



Teacher Compensation and the Sustainability of the Education Workforce: A Bibliometric Analysis

Rehan Sapto Rosada^{1*}, Sulyanto Sulyanto², Nur Wening³, Eka Pariyanti⁴

¹ Student Doctor of Management Science, Graduate School Universitas Terbuka, Indonesia.

² Faculty of Economics and Business, Jenderal Soedirman University, Indonesia.

³ Post Graduate Program of Management, Universitas Teknologi Yogyakarta, Indonesia

⁴ Doctor of Management Science, Graduate School Universitas Terbuka, Indonesia

* Corresponding Author. Email: 501243154@ecampus.ut.ac.id

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ABSTRACT

Penelitian ini memetakan riset global mengenai kompensasi guru dan keberlanjutan tenaga pendidik serta menilai posisi kompensasi dalam diskursus keberlanjutan pendidikan. Keberlanjutan pendidikan dipahami sebagai kapasitas sistem untuk mempertahankan mutu dan kontinuitas layanan, sedangkan keberlanjutan tenaga pendidik merujuk pada kemampuan menarik, mendukung, dan mempertahankan guru tanpa mengurangi kesejahteraan, motivasi, dan komitmen mereka. Analisis bibliometrik dilakukan terhadap 476 artikel Scopus periode 2014-2024 menggunakan prosedur PRISMA, Bibliometrix, dan VOSviewer. Publikasi meningkat setelah 2020; tema keberlanjutan, pendidikan, keterlibatan, dan transformasi digital mendominasi, sedangkan istilah kompensasi berada di perifer. Beban kerja, motivasi, kepemimpinan, pengembangan profesional, dan evaluasi program menjadi tema penghubung. Posisi perifer tidak menunjukkan rendahnya arti kompensasi, tetapi mencerminkan pemisahan antara literatur pedagogi-teknologi dan HRM-ekonomi ketenagakerjaan. Kontribusi penelitian ini adalah memperluas Sustainable HRM ke konteks pendidikan dengan menempatkan kompensasi sebagai mekanisme keberlanjutan tenaga pendidik melalui keadilan, pengakuan, kesesuaian beban kerja-imbalan, kesejahteraan, komitmen, dan retensi.

This study maps global research on teacher compensation and the sustainability of the education workforce and examines compensation's position within educational sustainability discourse. Educational sustainability is defined as the capacity of education systems to maintain service quality and continuity, whereas workforce sustainability refers to their capacity to attract, support, and retain teachers without eroding well-being, motivation, or commitment. A bibliometric analysis was conducted on 476 Scopus-indexed articles published in 2014-2024 using a PRISMA-based procedure, Bibliometrix, and VOSviewer. Publications increased after 2020; sustainability, education, engagement, and digital-transformation themes dominated, while explicit compensation terms remained peripheral. Workload, motivation, leadership, professional development, and program evaluation served as bridging themes. Peripherality does not imply low substantive importance; it reflects a conceptual and disciplinary separation between pedagogy- and technology-oriented research and HRM and labor-economics research. The study's intellectual contribution is to extend Sustainable HRM into education by conceptualizing compensation as a workforce-sustainability mechanism operating through fairness, recognition, workload-reward reciprocity, well-being, commitment, and retention.



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INTRODUCTION

Teacher compensation, both financial and non-financial, has become an increasingly important issue in educational management because it is closely related to teacher motivation, professional satisfaction, retention, and instructional quality. Adequate salaries, benefits, and incentives can support work engagement and long-term commitment, while inadequate compensation may weaken morale and increase the risk of attrition (Borman & Dowling, 2008; Collie, 2017; Hanushek & Rivkin, 2007; Allegretto, 2023). Compensation is therefore not merely a payroll issue; it is one of the institutional mechanisms through which education systems allocate resources, recognize contribution, and maintain the continuity of educational services.

Educational sustainability refers to the capacity of an education system to maintain the quality, continuity, and adaptability of teaching and learning over time. The sustainability of the education workforce is treated as the human-resource dimension of that broader concept: the capacity to attract, support, develop, and retain sufficient numbers of qualified teachers without eroding their well-being, motivation, or long-term professional commitment. The two concepts are related but not identical. Educational sustainability concerns the continuity and resilience of the system as a whole, whereas workforce sustainability concerns the human conditions that make such continuity possible. Persistent teacher shortages, unequal pay structures, and turnover therefore place both workforce and educational sustainability at risk (Dolton & Marcenaro-Gutierrez, 2011; Hendricks, 2014; Carver-Thomas & Darling-Hammond, 2017; UNESCO, 2023b).

Sustainable Human Resource Management (Sustainable HRM) provides the principal theoretical lens for explaining this relationship. Rather than prioritizing short-term organizational efficiency alone, Sustainable HRM seeks to balance economic feasibility with employee well-being, equity, human-resource renewal, and long-term organizational continuity (Kramar, 2014; Lu et al., 2023; Griep et al., 2025). Within this perspective, compensation is best understood through a total rewards architecture that combines base salary, benefits, incentives, recognition, career support, professional development, and workload arrangements. Compensation does not produce workforce sustainability automatically; its contribution operates through perceived fairness and recognition, the adequacy of resources, and reciprocity between work demands and rewards. These mechanisms shape teacher motivation, well-being, commitment, and ultimately retention (Cachón-Rodríguez et al., 2022; Elrayah et al., 2023; Steiner et al., 2024).

This theoretical pathway has become more consequential as teachers' roles have expanded. Accountability pressures, technological change, and post-pandemic digitalization have added online facilitation, digital-content design, platform-based assessment, continuous communication, and other forms of less visible labor to teachers' work (Rapanta et al., 2020; Broadbent et al., 2023; UNESCO, 2023a). When these additional demands are not reflected in pay, allowances, time allocation, recognition, or development support, the perceived balance between workload and reward may deteriorate. In practice, compensation connects educational sustainability to workforce sustainability by determining whether expanded responsibilities are materially and symbolically recognized and whether teachers can sustain their well-being and commitment over time.

Sustainability is indexed in the literature through several related but distinct vocabularies. Education for Sustainable Development (ESD) and the Sustainable Development Goals (SDGs),

particularly SDG 4, capture education-centered sustainability agendas; SDG 8 and social sustainability capture decent work, equity, and worker well-being; Sustainable HRM and workforce sustainability address the long-term development and retention of human resources. Green Human Resource Management (Green HRM) captures environmentally oriented HR practices and overlaps with, but is narrower than, the broader Sustainable HRM agenda. Environmental, Social, and Governance (ESG) and Corporate Social Responsibility (CSR) refer to broader institutional responsibility and governance discourses in which employee treatment, fairness, and labor practices may be discussed. These terms are not treated in this study as synonyms for education workforce sustainability or as equivalent theoretical constructs. Instead, they are adjacent indexing vocabularies used to identify the broader sustainability literature within which teacher compensation may be discussed directly or indirectly.

Despite the practical connection between compensation and workforce continuity, the literature remains fragmented in at least three ways. Conceptually, many sustainability studies frame continuity through pedagogy, technology, institutional adaptation, or environmental responsibility, while compensation is treated as a separate administrative or fiscal variable. Disciplinarily, sustainability-oriented education research tends to develop in education, technology, and organizational journals, whereas pay, incentives, and retention are more often examined in HRM, labor economics, and public-policy research. Empirically, compensation studies frequently test isolated outcomes such as satisfaction, performance, or turnover in specific settings without embedding them in a longer-term model of workforce sustainability. This fragmentation can make compensation appear weakly connected in bibliometric networks even when it is substantively important.

Bibliometric analysis offers a systematic way to examine this fragmentation by mapping publication growth, collaboration patterns, citation structures, and keyword relationships at the field level. It can show which perspectives dominate, which concepts bridge otherwise separate clusters, and which topics remain weakly integrated (Aria & Cuccurullo, 2017; Zupic & Čater, 2015; Donthu et al., 2021). However, bibliometric centrality represents relational visibility within a selected corpus rather than the objective importance or causal effect of a construct. This distinction is central to the interpretation adopted in this study.

This study maps Scopus-indexed journal articles published from 2014 to 2024 to answer three questions: (1) how has research at the intersection of teacher compensation and sustainability developed; (2) which actors, sources, and intellectual structures organize the field; and (3) why does compensation occupy its observed network position, and what does that position imply for Sustainable HRM and educational policy? The study contributes intellectually by identifying a discursive and disciplinary decoupling between education-sustainability research and compensation research and by conceptualizing compensation as a workforce-sustainability mechanism linking fairness, recognition, workload reciprocity, well-being, commitment, and retention. It also provides an evidence-based basis for more specific, testable, and context-sensitive compensation policies.

METHOD

This study employed a bibliometric approach to map the development of global research on teacher compensation and the sustainability of the education workforce from 2014 to 2024. The purpose was not to estimate the causal effect of compensation, but to identify publication trends, leading contributors, collaboration patterns, intellectual structures, and conceptual relationships within the selected scholarly discourse. Bibliometric analysis was appropriate because it enables a systematic and replicable examination of large-scale bibliographic metadata and science-mapping patterns (Zupic & Čater, 2015; Donthu et al., 2021).

Data source and search strategy

The data source was Scopus, selected for its standardized metadata, international journal coverage, and compatibility with Bibliometrix and VOSviewer (Donthu et al., 2021; Pranckutė, 2021). The search was conducted on 29 August 2025 in titles, abstracts, and keywords. The query combined three conceptual blocks. The first identified the education workforce (teacher*, lecturer*,

and educator*). The second identified financial and non-financial compensation (compens*, "compensation management", "reward management", "total reward*", pay, salary, wage*, benefit*, and remuneration). The third identified sustainability vocabularies. ESD and SDG* represented education-centered sustainability; "sustainable HRM", "social sustainability", and "workforce sustainability" represented employee- and work-centered sustainability; "green HRM" captured environmentally oriented HRM discourse; and ESG and CSR captured broader responsibility and governance vocabularies. ESG, CSR, ESD, SDGs, Green HRM, and workforce sustainability were therefore included as complementary search vocabularies, not as interchangeable definitions.

((teacher OR lecturer* OR educator*)) AND ((compens* OR "compensation management" OR "reward management" OR "total reward*" OR pay OR salary OR wage* OR benefit* OR remuneration)) AND ((sustainab* OR "sustainable development" OR "sustainable HRM" OR "green HRM" OR ESG OR CSR OR ESD OR SDG* OR "social sustainability" OR "workforce sustainability"))).*

The initial search identified 1,465 documents. The breadth of the query was intentional because the study sought to capture both explicit and indirect connections between compensation and sustainability. Nevertheless, broad wildcards such as *sustainab** and *benefit** can retrieve generic uses, privilege highly indexed sustainability and technology topics, and miss studies that use local or alternative compensation terminology. Manual eligibility screening was used to reduce these risks, but it could not eliminate keyword-selection bias. The resulting maps are therefore interpreted as the structure of the Scopus-indexed discourse generated by this strategy rather than as a complete representation of the real-world relationship between compensation and workforce sustainability.

Screening and eligibility

The document selection process followed a PRISMA-based procedure consisting of identification, screening, eligibility, and inclusion to ensure transparency in the search and selection stages (Page et al., 2021; Rethlefsen et al., 2021). The documents were limited to English-language journal articles published between 2014 and 2024 and indexed in subject areas relevant to social sciences, economics, education, psychology, and management. After these filters were applied, 908 documents met the initial requirements. Titles, abstracts, and, when necessary, full texts were examined to determine whether they addressed teacher- or educator-related compensation and sustainability. Documents were excluded when they focused on non-education contexts, lacked a teacher-work or employment dimension, or contained insufficient bibliographic information. Because the review was designed to include indirect as well as explicit connections, some retained documents discuss compensation through adjacent themes such as workload, motivation, digital labor, professional development, or institutional sustainability rather than as their primary variable. After the eligibility review, 476 articles were retained as the final dataset for analysis. The screening process is presented in Figure 1.

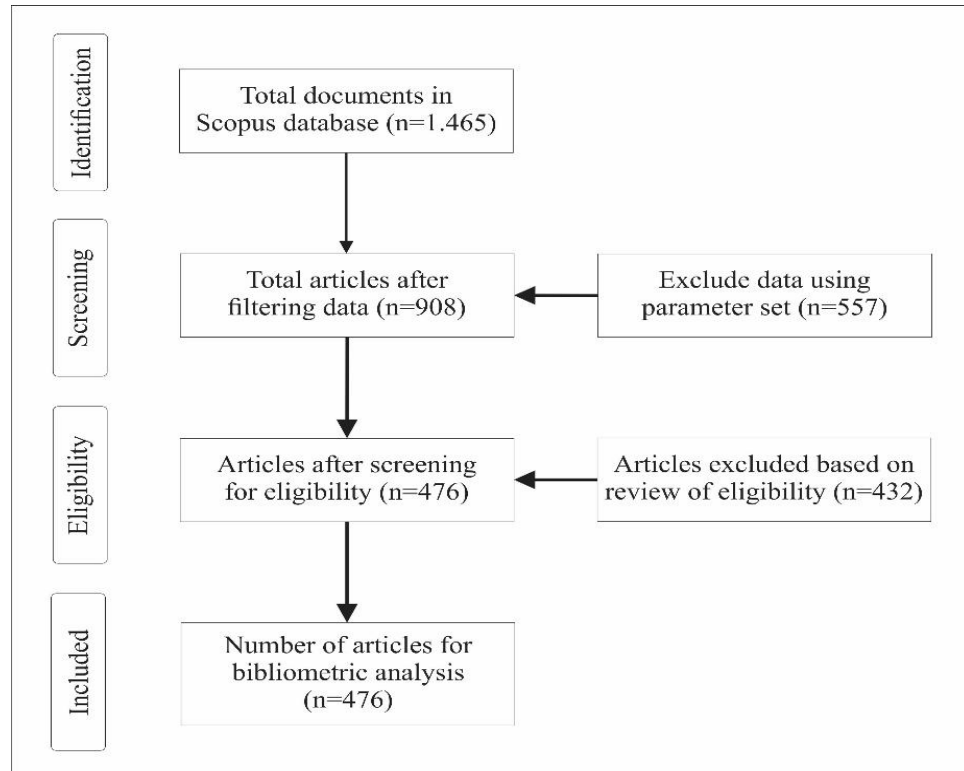


Figure 1. PRISMA Flow Diagram

Data analysis

The final dataset was analyzed using Bibliometrix and VOSviewer. Bibliometrix generated descriptive performance indicators, including publication growth, influential authors, sources, institutions, countries, and thematic development (Aria & Cuccurullo, 2017). VOSviewer visualized co-authorship, co-citation, and keyword co-occurrence networks to identify social, intellectual, and conceptual relationships (van Eck & Waltman, 2010, 2014).. The analysis covered performance analysis, co-authorship analysis, co-citation analysis, and keyword co-occurrence analysis. Interpretation followed a three-step logic: first, identifying what each indicator or map showed; second, examining plausible disciplinary, publication, and institutional reasons for the pattern; and third, explaining its meaning for Sustainable HRM and education workforce sustainability. Node size and network position were interpreted as visibility and relational connectedness within the corpus. Peripherality was not treated as proof of low substantive importance, novelty, or causality, because science maps describe how published knowledge is organized rather than how policy mechanisms operate in practice.

RESULTS AND DISCUSSION

Results

Publication Trends

As shown in Figure 2, research on teacher compensation and sustainability followed a clear upward trajectory from 2014 to 2024. Publications increased from 6 documents in 2014 to 113 in 2024. The pattern can be divided into an embryonic phase (2014-2018), a moderate-acceleration phase (2019-2020), and a rapid-expansion phase (2021-2024), when annual output reached 58, 76, 101, and 113 documents. The post-2020 increase coincided with pandemic-driven digital and hybrid teaching, renewed concern about teacher readiness and shortages, and the growing visibility of sustainability agendas (Rapanta et al., 2020; Broadbent et al., 2023; UNESCO, 2023a, 2023b). However, the subsequent citation and keyword results show that this growth was driven more strongly by pedagogical continuity, digital adaptation, and institutional resilience than by direct compensation research. Epistemically, the field expanded around the question of how education

systems could continue operating under disruption, while the material recognition of teachers' expanded work remained less central.

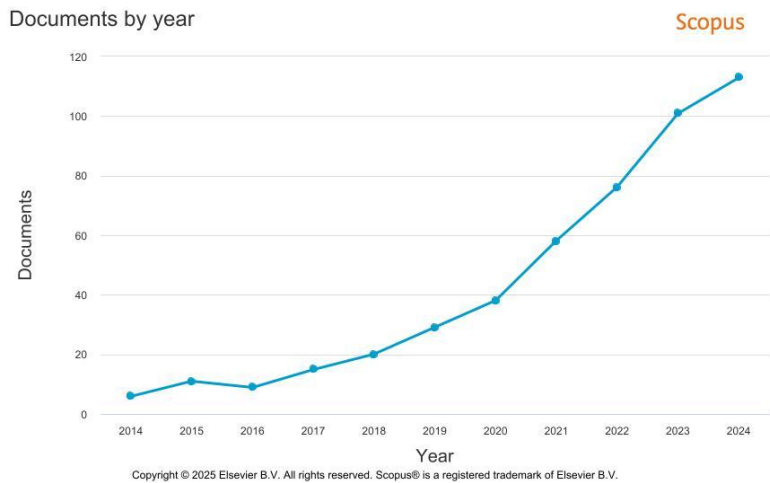


Figure 2. *Annual Publication TrendsThe Research Trend*

Figure 3 shows that citation visibility is concentrated in broad-scope and open-access journals. PLOS ONE is a prominent outlet, while Sustainability, Education Sciences, and Frontiers in Education gained visibility after 2020. This outlet structure supports interdisciplinary diffusion, but it also creates a framing effect: journals centered on sustainability and educational innovation give greater visibility to digital transformation, engagement, and institutional adaptation than to compensation research published under HRM, labor economics, or public-policy vocabularies. The observed citation structure thus reflects not only substantive interest but also the channels through which knowledge is indexed and circulated (Brainard, 2019; Piwowar et al., 2018; Wakeling et al., 2016).

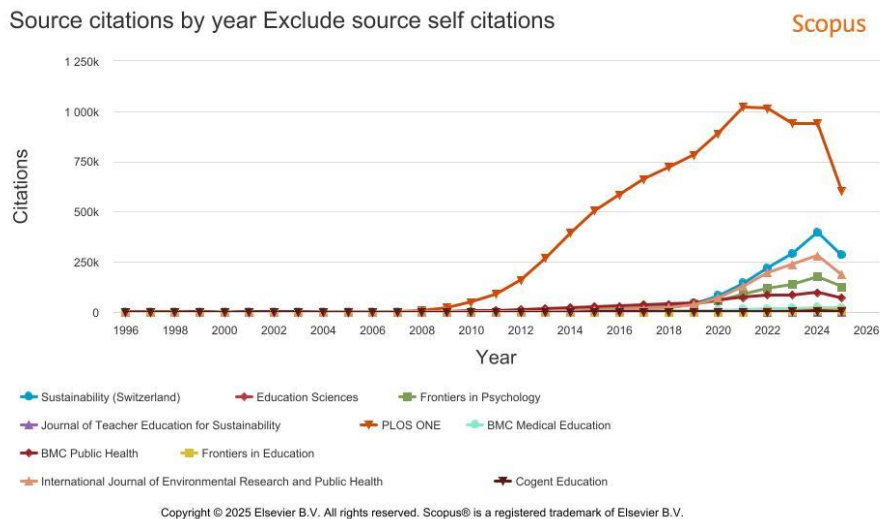


Figure 3. *Source Citations per Year*

Collaboration Structure

Author Collaboration Structure

Figure 4 shows a clustered co-authorship network linked by several bridging authors. The network is therefore connected, but its integration appears actor-dependent: specific authors connect research groups that otherwise use different disciplinary vocabularies. This pattern suggests that compensation and sustainability are being linked through selective collaborations rather than through a fully consolidated conceptual community.

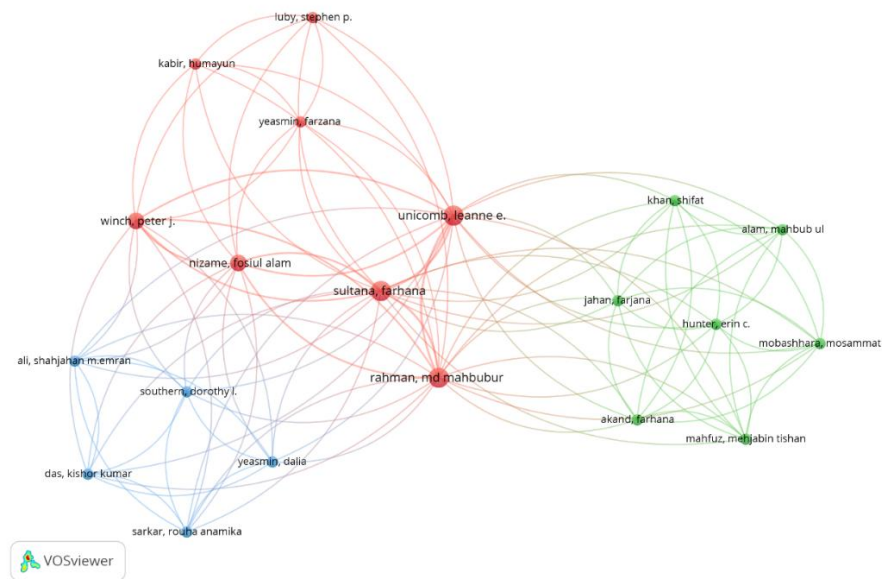


Figure 4. Author co-authorship network

Bridging authors can facilitate the transfer of HRM, education, and sustainability perspectives, but the continued cluster structure also indicates room for stronger interdisciplinary research programs. In bibliometric terms, node size, link density, and line thickness represent relative collaboration visibility and strength rather than the quality or substantive integration of the resulting knowledge (van Eck & Waltman, 2010).

Institutional Collaboration Structure

Figure 5 reveals a dense institutional cluster, particularly among Australian universities, together with institutions that connect national and international partners. The network indicates that cross-institutional exchange supports the field's growth and visibility.

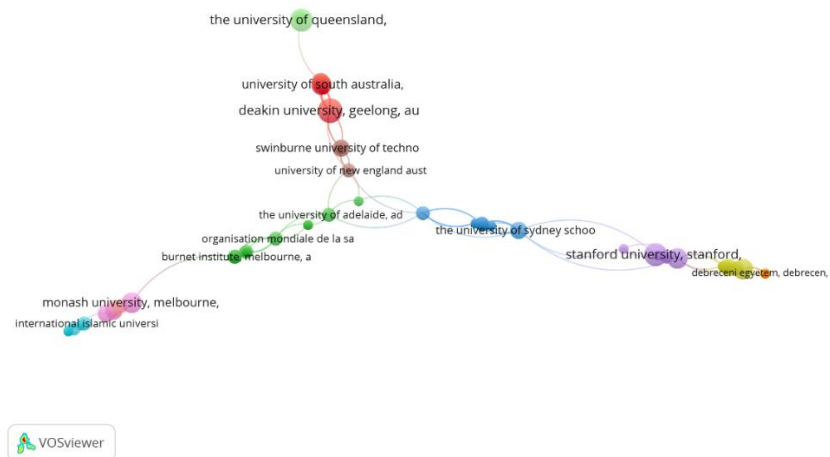


Figure 5. Organization co-authorship network

At the same time, concentration around a limited set of institutions may shape which problems receive attention and which methodological and policy perspectives become dominant. For a topic as context-dependent as teacher compensation, broader participation from institutions in lower-resource and diverse employment systems would strengthen the comparative relevance of the literature (Adams, 2013; Glänzel & Schubert, 2001).

Country Collaboration Structure

Figure 6 identifies the United States, the United Kingdom, and Australia as major hubs, while Southern European and Asian countries form regional clusters. This pattern demonstrates internationalization, but also uneven knowledge production.

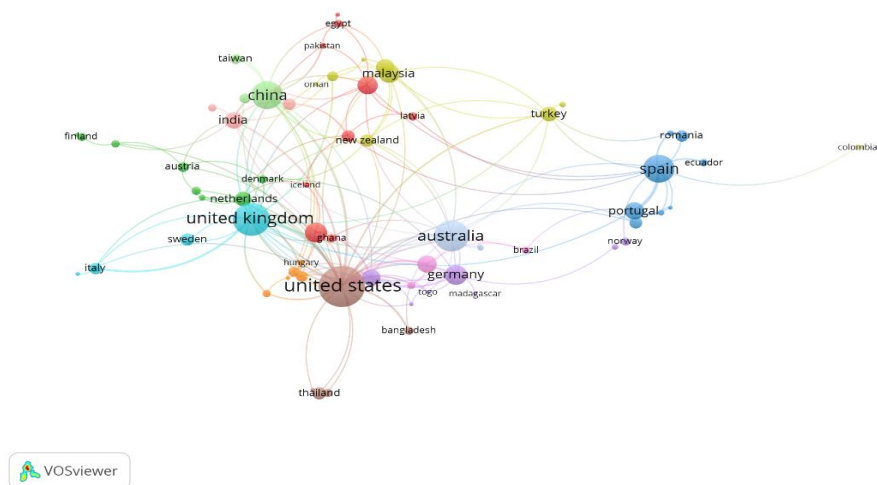


Figure 6. Countries co-authorship network

Because compensation structures, teacher status, and fiscal capacity vary substantially across systems, the dominance of high-income-country hubs may contribute to an emphasis on digital readiness, institutional innovation, and professional development rather than on basic pay adequacy and informal or precarious employment. Country centrality should therefore be read as research visibility, not as universal representativeness (Newman, 2001; Larivière et al., 2015).

Across authors, institutions, and countries, collaboration is becoming more connected. The presence of bridging actors supports knowledge exchange across clusters and increases the international visibility of the field.

Network connectivity, however, does not necessarily mean conceptual integration. The field has developed an international infrastructure for collaboration, but the later keyword results show that compensation remains weakly embedded in the core sustainability vocabulary. This difference between social integration and conceptual integration is one of the field's defining characteristics.

Intellectual Structure and Influential Documents

Figure 7 shows that the source co-citation network draws on education, educational psychology, public health, sustainability studies, and broader social sciences. This interdisciplinary base is valuable because teacher sustainability involves well-being, governance, institutional quality, and workforce continuity.

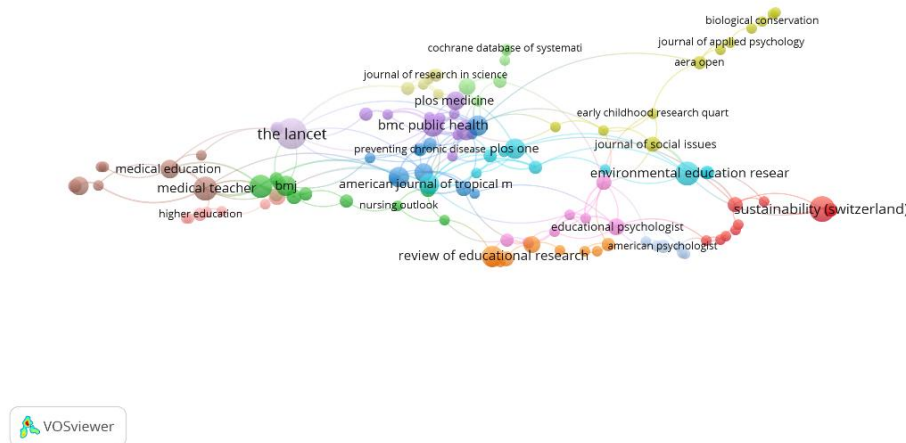


Figure 7. Source co-citation network

HRM and labor-economics sources do not appear to form an equally dominant core. The intellectual structure therefore helps explain why compensation is visible mainly through adjacent outcomes, such as well-being, engagement, workload, and retention, rather than as a central sustainability construct (Kramar, 2014; Lu et al., 2023; Griep et al., 2025).

Figure 8 indicates that several authors function as shared reference points across clusters discussing education, sustainability, work behavior, and policy. Their centrality confirms an interconnected knowledge base, but the absence of a clearly compensation-centered co-citation core suggests that the field has not yet consolidated a common theoretical vocabulary for linking reward systems to workforce sustainability. In other words, the field borrows from multiple traditions without fully integrating them (van Eck & Waltman, 2010; Zupic & Čater, 2015).

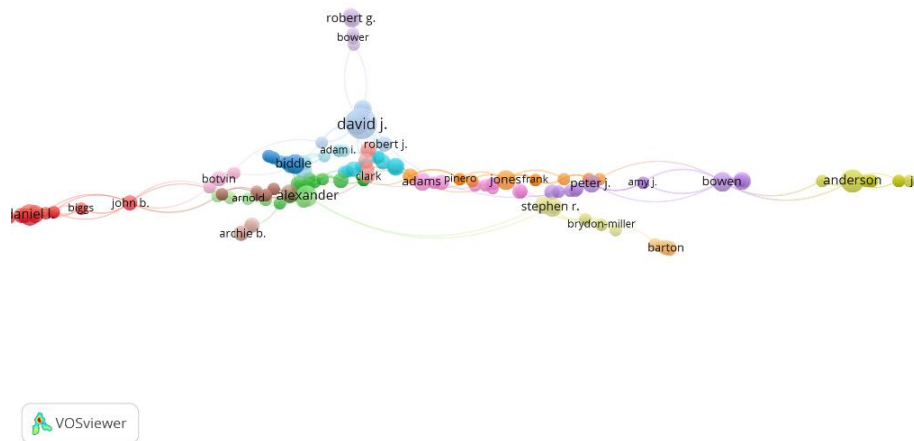


Figure 8. Author co-citation network

Table 1 further shows a visibility asymmetry in the corpus. The most-cited documents are dominated by digital learning, technology-enhanced education, e-learning, teacher readiness, online assessment, and metaverse-based learning rather than by studies explicitly centered on compensation. This does not mean that these documents directly demonstrate compensation effects. Instead, it shows that educational sustainability has been most visible when framed as technological and pedagogical adaptation (Daniela et al., 2018; Gherheş et al., 2021; Lee & Hwang, 2022; Salloum et al., 2023).

Table 1. The 10 most cited Documents in the Corpus

No.	Title	Author	Year	Publisher	Citations
1	Entrepreneurship education through successful entrepreneurial models in higher education institutions	(Boldureanu et al., 2020)	2020	MDPI	316
2	Technology-Enhanced Education through VR-Making and Metaverse-Linking to Foster Teacher Readiness and Sustainable Learning	(Lee & Hwang, 2022)	2022	MDPI	208
3	E-learning vs. Face-to-face learning: Analyzing students' preferences and behaviors	(Gherheş et al., 2021)	2021	MDPI	208
4	Experience of e-learning and online assessment during the COVID-19 pandemic at the College of Medicine, Qassim University	(Elzainy et al., 2020)	2020	Elsevier B.V.	191
5	Student Perceptions of Academic Engagement and Student-Teacher Relationships in Problem-Based Learning	(Amerstorfer & Freiin von Münster-	2021	Frontiers Media S.A.	158

No.	Title	Author	Year	Publisher	Citations
6	Technology Use for Teacher Professional Development in Low- and Middle-Income Countries: A systematic review	Kistner, (Hennessy et al., 2022)	2022	Elsevier Ltd	129
7	Perception towards online/blended learning at the time of Covid-19 pandemic: an academic analytics in the Indian context	(Bordoloi et al., 2021)	2021	Emerald Group Holdings Ltd.	128
8	Application of machine learning in predicting performance for computer engineering students: A case study	(Buenaño-Fernández et al., 2019)	2019	MDPI	125
9	Sustainability Model for the Continuous Intention to Use Metaverse Technology in Higher Education: A Case Study from Oman	(Salloum et al., 2023)	2023	Multidisciplinary Digital Publishing Institute (MDPI)	119
10	Sustainable higher education and Technology-Enhanced Learning (TEL)	(Daniela et al., 2018)	2018	MDPI	114

The citation pattern has two implications. First, digital and hybrid teaching have expanded teachers' responsibilities through online facilitation, digital assessment, content design, platform management, and support beyond classroom hours (Bordoloi et al., 2021; Elzainy et al., 2020; Hennessy et al., 2022). Second, broad-scope technology and sustainability papers may accumulate more citations than compensation studies located in specialized HRM, economics, or policy outlets. The dominance of technology-related documents therefore reflects both a substantive shift in educational work and a publication-visibility effect. It also exposes the central gap examined here: the literature has intensively studied how education adapts technologically, but has less often examined how reward systems recognize the additional work required for that adaptation.

Conceptual Structure

Figure 9 shows the keyword co-occurrence network. Sustainability occupies the most central position and is strongly connected with education, teacher education, students, engagement, artificial intelligence, and climate change. The network therefore frames educational sustainability primarily through pedagogical, technological, and organizational adaptation. Compensation-related language is not absent, but it is not part of the field's dominant conceptual core (Cobo et al., 2011; van Eck & Waltman, 2014; Waltman et al., 2010).

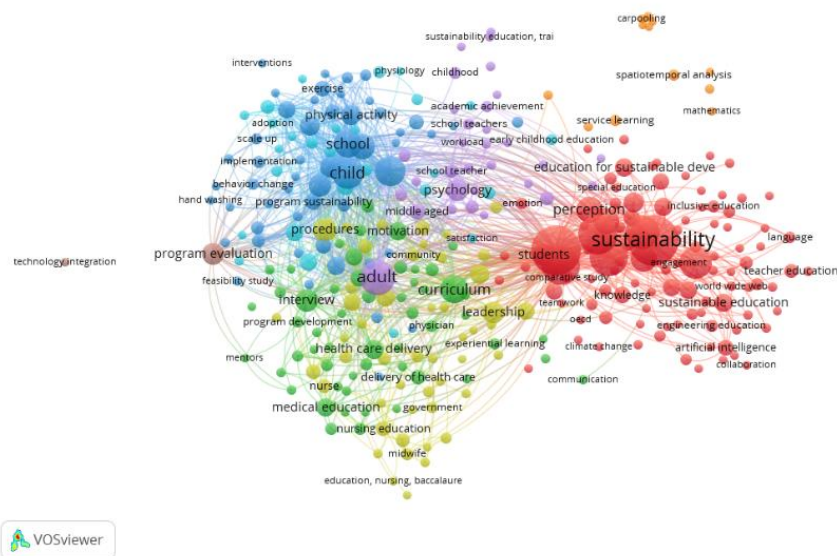


Figure 9. Keywords Co-Occurrence network

Explicit compensation terms, including salary, wage, allowance, and benefits, occupy more peripheral positions. Three complementary explanations are plausible. First, disciplinary separation places sustainability research mainly in education and technology outlets, while compensation research is often located in HRM, labor economics, and public policy. Second, education systems frequently frame compensation as a budgetary or administrative input rather than as a sustainability mechanism. Third, compensation is semantically fragmented across pay, salary, wage, remuneration, allowance, benefits, incentives, rewards, and recognition, which can disperse a single substantive issue across several smaller nodes. The peripheral position is therefore partly a feature of how the field is organized and named.

Importantly, peripherality does not demonstrate low practical importance, nor does it by itself prove that compensation is an emerging theme. In a co-word map, it indicates relatively weak co-occurrence and connectivity within the selected corpus. Without a dedicated temporal-overlay analysis, the more defensible interpretation is that compensation is under-integrated and underexplored in sustainability-oriented education research. This distinction turns a descriptive network result into a theoretical finding: the literature acknowledges outcomes such as well-being, commitment, and retention, but has not consistently made the reward architecture that supports those outcomes explicit.

The bridging themes clarify how this integration can occur. Workload links compensation to the reciprocity between demands and rewards; motivation captures the economic and symbolic value of recognition; leadership shapes distributive and procedural fairness in the allocation and communication of rewards; professional development operates as both a non-financial reward and an investment in future capability; and program evaluation provides the evidence and governance needed to assess equity, well-being, and retention outcomes. Through these mechanisms, compensation can influence education workforce sustainability indirectly by shaping teacher well-being, motivation, commitment, and the decision to remain (Cachón-Rodríguez et al., 2022; Elrayah et al., 2023; Kang & Lee, 2021).

From a Sustainable HRM perspective, this pattern reveals a theoretical omission. The literature frequently endorses employee well-being and long-term organizational continuity, but it often leaves the design of rewards implicit. The present mapping makes that omission visible and proposes a more explicit pathway: compensation design influences fairness, recognition, and workload-reward reciprocity; these shape well-being, motivation, and commitment; and those outcomes influence retention and the sustainability of the education workforce (Kramar, 2014; Lu et al., 2023; Griep et al., 2025).

Discussion

Taken together, the findings reveal a paradox. Research on teacher-related sustainability has expanded rapidly and become socially and intellectually interconnected, yet compensation remains weakly integrated into its conceptual core. The study interprets this not as evidence that compensation is unimportant, but as a discursive decoupling between two research traditions. Pedagogy- and technology-oriented sustainability research asks how education can remain adaptive and continuous, whereas HRM and labor-economics research asks how pay, rewards, and employment conditions influence behavior. Because the traditions use different outlets, keywords, and levels of analysis, the material conditions that sustain teachers can remain less visible within the sustainability network.

Explaining the Marginalization of Compensation

The marginalization of compensation is reinforced by institutional and epistemic factors. In policy and organizational discourse, teacher pay is often treated as a recurrent cost constrained by public budgets, while sustainability is framed through innovation, digitalization, curriculum, and organizational resilience. In publication systems, broad-scope technology and sustainability studies attract wide interdisciplinary citation, whereas compensation studies may remain within specialized and locally bounded literatures. At the semantic level, multiple labels divide the reward domain.

These mechanisms explain why compensation can be practically consequential yet bibliometrically peripheral.

Sustainable HRM provides the theoretical basis for resolving this separation. If sustainability requires the long-term preservation and renewal of human resources, then compensation cannot remain a background cost variable. It is one of the institutional arrangements through which schools provide resources, communicate recognition, enact fairness, and establish reciprocity between teachers' contributions and organizational support. The contribution of compensation is therefore relational rather than purely monetary: its effects depend on whether teachers perceive reward systems as adequate, transparent, equitable, and responsive to workload and career development. This reframes compensation as part of the social and organizational infrastructure of workforce sustainability (Kramar, 2014; Lu et al., 2023; Griep et al., 2025).

Digital Transformation, Invisible Labor, and Total Rewards

The prominence of digital themes clarifies the policy mechanism. Digital transformation expands teachers' roles through content design, online facilitation, platform administration, digital assessment, data reporting, and continuous communication. These tasks increase the amount, complexity, and temporal reach of work. When additional digital labor is not recognized through pay, allowances, workload credits, protected time, development support, or formal recognition, perceived workload-reward imbalance may reduce well-being and motivation and weaken long-term commitment. The argument for total rewards therefore does not follow from digital transformation alone. It follows from the mismatch between expanded work demands and the institutional rewards used to acknowledge and support those demands (Rapanta et al., 2020; Broadbent et al., 2023; UNESCO, 2023a).

Theoretical Contribution to Sustainable HRM

The study's theoretical contribution is threefold. First, it identifies a conceptual and disciplinary decoupling that explains why compensation has remained peripheral in educational sustainability research. Second, it extends Sustainable HRM into educational management by making reward architecture an explicit component of workforce sustainability rather than an assumed background condition. Third, it specifies a testable mechanism linking compensation design to fairness, recognition, workload reciprocity, well-being, motivation, commitment, and retention. This mechanism provides a basis for future empirical studies without claiming that the bibliometric map itself establishes causality.

The next step for the field is therefore not simply to add more compensation keywords, but to integrate compensation into multilevel models connecting school-level reward practices, teacher-level psychological and behavioral outcomes, and system-level continuity. Such integration would move the literature from descriptive coexistence toward explanatory theory.

Implications for Educational Management and Policy

The findings support a specific sequence for educational management and policy. The first step is a workload-reward audit rather than an immediate across-the-board compensation recommendation. Schools and education authorities should map classroom teaching, preparation, assessment, administration, mentoring, digital-content production, platform management, and out-of-hours communication, and then compare these demands with base pay, allowances, workload credits, protected time, benefits, and recognition. This directly addresses workload as the principal bridge between compensation and workforce sustainability.

Audit results can inform a sustainable total rewards architecture. Its components may include adequate and transparent base pay; targeted allowances for hard-to-staff settings, additional responsibilities, and digital roles; benefits that protect well-being; professional-development and career opportunities; non-financial recognition; and workload arrangements that prevent continuous digital availability. Because leadership is a bridging theme, eligibility criteria, decision rules, communication, appeal procedures, and periodic review should be explicit. Fairness must be procedural as well as distributive. Performance-related incentives should be accompanied by ethical safeguards and evaluated for intended and unintended effects (Lavy, 2020; Muralidharan & Sundararaman, 2011).

The centrality of digital-transformation themes suggests a particularly concrete policy priority: making digital labor visible. Institutions can record digital workload in formal job descriptions, assign time credits or role allowances for platform and assessment responsibilities, provide devices and connectivity support, establish protected communication windows, and link digital training to career recognition. These measures address the identified pathway from expanded digital responsibilities to workload pressure, perceived reward imbalance, well-being, motivation, and commitment.

Implementation should be phased and evaluated rather than assumed to be effective. Relevant indicators include perceived compensation fairness, weekly digital and administrative workload, teacher well-being and motivation, participation in professional development, turnover and vacancy rates, and the distribution of rewards across schools and teacher groups. Targeted incentives and salary adjustments may be appropriate in hard-to-staff or disadvantaged contexts, but they should be tested for retention effects, distributional equity, and fiscal sustainability (OECD, 2023; World Bank, 2023; Candelaria et al., 2024; Morgan et al., 2023; Zamarro et al., 2024).

The peripheral network position of compensation is not, by itself, evidence that a particular policy will work. Its policy value lies in revealing an under-integrated issue and identifying the mechanisms and indicators that should be examined. Accordingly, compensation reform should be coordinated with workload design, teacher development, leadership practices, and school-improvement planning and assessed through evidence rather than normative assertion.

Limitations and Future Research

This study has substantive, methodological, and epistemological limitations. First, the corpus was limited to Scopus-indexed, English-language journal articles. Scopus coverage privileges particular journals, regions, and publication traditions, so the resulting knowledge structure may underrepresent local-language research, policy reports, collective-bargaining evidence, and compensation studies published outside highly indexed outlets (Falagas et al., 2008; Mongeon & Paul-Hus, 2016; Pranckutė, 2021). Country and source centrality should therefore not be interpreted as a complete representation of global knowledge.

Second, the search strategy intentionally used broad sustainability vocabularies, including ESG, CSR, ESD, SDG*, social sustainability, and workforce sustainability, as well as broad compensation terms such as benefit*. This improved sensitivity to indirect connections but also created keyword-selection risk. Generic uses of "benefit" or "sustainability" may increase the visibility of technology and pedagogical studies, while compensation research using local terminology may be missed. Manual screening reduced but could not eliminate this problem. The findings are therefore sensitive to query design, thesaurus choices, database indexing, and network parameters.

Third, bibliometric maps represent the visibility and relational organization of published discourse rather than social reality. Co-occurrence does not establish conceptual equivalence, centrality does not measure practical importance, peripherality does not prove novelty, and citation counts are affected by publication age, outlet visibility, and disciplinary citation practices. The mechanism proposed in this study is theory-guided and consistent with the mapped themes, but it remains a proposition for empirical testing rather than a causal result.

Future research should test the robustness of the map through narrower and alternative search strings, explicit exclusion of generic benefit terminology, cross-database comparisons involving Web of Science, ERIC, or Dimensions, and temporal-overlay or bibliographic-coupling analyses. A focused systematic review of the compensation-centered subset could examine the substantive evidence behind the proposed mechanisms. Comparative, mixed-method, longitudinal, quasi-experimental, and multilevel studies are also needed to test how reward adequacy, digital workload recognition, leadership fairness, and professional development influence teacher well-being, commitment, retention, and educational quality across public-private and national contexts.

CONCLUSION

This study maps the development of 476 Scopus-indexed articles published between 2014 and 2024 and establishes a clear scientific position: the peripheral location of compensation in educational sustainability research is not evidence of low importance, but evidence of conceptual, disciplinary, and publication-based decoupling. Sustainability-oriented education research has been organized mainly around pedagogy, technology, engagement, and institutional adaptation, while compensation has remained dispersed across HRM, labor-economics, and policy vocabularies. By making this separation visible, the study extends Sustainable HRM into educational management and conceptualizes compensation as a workforce-sustainability mechanism operating through fairness, recognition, workload-reward reciprocity, well-being, motivation, commitment, and retention. The mapping does not prove causal effects, but it identifies a testable theoretical pathway and a more precise policy agenda. Maintaining the education workforce therefore requires compensation systems that recognize both conventional and digital work, integrate financial and non-financial rewards, apply transparent and equitable governance, and remain fiscally feasible. The study's central contribution is to reposition compensation from a peripheral administrative input to an explicit component of the social and organizational infrastructure that sustains teachers and the continuity of educational services.

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REFERENCES

- Adams, J. (2013). The fourth age of research. *Nature*, 497(7451), 557–560. <https://doi.org/10.1038/497557a>
- Allegretto, S. (2023). Teacher pay penalty still looms large Trends in teacher wages and compensation through 2022. epi.org/274103
- Amerstorfer, C. M., & Freiin von Münster-Kistner, C. (2021). Student Perceptions of Academic Engagement and Student-Teacher Relationships in Problem-Based Learning. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.713057>
- Aria, M., & Cuccurullo, C. (2017). bibliometrix : An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Boldureanu, G., Ionescu, A. M., Bercu, A.-M., Bedrule-Grigoruță, M. V., & Boldureanu, D. (2020). Entrepreneurship Education through Successful Entrepreneurial Models in Higher Education Institutions. *Sustainability*, 12(3), 1267. <https://doi.org/10.3390/su12031267>
- Bordoloi, R., Das, P., & Das, K. (2021). Perception towards online/blended learning at the time of Covid-19 pandemic: an academic analytics in the Indian context. *Asian Association of Open Universities Journal*, 16(1), 41–60. <https://doi.org/10.1108/AAOUJ-09-2020-0079>
- Borman, G. D., & Dowling, N. M. (2008). Teacher Attrition and Retention: A Meta-Analytic and Narrative Review of the Research. *Review of Educational Research*, 78(3), 367–409. <https://doi.org/10.3102/0034654308321455>
- Brainard, J. (2019). Open-access megajournals lose momentum as the publishing model matures. *Science*. <https://doi.org/10.1126/science.aaz4585>
- Broadbent, J., Ajjawi, R., Bearman, M., Boud, D., & Dawson, P. (2023). Beyond emergency remote teaching: did the pandemic lead to lasting change in university courses? *International Journal of Educational Technology in Higher Education*, 20(1), 58. <https://doi.org/10.1186/s41239-023-00428-z>

- Buenaño-Fernández, D., Gil, D., & Luján-Mora, S. (2019). Application of Machine Learning in Predicting Performance for Computer Engineering Students: A Case Study. *Sustainability*, 11(10), 2833. <https://doi.org/10.3390/su11102833>
- Cachón-Rodríguez, G., Blanco-González, A., Prado-Román, C., & Del-Castillo-Feito, C. (2022). How sustainable human resources management helps in the evaluation and planning of employee loyalty and retention: Can social capital make a difference? *Evaluation and Program Planning*, 95, 102171. <https://doi.org/10.1016/j.evalprogplan.2022.102171>
- Candelaria, C. A., Nienstedt, L., Penner, E. K., Ainsworth, A. J., & Liu, Y. (2024). Should They Pay, or Should I Go? *Differential Responses to Base Salary Increases* (24–1003). <https://doi.org/10.26300/jwy5-c233>
- Carver-Thomas, D., & Darling-Hammond, L. (2017). Teacher Turnover: Why It Matters and What We Can Do About It. <https://doi.org/10.54300/454.278>
- Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011b). Science mapping software tools: Review, analysis, and cooperative study among tools. *Journal of the American Society for Information Science and Technology*, 62(7), 1382–1402. <https://doi.org/10.1002/asi.21525>
- Collie, R. J. (2017). Teachers' Social and Emotional Competence: Links with Social and Emotional Learning and Positive Workplace Outcomes. In *Social and Emotional Learning in Australia and the Asia-Pacific* (pp. 167–184). Springer Singapore. https://doi.org/10.1007/978-981-10-3394-0_9
- Daniela, L., Visvizi, A., Gutiérrez-Braojos, C., & Lytras, M. D. (2018). Sustainable Higher Education and Technology-Enhanced Learning (TEL). *Sustainability*, 10(11), 3883. <https://doi.org/10.3390/su10113883>
- Dolton, P., & Marcenaro-Gutierrez, O. D. (2011). If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance. *Economic Policy*, 26(65), 5–55. <https://doi.org/10.1111/j.1468-0327.2010.00257.x>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Elrayah, M., Moustafa, M. A., Hamid, E. M., & Ahmed, S. Y. (2023). How does Job Autonomy Influence Teachers' Turnover Intention? Testing the Mediating Effects of Job Stress and Job Satisfaction. *Journal of Law and Sustainable Development*, 11(11), e1731. <https://doi.org/10.55908/sdgs.v11i11.1731>
- Elzainy, A., El Sadik, A., & Al Abdulmonem, W. (2020). Experience of e-learning and online assessment during the COVID-19 pandemic at the College of Medicine, Qassim University. *Journal of Taibah University Medical Sciences*, 15(6), 456–462. <https://doi.org/10.1016/j.jtumed.2020.09.005>
- Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. *The FASEB Journal*, 22(2), 338–342. <https://doi.org/10.1096/fj.07-9492LSF>
- Gherheș, V., Stoian, C. E., Fărcașiu, M. A., & Stanici, M. (2021). E-Learning vs. Face-To-Face Learning: Analyzing Students' Preferences and Behaviors. *Sustainability*, 13(8), 4381. <https://doi.org/10.3390/su13084381>
- Glänzel, W., & Schubert, A. (2001). Double effort = Double impact? A critical view at international co-authorship in chemistry. *Scientometrics*, 50(2), 199–214. <https://doi.org/10.1023/A:1010561321723>

- Griep, Y., Hansen, S. D., Kraak, J. M., Sherman, U., & Bankins, S. (2025). Sustainable human resource management: The good, the bad, and making it work. *Organizational Dynamics*, 54(2), 101112. <https://doi.org/10.1016/j.orgdyn.2024.101112>
- Hanushek, E. A., & Rivkin, S. G. (2007). Pay, Working Conditions, and Teacher Quality. *The Future of Children*, 17(1), 69–86. <https://doi.org/10.1353/foc.2007.0002>
- Hendricks, M. D. (2014). Does it pay to pay teachers more? Evidence from Texas. *Journal of Public Economics*, 109, 50–63. <https://doi.org/10.1016/j.jpubeco.2013.11.001>
- Hennessy, S., D'Angelo, S., McIntyre, N., Koomar, S., Kreimeia, A., Cao, L., Brugha, M., & Zubairi, A. (2022). Technology Use for Teacher Professional Development in Low- and Middle-Income Countries: A systematic review. *Computers and Education Open*, 3, 100080. <https://doi.org/10.1016/j.caeo.2022.100080>
- Kang, E., & Lee, H. (2021). Employee Compensation Strategy as Sustainable Competitive Advantage for HR Education Practitioners. *Sustainability*, 13(3), 1049. <https://doi.org/10.3390/su13031049>
- Kramar, R. (2014). Beyond strategic human resource management: is sustainable human resource management the next approach? *The International Journal of Human Resource Management*, 25(8), 1069–1089. <https://doi.org/10.1080/09585192.2013.816863>
- Larivière, V., Gingras, Y., Sugimoto, C. R., & Tsou, A. (2015). Team size matters: Collaboration and scientific impact since 1900. *Journal of the Association for Information Science and Technology*, 66(7), 1323–1332. <https://doi.org/10.1002/asi.23266>
- Lavy, V. (2020). Teachers' Pay for Performance in the Long-Run: The Dynamic Pattern of Treatment Effects on Students' Educational and Labour Market Outcomes in Adulthood. *The Review of Economic Studies*, 87(5), 2322–2355. <https://doi.org/10.1093/restud/rdaa002>
- Lee, H., & Hwang, Y. (2022). Technology-Enhanced Education through VR-Making and Metaverse-Linking to Foster Teacher Readiness and Sustainable Learning. *Sustainability*, 14(8), 4786. <https://doi.org/10.3390/su14084786>
- Lu, Y., Zhang, M. M., Yang, M. M., & Wang, Y. (2023). Sustainable human resource management practices, employee resilience, and employee outcomes: Toward common good values. *Human Resource Management*, 62(3), 331–353. <https://doi.org/10.1002/hrm.22153>
- Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics*, 106(1), 213–228. <https://doi.org/10.1007/s11192-015-1765-5>
- Morgan, A., Nguyen, M., Hanushek, E. A., Ost, B., & Rivkin, S. (2023). Attracting and Retaining Highly Effective Educators in Hard-to-Staff Schools. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4400693>
- Muralidharan, K., & Sundararaman, V. (2011). Teacher performance pay: Experimental evidence from India. *Journal of Political Economy*, 119(1), 39–77. <https://doi.org/10.1086/659655>
- Newman, M. E. J. (2001). The structure of scientific collaboration networks. *Proceedings of the National Academy of Sciences*, 98(2), 404–409. <https://doi.org/10.1073/pnas.98.2.404>
- OECD. (2023). Education at a Glance 2023: OECD Indicators. *OECD Publishing*. <https://doi.org/10.1787/e13bef63-en>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, n71. <https://doi.org/10.1136/bmj.n71>

- Piwowar, H., Priem, J., Larivière, V., Alperin, J. P., Matthias, L., Norlander, B., Farley, A., West, J., & Haustein, S. (2018). The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ*, 6, e4375. <https://doi.org/10.7717/peerj.4375>
- Pranckutė, R. (2021). Web of Science (WoS) and Scopus: The Titans of Bibliographic Information in Today's Academic World. *Publications*, 9(1), 12. <https://doi.org/10.3390/publications9010012>
- Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigital Science and Education*, 2(3), 923–945. <https://doi.org/10.1007/s42438-020-00155-y>
- Rethlefsen, M. L., Kirtley, S., Waffenschmidt, S., Ayala, A. P., Moher, D., Page, M. J., Koffel, J. B., Blunt, H., Brigham, T., Chang, S., Clark, J., Conway, A., Couban, R., de Kock, S., Farrah, K., Fehrmann, P., Foster, M., Fowler, S. A., Glanville, J., ... Young, S. (2021). PRISMA-S: an extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. *Systematic Reviews*, 10(1), 39. <https://doi.org/10.1186/s13643-020-01542-z>
- Salloum, S., Al Marzouqi, A., Alderbashi, K. Y., Shwede, F., Aburayya, A., Al Saidat, M. R., & Al-Marroof, R. S. (2023). Sustainability Model for the Continuous Intention to Use Metaverse Technology in Higher Education: A Case Study from Oman. *Sustainability*, 15(6), 5257. <https://doi.org/10.3390/su15065257>
- Steiner, E. D., Woo, A., & Doan, S. Y. (2024). Larger Pay Increases and Adequate Benefits Could Improve Teacher Retention: Findings from the 2024 State of the American Teacher Survey. www.rand.org/t/RR1108-13
- UNESCO. (2023a). Global Education Monitoring Report 2023: Technology in education: A tool on whose terms? *GEM Report UNESCO*. <https://doi.org/10.54676/UZQV8501>
- UNESCO. (2023b). Global report on teachers Addressing teacher shortages. <http://www.unesco.org/open-access/terms-use-ccbysa-en>
- van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
- van Eck, N. J., & Waltman, L. (2014). Visualizing Bibliometric Networks. In *Measuring Scholarly Impact* (pp. 285–320). Springer International Publishing. https://doi.org/10.1007/978-3-319-10377-8_13
- Wakeling, S., Willett, P., Creaser, C., Fry, J., Pinfield, S., & Spezi, V. (2016). Open-Access Mega-Journals: A Bibliometric Profile. *PLOS ONE*, 11(11), e0165359. <https://doi.org/10.1371/journal.pone.0165359>
- Waltman, L., van Eck, N. J., & Noyons, E. C. M. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of Informetrics*, 4(4), 629–635. <https://doi.org/10.1016/j.joi.2010.07.002>
- World Bank. (2023). Making Teacher Policy Work. *World Bank*. <https://doi.org/10.1596/40579>
- Zamarro, G., Camp, A., McGee, J., Wilson, T., & Vernon, M. (2024). Teacher Salary Raises and Turnover: Evidence from the First Year of the Arkansas LEARNS Act (24–972). <https://doi.org/10.26300/f56r-2b92>
- Zupic, I., & Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, 18(3), 429–472. <https://doi.org/10.1177/1094428114562629>