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Journal of Engineering, Science and Technology at the Crossroads of Science and Education: A Bibliometric Review (2009–2025)

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A B S T R A C T

This study presents a bibliometric analysis of publications in the Journal of Engineering, Science and Technology (JESTEC) indexed in Scopus from 2009 to July 2025, consisting of 3,825 documents. The analysis explores publication trends, geographic distribution, citation metrics, keyword frequency, and thematic clusters. Findings reveal a steady growth in international authority and highlight the increasing prominence of education-related research, particularly in topics aligned with the Sustainable Development Goals (SDGs), such as energy systems, waste valorization, and digital tools. Notably, 964 documents (over 25% of total publications) were identified as education-focused, with a peak in 2023. This trend underscores JESTEC's evolving role as not only a scientific journal but also a platform for educational innovation. The study suggests that JESTEC could further enhance its impact by formally recognizing education-driven research within its editorial direction, reflecting the real-world application of science and engineering through instructional design and training.

A R T I C L E   I N F O

1. INTRODUCTION

In the evolving landscape of academic publishing, discipline-specific journals play a critical role in shaping the direction of scientific inquiry and technological advancement. The *Journal of Engineering, Science and Technology (JESTEC)*, established in 2006 and published by Taylor's University, Malaysia, is one such platform committed to the dissemination of research that contributes to the development of engineering and scientific knowledge. Indexed by Scopus since 2010 and Clarivate's Emerging Sources Citation Index (ESCI) since 2016, JESTEC has steadily grown in visibility and credibility, especially within the engineering and applied science communities (see https://jestec.taylors.edu.my/).

JESTEC is not a multidisciplinary journal; rather, it is firmly focused on science and engineering. Within that scope, it welcomes theoretical, computational, and experimental research that advances core disciplinary knowledge. One notable aspect of its growth is the increasing number of submissions that demonstrate how scientific and engineering innovations are translated into real-world applications, including education. Because engineering solutions are often adopted in instructional tools, digital learning environments, and training systems, educational applications have become a meaningful secondary focus within JESTEC's portfolio, though not its primary scope.

Open access and rigorous double-blind peer review ensure that JESTEC maintains high scholarly standards while supporting inclusive and equitable knowledge dissemination. Led by Editor-in-Chief Assoc. Prof. Dr. Abdulkareem Sh. Mahdi Al-Obaidi, the journal publishes six issues annually and covers a wide range of topics, from materials engineering to computational mechanics, thermodynamics, and energy systems. Bibliometric analysis enables us to assess the impact and trajectory of scholarly journals based on citation trends, author affiliations, and thematic focus areas. Prior works have demonstrated how bibliometric mapping tools like VOSviewer can reveal patterns in engineering education research, nanotechnology, and sustainability studies within JESTEC (Al Husaeni & Nandiyanto, 2022; Nandiyanto *et al.*, 2021). However, a comprehensive article dedicated to mapping JESTEC's evolution, influence, and educational relevance remains absent from the literature.

Previous bibliometric studies (Sidik *et al.*, 2025; Al Husaeni *et al.*, 2024; 2022; Nandiyanto *et al.*, 2023a; Nandiyanto *et al.*, 2023b; Nandiyanto *et al.*, 2024a; Nandiyanto *et al.,* 2025a) have explored the evolution of various journals and research domains using quantitative mapping techniques. Building on these methodological foundations, this article aims to provide a comprehensive bibliometric analysis of the Journal of Engineering, Science and Technology (JESTEC), focusing on its publication trends, international authorship, citation impact, and educational relevance over the period 2009 to mid-2025. Specifically, it examines how engineering knowledge disseminated through JESTEC has contributed not only to core scientific research but also to educational innovation, with particular emphasis on Sustainable Development Goals (SDGs)-aligned themes. The novelty of this study lies in positioning JESTEC as both a scientific outlet and an emerging platform for engineering-based educational transformation.

2. METHODS

This study employed a bibliometric approach to analyze the publication output of the *Journal of Engineering, Science and Technology (JESTEC)* from 2009 to July 2025. Detailed procedures for bibliometric analysis are explained elsewhere (Rochman et al., 2024; Al Husaeni & Nandiyanto, 2022; Al Husaeni & Al Husaeni, 2022). Data were retrieved from the Scopus database using the journal's International Standard Serial Number (ISSN: 1823-4690) as the search parameter. The

extraction was conducted in July 2025 and included all document types indexed in Scopus under JESTEC.

The bibliometric analysis focused on four main indicators: (i) annual publication trends, (ii) country-wise contributions, (iii) the most cited articles, and (iv) the subset of documents with educational relevance. The latter was identified by filtering documents using the keyword "education" in titles, abstracts, and keywords. A total of 3,825 documents were retrieved, of which 964 were categorized as education-related. Descriptive statistics were used to generate frequency distributions and trend analyses. Visualization of bibliometric data (including publication growth and geographic output) was created using Scopus' built-in analytics tools. Most-cited documents were listed based on total citations indexed in Scopus as of July 2025. The analysis also included a qualitative categorization of recent education-related publications (2022-2025) to provide examples of how science and engineering knowledge has been applied to support instructional innovations, learning tools, and curriculum development. These were organized into tables with reference to volume, issue, and page numbers.

The bibliometric approach was selected because it allows for a systematic and reproducible assessment of publication performance and thematic development over time. This method is particularly effective for tracking journal evolution, author impact, and the scope of applied contributions in a field. By combining quantitative metrics with thematic focus, the study offers insight into JESTEC's dual role as both a disseminator of engineering science and a platform for its educational applications.

3. RESULTS AND DISCUSSION
3.1. Publication Growth Trends in JESTEC (2009-2025)

The *Journal of Engineering, Science and Technology (JESTEC)* JESTEC has demonstrated a significant increase in publication output over the past 15 years. As shown in **Figure 1**, the number of articles published annually has risen from under 100 in 2009 to over 400 in both 2022 and 2023. This growth indicates an expanding contributor base and the journal's rising visibility, especially after being indexed in Scopus in 2010 and Clarivate's ESCI in 2016. The reduction in publication numbers observed in 2024 and the first half of 2025 reflects a deliberate editorial decision rather than a decline in submissions or interest.
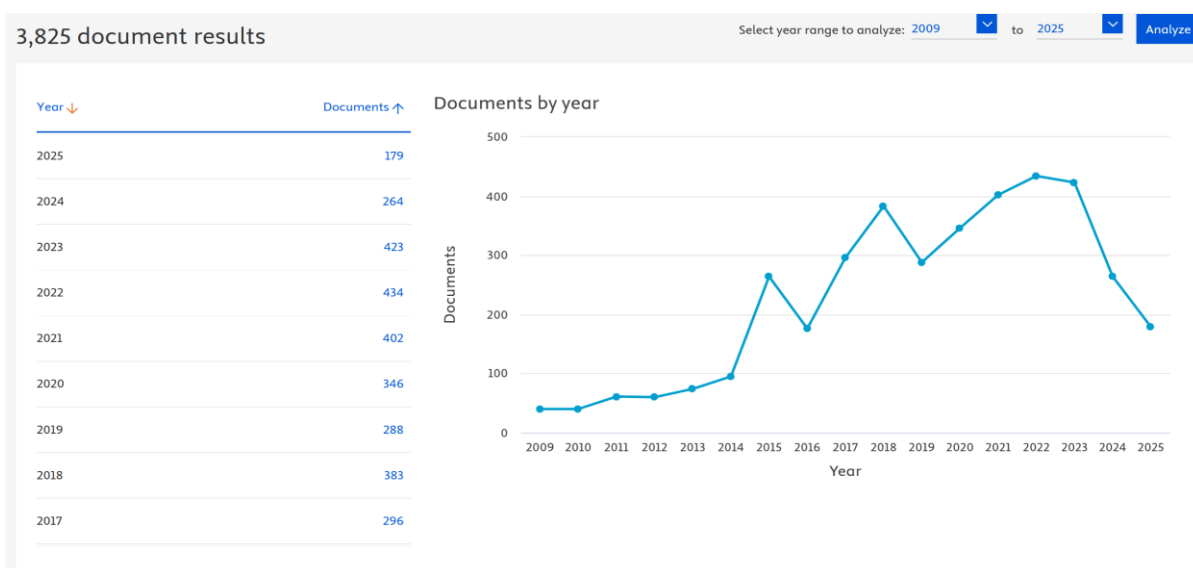

Figure 1. Annual publication output of the Journal of Engineering, Science and Technology (JESTEC) indexed in Scopus (2009–2025).

This decision was informed by a critical analysis of citation performance, readership engagement, research quality, and alignment with emerging publication trends. In response, the editorial board refined its publication strategy to prioritize impact-driven, high-quality research that aligns with the journal's evolving thematic focus and scientific standards.

The increasing publication volume also correlates with a wider range of topics and broader global participation, reinforcing JESTEC's relevance in the engineering science landscape. Particularly after 2018, the journal has increasingly attracted manuscripts related to sustainable technologies, digital systems, and applied engineering models, reflecting its growing alignment with emerging interdisciplinary and SDG-oriented themes.

3.2. Geographical Contributions to JESTEC

A breakdown of authorship by country (**Figure 2**) reveals that *JESTEC* receives its highest number of submissions from Malaysia (1,260 articles), followed closely by Indonesia (1,017) and India (627). Iraq (538). Other notable contributors include the United Kingdom (78), Japan (74), Saudi Arabia (68), and Iran (62). These figures reflect strong engagement from Southeast Asia and the Middle East, regions where engineering research is rapidly expanding and where JESTEC offers an accessible and credible outlet.
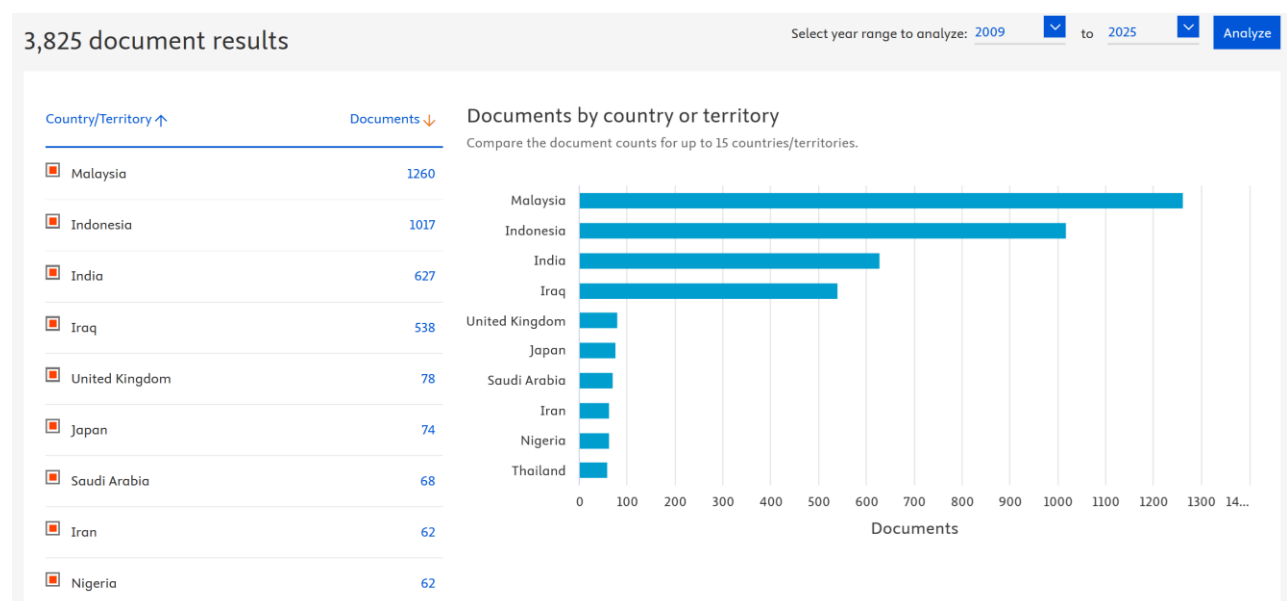

Figure 2. Top contributing countries to JESTEC publications from 2009 to 2025, based on Scopus-indexed document counts.

This distribution also highlights the journal's strategic importance in amplifying engineering voices from the Global South and underrepresented regions, where access to high-impact publication platforms often remains limited. JESTEC's open-access model promotes inclusivity by providing free access to readers worldwide, while offering authors a transparent and accessible platform for disseminating their research.

3.3. Most Cited Articles in JESTEC

Citation analysis provides insight into the journal's most impactful works. **Table 1** presents the 12 most cited JESTEC articles specifically related to education and bibliometric studies, based on Scopus data as of July 2025. The top-cited article (Nandiyanto et al., 2021) analyzes chemical engineering trends during the COVID-19 pandemic using VOSviewer and has garnered 101 citations. Other highly cited papers include bibliometric mappings of engineering education,

studies on SDGs, biomass pretreatment, and innovative educational methods such as chatbot-assisted grammar learning and nanotechnology for students with disabilities.

Table 1. Top 12 most cited articles in the Journal of Engineering, Science and Technology (JESTEC) in term of education based on Scopus citation counts as of July 2025.

No	Title	Cited by	Reference
1	A bibliometric analysis of chemical engineering research using VOSviewer and its correlation with Covid-19 pandemic condition	101	Nandiyanto *et al.* (2021)
2	Bibliometric computational mapping analysis of publications on mechanical engineering education using VOSviewer	89	Al Husaeni and Nandiyanto (2022)
3	Sustainable Development Goals (SDGs) in Science Education: Definition, Literature Review, and Bibliometric Analysis	86	Maryanti *et al.* (2022)
4	Microwave-assisted pretreatment of lignocellulosic biomass: A review	85	Saleem *et al.* (2015)
5	Fragmentation issue in Malaysian industrialised building system (IBS) projects	84	Nawi *et al.* (2014)
6	Bibliometric analysis of engineering research using VOSviewer indexed by Google Scholar	76	Nandiyanto and Al Husaeni (2022)
7	Combustion analysis of algal oil methyl ester in a direct injection compression ignition engine	56	Hariram and Mohan Kumar (2013)
8	Teaching "nanotechnology" for elementary students with deaf and hard of hearing	55	Nandiyanto *et al.* (2018)
9	Understanding Covid-19 particle contagion through aerosol droplets for students with special needs	50	Maryanti *et al.* (2020)
10	Adsorption isotherm of mesopore-free submicron silica particles from rice husk	46	Ragadhita *et al.* (2019)
11	Counseling guidance in science education: Definition, literature review, and bibliometric analysis	41	Solehuddin *et al.* (2023)
12	Gengbot: A chatbot-based grammar application on mobile instant messaging as language learning medium	38	Haristiani *et al.* (2019)

These citation patterns suggest that articles integrating engineering with bibliometric methods, educational applications, and sustainability themes attract higher scholarly attention. The prominence of SDG-oriented research also highlights JESTEC's alignment with evolving global science policy priorities. Indeed, the successful JESTEC is in line with the best journals in Indonesia, such as Indonesian Journal of Science and Technology (IJoST) (see **Table 2**), ASEAN Journal of Science and Engineering (AJSE) (see **Table 3**), and ASEAN Journal for Science and Engineering in Materials (AJSEM) (see **Table 4**).

Table 2. Current publications in IJoST.

No	Title	Reference
1	Measurement and quantitative analysis of ozone generation in radiation treatment room due to high-energy photon.	Cho and Choi (2025)
2	Effect of solvent pre-treatment and catalyst on microwave-assisted pyrolysis of rice straw.	Hamzah *et al.* (2025)
3	Synthesis and investigation of dithiocarbamate derivatives as polyfunctional ingredients in rubber compounds.	Kochetkov *et al.* (2025)
4	Enhanced product defect detection in smart manufacturing using ConvNeXt-stacked autoencoder architecture.	Hasan *et al.* (2025)

Table 2 (Continue). Current publications in IJoST.

No	Title	Reference
5	Optimization of piper trilinier diagram using lithium isotope systematics: An application for detecting the contribution of geothermal water from Aso Caldera after earthquake 2016 in Kumamoto aquifer, Japan.	Umam *et al.* (2025)
6	Ganciclovir-loaded chitosan nanoparticles and their activity against HSV-1 inducing herpetic retinitis.	Haruna *et al.* (2025)
7	H2O2-modified geopolymers as integrated adsorbent-catalysts for FFA removal and biodiesel production from crude palm oil.	Wahyuni *et al.* (2025)
8	Integration of water heating systems with car air conditioning systems: A bibliometric analysis, lab-scale investigation, and potential applications.	Rusdjijati *et al.* (2025)
9	Chemical looping systems for hydrogen production and their implementation in Aspen Plus software: A review and bibliometric analysis.	Vanegas *et al.* (2025)
10	Comprehensive characterization of gelatin films from goat skin incorporating konjac glucomannan: Physical, mechanical, and molecular properties.	Hasdar *et al.* (2024)

Table 3. Current publications in AJSE.

No	Title	Reference
1	Integrated CRITIC-TOPSIS and Monte Carlo sensitivity analysis for optimal various natural fibre selection in sustainable building insulation composites to support the Sustainable Development Goals (SDGs).	Rahman *et al.* (2025)
2	Analysis of electric vehicle (EV) transmission performance through helical rotor gear systems with variable helix angles.	Hassan *et al.* (2025)
3	Current strategies for mitigating airborne pathogen transmission: An integrative review based on aerosol science and particle technology to support the Sustainable Development Goals (SDGs), complemented by a bibliometric analysis.	Ragadhita *et al.* (2025)
4	What evidence supports the advancement of language learning through digital innovation? Toward achieving Sustainable Development Goals (SDGs) in the 21st century completed with bibliometric analysis.	Al Husaeni and Haristiani (2025)
5	Development of interpolymer complexes for soil structure and water retention: A scientific and technological contribution to Sustainable Development Goals (SDGs).	Mukhamedov *et al.* (2025)
6	Smart electric resistance welding based on artificial intelligence (AI) based on real-time adaptive statistical features completed with bibliometric analysis.	Fufon *et al.* (2025)
7	Role of coastal vegetation belts in mitigating tsunami waves: Bibliometric analysis, numerical, and spatial analysis.	Usman *et al.* (2025)
8	Comprehensive review on wastewater treatment using nanoparticles: Synthesis of iron oxide magnetic nanoparticles, publication trends via bibliometric analysis, applications, enhanced support strategies, and future perspectives.	Mohammed *et al.* (2025)
9	Digital educational media for hospital waste management: addressing waste types, illegal disposal, and environmental impact.	Rahadi *et al.* (2025)
10	Synthesis and characterization of acetylene alcohols via alkynylation of heteroatomic aldehydes with phenylacetylene under various reaction parameters completed with spatial chemical structure, literature review, and bibliometric analysis.	Otamukhamedova *et al.* (2025)

Table 4. Current publications in AJSEM.

No	Title	Reference
1	Uncovering the full potential utilization of petroleum reserves residue for sustainable energy supply.	Khan *et al*. (2025)
2	Solvent recovery from industrial paint waste using batch distillation: The effect of temperature.	Setyawan *et al*. (2025)
3	Correlation of metabolomics and functional foods research in 2020 to 2023: Bibliometric analysis.	Dewi (2025)
4	In-vitro analysis of antimicrobial activities of green synthesized silver oxide nanoparticles on some microorganisms found in open wound.	Abdulmaleek *et al*. (2025)
5	Performance study of biocoating material with damar and silica extract from rice husk on mild steel in NaOH solution.	Saputra *et al*. (2025)
6	The use of zeolite material as a filtration media in waste treatment: Bibliometric analysis.	Oktaviani (2025)
7	A dynamic area-pressure model applied to crystals in a pot plant battery and other space matter.	Strömberg (2024)
8	Exploring diverse substrates for enhanced water splitting: tailoring energy conversion and storage through specific qualities with its limitations.	Waheed *et al*. (2024)
9	Hard and Soft Acids and Bases (HSAB): Investigating adduct formation in non-aqueous solvent media with selected divalent class B metal ions in chemistry.	Onwudinjo (2024)
10	Synthesis, characterization, and antimicrobial studies of some metal (II) complexes of some azo dyes.	Aladesusi and Eke (2023)

4.3. Education-Focused Research within JESTEC

Although JESTEC is not a multidisciplinary journal, it has increasingly published works that apply engineering and scientific innovation to educational settings. Using "education" as a keyword filter, 964 out of 3,825 documents (25.2%) were identified as having educational relevance. These papers typically focus on instructional tools, engineering learning modules, sustainability education, or technology-assisted pedagogy.

As shown in **Figure 3**, education-related publications have grown steadily over time, peaking at 166 documents in 2023, followed by 129 in 2024 and 103 in the first half of 2025. This trajectory highlights a rising emphasis within the journal on educational innovation, particularly in science, technology, engineering, and mathematics (STEM) disciplines, as well as on SDG-oriented research. The increased volume also reflects JESTEC's growing appeal to researchers exploring the intersection between engineering practice and educational application.

A country-level view of education-themed publications, presented in **Figure 4**, confirms that Indonesia leads with 570 articles, followed by Malaysia (260) and India (81). This distribution aligns with ongoing educational reforms, rapid digitalization, and a strong regional focus on integrating engineering knowledge with sustainable and inclusive learning initiatives. The dominant contributions from Southeast Asia further underscore JESTEC's strategic positioning in advancing educational applications of engineering research in the Global South.

(SOURCE-ID (18200156709)) AND (education)

964 document results

Select year range to analyze: 2009 to 2025 Analyze

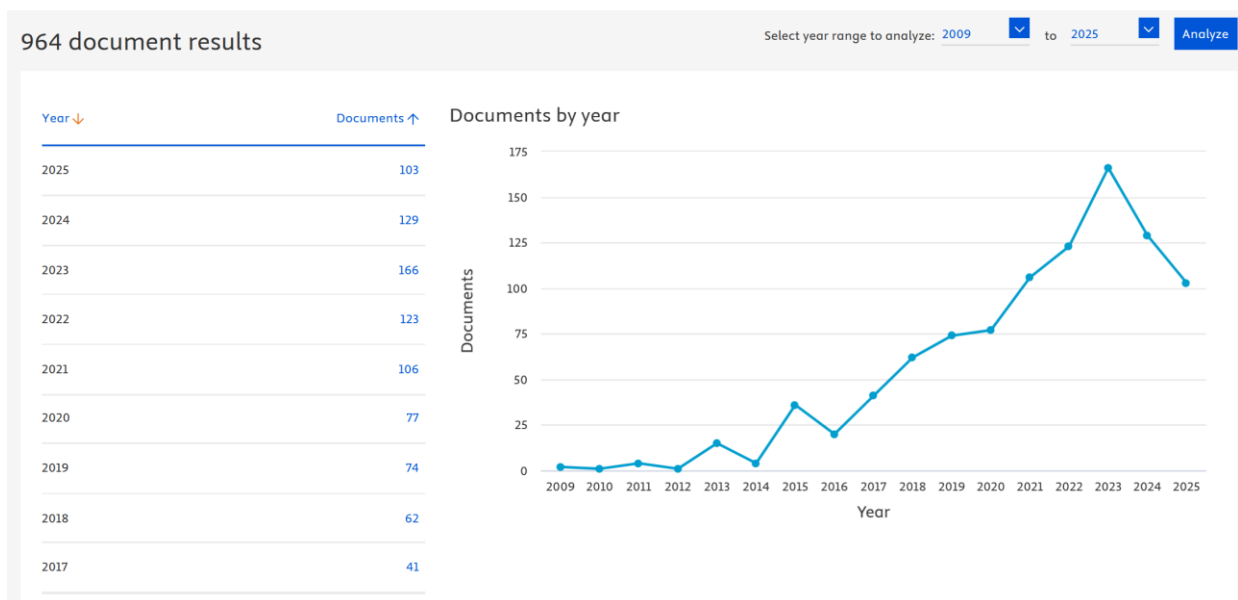| Year ↓	Documents ↑
2025	103
2024	129
2023	166
2022	123
2021	106
2020	77
2019	74
2018	62
2017	41

Documents by year

Figure 3. Annual trends in education-related publications in JESTEC from 2009 to 2025, illustrating the journal's rising emphasis on STEM education and SDG-aligned contributions.

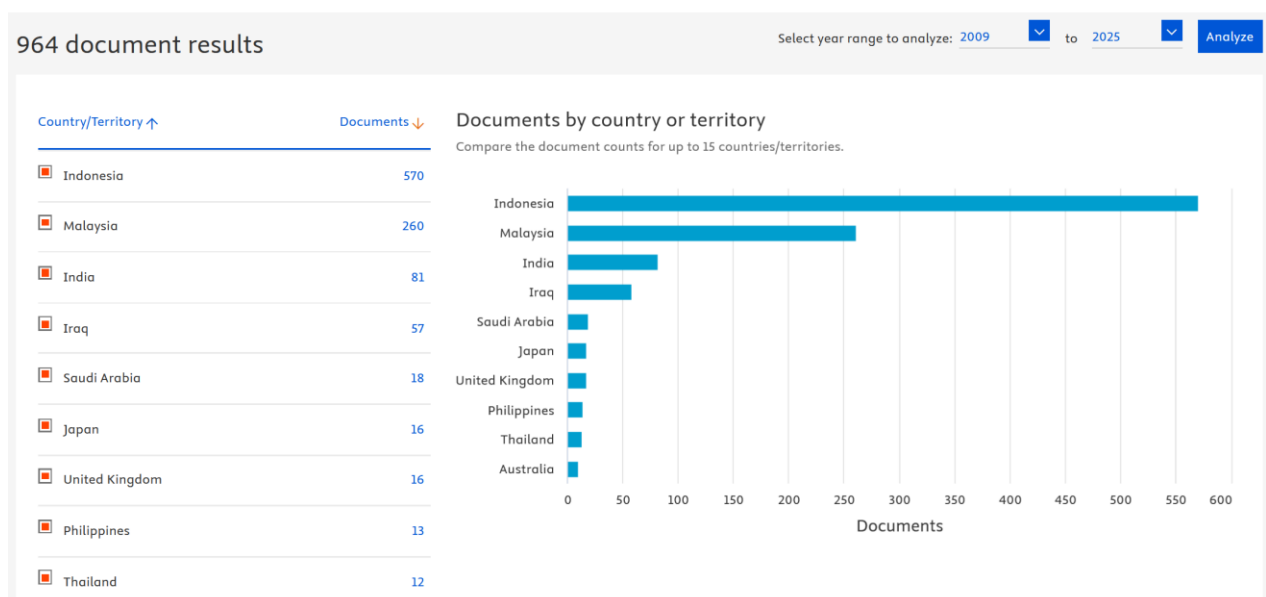(SOURCE-ID (18200156709)) AND (education)

964 document results

Select year range to analyze: 2009 to 2025 Analyze

Country/Territory ↑	Documents ↓
Indonesia	570
Malaysia	260
India	81
Iraq	57
Saudi Arabia	18
Japan	16
United Kingdom	16
Philippines	13
Thailand	12

Documents by country or territory
Compare the document counts for up to 15 countries/territories.

Figure 4. Top contributing countries to education-related publications in JESTEC from 2009 to 2025, based on Scopus-indexed data.

3.5. Featured Examples of Educational Applications

To illustrate the breadth and depth of education-related contributions in JESTEC, **Table 5** presents 21 selected articles published between 2022 and 2025. These studies span a variety of educational innovations, including:

(i) Techno-economic feasibility analyses for educational tools (e.g., board games, solar panels)
(ii) Material-based learning aids (e.g., fire-retardant bamboo, cornflour insulators)
(iii) Waste-to-education innovations aligned with SDGs
(iv) Scoping reviews on artificial intelligence, deep learning, and sustainability in pedagogy

Table 5. Selected education-focused articles published in JESTEC from 2022 to 2025, emphasizing the integration of science and technology with educational applications aligned to the SDGs.

No	Title	Reference (Author, Year)
1	Techno-economic feasibility of educational board game production from agro-industrial waste in support of Sustainable Development Goals (SDGs) through science and technology integration	Mukmin *et al*. (2025)
2	Harnessing biomass for Sustainable Development Goals (SDGs): Definition, bibliometric, application, opportunities, and challenges	Nandiyanto *et al*. (2025)
3	Techno-economic analysis of solar panel production from recycled plastic waste as a sustainable energy source for supporting digital learning in schools based on SDGs and science-technology integration	Indra *et al*. (2025)
4	Engineering research and scientific contributions at Universitas Pendidikan Indonesia: Trends, challenges, and future directions	Solehuddin *et al*. (2025)
5	Interpretive structural model to enhance research productivity in Indonesia based on the science and technology index	Hamidah *et al*. (2025)
6	Deep learning applied in education: Scoping review	Saputra *et al*. (2024)
7	Experimental demonstration for teaching the concept of steam engine power plant to vocational students to support the SDGs and its comparison to Indonesian Merdeka Curriculum	Fiandini *et al*. (2024)
8	FTIR of pyrolysis of polypropylene microparticles and its chemical reaction mechanism completed with computational bibliometric review to support SDGs	Nandiyanto *et al*. (2024)
9	Teaching the Doppler effect to students with deaf and hard of hearing	Efrina *et al*. (2023)
10	Adsorption isotherm characteristics of calcium carbon microparticles prepared from chicken bone waste to support SDGs	Nandiyanto *et al*. (2023c)
11	Computational calculation of adsorption isotherm characteristics of carbon microparticles prepared from mango seed waste to support SDGs	Nandiyanto *et al*. (2023d)
12	A new synthesis of cellulose fiber: The influence of ionic liquid concentration on the formation of controllable size nanoparticles	Mudzakir *et al*. (2023)
13	A computational bibliometric analysis of science education research using VOSviewer	Maryanti *et al*. (2023)
14	Utilization of cornflour particles as a model for thermal insulator for teaching students with hearing impairments	Hidayat *et al*. (2023)
15	Empirical demonstration of fire-retardant bamboo to junior high school students for understanding physicochemical properties	Affah *et al*. (2023)
16	Project effectivity of adsorbent from food waste for learning achievement of education for Sustainable Development	Anggraeni *et al*. (2023)
17	Sustainable development goals (SDGs) in science education: Definition, literature review, and bibliometric analysis	Maryanti *et al*. (2022)
18	Particle and pore size of rice husk ash on brake pads: Experiments and bibliometric review	Nandiyanto *et al*. (2022a)
19	Adsorption isotherm analysis of floating composite ZIF-8 in epoxy cubes	Nandiyanto *et al*. (2022b)
20	Teaching brake pad concepts from palm fronds and rice husks to high school students	Anggraeni *et al*. (2022)
21	Shell and tube heat exchanger design for TiO_2 particle production	Nandiyanto *et al*. (2022c)

This curated set of articles reflects how engineering principles are increasingly being translated into instructional tools, especially in sustainability education, STEM curriculum development, and inclusive pedagogy for diverse learner groups (e.g., students with hearing impairments). While these themes extend beyond JESTEC's traditional disciplinary scope, they underscore the journal's evolving relevance as a platform for applied engineering education and its alignment with broader developmental and policy objectives, particularly those related to the SDGs.

3.6. Thematic Trends in Engineering Applications for Education

The review of educationally focused publications in *JESTEC* reveals several recurring themes that illustrate how engineering research is applied in educational contexts. A notable emphasis is placed on sustainability-driven design, including initiatives that transform agro-industrial waste into educational tools. For example, some researchers (Mukmin et al., 2025) developed an educational board game from waste materials, a dual-purpose innovation that supports both waste valorization (a significant engineering challenge) and hands-on science education aligned with the SDGs.

Other studies (Indra *et al*., 2025; Nandiyanto *et al*., 2025b) emphasize the use of recycled materials (such as plastic waste and biomass) in creating engineering prototypes intended for classroom use. These works underscore a bidirectional relationship between engineering system design and educational practice, where engineering functions both as content and as a delivery medium for instructional innovation.

Importantly, many of these contributions adopt a techno-economic feasibility frameworks to assess the practicality of integrating engineering-derived tools into formal learning environments. This analytical approach evaluates whether such innovations are scalable, cost-effective, and adaptable for widespread use in public schools or vocational training programs, factors essential for meaningful impact in education systems.

3.7. SDG Integration and Environmental Engineering in Learning

A large portion of the education-related articles also demonstrate explicit alignment with the United Nations SDGs. These include studies on water purification (such as food-waste-based adsorbents for wastewater treatment), sustainable energy systems (including recycled solar panels), and environmentally responsible manufacturing (for example, biodegradable thermal insulators).

Articles (Nandiyanto *et al*., 2024b; Anggraeni *et al*., 2023) frequently combine materials engineering experiments with pedagogical framing, creating hands-on modules or teaching aids designed to increase environmental literacy among students. This convergence is significant because SDG-oriented research has become a priority in both science policy and academic publishing, and JESTEC actively contributes to this space within its science-and-engineering-specific scope.

For instance, the fabrication of brake pads from biomass waste or ZIF-8-integrated epoxy composites (usually considered advanced materials science topics) is presented in a format that enables their use in high school or undergraduate classrooms. These applications retain their technical integrity while being recontextualized for instructional purposes, enabling students to engage with authentic engineering concepts through accessible, real-world examples.

3.8. Engineering Tools for Inclusive and Specialized Education

A particularly impactful theme is the application of engineering research to inclusive and specialized education, particularly for students with disabilities. Articles (Efrina *et al*., 2023; Hidayat *et al*., 2023) explore how visual and tactile simulation tools, derived from engineering models, can support learners who are deaf or hard of hearing. These studies integrate concepts from signal processing (e.g., Doppler effect instructional devices), thermal physics (e.g., biodegradable thermal insulators), and physical chemistry (e.g., FTIR-based demonstrations) to create multisensory learning environments.

These innovations are significant because they translate abstract engineering concepts into concrete, experiential formats, thereby enhancing accessibility for students with cognitive or physical differences. This approach aligns with the principles of Universal Design for Learning (UDL), which advocate for multiple sensory inputs, flexible instructional strategies, and differentiated learning pathways within STEM education.

Furthermore, these contributions reflect how JESTEC authors are extending the impact of engineering research beyond traditional laboratory contexts into the domain of educational equity and accessibility—a space traditionally underrepresented in core engineering journals. By supporting inclusive pedagogy, JESTEC demonstrates its evolving role in bridging scientific rigor with social relevance.

3.9. Computational Approaches and Bibliometric Literacy

Beyond applied classroom tools, JESTEC has increasingly positioned itself as a leading platform for publishing computational and bibliometric studies related to science and engineering education. Articles (Maryanti *et al*., 2022; Maryanti *et al*., 2023; Al Husaeni & Nandiyanto, 2022; Solehuddin *et al*., 2023) exemplify this trend. These studies employ tools such as VOSviewer, keyword co-occurrence mapping, and citation network analysis to trace developments in engineering education, SDG integration, and nanotechnology instruction.

This computational approach is valuable because it facilitates evidence-based decision-making in curriculum design, research planning, and policy formulation. Moreover, bibliometric literacy is becoming an essential component of research training in engineering graduate programs, an area where JESTEC's contributions offer accessible, data-driven, and pedagogically relevant models.

The inclusion of such meta-research enhances JESTEC's evolving role as a reflective academic space, where contributors are encouraged not only to build technological solutions but also to critically examine the structural dynamics and knowledge ecosystems that shape the field of engineering education.

3.10. Implications for JESTEC's Editorial Strategy

The observed trends suggest that JESTEC's editorial board may benefit from formally recognizing educational applications as a sub-theme under its existing aims and scope. While the journal remains firmly grounded in engineering science and technology, the growing volume and methodological rigor of education-oriented articles (often employing experimental, computational, and techno-economic approaches) demonstrate sustained scholarly value and relevance.

Furthermore, the high citation impact of education-aligned works (see **Table 1**) indicates that such contributions are not only well-received but also influential within the broader academic community. For example, publications on bibliometric mapping, sustainable material applications in classrooms, and digital learning technologies consistently rank among JESTEC's most-cited articles. In light of this, strategically promoting education-related special issues, thematic

collections, or invited reviews could further enhance the journal's international visibility and citation performance.

In addition, these developments are aligned with global academic priorities such as SDG integration, environmental responsibility in engineering, and inclusive innovation, all of which are expected to remain prominent themes over the coming decade. By continuing to support high-quality educational applications of engineering research, JESTEC positions itself as a progressive and responsive journal, attuned to the evolving societal roles of science and technology.

3.11. Trends in Article Typology: From Case Studies to Review-Based Education Models

An analysis of document types within JESTEC's education-focused segment reveals a discernible shift from purely experimental studies toward case-based pedagogical designs and review-oriented educational models. Several articles employ action research frameworks or empirical demonstration methods, particularly when aimed at school or vocational learners. Examples include steam engine teaching models (Rohmatillah *et al*., 2024) and fire-retardant bamboo prototypes (Anggraeni *et al*., 2023), which are fabricated using standard engineering procedures and subsequently evaluated through pre- and post-intervention educational assessments

These studies typically follow a quasi-experimental or design-based research approach, in which engineering innovation serves both as the subject matter and as the instructional medium. This dual-purpose design ensures that engineering artifacts are assessed not only for their technical performance but also for their cognitive and educational impact. Such hybrid evaluation strategies reflect a mature integration of educational theory and engineering validation, thereby elevating the scholarly rigor of these contributions.

Conversely, a growing number of review-based articles (such as bibliometric analyses of sustainable development education (Maryanti *et al*., 2023) and deep learning applications in instructional contexts (Wahyuni *et al*., 2024) emphasize secondary data synthesis. These papers are frequently enhanced through visual bibliometric tools, including VOSviewer-generated maps and network diagrams, which improve interpretability and accessibility. This is particularly beneficial for early-career researchers and postgraduate students entering the interdisciplinary field of engineering education.

3.12.   Table and Figure Analyses: Visualizing Impact and Scope

Table 1 for *Top Cited Articles in JESTEC Related to Education*, presents a curated selection of 10–20 highly cited publications, with citation counts ranging from 10 to over 80. These articles address topics such as SDG-focused science education, the integration of bibliometric literacy in instructional contexts, and material-science demonstrations designed for educational engagement. The table illustrates that engineering research with educational applications is not only within JESTEC's scope but also receives significant academic attention, as reflected in its citation impact.

In contrast, **Table 5**, titled *Recent Publications in JESTEC Related to Educational Engineering Applications*, features a broader range of recently published works (primarily from 2023 to 2025) most of which currently have few or no citations due to their recency. Nevertheless, they demonstrate strong thematic continuity with earlier high-impact publications, especially in their alignment with SDGs, the use of waste-based engineering solutions, and interdisciplinary pedagogical innovation. This table serves as an anticipatory index, showcasing research with strong potential for future citations and emerging scholarly relevance.

Figure 1 visualizes the annual growth in education-related publications in JESTEC between 2009 and 2025. The chart reveals a marked increase in 2023 and 2024, corresponding with global momentum around SDG integration and the post-COVID transition to alternative STEM pedagogies. This visual complements the tabular, and it summaries by highlighting JESTEC's evolving role in science- and engineering-based educational research.

3.13. Scientific Communication and Visual Demonstration as Educational Tools

Another key trend in *JESTEC*'s educational publications is the integration of visual demonstrations and simulation-based techniques to enhance conceptual understanding in STEM education. For example, several studies (Anggraeni *et al.*, 2023; Yuniarto *et al.*, 2024) have showcased the educational potential of infrared spectroscopy and thermal physics through tools such as animated particle models, diagrammatic storytelling, and color-coded reaction mechanisms. These instructional tools are often implemented in classroom settings to assess their impact on student engagement and learning retention.

Such research repositions engineering not only as content to be learned but also as a vehicle for teaching complex scientific principles. This reflects a broader pedagogical trend: employing engineering methodologies—such as simulation, prototyping, and instrumentation—as cross-disciplinary educational tools in fields like chemistry, physics, and environmental science.

This instructional shift also aligns with the epistemic fluency model in education, which encourages students to develop the capacity to blend practical engineering problem-solving with abstract scientific reasoning. By incorporating hands-on, visually enriched strategies, these approaches facilitate deeper cognitive processing and broaden accessibility in STEM learning environments.

JESTEC's growing portfolio of such studies offers a valuable reference point for educators and curriculum developers seeking to incorporate engineering-based tools into science instruction across educational levels.

3.14. Engineering Education for Societal Impact: Inclusive, Sustainable, and Scalable

One of the most compelling features of JESTEC's education-oriented publications is their emphasis on socially responsive and community-embedded engineering education. Whether through the development of inclusive tools for learners with disabilities or the use of locally sourced materials for science instruction in underserved regions, these articles highlight a clear focus on scalability, affordability, and cultural relevance.

In particular, the use of palm sugar, chicken bones, and mango seeds as experimental materials demonstrates a thoughtful engagement with indigenous resources and local ecosystems. This context-aware approach enhances the replicability of teaching interventions, especially in resource-constrained educational environments across Southeast Asia, where many contributing authors are based.

Moreover, these practices strongly align with multiple SDGs, specifically, SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 12 (Responsible Consumption and Production). They promote not only scientific literacy, but also environmental consciousness and civic responsibility among students, which are critical competencies in the 21st-century educational landscape.

Crucially, the engineering solutions presented are not solely technical in nature; they are anchored in pedagogical frameworks that emphasize learner-centered design and outcome-based education. Many of these studies utilize robust mixed-methods assessment strategies, including

quantitative pre-post testing and qualitative evaluations such as interviews and classroom observations, to substantiate the instructional value of the proposed innovations.

3.15. JESTEC's Evolving Role in Educational Engineering Research

The cumulative findings of this review suggest that JESTEC is increasingly recognized as a platform for research at the intersection of engineering, education, and sustainability. While the journal's core focus remains on advancing engineering science and technology, its explicit inclusion of engineering education in its Aim and Scope provides a formal basis for the growing number of publications in this area. The increasing volume, scholarly impact, and thematic coherence of education-focused contributions reflect a strategic alignment with the journal's mission to support both engineering advancement and instructional innovation.

This trend also mirrors the global rise of STEM-focused educational research, particularly in relation to SDGs and inclusive pedagogical practices.

To strengthen this direction, JESTEC could consider curating special issues or themed collections (for example, *Engineering Education for Sustainable Development* or *STEM Pedagogy through Engineering Prototypes*) to further legitimize and promote this growing research stream. Such editorial initiatives would enhance JESTEC's scholarly profile, broaden its contributor base, and solidify its role as a forward-looking journal responsive to evolving societal needs.

3.16. Policy Implications for Engineering Journals and Research Management

The emerging trend of education-focused engineering research in JESTEC underscores the need for strategic policy interventions at both the editorial and institutional levels. From an editorial perspective, the journal may benefit from establishing dedicated submission tracks or themed sections that explicitly accommodate research on engineering-based instructional innovations, technology-enhanced STEM pedagogies, and curriculum development leveraging engineering tools.

Such categorization would facilitate more accurate indexing, enhance discoverability in educational databases, and allow cross-disciplinary visibility beyond engineering repositories. It would also provide greater pedagogical recognition for impactful articles that might otherwise be subsumed under broad thematic categories.

From the standpoint of research institutions (particularly in Southeast Asia, where author concentration is high) these trends point to the growing maturity of interdisciplinary research ecosystems. Institutions like Universitas Pendidikan Indonesia, among others, have cultivated research clusters that consistently produce high-quality educational engineering outputs. Institutional research strategies should consider reinforcing these efforts through targeted seed funding, capacity-building programs, and publication incentives, aligned with internationalization priorities and SDG frameworks.

Additionally, integrating engineering design methodologies and scientific prototyping into pre-service teacher training curricula could accelerate the classroom application of such innovations. In this way, what currently emerges in JESTEC as a publication pattern may serve as the foundation for systemic educational reform, amplifying the societal impact of engineering research in the long term.

3.17. Thematic Convergence: SDGs, Education, and Engineering

Across the analyzed JESTEC archive (particularly among the 964 education-tagged documents) a clear thematic convergence emerges around three central pillars: (i) engineering innovation, (ii) pedagogical delivery, and (iii) sustainability. This triadic alignment frequently materializes in

studies that incorporate waste-derived materials (e.g., rice husk ash, chicken bones, mango seed waste) into demonstration-based science education, explicitly framing these interventions within one or more SDG targets

This convergence is highly relevant to global academic discourse on Education for Sustainable Development (ESD) and reflects alignment with international funding priorities. Through engineering methodologies (such as material transformation, system modeling, or process optimization) authors are developing replicable, resource-sensitive, and pedagogically grounded teaching innovations.

Importantly, many of these contributions extend well beyond conceptual or feasibility explorations. They integrate quantitative assessments of learning outcomes, address equity and accessibility considerations, and frequently discuss the potential for long-term implementation or community adoption. These dimensions collectively elevate the work from project-based case studies to rigorous scholarly contributions with broader educational and societal implications.

3.18. Bibliometric and Visual Insights Support Thematic Maturity

The bibliometric visualizations and keyword mapping provide compelling evidence that education-related publications in JESTEC are not sporadic or incidental. Instead, they form distinct, interrelated thematic clusters, including:
 (i) "Engineering and sustainability,"
 (ii) "STEM education and design tools,"
 (iii) "Waste reuse and school learning,"
 (iv) "Computational tools for instructional content."

These clusters reflect the emergence of mature subdomains within JESTEC, suggesting that educational applications of engineering research are evolving into coherent research streams. This pattern not only reinforces the journal's multidisciplinary relevance but also provides a clear signal to prospective authors and readers that JESTEC is a credible and welcoming platform for education-focused innovations rooted in engineering science.

Moreover, this thematic consistency may encourage greater international submissions, foster institutional collaboration, and support citation growth across academic networks. In turn, this contributes positively to JESTEC's impact metrics and enhances its visibility within indexing platforms such as Scopus and Clarivate's ESCI. The structured nature of these contributions supports sustained scholarly engagement and positions JESTEC as a thought leader in the educational dimensions of engineering research.

3.19. Authors and Institutional Leadership

Analysis of co-authorship networks and top-cited education-focused articles reveals several key contributors and academic institutions actively shaping this emerging field. Notably, scholars with consistent output in areas such as waste-based materials, science learning tools, and bibliometric analyses have established a recognizable and influential research agenda within JESTEC.

This pattern underscores how individual scholarly leadership, when sustained across multiple volumes and supported by collaborative institutional ecosystems, can catalyze thematic innovation within a journal. Moreover, the strong representation from Indonesian universities reflects a regional specialization and a form of academic soft power that aligns with national priorities in education, sustainability, and innovation.

To broaden the journal's academic footprint, JESTEC may benefit from encouraging greater engagement from other Southeast Asian research hubs, including Malaysia, Thailand, and the Philippines. Facilitating cross-country collaboration in education-oriented engineering research could emerge as a new strategic direction, enhancing both the journal's regional diversity and its international relevance.

3.20. Challenges and Limitations

Despite the encouraging trends in education-oriented engineering research published in JESTEC, several challenges and limitations warrant consideration:

First, citation latency affects the immediate visibility and impact of newer articles. Many recent publications (particularly those from 2023 to 2025) have yet to accumulate citations despite demonstrating high methodological quality and thematic relevance. This is a known limitation of bibliometric analyses based on recent data and emphasizes the need for complementary metrics to evaluate scholarly influence.

Second, although engineering education is explicitly mentioned in JESTEC's Aims and Scope, the journal is primarily indexed and categorized under engineering databases rather than educational repositories. As a result, some education-focused contributions (particularly those grounded in pedagogy or instructional design) may have limited discoverability among audiences searching in education-specific databases. To address this, the journal could consider optimizing keyword tagging, encouraging the inclusion of education and STEM pedagogy in author-selected keywords, and exploring cross-indexing opportunities in interdisciplinary databases that include both engineering and educational research.

Third, some education-focused papers lack integration with established educational theories. While they offer robust engineering applications, the absence of pedagogical frameworks (such as constructivism, inquiry-based learning, or experiential models) limits their instructional value and theoretical contribution. Future submissions should strive to bridge this gap by grounding technological innovation within clearly articulated teaching and learning paradigms.

Fourth, this study expands upon existing literature on science and engineering education by documenting recent contributions beyond JESTEC. **Table 6** presents a sample of 29 articles published in 2025 that address diverse topics such as instructional design, cognitive load, learning motivation, artificial intelligence in teaching, and the use of indigenous materials in science education. These studies provide additional context for understanding the evolving landscape of educational research in STEM and underscore the multidisciplinary momentum surrounding engineering-based pedagogy.

Table 6. Previous studies on science and engineering education.

No	Title	Reference
1	Depression from and fear of covid-19 as predictors of pre-service teachers' mathematics anxiety.	Awofala and Ogunsanya (2025)
2	Exploration of students' attitudes towards science: A case study research in junior high schools.	Laksmana *et al*. (2025)
3	Paradox of precision: Challenges with ESP32 accuracy in physics educational tools.	Risdianto *et al*. (2025)
4	Studies on characteristics of yogurt made with addition of various plant extracts for education purposes.	Widhiya *et al*. (2025)
5	Design and development of hair cutting service search and call application using android-based waterfall method.	Zebua and Harianja (2025)
6	Self-efficacy as a mediator between motivation and confidence in mathematics.	Bendol and Dalayap Jr. (2025)

Table 6 (Continue). Previous studies on science and engineering education.

No	Title	Reference
7	Effects of GeoGebra instruction and team-based learning strategy on senior secondary school students' achievement in mathematics.	Awofala and Nwoke (2025)
8	Analyzing junior high school students' cognitive load in a science subject: A case study.	Hidayat *et al.* (2025)
9	Examining the impact of block-based visual programming in programming education: A systematic review.	Sonjaya and Munir (2025)
10	Cultivating the pedagogical competence of pre-service science teachers through microteaching.	Kazeem *et al.* (2025)
11	Effect of two instructional strategies on students' achievement in selected abstract concepts in biology.	Adewumi *et al.* (2025)
12	The impact of phonetic rhythmicity on speech and communication skills of elementary students with special needs.	Sirodjovna and Abduraxmon (2025)
13	The future of teaching: Artificial intelligence (AI) and artificial general intelligence (AGI) for smarter, adaptive, and data-driven educator training.	Balasubramanian (2025)
14	Student teaching and instructional materials in the 21st-century classroom: A literature review.	Pecson and Sarmiento (2025)
15	Students' virtual classroom experiences in the post-covid-19 era.	Adebakin *et al.* (2025)
16	Context evaluation in nanotechnology courses: A context, input, process, and product (CIPP) model perspective.	Ragadhita *et al.* (2025)
17	Assessment of instructional material relevance and availability for biology education.	Umeohana (2025)
18	The emergence of new technologies in metalwork/automobile industries: Issues, challenges and opportunities in emanating from for delivery of technical education on a pandemic era.	Ogundele *et al.* (2025)
19	Bibliometric analysis using vosviewer with publish or perish of computational thinking and mathematical thinking in elementary school.	Abidin *et al.* (2025)
20	Problem based learning (PBL) learning model for increasing learning motivation in chemistry subject: Literature review with bibliometric analysis.	Arifiani *et al.* (2025)
21	Perception of early childhood education lecturers on the use of virtual learning.	Salman and Yahaya (2025)
22	Preparing future geography teachers through problem-based learning technology: A short review.	Saidirasilovna (2025)
23	The ethical and educational implications of greenwashing in corporate sustainability practices.	Kamraju (2025)
24	The impact of project-based learning (PjBL) on students' motivation and learning outcomes: A literature review.	Pratiwi *et al.* (2025)
25	Development and validation of CalTech (calculator techniques) exercises manual.	Vicera (2025)
26	Utilization of dynamic visualization tools: Enhancing students' motivation and engagement in biology education.	Villavecencio *et al.* (2025)
27	Effect of preparatory homework on pupils' academic performance in basic science.	Sulyman *et al.* (2025)
28	Accessibility and utilization of artificial intelligence (AI)-based intelligent tutoring systems (ITS) and information and communication technology (ICT) in enhancing biology education.	Ibrahim *et al.* (2025)
29	Perceptions of senior high school science, technology, engineering, and mathematics (STEM) students toward STEM and non-STEM courses: A comparative qualitative study.	Camilon *et al.* (2025)

3.21. Strategic Recommendations for Enhancing JESTEC's Impact and Visibility

To capitalize on the trends identified and address current limitations, the following strategies are recommended:

(i) Formalize Educational Themes within Editorial Scope
Introduce special issues or dedicated tracks on *Engineering Education*, *Sustainable Instructional Design*, or *STEM Teaching through Engineering Tools*. This will legitimize existing trends and attract targeted submissions from the growing engineering education community.

(ii) Enhance Keyword Tagging and Cross-Indexing
Encourage authors to include terms such as "engineering education," "STEM pedagogy," "instructional innovation," and "science teaching tools." Explore partnerships or cross-listing with interdisciplinary databases (e.g., ERIC, DOAJ Education Collection).

(iii) Improve Citation Impact
(a) Promote open-access visibility via social media, research sharing platforms (e.g., ResearchGate, Academia.edu), and Google Scholar optimization.
(b) Encourage authors to include citation-friendly formats such as reviews, bibliometric analyses, and meta-analyses, which often gain citations faster.
(c) Launch invited review series on emerging topics like *ESD* and *Digital Learning in Engineering*.
(d) Provide post-publication promotion support (e.g., infographic summaries, author interviews, visual abstracts).

(iv) Support for Broader International Contributions
Encourage submissions from underrepresented regions (Africa, Latin America, Eastern Europe) through targeted calls and fee waivers, where applicable. Promote cross-institutional collaborations to diversify authorship and topic coverage.

(v) Encourage Theory-Driven Educational Submissions
Require authors submitting education-oriented manuscripts to reference recognized pedagogical frameworks (e.g., constructivism, universal design for learning), enhancing academic credibility and reader confidence.

(vi) Monitor and Support Early Citations
Develop a "featured new articles" section on the journal's homepage or newsletter to improve early exposure. Encourage early citation via editorial commentaries or linked discussions.

(vii) By adopting these measures, JESTEC can significantly enhance its citation performance, extend its global reach, and move strategically from a Q3 to Q2 Scopus ranking. More importantly, it will position itself as a critical node in the emerging discourse on engineering-enabled education for sustainable and inclusive development.

4. CONCLUSION

This study conducted a comprehensive bibliometric analysis of the *Journal of Engineering, Science and Technology (JESTEC)*, examining 3,825 documents indexed in Scopus from 2009 to July 2025. It specifically highlighted the journal's evolving contributions to engineering education, identifying 964 documents (25.2%) with direct educational relevance. Despite being traditionally categorized as a journal in engineering science and technology, JESTEC has increasingly supported applied educational research, particularly in areas aligned with sustainability, instructional design, and digital innovation.

The results reveal that many of the journal's most-cited and thematically rich articles incorporate engineering solutions for educational contexts, such as using waste-based materials for science teaching, implementing techno-economic analysis in instructional tools, and applying bibliometric mapping to inform curriculum design. These contributions not only reflect scientific rigor but also offer tangible pedagogical value, often aligning with SDGs and inclusive learning models.

Importantly, while *engineering education* is already acknowledged in JESTEC's official *Aims and Scope*, discoverability in education-specific databases remains limited. This presents a key area for strategic development, especially for interdisciplinary readers and indexing algorithms. Furthermore, the analysis surfaced several ongoing challenges. These include:

(i) Citation latency, especially for recent high-quality articles.

(ii) Limited indexing under educational repositories, reducing cross-disciplinary visibility.

(iii) Occasional lack of theoretical integration in education-themed papers.

(iv) Regional concentration of authorship, limiting global representation

(v) Despite these limitations, the study affirms that JESTEC is emerging as an influential platform for engineering-based instructional research and offers considerable untapped potential for leadership in this niche.

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