes were more prevalent in publications around 2018–2019. Meanwhile, topics such as statistics,

implementation, and intervention are associated with colors indicating more recent years (approximately 2020–2022), reflecting a shift in research focus over time. Additionally, topics such as activity, English, and tasks appear with color patterns that place them at the earlier end of the spectrum, prior to 2019. This overlay visualization illustrates the temporal evolution of research themes in attitude instrument development, showing a shift from foundational topics such as validation and teaching methods toward more applied themes like implementation and intervention in recent years.

The results of the analysis with VOSViewer next visualize the density of items or keywords. The keyword “student” shows its relationships with various themes and other keywords, such as validation, teaching, COVID, group, emotion, and others.

The higher the keyword density, the stronger the relationship with the concept of affective attitude instrument development.

This study examines the development trends of attitude (affective) instruments over the past decade through bibliometric analysis. The results demonstrate interesting dynamics in terms of publication volume, global collaboration, and the evolution of research themes.

Analysis of annual publication trends and the impact of the pandemic

Data show a significant surge in publications in 2021–2022, peaking at nearly 140 documents in 2022. This phenomenon is closely related to the COVID-19 pandemic, which forced a paradigm shift in education to online learning. This aligns with the findings of Cretu & Ho (2023), who stated that the global crisis has triggered an urgent need for researchers to develop new instruments to measure students’ attitudes, adaptation, and anxiety in digital learning environments. The decline in 2023 was likely due to a time lag in data indexing during sampling.

However, overall, this topic showed annual growth of 11.83%, reflecting the vitality of psychometric research in the modern era.

Geographic distribution and dominance of scientific fields

The United States (80+ papers) and the United Kingdom lead in publication volume and citation count (the UK reaching 1,883 citations). These findings support the assertion that developed countries play a central role in the development of psychometric theory. Interestingly, Indonesia ranks seventh, indicating the high enthusiasm of domestic researchers in this field. (Ma & Hui, (2023). The finding that 22.1% of publications were in the Social Sciences, followed by Medicine (14.4%), suggests that attitude instruments are not limited to education but are also crucial in health interventions and in human behavior more broadly. This is reinforced by Roza-García et al.’s (2023) study on the validation of student perception scales in online collaborative international learning experiences, which emphasizes the need for reliable instruments in digital environments (Hossain et al., 2022; Purnomo, 2020; Symbolon, 2022; Tlili et al., 2022).

Thematic evolution: from identity to methodological validation

TreeMap and Word Cloud analyses highlight the keywords “female,” “male,” and “human.” This indicates that the demographic variable of gender remains a central focus in many attitude studies. However, overlay and thematic map visualizations indicate a substantial shift. Prior to 2018, the research focus was primarily on tasks and activities; in the 2020–2022 period, the trend shifted toward “ICT,” “Validation,” and “CFA” (Confirmatory Factor Analysis). This shift indicates that current research standards for attitude instruments increasingly demand statistical rigor through rigorous construct validity testing

(Gunes et al., 2022). As stated by (Effendi et al., 2021). Digitalization in education (ICT) demands affective instruments that are better adapted to online behavior.

Collaborative networks and intellectual connectivity

The global collaboration map demonstrates that geography is no longer a barrier to scientific development. Prolific authors like Rhodes RE (31 articles) are central to collaborative networks, often involving cross-border partnerships (MCPs) among the USA, the UK, and Canada. In Indonesia, increasing international collaboration is a strategic step to improve the citation impact and quality of national research. This collaboration helped standardize the instrument to ensure cross-cultural validity, a crucial aspect in developing global attitude instruments (Agboola & Tsai, 2012).

This study concludes that the development of affective attitude instruments has transformed from classical psychometrics to the digital era and commercialization, marked by an increased focus on statistical validation (CFA), ICT integration, and the need for adaptive instruments for post-pandemic online learning. The United States' dominance as a theoretical hub does not preclude Indonesia from becoming a key player if supported by international collaboration and English-language publications. Based on the literature mapping, three recommendations are made. First, for curriculum developers, the *Merdeka* Curriculum needs to be supplemented with technical guidelines and examples of attitude assessment instruments with proven cross-cultural validity to address policy and implementation gaps. Second, for teachers and schools, it is recommended to use modern validation approaches, such as CFA, and to integrate them with online learning evaluation systems. Third, for researchers, future research should focus on developing instruments that bridge

the intention-behavior gap in the context of digital learning and student mental health interventions, leveraging learning analytics technology.

■ CONCLUSION

Based on a bibliometric analysis of publications on the development of affective attitude instruments from 2014 to 2023, this study concludes four key points. First, the publication trend shows a significant increase from 2018 to 2022, peaking in 2022 (nearly 140 documents). This was driven by the COVID-19 pandemic, which shifted the focus toward adaptive instruments for digital learning, resulting in an annual growth rate of 11.83%. The decline in 2023 does not reflect the actual trend because the data was collected on October 7, 2023, which does not represent a full year. Second, the knowledge structure reveals a geographical imbalance, with developed countries (the US and UK) dominating the production of psychometric theory. At the same time, Indonesia ranks seventh, indicating strategic opportunities through international collaboration. The dominance of binary gender keywords (female/male) reflects the common practice of not measuring the pedagogical quality of instruments. Thematically, there has been a shift from a focus on demographic identity (2014–2017) to statistical validation (CFA) and ICT integration (2018–2022), and then to the commercialization of digital affective theory (2023).

Third, thematic mapping shows a separation between the themes of validity/reliability and e-learning, which indicates that the literature rarely combines the two, not evidence of the absence of validation practices. Therefore, the prospect for future research is to develop an integrated validation framework with a digital platform that bridges the gap between students' intentions and behaviors. Fourth, the evolution of psychometric theory reflects the journey from classical psychometrics (2014–2017), the behavioral

paradigm (2018–2020), pandemic adaptation (2021–2022), to the era of digital affective commercialization (2023 onwards), which shows a dynamic response to global policies, crises, and technological innovations. Based on these findings, three recommendations are proposed: (1) curriculum developers provide technical guidance for attitude instruments that are tested cross-culturally; (2) teachers and schools use a modern validation approach (CFA) integrated with online evaluation systems; and (3) researchers focus on developing instruments that bridge the gap between intentions and behaviors in digital learning and learning analytics-based mental health interventions.

■ DECLARATION OF GENERATIVE AI USAGE IN THE WRITING PROCESS

During the writing of this manuscript, the author used translate AI (Artificial Intelligence) to help instantly process, interpret, and translate text or audio across languages, adjusting for cultural context, idiom, and grammar. The author has reviewed and edited the content generated by this tool and is fully responsible for the content of the published article.

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