



Mapping the Research Landscape of Formative Assessment in Higher Secondary Schools: A Bibliometric Study

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Abstract

Purpose: This study aims to map the research landscape of formative assessment in higher secondary schools by examining publication patterns, key contributors, thematic structures, conceptual linkages, country collaboration networks, and influential institutions. The goal is to provide a comprehensive understanding of how the field has evolved and where major scholarly contributions are concentrated. **Design/methodology/approach:** A bibliometric research design supported by science-mapping techniques was employed. Data were retrieved from the Scopus database (2000–2024). A total of 484 publications were analyzed after applying PRISMA-inspired screening procedures. Descriptive statistics were generated using Excel, while VOSviewer was used to construct co-authorship, keyword co-occurrence, citation, intellectual structure, and country collaboration networks. **Findings:** Results show a significant increase in research output after 2020, indicating growing global interest in formative assessment. A small core of authors drives the field, while the United States, Indonesia, the United Kingdom, Hong Kong, and Norway emerge as leading contributors. Keyword analysis identified 143 core concepts forming 12 thematic clusters, with “formative assessment,” “assessment for learning,” “feedback,” and “self-assessment” at the center. Intellectual structure mapping revealed 15 thematic clusters highlighting strong theoretical foundations, methodological diversity, and increasing integration of digital learning environments. Eight

distinct country collaboration clusters demonstrate regionally concentrated yet globally connected research patterns. **Research limitations/implications:** This study is limited to the Scopus database; future research may integrate additional sources for broader coverage. The findings provide insights for policymakers, researchers, and educators seeking to advance formative assessment practices. **Originality/value:** This is one of the few studies offering a comprehensive, data-driven overview of formative assessment research specifically within higher secondary education, integrating intellectual, conceptual, and geographical perspectives.

Keywords: Quality education, formative assessment; assessment for learning; bibliometric analysis; secondary education; VOSviewer

1. Introduction

Formative assessment is widely recognized as an active and ongoing process that engages learners in meaningful reflection rather than simply receiving feedback (Manuscript, 2021). As educational contexts continue to grow more complex, especially within higher secondary education, the role of assessment practices has become increasingly critical for supporting student learning and development (Hadiastriani & Djarot, 2024). In secondary and higher secondary education, formative assessment understood as continuous evaluation integrated into the learning process has been repeatedly shown to enhance academic achievement, deepen understanding, and promote active learning behaviors (Shaikh et al., 2024).

Despite these benefits, effectively implementing formative assessment in higher secondary education remains a challenge. Many educators struggle with issues such as limited time, unfamiliarity with assessment tools, and inconsistent institutional support (Antonioni & James, 2014). At the same time, researchers continue to expand work in this area across multiple disciplines, demonstrating that formative assessment plays a significant role in shaping student engagement, motivation, and overall academic success (Zhang et al., 2023). Moreover, because higher secondary education is guided by the right to equitable and meaningful learning experiences, formative assessment becomes central to promoting learning quality and ensuring that diverse forms of classroom engagement are recognized and supported (Chazi-Nacimba et al., 2024).

The pressures faced by higher secondary education including rapid digital transformation, varied learning needs, and increasing student diversity further highlight the importance of formative assessment as an adaptable and inclusive pedagogical tool (Chazi-Nacimba et al., 2024). such as self-assessment, peer evaluation, and continuous improvement practices not only foster deeper learning but also support learners who may not be part of traditional academic pathways, contributing to broader inclusion (Chazi-Nacimba et al., 2024). When paired with

strong quality indicators in summative assessments, formative approaches allow schools to refine their evaluation systems, provide targeted support, and strengthen academic programs (Shaikh et al., 2024). These practices also cultivate reflective thinking, promote learner autonomy, and help students acquire essential skills for lifelong learning.

Even so, challenges persist. Research shows that while many teachers hold positive attitudes toward formative assessment, its widespread adoption in higher secondary education depends on how teachers perceive influencing factors such as workload, training, assessment culture, and institutional expectations (Alotaibi, 2018). Understanding these complexities is crucial because effective assessment practices directly influence teaching quality, student satisfaction, and overall school performance.

Given the rapid expansion of research on formative assessment in higher secondary education, a bibliometric analysis is essential for mapping the scholarly landscape. In this critical developmental stage—where students transition from structured schooling to independent higher education—formative assessment serves as a vital tool for fostering self-regulated learning and academic resilience. A systematic analysis helps identify influential authors, emerging themes, and methodological patterns unique to the higher secondary context, such as the tension between formative feedback and high-stakes exit examinations. Bibliometric analysis conducted recently on formative assessments shows a significantly high increase in number, particularly on topics related to digital technologies and artificial intelligence and within the classrooms (Li & Rohayati, 2025). By examining publication trends and intellectual structures within the field, this study provides a comprehensive overview of how formative assessment has been conceptualized, applied, and studied across global higher secondary education contexts.

- To identify the most productive authors contributing to research on formative assessment in higher secondary schools and analyze their publication output.
- To examine the geographical distribution of publications and determine the most influential countries in the field
- To analyze the temporal evolution of research output and identify major trends in the development of the field over time.
- To categorize the literature by subject area and understand the disciplinary foundations of research on formative assessment in higher secondary schools.
- To map the intellectual structure of the field by identifying major themes, theoretical foundations, and research streams.
- To explore the key concepts investigated in the literature and analyze how these concepts are interconnected within the field.
- To identify the most highly cited articles and evaluate their impact on shaping the research landscape.

- To identify major countries and collaboration clusters contributing to the research on formative assessment in higher secondary schools.
- To determine the most productive and influential institutions contributing to research in this domain.

2. Methods

This study employs a bibliometric approach to systematically map the research landscape on formative assessment in higher secondary education. The methodology is organized into several key components to ensure clarity and replicability. The research design outlines the overall structure and approach used in the study, while the data source section explains where the publication records were retrieved from. The scope and coverage define the time period, document types, and thematic boundaries included in the analysis. The search strategy describes the specific steps taken to identify relevant studies on formative assessment. The data extraction process details how publication information was collected and prepared. Finally, the data analysis section presents the techniques used to examine publication trends, influential authors, thematic patterns, and major research clusters. Together, these components form a structured framework for conducting a comprehensive bibliometric analysis.

2.1 Research Design

This study adopted a bibliometric research design complemented by science mapping techniques to analyse the research landscape on formative assessment in higher secondary schools. Bibliometric methods enable the systematic examination of publication patterns, citation structures, and collaborative linkages, while science mapping provides visual insights into the intellectual, conceptual, and social structures within a research field. This combined methodological approach aligns with established practices in recent bibliometric studies in the educational domain

2.2 Data Source

All bibliographic data were retrieved from the Scopus database, selected for its extensive coverage of peer-reviewed publications and rich citation metadata. Scopus is widely recognized as a reliable and comprehensive source for bibliometric and science-mapping research, making it suitable for obtaining high-quality data for analysis, as reflected in similar studies in the literature.

2.3 Scope and Coverage

The search focused on scholarly literature addressing formative assessment within the context of higher secondary education. To ensure broad coverage, the search was conducted across the Article Title, Abstract, and Keywords fields. A range of document types—including journal articles, reviews, conference papers, and book chapters—was included to capture the full scope of academic contributions to the field. The publication period was limited to 2000–2024 to allow the study to explore

developments and trends in formative assessment research over the past two decades.

2.4 Search Strategy

A structured search strategy incorporating Boolean operators and key terms was employed to retrieve relevant literature. The search terms included variations of “formative assessment,” “assessment for learning,” and educational level descriptors such as “high school,” “secondary school,” and “higher secondary.” These terms were combined to ensure that the dataset reflected research specifically focused on formative assessment practices within upper-secondary educational settings. This systematic search approach is consistent with strategies employed in prior bibliometric studies in education

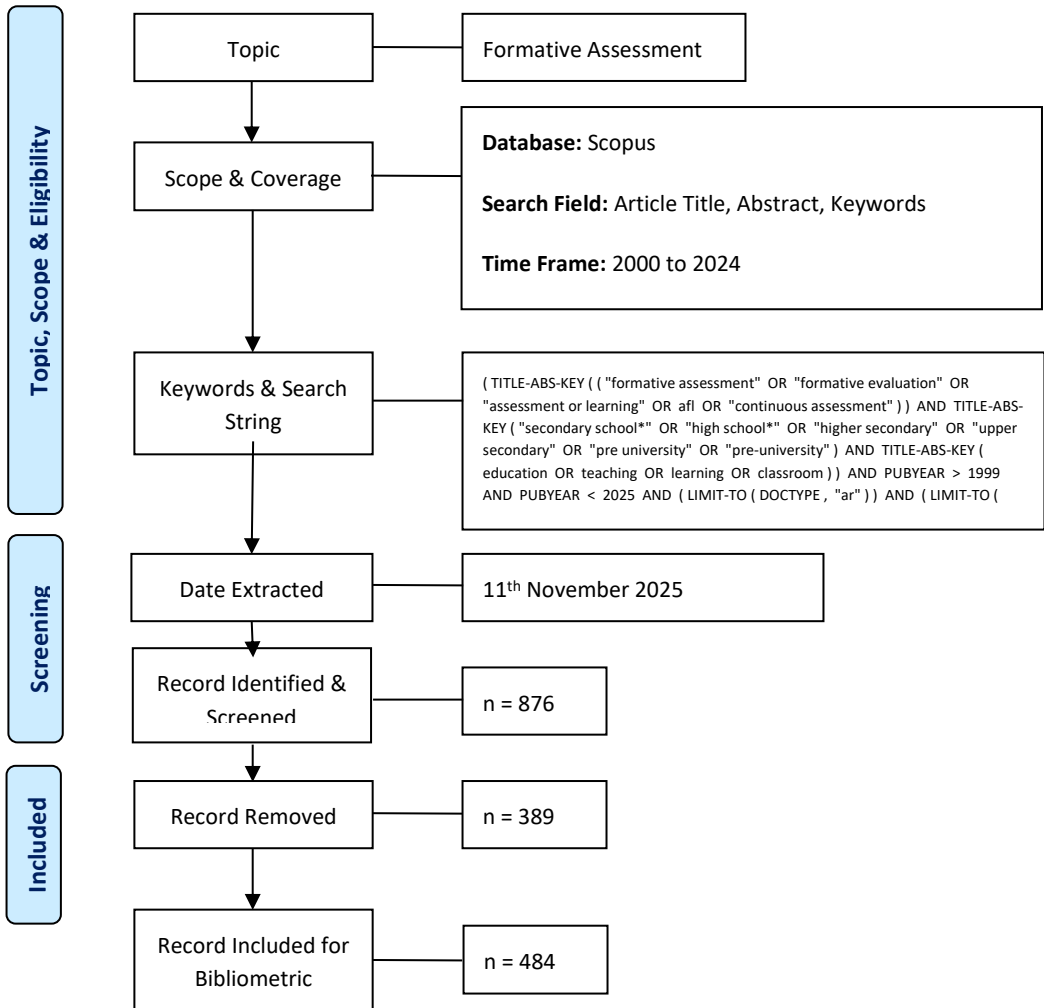
2.5 Data Extraction

Data extraction was carried out on 11 November 2025. The initial search identified 876 records. A multi-stage screening process was conducted following PRISMA-inspired procedures, similar to the approach illustrated in the sample paper. After removing 389 records due to duplication, irrelevance, or incomplete metadata, a total of 484 records remained for final analysis. Extracted metadata included authorship, institutional affiliations, keywords, abstracts, publication year, source titles, and citation information.

2.6 Data Analysis

Following extraction, the final dataset was exported into CSV format for analysis. Descriptive analyses such as yearly publication trends, geographical contributions, and subject-area classification were performed using Microsoft Excel. For network-based bibliometric analyses, VOSviewer was employed to generate co-authorship networks, keyword co-occurrence maps, citation structures, and country collaboration visualizations. These tools enabled the identification of research clusters, thematic patterns, and structural relationships within the dataset. The use of Excel and VOSviewer aligns with analytical procedures widely adopted in bibliometric and science-mapping research in education, as demonstrated in the sample study

Figure 1. Flow diagram of the search strategy



Source: Zakaria et al. (2020)

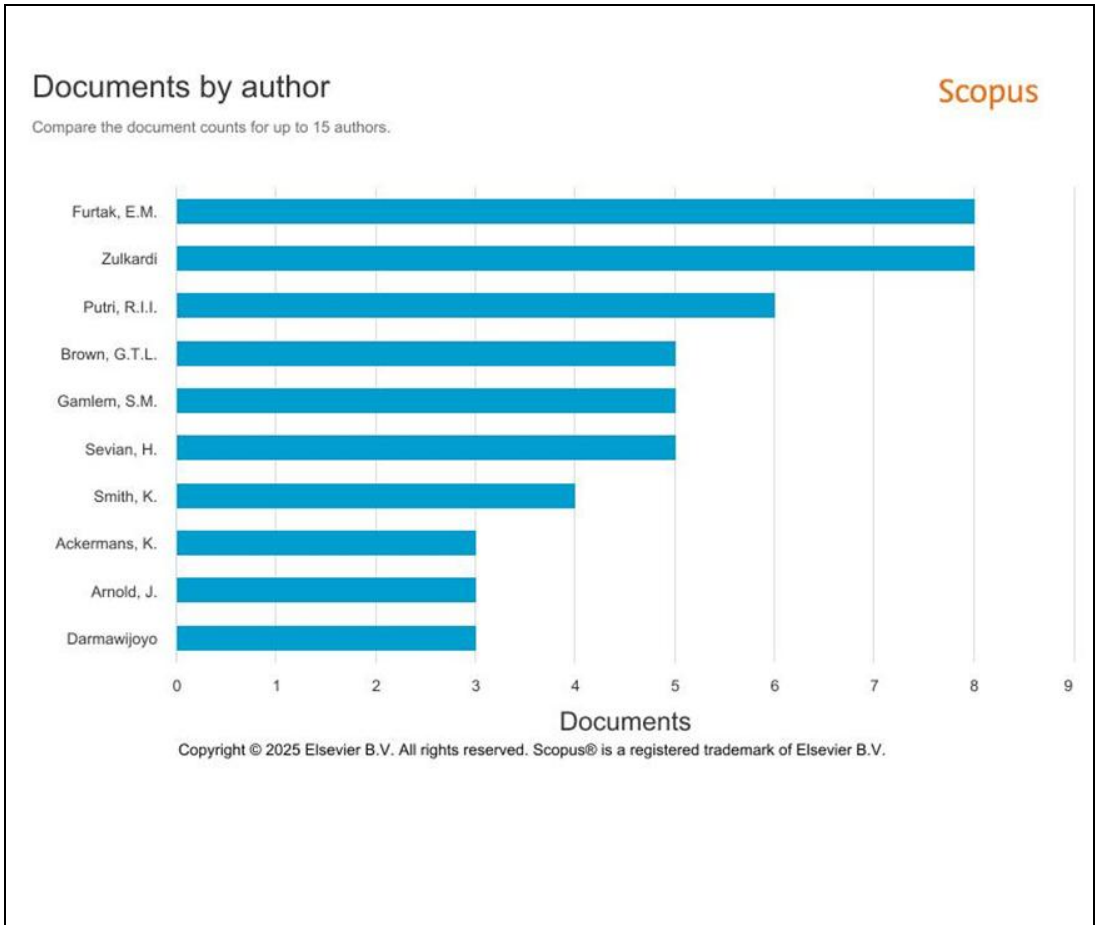
3 Results

The analysis of the disciplinary distribution of publications provides insight into how research on formative assessment in higher secondary schools is positioned across various academic fields. By examining the subject domains represented in the literature, this section highlights the thematic and disciplinary boundaries shaping

the research landscape. The findings reveal how different scholarly areas contribute to the development of knowledge in this field, illustrating both the concentration of studies within certain disciplines and the interdisciplinary nature of the topic. This overview helps establish the intellectual context within which formative assessment research has evolved.

3.1. Scholarly Contribution Leaders

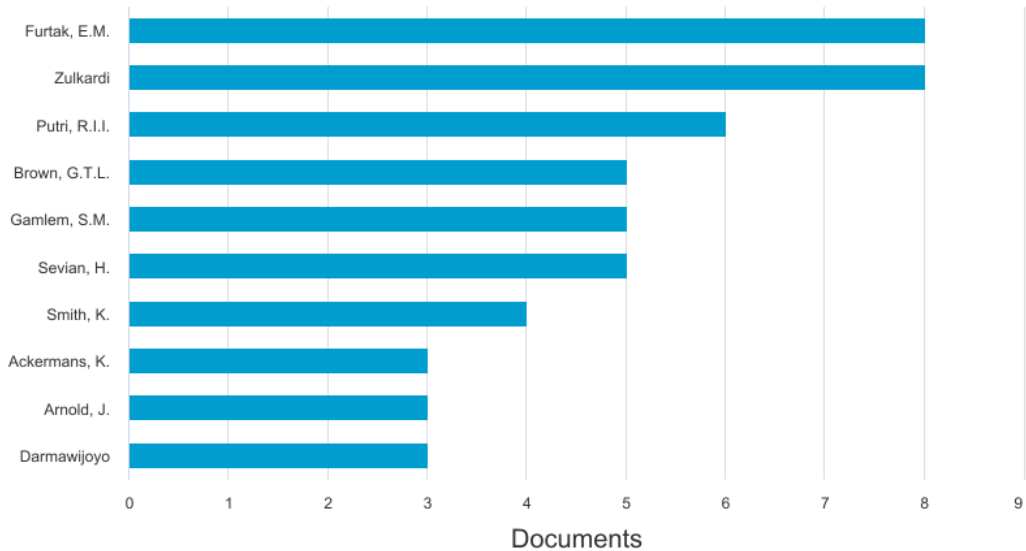
Table 1: Document by author



Documents by author

Scopus

Compare the document counts for up to 15 authors.



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Table 1 highlights the most productive authors in the field, revealing a concentration of contributions among a relatively small group of leading researchers. Furtak, E.M. and Zulkardi emerge as the most prolific authors, each with 8 publications, demonstrating their substantial and sustained influence on formative assessment research. Putri, R.I.I. follows with 6 publications, while Brown, G.T.L., Gamlem, S.M., and Sevian, H. each contribute 5 publications, indicating a strong research presence and consistent scholarly engagement in the field. Smith, K. appears next with 4 publications, while Ackermans, K., Arnold, J., and Darmawijoyo each have 3 publications, completing the list of the top 10 most active authors. This distribution shows that although many researchers contribute to formative assessment research, a small core group drives much of the scholarly output, shaping theoretical development, empirical work, and methodological advances in the field. The presence of authors from diverse countries such as the United States, Indonesia, and Europe also underscores the global and collaborative nature of formative assessment scholarship.

3.2. Global Research Footprint & Leading Nations

Table 2: Document country or territory

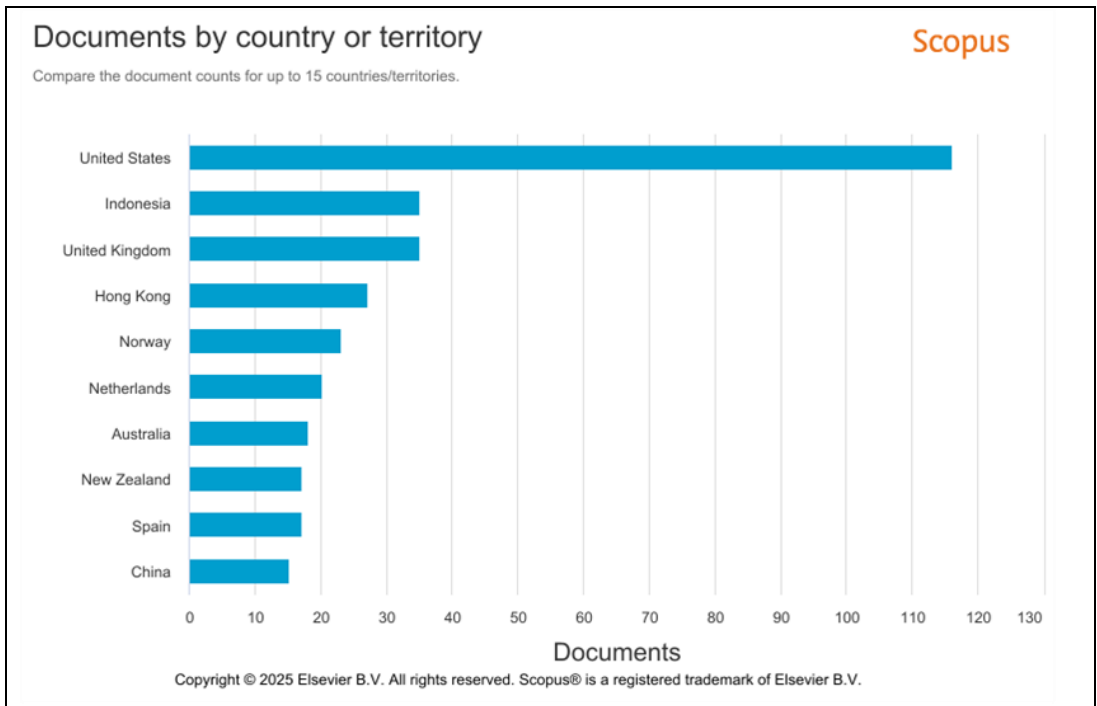


Table 2 represents the geographical distribution of publications, revealing a strong concentration of research productivity in a limited number of countries, with the United States leading by a substantial margin. The United States contributes the highest number of documents (116), demonstrating its dominant role in formative assessment research and its extensive educational research infrastructure. Indonesia and the United Kingdom follow with 35 publications each, indicating significant regional engagement from Southeast Asia and Europe. Hong Kong (27) also shows a prominent contribution, reflecting its strong academic emphasis on assessment reform and learner-centered pedagogy. Norway (23) and the Netherlands (20) continue this European presence, both known for progressive educational policies and active research communities. Australia (18) and New Zealand (17) demonstrate strong representation from the Oceania region, consistent with their long-standing focus on assessment for learning practices. Spain (17) and China (15) complete the top ten, showing active participation from Southern Europe and East Asia. Overall, the distribution indicates that formative assessment research is primarily led by Western and Asia-Pacific countries, with the United States exerting a disproportionately large influence, while emerging contributions from regions such as Southeast Asia and Europe reflect a growing global interest in the field.

3.3. Temporal Progression of Research Output

Table 3: Year of Publications

Year	Total Publications	Percentage (%)
2024	55	12.56
2023	49	11.19
2022	46	10.50
2021	52	11.87
2020	37	8.45
2019	28	6.39
2018	34	7.76
2017	24	5.48
2016	21	4.79
2015	18	4.11
2014	13	2.97
2013	16	3.65
2012	10	2.28
2011	15	3.42
2010	16	3.65
2009	11	2.51
2008	10	2.28
2007	9	2.05
2006	4	0.91
2005	2	0.46
2004	7	1.60
2003	1	0.23
2002	2	0.46
2001	1	0.23
2000	3	0.68

Table 3 presents the annual distribution of publications, showing a steady increase in research output over the past two decades, with a particularly sharp rise in recent years. The highest number of publications appeared in 2024 (55; 12.56%), followed closely by 2021 (52; 11.87%), 2023 (49; 11.19%), and 2022 (46; 10.50%), indicating that research on formative assessment gained significant momentum in the early 2020s. The early 2000s reflect a relatively flat period, with very low publication activity years such as 2001 and 2003 recorded only one article each (0.23%), and most years before 2006 produced fewer than 10 documents. A gradual growth phase began around 2007, leading to moderate but sustained increases between 2010 and 2019, when annual outputs ranged between 10 and 34 publications. A clear turning point appears after 2016, where the trajectory begins to rise more noticeably, but the most dramatic surge occurs after 2020, marking the start of a rapid expansion phase likely influenced by global educational shifts, digital learning environments, and increased emphasis on assessment innovation. Overall, the trend demonstrates a transition from slow early development to accelerated and intensive research activity in the last decade highlighting a significant rise in scholarly attention toward formative assessment, especially from 2020 onward.

3.3 Subject Domain Representation

Table 4: Subject Area

Subject Area	Total Publications	Percentage (%)
Arts and Humanities	71	16.2
Computer Science	63	14.4
Psychology	50	11.4
Mathematics	33	7.5
Chemistry	29	6.6
Engineering	27	6.2
Medicine	25	5.7
Health Professions	22	5.0
Business, Management and Accounting	21	4.8
Earth and Planetary Sciences	7	1.6
Physics and Astronomy	7	1.6
Agricultural and Biological Sciences	5	1.1
Decision Sciences	5	1.1
Energy	5	1.1

Environmental Science	5	1.1
Chemical Engineering	4	0.9
Biochemistry, Genetics and Molecular Biology	3	0.7
Immunology and Microbiology	2	0.5
Materials Science	2	0.5
Multidisciplinary	2	0.5
Pharmacology, Toxicology and Pharmaceutics	2	0.5
Economics, Econometrics and Finance	1	0.2
Nursing	1	0.2

Table 4 shows the distribution of the 438 subject-area classifications assigned to the dataset in Scopus, revealing that Social Sciences overwhelmingly dominate the field. Arts and Humanities contribute 71 publications (16.2%), followed by Computer Science with 63 (14.4%) and Psychology with 50 (11.4%), indicating strong theoretical, technological, and cognitive dimensions within formative assessment research. Mathematics accounts for 33 publications (7.5%), Chemistry 29 (6.6%), Engineering 27 (6.2%), Medicine 25 (5.7%), Health Professions 22 (5.0%), and Business, Management and Accounting 21 (4.8%), highlighting the widespread interdisciplinary reach of the topic. Smaller shares come from Earth and Planetary Sciences and Physics and Astronomy with 7 each (1.6%), Agricultural and Biological Sciences, Decision Sciences, Energy, and Environmental Science with 5 each (1.1%), and Chemical Engineering with 4 (0.9%). Minimal representation is found in Biochemistry, Genetics and Molecular Biology with 3 (0.7%), Immunology and Microbiology, Materials Science, Multidisciplinary, and Pharmacology, Toxicology and Pharmaceutics with 2 each (0.5%), and Economics, Econometrics and Finance and Nursing with 1 each (0.2%). Overall, the pattern confirms that formative assessment research is predominantly situated within Social Sciences but extends across a broad spectrum of academic disciplines.

3.4 Thematic and Disciplinary Spread of Research

Figure 2: Thematic and Disciplinary Spread of Research

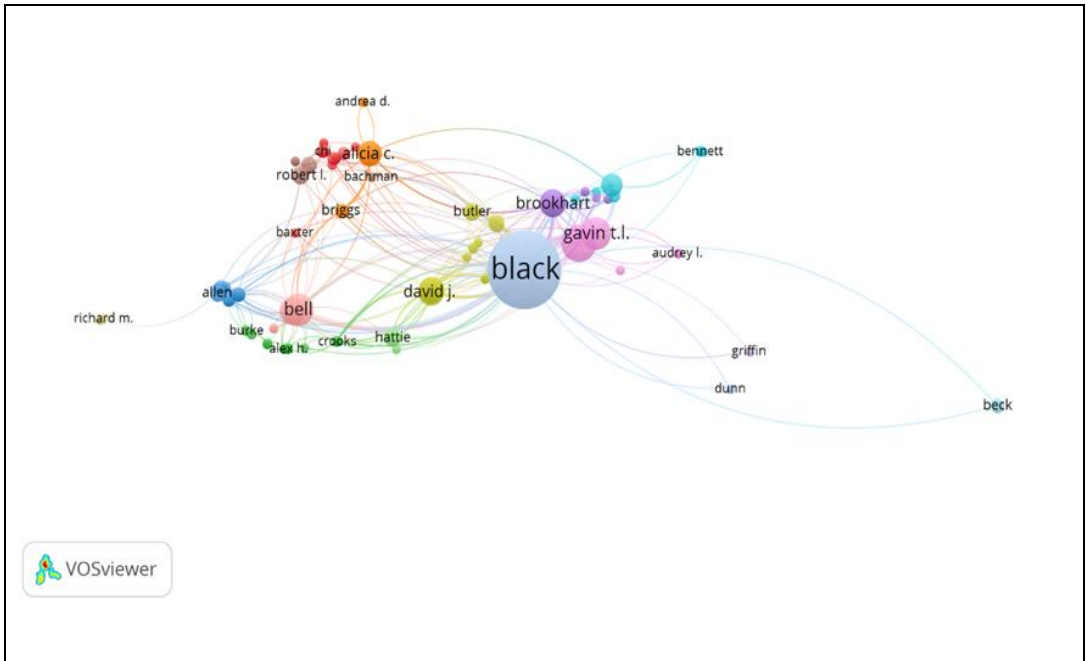


Figure 2 presents the intellectual structure of the research landscape on formative assessment in higher secondary schools using VOSviewer’s co-citation clustering, which organizes the contributing authors into fifteen color-coded thematic communities. For this analysis, a minimum threshold of three citations per author was applied, and 100 authors met this inclusion criterion, forming the basis of the co-citation network. At the center of the map lies Cluster 12, which embodies the core theoretical foundations of assessment, including essential work on assessment for learning, feedback processes, and teacher assessment literacy. This central cluster anchors the intellectual structure, reflecting its direct and enduring relevance to formative assessment. Surrounding this core are several influential clusters that collectively shape the field.

Cluster 1 consists of scholars from the learning sciences and cognitive psychology, whose work on mental models, prior knowledge, metacognition, and conceptual change provides theoretical understanding of how formative assessment supports learning. Cluster 2 captures classroom-based inquiry, science and mathematics education research, and teacher instructional practices, offering discipline-specific insights into how formative assessment is implemented in real classroom contexts. Cluster 3 and Cluster 4 contribute methodological strength; the former focuses on general educational research and instructional design, while the latter highlights

qualitative methodologies, reflective learning, and research design frameworks that support rigorous formative assessment inquiry.

Cluster 5 represents classroom assessment practices, including formative feedback, rubrics, and performance evaluation, directly reflecting applied dimensions of assessment for learning. Cluster 6 contributes large-scale assessment and psychometric perspectives, offering insights into measurement design that inform reliable and valid formative assessment tools. Closely related, Cluster 7 focuses on statistical modeling, value-added analysis, and data-driven decision making approaches that enhance teachers' interpretation of assessment evidence. Cluster 8 highlights meta-analysis and effect-size research that synthesizes evidence on instructional effectiveness and assessment interventions.

Cluster 9 contains work on teacher evaluation systems and observation frameworks, which, although not formative in focus, contribute to understanding teacher instructional improvement. Cluster 10 extends formative assessment research into higher secondary education pedagogy, while Cluster 11 centers on influential studies of feedback and instructional effectiveness that underpin many formative assessment strategies. The smaller clusters provide complementary perspectives: Cluster 13 contains publication platforms and broad empirical studies that support dissemination of formative assessment research; Cluster 14 focuses on competency-based assessment and learning progressions, reinforcing the alignment between learning goals and formative judgments; and Cluster 15 highlights technology-enhanced assessment and learning analytics, demonstrating emerging digital pathways for real-time feedback. Together, these fifteen clusters reveal a rich and interconnected intellectual landscape, demonstrating that formative assessment research draws on strong theoretical foundations, diverse methodological traditions, and increasingly technology-supported analytical approaches that collectively shape its development in higher secondary education.

3.5 Core Concepts and Their Thematic Linkages

For this analysis, a minimum threshold of 3 occurrence of keywords was applied, and 143 keywords met this inclusion criterion

Fig. 3: Network visualization map of the author keywords

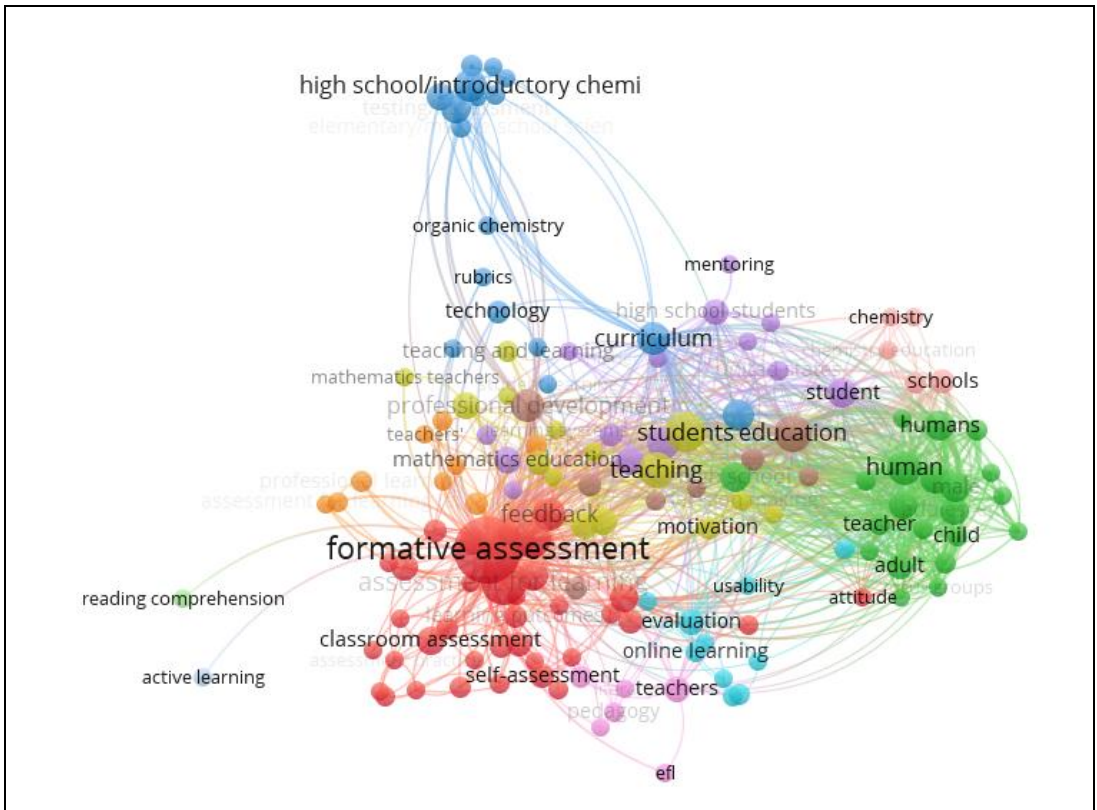


Figure 3 illustrates the conceptual structure of research on formative assessment in higher secondary schools through VOSviewer’s keyword co-occurrence mapping. For this analysis, a minimum threshold of three keyword occurrences was applied, and 143 keywords met this requirement. These keywords formed 1,233 total links with a combined link strength of 2,335, revealing 12 colour-coded conceptual clusters. The red cluster (Cluster 1) is the largest and represents the core of the field, containing concepts such as formative assessment, assessment for learning, assessment literacy, classroom assessment, rubrics, feedback, self-assessment, and learning outcomes. This cluster reflects the central pedagogical and assessment practices that underpin formative assessment. The green cluster (Cluster 2) includes concepts related to learner characteristics such as adolescent, child, adult, female, student involvement, and health education, emphasizing how formative assessment intersects with learner diversity and wellbeing. The blue cluster (Cluster 3) focuses on science and chemistry education, featuring terms like high school chemistry, curriculum, collaborative learning, organic chemistry, and teaching practices—indicating strong disciplinary engagement with formative assessment in STEM contexts.

The yellow cluster (Cluster 4) highlights technology-enhanced and cognitive learning processes, containing keywords such as e-learning, mobile learning, computer-aided instruction, motivation, learning achievement, and self-regulated learning. The purple cluster (Cluster 5) relates to teaching, curriculum, scaffolding, academic performance, secondary education, and mentoring, illustrating how formative assessment informs instructional design and teacher support. The light blue cluster (Cluster 6) contains methodological and evaluative concepts such as design research, evaluation, usability, PISA, questionnaires, and online learning, representing the methodological tools used in formative assessment research. The orange cluster (Cluster 7) focuses on science learning processes, including conceptual understanding, professional learning, perceptions, physics, student achievement, and student agency. The brown cluster (Cluster 8) contains research-oriented terms like learning progressions, randomized controlled trials, professional development, teacher learning, and secondary science, highlighting evidence-based approaches to improving practice.

The light green cluster (Cluster 9) features language and literacy-related terms, including EFL, pedagogy, literacy, continuing professional development, and teacher practices. The pink cluster (Cluster 10) relates to chemistry education, problem solving, and school settings. The light purple cluster (Cluster 11) focuses specifically on reading comprehension, while the peach/cream cluster (Cluster 12) isolates active learning as a distinct emergent concept. Collectively, these twelve colour-coded clusters demonstrate a tightly connected conceptual landscape in which formative assessment is linked with pedagogy, disciplinary learning, student cognition, digital tools, professional development, and methodological approaches. The map shows that formative assessment research in higher secondary education is multidimensional and interconnected, integrating core assessment practices with technology, subject-specific applications, teacher learning, and diverse student needs.

3.6 High-Impact Publications

Table 5: Top 10 most cited articles

Title	Year	Cited by
Teachers developing assessment for learning: Impact on student achievement	2004	415
The missing disciplinary substance of formative assessment	2011	229
Formative assessment and feedback: Making learning visible	2012	194
Rubrics and self-assessment scripts effects on self-regulation, learning and self-efficacy in secondary education	2012	181

Teachers learning how to learn	2009	148
Language assessment training in Hong Kong: Implications for language assessment literacy	2015	141
Linking a learning progression for natural selection to teachers' enactment of formative assessment	2012	141
Students' conceptions of assessment: Links to outcomes	2008	141
Assessment for student improvement: Understanding Hong Kong teachers' conceptions and practices of assessment	2009	139
Developing Web-based assessment strategies for facilitating junior high school students to perform self-regulated learning in an e-Learning environment	2011	133

Table 5 presents the top 10 most cited articles in the field, revealing a set of highly influential publications that have shaped the theoretical and practical understanding of formative assessment in secondary education. The most cited work is *“Teachers developing assessment for learning: Impact on student achievement”* (2004), with 415 citations, highlighting its foundational role in demonstrating how formative assessment directly contributes to improved learner outcomes. This is followed by *“The missing disciplinary substance of formative assessment”* (2011), cited 229 times, which offers a critical perspective on the need for discipline-specific formative assessment practices. Several articles published in 2012 appear prominently in the list—including *“Formative assessment and feedback: Making learning visible”* (194 citations) and *“Rubrics and self-assessment scripts effects on self-regulation, learning and self-efficacy in secondary education”* (181 citations)—reflecting a particularly productive period in which formative assessment research expanded into areas of feedback, metacognition, and student self-regulation. Other highly cited works, such as *“Teachers learning how to learn”* (2009; 148 citations) and *“Assessment for student improvement: Understanding Hong Kong teachers' conceptions and practices of assessment”* (2009; 139 citations), emphasize teacher beliefs and professional development as core dimensions of assessment reform. Studies from Hong Kong and natural science classrooms also stand out, including *“Language assessment training in Hong Kong”* (2015; 141 citations) and *“Linking a learning progression for natural selection to teachers' enactment of formative assessment”* (2012; 141 citations), which illustrate the growing global and disciplinary diversity of research in this field. Finally,

the inclusion of technology-focused research such as *“Developing Web-based assessment strategies...”* (2011; 133 citations) underscores the increasing relevance of digital learning environments. Overall, these highly cited articles represent seminal contributions that have significantly influenced policy, classroom practice, and subsequent research directions in formative assessment.

3.7 Mapping Country Collaboration Patterns

Fig. 4: Mapping Country Collaboration Patterns

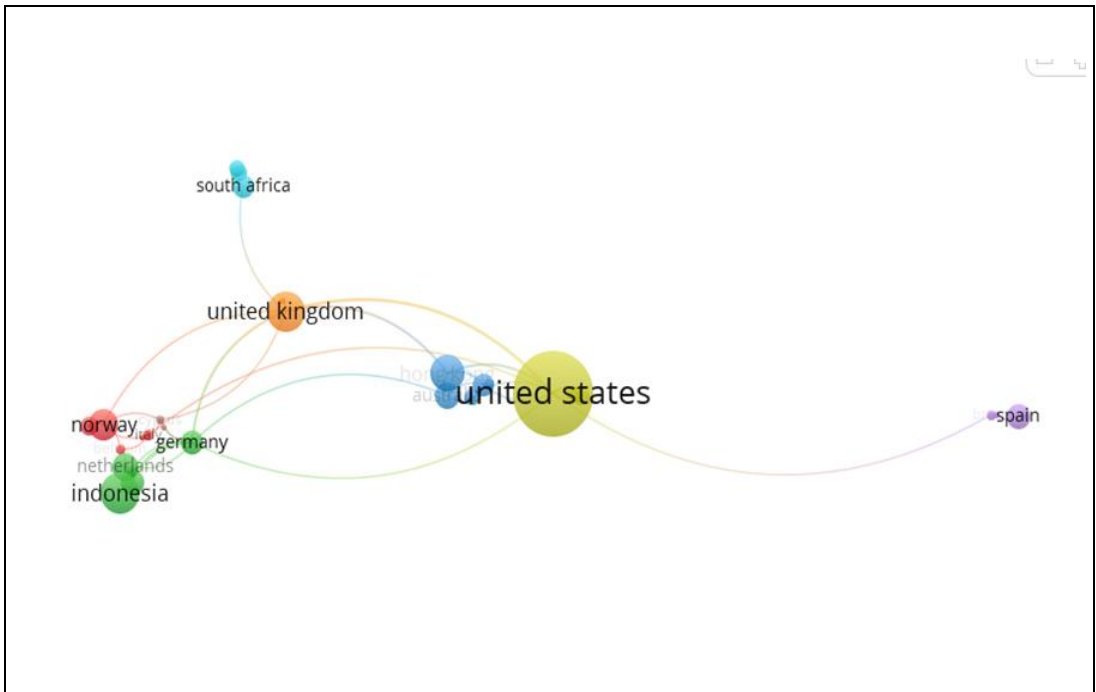


Figure 4 presents the country collaboration network in research on formative assessment, generated through VOSviewer’s co-authorship analysis at the country level. A minimum threshold of two citations per country was applied, and 51 countries met this requirement, forming a collaborative network containing 48 links with a total link strength of 62. The visualization reveals eight distinct colour-coded clusters, each representing a regional or thematic pattern of international research collaboration. The red cluster (Cluster 1) brings together European nations such as Belgium, Italy, North Macedonia, Norway, Slovenia, and Sweden, indicating strong intra-European cooperation in assessment research. The green cluster (Cluster 2) comprises Germany, Indonesia, the Netherlands, New Zealand, and Tanzania, reflecting collaborations between European, Asian, and Pacific regions. The blue cluster (Cluster 3) includes Australia, Canada, China, Hong Kong, and Singapore, representing a highly

connected Asia–Pacific research community with strong contributions to formative assessment scholarship. The yellow cluster (Cluster 4) links Albania, Chile, Israel, Turkey, and the United States, showing a diverse set of collaborations spanning North America, South America, Europe, and the Middle East.

The orange cluster (Cluster 5) includes Brazil, Colombia, Portugal, and Spain, reflecting a coherent Lusophone and Ibero-American research network. The purple cluster (Cluster 6) contains Japan, South Africa, and Taiwan, groups that contribute significant empirical work to assessment practices across different educational systems. The light green cluster (Cluster 7) features Greece, Ireland, and the United Kingdom, illustrating strong European and Anglophone partnerships. Lastly, the light blue cluster (Cluster 8) covers Cyprus and Switzerland, forming a small but distinct collaborative unit. Collectively, these eight clusters reveal that formative assessment research is globally distributed but regionally concentrated, with the United States, United Kingdom, China, and Australia emerging as central nodes linking multiple regions through strong collaborative ties. The colour-coded patterns highlight the interconnected yet regionally differentiated nature of international scholarship, demonstrating how global networks shape the development and dissemination of formative assessment research.

3.8 Institutional Drivers of Research Productivity

Table 6: Most influential institutions

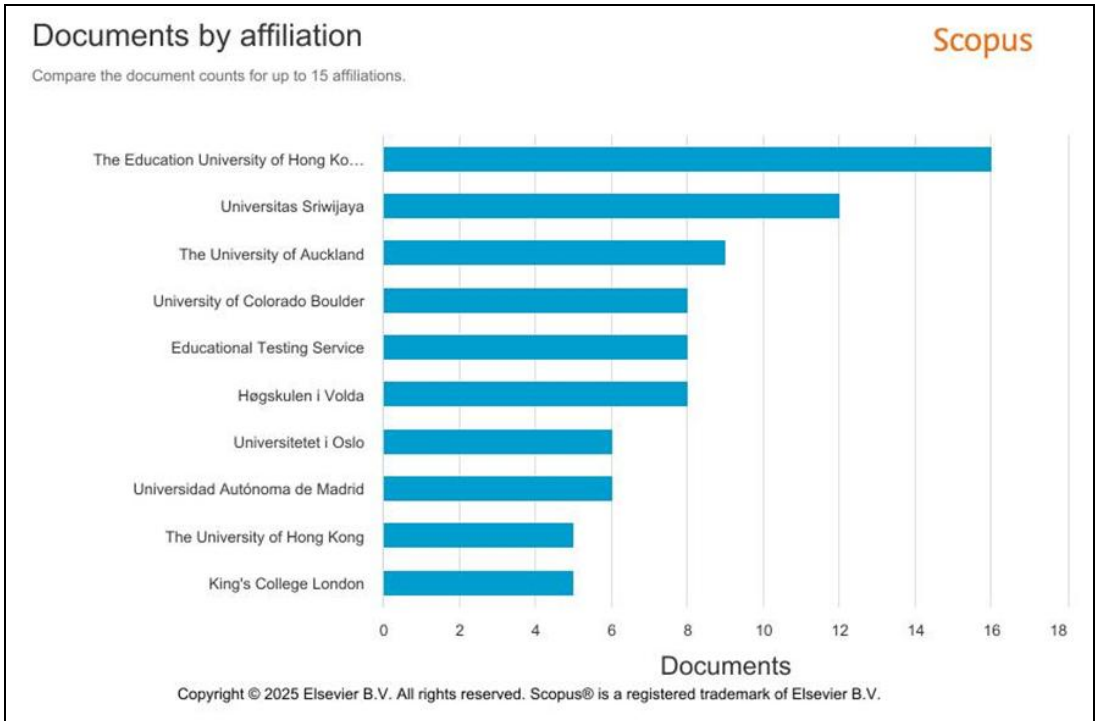


Table 6 highlights the most influential institutions contributing to research on formative assessment, demonstrating that scholarly output is concentrated within a group of leading universities and educational research centers. The Education University of Hong Kong stands out as the most productive institution with 16 publications, underscoring its central role in advancing assessment for learning and teacher education research. Universitas Sriwijaya follows with 12 publications, reflecting strong regional leadership in formative assessment studies within Southeast Asia. The University of Auckland contributes 9 publications, indicating New Zealand’s active engagement in assessment literacy and feedback research. Three institutions—the University of Colorado Boulder, Educational Testing Service (ETS), and Høgskulen i Volda—each produce 8 publications, signifying meaningful contributions to assessment practices, measurement, and pedagogical innovation. Universitetet i Oslo and Universidad Autónoma de Madrid each have 6 publications, representing notable European involvement in the field. Completing the top group, The University of Hong Kong, King’s College London, the University of Nottingham, the University of Massachusetts Boston, and Universitas Negeri Malang each contribute 5 publications, highlighting a geographically diverse set of institutions

supporting global research growth. Overall, the distribution shows that leading teacher education universities, major research organizations, and internationally recognized academic centers play a pivotal role in shaping formative assessment scholarship worldwide.

4 Discussion

The findings of this bibliometric study offer a comprehensive understanding of how research on formative assessment in higher secondary schools has evolved, expanded, and diversified over the past two decades. The analysis demonstrates that scholarly output has increased substantially since 2020, reflecting heightened global attention toward assessment practices, digital learning environments, and evidence-based teaching. The dominance of contributions from the United States, Indonesia, the United Kingdom, Hong Kong, and several European nations indicates that formative assessment research is primarily concentrated in regions with well-established educational research infrastructures and strong policy interest in assessment reform.

The intellectual structure revealed through co-citation analysis indicates that the field is grounded in robust theoretical foundations, including assessment for learning, feedback theory, cognitive psychology, and classroom assessment practices. The existence of 15 author clusters and 12 keyword clusters illustrates the multidimensional nature of formative assessment, spanning domains such as teacher learning, student agency, digital assessment, science and mathematics education, and competency-based learning. This demonstrates that formative assessment is not a singular construct but an interconnected web of instructional, psychological, disciplinary, and methodological perspectives.

The country collaboration patterns further highlight a globally distributed yet regionally clustered research landscape. Strong Asia-Pacific and European partnerships reflect sustained international collaboration, although some regions remain underrepresented. Additionally, the identification of key institutions and influential publications underscores that a relatively small number of research centres and scholars drive much of the theoretical and empirical developments in the field. Overall, the discussion reinforces that formative assessment research is rapidly expanding, interdisciplinary, and strongly influenced by global educational trends and structural collaborations.

5 Conclusion

Summary: This study mapped the research landscape of formative assessment in higher secondary schools using bibliometric and science-mapping techniques. Through analysis of 484 publications indexed in Scopus, the study identified leading authors, productive countries, influential institutions, major thematic clusters, and conceptual linkages within the field. Research output has intensified in recent years, with 12 concept clusters and 15 intellectual clusters indicating wide thematic

diversity. Country collaboration analysis revealed eight distinct international partnership clusters, and citation analysis identified highly influential works shaping the field.

Contribution: The study contributes to literature by providing the first comprehensive bibliometric overview focused specifically on formative assessment in higher secondary schooling. It integrates intellectual, conceptual, geographical, and institutional perspectives, offering a structured understanding of how theoretical foundations, research themes, and methodological approaches interact. The findings can inform policy makers, curriculum developers, and educators seeking evidence-based insights to strengthen formative assessment practices. It also provides future researchers with a clear map of existing knowledge structures and emerging areas.

Limitation of the study: The analysis was limited to publications indexed in Scopus, which, although comprehensive, may exclude relevant literature available in other databases such as Web of Science or ERIC. Additionally, bibliometric analyses depend on citation patterns, which may disadvantage recently published works or studies from less visible regions. Manual screening introduces the possibility of classification bias despite rigorous procedures.

Future research: Future work could expand the dataset by incorporating multiple databases and applying advanced text-mining or machine-learning techniques. Comparative bibliometric studies across educational levels could reveal how formative assessment practices differ between primary, secondary, and tertiary settings. Further research might also explore thematic evolution through longitudinal analysis or investigate underrepresented regions to support a more equitable global understanding of formative assessment. Amin et al. (2025) supports a well-rounded strategy that protects the privacy and ethical issues essential to preserving the integrity of educational systems while utilizing AI's transformative potential.

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