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REFLECTIONS OF STUDENT AND NUTRITION THEMES IN SCIENCE EDUCATION: A BIBLIOMETRIC ANALYSIS

(Research Article)

Rabia Acemioglu https://orcid.org/0000-0003-4369-2986
Iğdır University, Tuzluca Vocational School, Türkiye
racemioglu@gmail.com

Biodata:

Rabia Acemioglu works as a lecturer in the child development program at Iğdır University Tuzluca Vocational School Child Development Program, Igdır, Türkiye. She completed her doctorate in Science Education in 2025.

REFLECTIONS OF STUDENT AND NUTRITION THEMES IN SCIENCE EDUCATION: A BIBLIOMETRIC ANALYSIS

Rabia ACEMİOGLU*

racemioglu@mail.com

Abstract

This study aims to investigate the level of interaction among the concepts of "student," "nutrition," and "science education" in the academic literature through bibliometric analysis. Developing healthy dietary habits during childhood and adolescence is essential not only for maintaining physical well-being but also for enhancing cognitive functions and academic achievement. In this context, science education emerges as a critical pedagogical medium for embedding health-related behaviors within school settings. Its interdisciplinary structure not only enables the transmission of scientific knowledge but also facilitates the acquisition of lifelong skills and habits. The thematic richness and instructional flexibility of science education allow for more effective integration of health-oriented content, thereby fostering meaningful connections between scientific understanding and everyday life. In this study, a case study model was adopted, and 70 academic publications indexed in the Web of Science database between 2000 and 2025 were analyzed. The publications were examined in terms of temporal trends, geographic distribution, authorship productivity, thematic domains, keyword clusters, and citation networks. The findings reveal increasing scholarly attention to these themes and underscore the transformative potential of science education in shaping students' nutritional behaviors.

Keywords: Education, learning, nutrition, science

1. Introduction

Nutrition is a fundamental aspect of life that directly influences an individual's physical, mental, and cognitive development. For students, particularly those in developmental stages, maintaining a sufficient and balanced diet plays a critical role not only in preserving overall health but also in enhancing academic achievement, attention span, and learning capacity (Florence, Asbridge, & Veugelers, 2008). In this regard, the investigation of students' dietary habits has become an increasingly prominent area of interest within the field of educational sciences. Indeed, existing research highlights that students' nutritional patterns affect not only their personal well-being but also their classroom behaviors, motivation toward learning, and cognitive functioning (Burrows, Goldman, & Pursey, 2017).

Science education is recognized as an approach that aims to help students access scientifically grounded knowledge relevant to their lives and apply this knowledge in everyday contexts. Due to its inherently interdisciplinary nature, science education allows for the integration of themes such as health, environment, and sustainability into the educational process (Bybee, 2013). In this context, examining students' nutritional behaviors from the perspective of science education is critical not only for fostering individual health awareness but also for promoting community-based sustainable lifestyle habits. For instance, there is growing empirical evidence suggesting that school-based nutrition interventions grounded in science education frameworks have significant impacts on students' knowledge levels and

behavioral outcomes (Contento, 2007; Raby Powers et al., 2005; Sharma et al., 2004; Slavin & Lloyd, 2012). However, there appears to be a lack of systematic reviews addressing how the concepts of "student," "nutrition," and "science education" are structured within the scientific literature. Identifying this gap and mapping the scholarly relationships among these three core concepts can provide a valuable foundation for the development of educational policies and the advancement of interdisciplinary research agendas. In this regard, bibliometric analysis methods offer a means of uncovering the evolution of the literature by analyzing publication trends, keyword associations, and citation networks within a given field (Donthu et al., 2021). This methodology is particularly effective in identifying contextual patterns and research gaps among densely populated academic topics. Accordingly, this study analyzes the development of scientific publications indexed in the field of science education that include the keywords "student," "science education," and "nutrition" between 2000 and 2025 through a bibliometric lens. The main objective of the study is to reveal the research agenda of the field by analyzing trends and collaboration networks of academic studies located at the intersection of these three key concepts. In doing so, this research will not only map the existing literature in educational sciences but also provide a reference framework that can guide future interdisciplinary studies.

1.1. Literature Review

In recent years, the fields of nutrition and science education have converged at a critical intersection, particularly in terms of student-centered learning, experiential practices, and the integration of contemporary instructional approaches. Studies that enhance the transmission of scientific knowledge, elevate students' cognitive levels, and support the integration of interdisciplinary contexts such as nutrition into science education have gained increasing attention in this regard (Çepni et al., 2006; Akerson & Donnelly, 2010; Schmidt et al., 2005).

For instance, the study conducted by Çepni et al. (2006) examined the impact of computer-assisted instructional materials on students' cognitive performance, misconceptions, and attitudes toward science courses. The findings demonstrated that technological tools help make scientific content more comprehensible. This suggests that the use of technology-supported materials in the integration of nutrition and science education may facilitate students' conceptual understanding. Another example of this approach is provided by Goto & Schneider (2009), who evaluated the implementation of an alternative instructional method called "interteaching" in nutrition and food science education. Their findings revealed that this method, which encourages active student participation, contributes significantly to the effective comprehension of nutrition-related topics within a science-based framework. Overall, these findings underscore the importance of adopting active learning strategies rather than traditional lecture-based models when integrating nutrition themes into science education content.

The integration of nutrition education into science education is noteworthy not only for enhancing students' content knowledge but also for its potential to foster metacognitive, communicative, and behavioral competencies. Pedagogical models that encourage students to reflect on their own learning processes, reassess their thinking strategies, and connect acquired knowledge to real-life contexts play a crucial role in this synthesis. In a study by Gezer Templeton et al. (2021), the "exam wrapper" strategy was employed to explore how students' thinking skills in the domain of nutrition could be improved. The findings indicated that this approach enables students to reconsider their learning strategies and promotes self-regulated learning. From the perspective of science education, such outcomes emphasize that it is equally important for students to critically evaluate their own learning processes as it is to gain experience-based knowledge. Another study conducted by Reitmeier and Vrchota

(2009) focused on students' self-assessment of their oral presentation skills within the context of nutrition education. The findings emphasized that such reflective practices enhance student awareness and strengthen scientific communication competencies. These results, highlighting the role of oral presentation, discussion, and expressive skills in science education, suggest that incorporating nutrition-related themes can meaningfully contribute to the development of these abilities. In this respect, the inclusion of constructivist approaches aimed at fostering such skills within educational settings encourages students not only to be passive consumers of knowledge but also to become active constructors and interpreters of information (Tanner, 2012). Supporting this perspective, the "Choice, Control, and Change" intervention program designed for middle school students demonstrates that the integration of nutrition-focused education can be effectively adapted to younger age groups, facilitating skill development through interdisciplinary engagement (Gray, Contento, & Koch, 2015). The aforementioned program not only supports middle school students in developing healthy eating behaviors but also aims to ensure that these behaviors are grounded in scientifically informed understanding. It encourages students to make informed dietary choices while simultaneously helping them construct decision-making processes based on scientific reasoning. This underscores the necessity of designing science education content in ways that establish meaningful connections with everyday life.

In a related study, Lee, Contento, and Koch (2013) employed a process evaluation model to systematically examine the effectiveness and implementation strategies of nutrition education programs at the middle school level. Their research provided a conceptual framework that highlighted the relationship between implementation processes and program outcomes. Within this framework, factors such as implementation quality, teacher competence, and levels of student engagement were found to be directly associated with observed behavioral outcomes. Such models emphasize that nutrition-based interventions in science education should not be limited to the transmission of knowledge; rather, they should also address behavioral development. Supporting this view, Bohn and Schmidt (2007) investigated the integration of experiential learning strategies in large-scale food science courses. Their findings reported that hands-on activities positively influenced both student engagement and learning outcomes. Indeed, these findings emphasize the necessity of implementing practice-oriented activities within science education by contextualizing them through concrete, everyday life themes such as nutrition. In addition, Costabile (2020) conducted a study during the COVID-19 pandemic that utilized online simulations to deliver biochemistry laboratory content, demonstrating that nutrition-based science education can be effectively implemented in remote learning environments as well. This study highlights that technology-supported instructional approaches can continue to foster learning processes even in times of crisis. Similarly, Teri et al. (2014), in their investigation of the pedagogical impact of mobile learning applications, reported that mobile technologies enhance student engagement, provide flexible learning environments, and support educational settings responsive to individual learning differences. These findings suggest that the integration of nutrition-related themes into science curricula through online learning tools holds significant potential both for educational technologies and interdisciplinary instructional design. Such integration enables the provision of interactive, personalized learning experiences that are closely linked to students' everyday lives. In this context, nutrition-themed content delivered via mobile learning platforms is projected to enhance students' science literacy as well as their awareness of healthy lifestyles. From a clinical standpoint, Stimac et al. (2016) contribute to this dialogue by illustrating how topics related to biology and health can be meaningfully embedded within the framework of science education, thereby reinforcing the connection between nutritional science and health education.

The body of literature reviewed thus far underscores the necessity of approaching nutrition-related themes within science education from a multidimensional and interdisciplinary perspective. Educational approaches that emphasize not only knowledge transmission but also the development of skills, attitudes, and behaviors constitute a shared foundation for both science education and nutritional science. However, comprehensive studies that simultaneously examine the interaction of the keywords "student," "nutrition," and "science education" within a bibliometric framework remain scarce in the existing literature. Current research typically focuses either solely on student nutrition or explores diverse health-related themes under the umbrella of science education. This highlights a critical gap in understanding how knowledge production at the intersection of these domains has evolved and where significant shortcomings may still exist. Moreover, the extent to which nutrition is represented within science education varies across cultural, geographical, and political contexts a topic that has not yet been sufficiently explored. For example, while a substantial number of studies on student nutrition behaviors have been conducted in high-income countries, such research remains limited in low- and middle-income settings (Neumann et al., 2002; Popkin et al., 2012; Black et al., 2013; Meshkovska et al., 2023; Shinde et al., 2023). These disparities should be considered as critical factors in shaping educational policies and designing curricula. In this context, the primary aim of the present study is to systematically examine the publications indexed in the Web of Science database between 2000 and 2025 that include the keywords “student,” “nutrition,” and “science education.” Through this bibliometric inquiry, the study seeks to reveal the quantitative and thematic patterns of scientific production across these concepts. The findings derived from the analysis will illuminate key areas of focus within the literature, patterns of scholarly collaboration, citation networks, and emerging research gaps. It is anticipated that the results will contribute to enhancing interdisciplinary collaboration, expanding science-based health education practices, and supporting the development of students’ life skills. Accordingly, this study seeks to address the following research questions:

- What are the annual publication trends of academic studies that address both student and nutrition themes within the context of science education between 2000 and 2025?
- How have author-based publication patterns evolved over time in studies focusing on student and nutrition themes in science education? Are there identifiable trends of increase or decline?
- In which countries are academic publications on student and nutrition-related topics within science education predominantly concentrated?
- How do the indexing distributions of academic studies on student and nutrition themes in science education reflect changes over time?
- How do the academic studies on student and nutrition themes within the scope of science education vary in terms of their associated research areas?
- What patterns of co-authorship emerge from academic publications addressing student and nutrition themes in science education?
- How are the keywords used in science education studies related to student and nutrition themes distributed and clustered?

2. Methodology

In this study, a case study model, one of the qualitative research designs, was adopted. This model offers an approach that allows for an in-depth examination of a bounded

phenomenon or system within its natural context. High-quality case studies are defined as a research design that necessitates a detailed analysis of processes or situations that unfold within a specific context and time frame (Yin, 2009). Frequently employed in the field of educational sciences, this model provides an effective analytical framework for revealing contextual patterns in detail (Merriam, 1998). Within this framework, the concepts of students and nutrition, which constitute the focal point of the research, were addressed as a bounded context and analyzed in terms of bibliometric characteristics. The concept of bibliometric analysis was first introduced to the literature as a systematic method through the works of Raisig (1962). Raisig defined bibliometric analysis as the process of collecting, organizing, and interpreting statistical data pertaining to information sources such as books and periodicals. In this regard, the bibliometric approach offers a robust methodological framework that enables the systematic analysis of publication trends, developmental stages, and research foci within a particular academic field. Therefore, in this study, which aims to reveal the structure of the literature on student nutrition within the field of science education, the case study design was deemed an appropriate method in line with the objective of achieving contextual depth and holistic analysis.

2.1. Data Collection Tool

In this study, the Web of Science (WoS) database was utilized as the primary data collection tool. Originally developed in the 1960s by the Institute for Scientific Information (ISI**)** to systematically track citation relationships within the scientific literature (Adriaanse & Rensleigh, 2011; Falagas et al., 2008), WoS has evolved into one of the most widely used platforms for monitoring, classifying, and evaluating scholarly publications. Owing to its citation-based architecture, WoS is now recognized as one of the oldest and most comprehensive reference sources available for academic research (Boyle & Sherman, 2006).

2.2. Data collection process

The dataset for this study was constructed through a systematic search of academic publications indexed in the Web of Science (WoS) database. In order to identify relevant studies that address the themes of student and nutrition within the context of science education, the keywords *"science education," "student,"* and *"nutrition"* were selected and combined using the Boolean operator "and." To ensure comprehensive coverage of the literature, the search was conducted using the *all records* option without applying any temporal restrictions, thereby encompassing the entire available publication range. As a result of this search strategy, a total of 70 academic publications were retrieved from the WoS database. These publications were then subjected to a bibliometric analysis based on the predefined keywords. The analysis focused on several bibliometric indicators, including annual publication trends, co-authorship productivity, research areas, indexing sources, keyword distributions, and country affiliations. This approach enabled a comprehensive overview of the scholarly landscape related to student and nutrition-focused research within science education literature.

2.3. Data analysis

Within the scope of this research, data obtained from 70 scientific publications focusing on the themes of science education**,** students, and nutrition**,** published between 2000 and 2025, were organized and analyzed using bibliometric analysis techniques. The dataset was categorized in alignment with the research questions and structured through quantitative analysis methods. The obtained dataset was classified and structured in accordance with the research questions. Accordingly, several bibliometric indicators were employed to examine

the distribution of publications by year**,** country**,** index**,** research domain**,** keywords**,** and authors. The results of this analysis were presented visually through graphs and figures. In addition, the VOSviewer software was utilized to analyze collaboration networks**,** conceptual clustering**,** and co-citation relationships among the publications. Through this software, the data sets were visualized in a manner that revealed the structural connections between related themes and the internal organization of the literature. As a result, a comprehensive overview was obtained regarding how the concepts of "student" and "nutrition" are structured within the broader landscape of science education literature.

2.4. Ethical issues

This study was conducted solely based on bibliometric data analysis, and no data were collected from human participants. Accordingly, no personal data were used during the research process, no experimental procedures were implemented, and no interaction with human subjects took place. Therefore, ethical committee approval is not required for this research.

3. Findings

This section presents the findings of the study, structured in accordance with the research questions, and focuses on the analysis of publications in the field of science education related to students and nutrition.

3.1.Temporal Distribution of Student and Nutrition Themed Publications in Science Education

Figure 1 illustrates the annual distribution of student and nutrition-related science education publications indexed in the Web of Science.

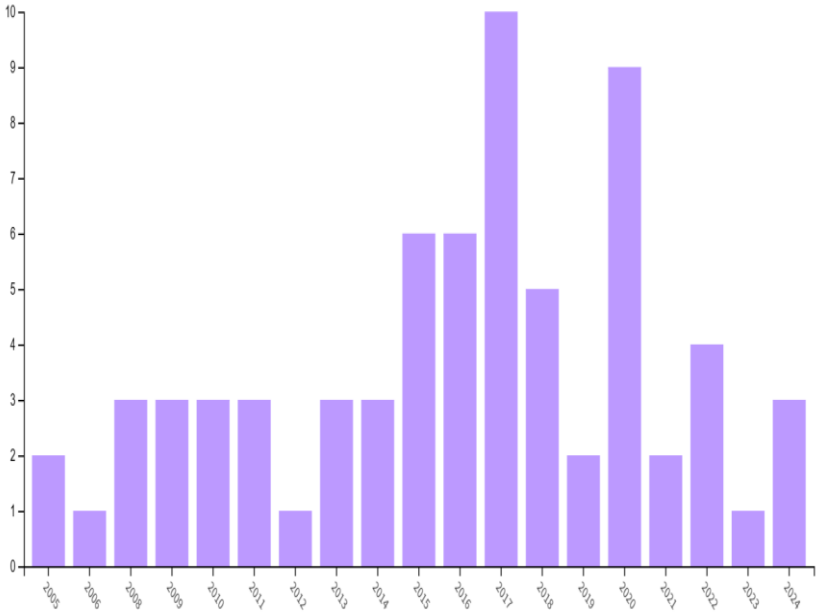

Figure 1. Distribution of science education studies related to students and nutrition by publication year

According to the data presented in Figure 1, the first publication on the subject appeared in 2005**.** The years with the highest number of publications were 2017 (f = 10)**,** 2020 (f = 9)**,** 2015 (f = 6), and 2016 (f = 6). A general examination of the chart reveals a notable upward trend in the number of publications beginning in 2015, with 2017 and 2020 representing the peak years of academic output on this topic.

3.2. Trends in the Number of Student and Nutrition-Themed Science Education Publications by Author Contribution

As a result of the search conducted in the Web of Science database, the most prolific authors contributing to student and nutrition-related studies within the field of science education were identified and are presented in Figure 2.

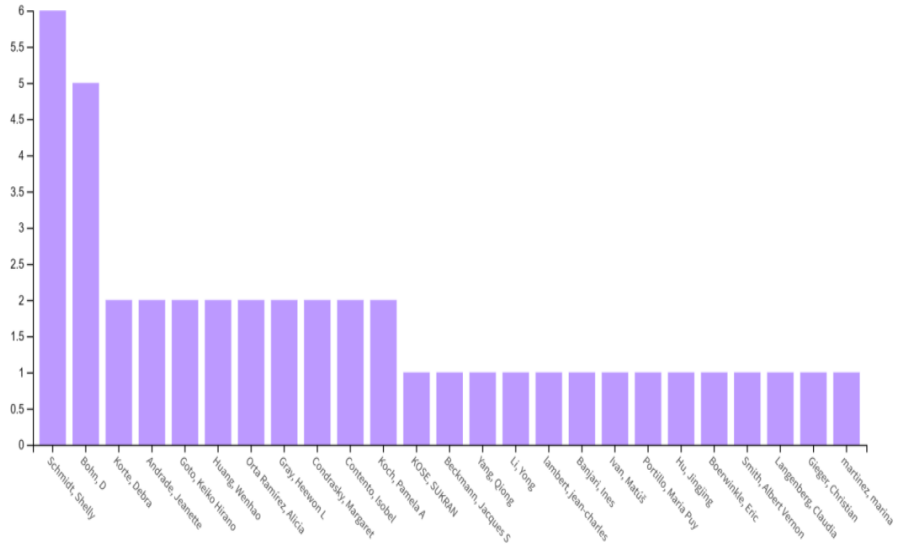

Figure 2. Distribution of student and nutrition-themed science education publications by author contribution

An examination of Figure 2 reveals that *Schmidt, Shelly* stands out as the most productive author in this domain, with a total of six publications (f=6). She is followed by *Bohn, Dawn* with five publications (f=5). Other contributors with notable output, each having two publications (f=2), include *Korte, Debra; Andrade, Jeanette; Goto, Keiko Hirano; Huang, Wenhao; Orta Ramirez, Alicia; Gray, Heewon L.; Condrasky, Margaret;* and *Contento, Isobel*. Overall, the graphic indicates that a limited number of authors have made concentrated contributions to the literature, while the majority of researchers in this area are represented by one or two publications.

3.3. Country distribution of student and nutrition-themed academic studies in the context of science education

According to searches conducted in the Web of Science (WoS) database, the distribution of student and nutrition-related science education publications by country is presented in Figure 3.

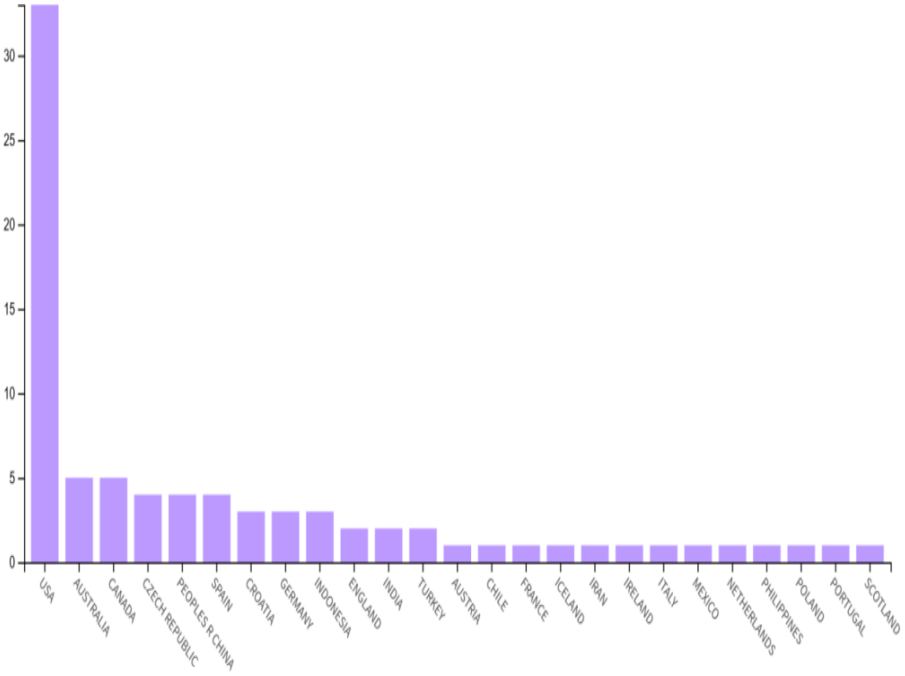

Figure 3. Country-wise distribution of student and nutrition-themed science education studies

As observed, the United States stands out prominently with the highest number of publications (f = 33), significantly surpassing other countries. It is followed by Australia and Canada, each contributing five publications. Subsequent contributions come from countries such as the Czech Republic, China, Spain, Croatia, Germany, and Indonesia, each represented by three or four studies. Overall, the data suggest that research on student and nutrition topics within the scope of science education is predominantly conducted by countries with strong roots in the Anglo-Saxon academic tradition, particularly in North America. In contrast, Turkey is represented by only two publications, indicating relatively limited academic engagement in this specific research area.

3.4. Index-based distribution of student and nutrition-themed academic publications in the field of science education

Figure 4 presents the indexes in which student and nutrition-focused academic studies within the field of science education have been published, based on data from the WoS database.

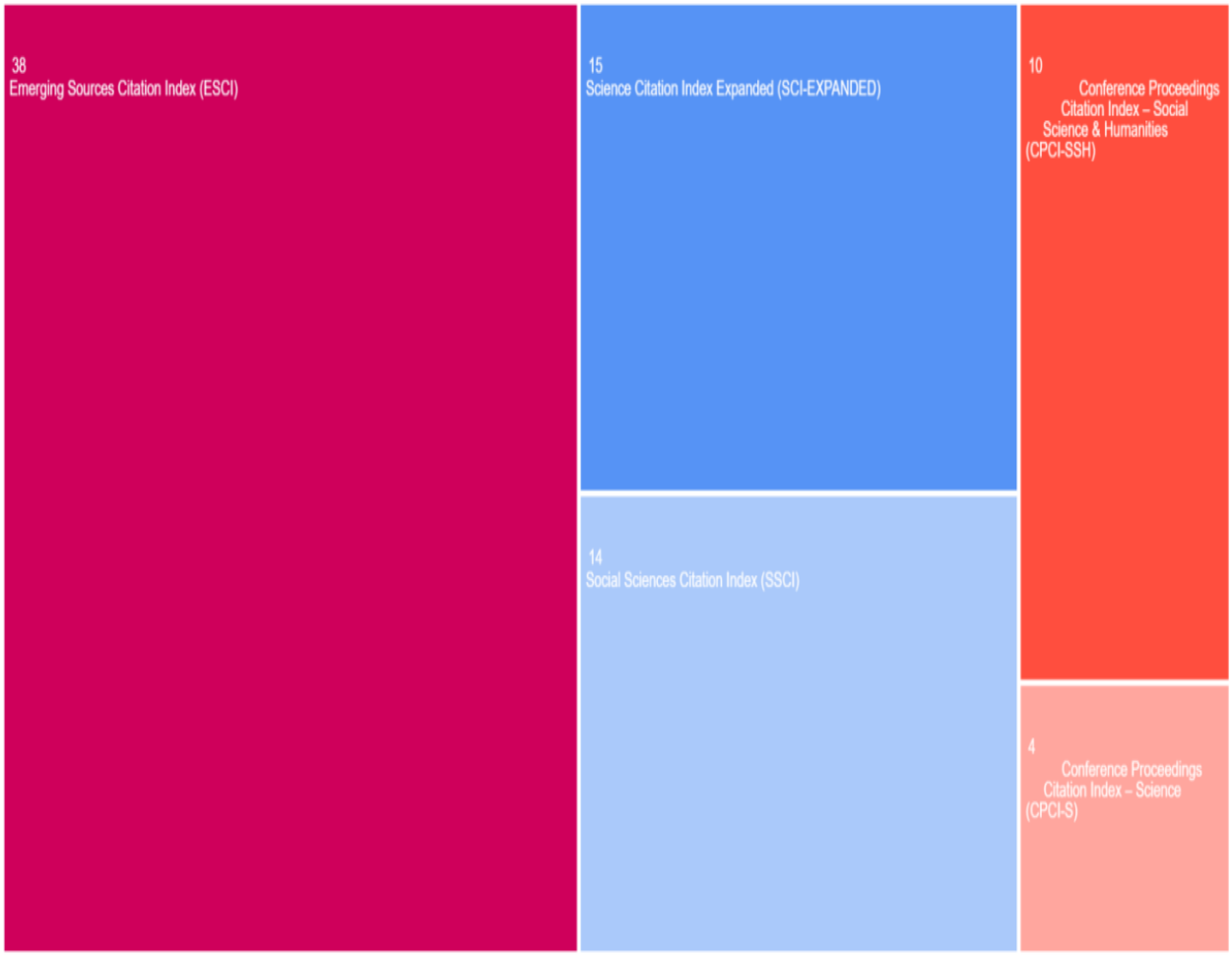

Figure 4. Distribution of student and nutrition-themed science education studies by index classification

An examination of Figure 4 reveals that the majority of these publications are indexed in the Emerging Sources Citation Index (ESCI)**,** with a total of 38 entries. The Science Citation Index Expanded (SCI-Expanded) ranks second, encompassing 15 publications, followed closely by the Social Sciences Citation Index (SSCI), which includes 14 publication**s** within the social sciences category. Additionally, 10 studies have been indexed in the Conference Proceedings Citation Index - Social Science & Humanities (CPCI-SSH), while 4 publications are listed in the Conference Proceedings Citation Index-Science (CPCI-S). This distribution indicates that although most publications are currently indexed in ESCI, a notable presence within more established citation indexes is also evident.

3.5. Distribution of science education publications on student and nutrition concepts by research areas

The thematic distribution of student and nutrition-focused science education studies indexed in the WoS database is presented in Figure 5.

Figure 5. Distribution of student and nutrition-themed science education studies by research area

As illustrated, the predominant research area is clearly Education Educational Researc, which accounts for 53 publications, making it the most represented field by a considerable margin. This is followed by contributions from Food Science Technology, Life Sciences Biomedicine Other Topics, and Nutrition Dietetics, each comprising three studies. The presence of these domains highlights the interdisciplinary nature of research in this field. Additionally, areas such as Agriculture, Biochemistry Molecular Biology, and Public Environmental Occupational Health are each represented by two publications. Furthermore, the figure shows that numerous other disciplines including Psychology, Chemistry, Pediatrics, Polymer Science, Sport Sciences, Computer Science, and Information Science are each associated with a single study. This broad range of subject areas underscores the multidimensional integration of nutrition within science education research.

3.6. Co-authorship distribution of academic studies on student and nutrition themes in science education

The co-authorship network presented in Figure 6 illustrates collaborative relationships among authors who have contributed to student and nutrition-themed studies within the scope of science education, as indexed in the WoS database

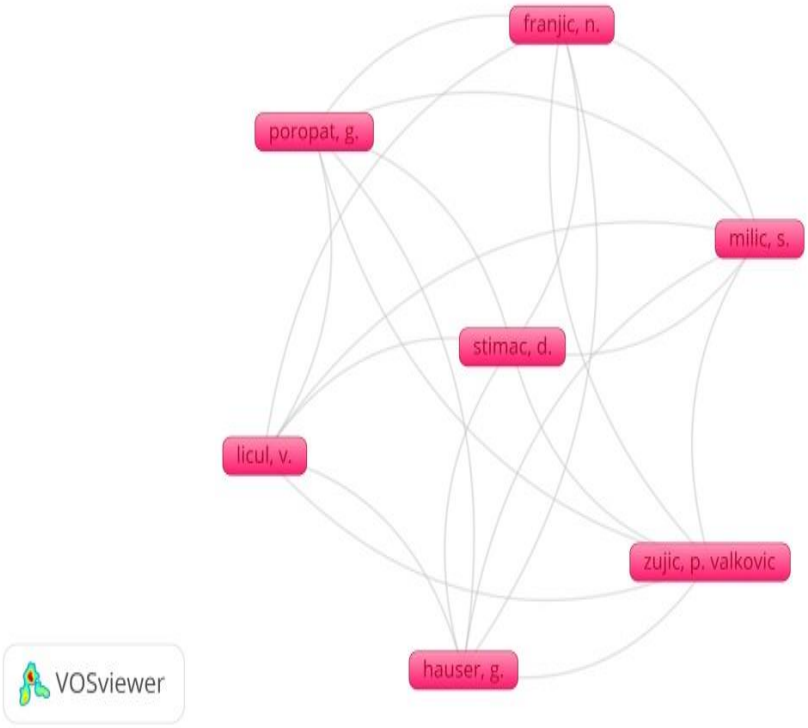

Figure 6. Co-authorship distribution of student and nutrition-themed science education studies

From a total of 169 authors identified in the dataset each with at least one publication and one citation 110 met the inclusion criteria and were included in the analysis. As shown in Figure 6, the authors with the highest number of co-authored publications include *Stimac, D.*, *Poropat, G.*, *Zujic, P.*, and *Valkovic*. These authors stand out for their central positions in the network and for maintaining a high number of collaborative connections. Their strong linkage density suggests not only high productivity levels but also robust multidimensional research collaborations. Notably, *Stimac, D.* is distinguished by a total of 54 citations, while the other prominent authors each received 46 citations. Additionally, Figure 6 reveals that *Stimac, D.* is positioned near the center of the network, indicating direct connections with numerous collaborators, further highlighting their pivotal role in the co-authorship structure.

3.7. Keyword-based distribution of student and nutrition-themed academic studies in science education

Figure 7 presents data derived from the Web of Science database regarding the co-occurrence analysis of keywords.

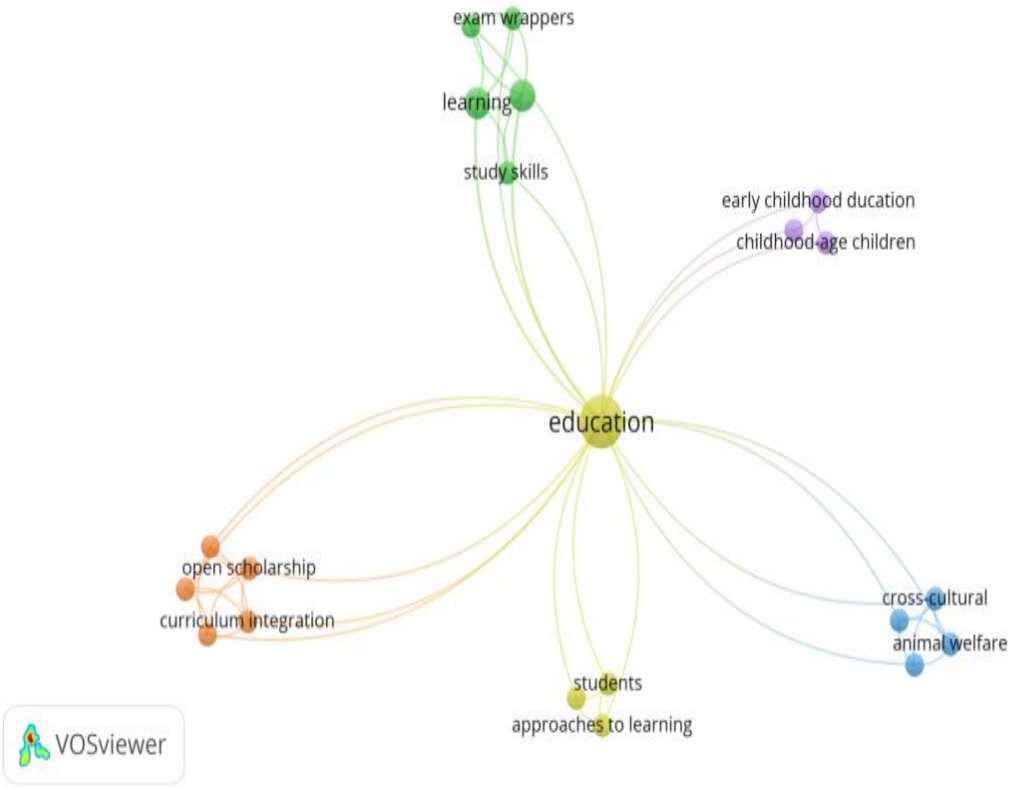

Figure 7. Keyword distribution of student and nutrition-themed science education studies

The visual presented in Figure 7 was generated based on a co-occurrence analysis of keywords extracted from 141 studies within the science education literature focusing on student and nutrition themes. The network structure illustrates how frequently used concepts in the literature are organized into thematic clusters and which keywords assume central roles within the scholarly discourse. According to the analysis results shown in the visual, the keyword *"education"* occupies a central position in the network and emerges as the most strongly connected node with other terms. The surrounding sub-themes are organized around five primary focal areas. First, keywords such as *"learning," "study skills"* and *"exam wrappers"* emphasize learning processes and cognitive strategies**.** Second, terms like *"early childhood education*" and *"childhood-age children*" reflect education practices targeting younger age groups. The third cluster, represented by keywords scuh as" *"open scholarship"* and *"curriculum integration"* highlights themes of interdisciplinary currciculum design. The fourth cluster centers on "animal welfare" and "cross-cultural" drawing attention to environmental, cultural and ethical awareness. Finally, the fifth group revolves around the terms *"students***"** and *"approaches to learning"* underscoring a strong focus on student-centered learning approaches**.**

4. Discussion and conclusion

This study employed a bibliometric approach to examine the publication trends between 2000 and 2025 in the field of science education, focusing on research shaped around the keywords “student,” “nutrition,” and “science education.” The analysis concentrated on various bibliometric indicators, including the number of publications, author distributions, country affiliations, index coverage, subject areas, keyword clusters, and co-authorship network structures. The findings indicate that the intersection of these three concepts within the scientific literature remains in a developmental phase, suggesting that scholarly integration across these domains is still emerging. Nevertheless, the results also point to a growing interdisciplinary potential, reflecting increasing collaboration and thematic convergence across the fields of science education and nutrition. Within this context, the discussion aims to interpret the current directions and gaps in the literature while offering suggestions for future research trajectories.

According to the results of this study, a notable upward trend in publication frequency has been observed since 2015. This increase appears to align with the global rise in attention to themes such as healthy living, combating obesity, and promoting sustainability within educational settings. As highlighted in the studies of Florence et al. (2008) and Gray et al. (2015), student nutrition is not only linked to individual health but also strongly associated with academic achievement, quality of learning, and behavioral development. Through its inherently interdisciplinary nature, science education has provided a meaningful platform for integrating nutrition-related topics. In this context, the publication peaks observed in 2017 and 2020 may be interpreted as reflective of a growing convergence between education policies and science-based public health initiatives.

The findings related to author distribution indicate that the majority of researchers contributing to this field are represented by only one or two publications, while a smaller group of highly productive scholars appear to shape the direction of the literature. For instance, scholars such as *Schmidt, Shelly* and *Bohn, Dawn* have demonstrated sustained engagement with the topic, thereby establishing academically influential profiles marked by consistent contributions. This pattern suggests that knowledge production in this area continues to be concentrated around specific centers and key actors. As noted by Gezer-Templeton et al. (2021), these central figures contribute not only through their publication volume but also by introducing methodological diversity and pedagogical innovation into the field. In particular, strategies such as experiential learning, metacognitive interventions, and student-centered assessment have been integrated into the science education literature through the work of these scholars and have been meaningfully connected with nutrition-related themes.

An analysis of country representation reveals that the United States holds a leading position by a significant margin in terms of scholarly output on student and nutrition themes within science education. This clear dominance can be attributed to several structural factors, including substantial investments in educational research and development, widespread support for interdisciplinary initiatives, and the institutionalization of academic publishing practices. In addition to the United States, other high-income countries such as Australia and Canada also make noteworthy contributions to the field. However, academic production on this topic appears to be relatively limited in countries such as Turkey. In this context, Neumann et al. (2011) also emphasize the scarcity of education-based research on student nutrition in low- and middle-income countries, suggesting that such gaps may hinder the effective development of educational policies related to health and well-being.

The findings regarding index distribution indicate that the majority of publications in this field are indexed under the Emerging Sources Citation Index (ESCI), while fewer studies appear in more established databases such as the Science Citation Index Expanded (SCI-E) and the Social Sciences Citation Index (SSCI). This distribution suggests that the field is still in a developmental phase in terms of academic maturity, and it is likely that a greater number of studies will appear in high-impact journals in the coming years. At the same time, the numerical dominance of ESCI-indexed publications highlights the increasing visibility of the topic and its growing presence on the academic agenda. In line with these observations, the promotion of interdisciplinary and practice-oriented research may enhance the potential for future publications to be accepted in higher-tier indices (Donthu et al., 2021).

The distribution of research areas indicates that nutrition-themed science education studies are predominantly clustered under the category of "Educational Research." However, the data also reveal significant intersections with other domains such as *Food Science Technology*, *Nutrition & Dietetics*, *Public Health*, and *Biochemistry*. This finding suggests that the literature encompasses not only educational perspectives but also biomedical, environmental, and social contexts. As demonstrated in the study by Bohn and Schmidt (2007), applied learning environments play a critical role in concretizing scientific knowledge related to nutrition, reinforcing the interdisciplinary nature of this field. The observed convergence across multiple domains provides science education with a fertile space for transdisciplinary expansion and enhances the visibility of life-relevant topics such as nutrition within instructional processes.

According to the co-authorship analysis, researchers such as *Stimac*, *Poropat*, and *Zujic* occupy central positions within the collaboration network, demonstrating strong connections with numerous co-authors and receiving a high number of citations. This pattern reflects a broader shift in academic knowledge production from individual contributions to more collaborative and networked forms of scholarship. Authors positioned centrally in scientific networks are distinguished not only by the number of publications but also by their degree of connectivity, effective models of collaboration, and roles as influential academic leaders (Adriaanse & Rensleigh, 2011). This structural configuration in the literature suggests that interdisciplinary integration is occurring not only at the content level but also through academic interaction and institutional cooperation. In this regard, increasing international collaborations especially for countries such as Turkey could significantly enhance both the visibility and impact of their contributions by enabling participation in influential global academic networks.

The keyword co-occurrence analysis revealed that the most frequently used terms in the dataset were "education," "students," "learning," "curriculum integration," and "early childhood education." This pattern underscores the centrality of student-centered pedagogy and the foundational role of healthy lifestyle habits developed during early childhood within the science education literature. Furthermore, the prominence of terms such as "open scholarship" and "cross-cultural" suggests that global educational paradigms and intercultural sensitivity are increasingly shaping research trends in this domain. Supporting this, the study by Teri et al. (2014) emphasized that mobile learning tools enhance student engagement, promote pedagogical flexibility, and foster learning environments responsive to individual differences. In this context, the integration of digital technologies with science education and nutrition-related content provides notable advantages in terms of both content diversity and accessibility, reinforcing the value of technology-enhanced, inclusive instructional approaches.

The overall assessment of the study demonstrates that the themes of *student* and *nutrition* should be addressed within science education not only at the content level but also through pedagogical, social, and cultural dimensions. The existing literature emphasizes holistic approaches that extend beyond the transmission of knowledge, aiming also at the cognitive, affective, and behavioral development of students. This finding reinforces the need for broader implementation of pedagogical strategies such as the metacognitive techniques proposed by Gezer-Templeton et al. (2021) and the interactive learning models advocated by Goto and Schneider (2009). It is essential that nutrition-related topics in science education be framed not solely as components of health knowledge but also as avenues to foster critical thinking, problem-solving, and decision-making skills. Such an integrative approach may enhance students' self-awareness and support the development of lifelong healthy habits. Based on the findings of this research, several recommendations have been proposed. First, nutrition-related themes should be more systematically embedded within science curricula and supported by experiential learning, digital applications, and student-centered assessment strategies. Second, teacher education programs should place greater emphasis on nutrition-related topics to enhance pre-service teachers' interdisciplinary thinking skills. Third, in developing countries such as Turkey, it is essential to increase the volume of research in this field, encourage participation in international academic networks, and promote multi-institutional collaborative projects. Fourth, policymakers and educational authorities should recognize the inclusion of health-related themes in science education not merely as curricular content but as a strategic component of public health promotion. Lastly, the integration of nutrition themes into science education should adopt a comprehensive approach that extends beyond the school context to include families, communities, and media environments. In conclusion, this study provides a theoretical contribution to both science education and nutrition education, offering a reference framework for future interdisciplinary research and serving as a valuable resource in advancing health-oriented educational transformation efforts.

Conflict of interest

There is no conflict of interest with any institution, organization or person in this research.

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