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The Innovative Teaching Strategies in Numeracy and Literacy to Achieve SDGs: A Systematic Literature Review

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Abstract. The pursuit of Sustainable Development Goals (SDGs) has driven significant advancements in global educational practices, particularly in the areas of numeracy and literacy. This study explores innovative teaching strategies designed to enhance these foundational skills, with a focus on their role in achieving SDG targets such as equitable access to quality education and promoting lifelong learning opportunities for all. The primary aim is to evaluate the effectiveness of these strategies in diverse educational contexts worldwide. A systematic literature review was conducted, analyzing data sourced from the Scopus database, covering publications from 2014 to 2024. The review included a detailed examination of 68 studies that met the inclusion criteria. The methodology involved the use of bibliometric tools like VOSviewer for mapping research themes and identifying trends in the field. The analysis revealed three major thematic clusters, highlighting the critical roles of numeracy, literacy, and their integration in educational strategies. The results indicate substantial improvements in student learning outcomes, critical thinking skills, and overall educational quality through the application of innovative teaching strategies in numeracy and literacy. These findings underscore the necessity of a holistic approach to education, integrating multiple competencies to effectively address the educational needs identified in SDG 4. The study concludes that the continued refinement and implementation of these strategies are crucial for advancing global educational objectives aligned with sustainable development. This research contributes valuable insights into the design and sustainability of educational policies and practices, offering a pathway to achieving broader educational and societal goals.

Keywords: numeracy, literacy, SDGs, SLR, teaching strategies

INTRODUCTION

The pursuit of Sustainable Development Goals (SDGs) has catalyzed significant advancements in global educational practices (Chua et al., 2017; Creese, 2016; Hamman et al., 2019; Murendo et al., 2024). Innovative teaching strategies in numeracy and literacy have emerged as pivotal tools for adopting comprehensive learning environments aimed at not only cultivating fundamental skills but also nurturing critical thinking and problem-solving abilities among learners (Bellini et al., 2019; Buljan et al., 2019; Olkishoo et al., 2019).

The significant research explored the innovative teaching strategies in numeracy and literacy within the context of SDGs. Studies have documented significant improvements in student learning outcomes, critical thinking skills, and overall educational quality through the implementation of these strategies (Tunstall et al., 2019; Vacher, 2019; Misunas et al., 2024; Spreckelsen & Juenger, 2017). Various factors influencing the adoption and sustainability of these approaches in diverse educational settings have been examined (Agnello, 2021; Volchok, 2019; Ward & Damjanovic, 2020). However, gaps persist in understanding the long-term impact of these strategies on achieving specific SDGs targets, such as equitable access to quality education (SDGs 4) and promoting lifelong learning opportunities for all (SDGs 4.7) (Larsen et al., 2019; Md-Ali et al., 2016; Scandurra & Alberio, 2021; Ward McIntosh et al., 2022).

The research conducted on innovative teaching strategies in numeracy and literacy to achieve SDGs played a crucial role in advancing educational practices globally (Larsen et al., 2019; Md-Ali et al., 2016; Sarva et al., 2023). It provided substantial evidence of the value of these strategies in improving student learning outcomes, advancing critical thinking skills, and improving overall educational quality. The identification of research gaps highlighted areas where further exploration and innovation are needed, guiding future efforts in educational policy and practice. The research underscored the transformative potential of innovative teaching approaches in advancing global educational agendas aligned with sustainable development objectives.

The research aimed to investigate innovative teaching strategies in numeracy and literacy towards achieving SDGs. It sought to explore existing literature to document significant improvements attributed to these strategies in diverse educational contexts worldwide. The

research aimed to identify and address gaps in understanding numeracy and literacy in the context of achieving SDGs. By doing so, the research aimed to offer innovative solutions and recommendations to enhance the implementation and sustainability of these teaching strategies, thereby contributing to the advancement of comprehensive educational objectives aligned with global sustainable development goals. The research questions investigated trend research of numeracy and literacy in inovation teaching achieving SDGs goals.

METHODS

A systematic literature review was employed to analyze the relationship between innovative teaching strategies, numeracy, literacy, and SDGs. The research methodology focused on accessing relevant literature through the Scopus database, specifically utilizing the search criteria: (TITLE-ABS-KEY ("innovative teaching strategies") OR (numeracy) AND (literacy) OR (SDGs)) AND PUBYEAR > 2014 AND PUBYEAR<2024 AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (EXACTKEYWORD, "Education") OR LIMIT-TO(EXACTKEYWORD, "Literacy") OR LIMIT-TO(EXACTKEYWORD, "Numeracy")) AND (LIMIT-TO(LANGUAGE, "English")) AND (LIMIT-TO(SUBJAREA, "SOCI")). This search strategy ensured inclusion of studies published in English from 2014 to 2024, focusing on open access sources related to education, literacy, and numeracy shown in Figure 1.

The data extracted from Scopus included details such as year of publication, publishing institution, countries of origin, journal names, document types, and specific research topics. Descriptive analysis was conducted to summarize the findings based on these parameters, facilitating a comprehensive understanding of the current landscape of research on innovative teaching strategies in relation to numeracy, literacy, and SDGs.

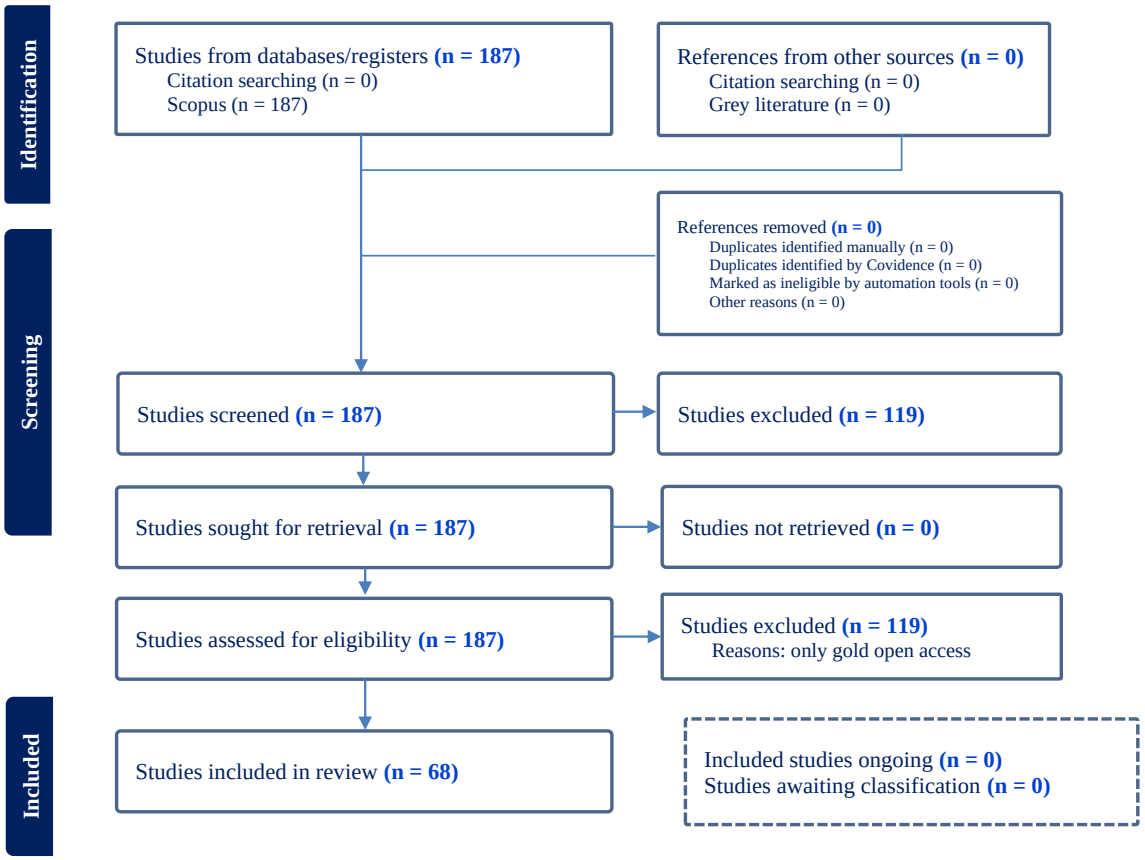

Figure 1. PRISMA Flow Chat using Covidence

To visualize and analyze the research development map, the data were exported in RIS file format for use in VOSviewer. This software facilitated the mapping of research themes and the visualization of relationships between key concepts within literature. The frequency of words and co-occurrence of terms were analyzed to identify top themes and recent trends in the field.

The systematic review used PRISMA guidelines, ensuring accurate methodology and transparency in data selection and analysis. Citation tracking of included articles was also performed to augment the comprehensiveness of the review process, thus providing foundation for synthesizing empirical evidence and generating insights into the impact of innovative teaching strategies on achieving SDGs objectives.

RESULTS AND DISCUSSION

Results of the PRISMA mapping using Covidence, as shown in Figure 1, indicated that a total of 187 records were identified from the Scopus database covering the years 2014 to 2024. During the screening stage, duplicate articles were removed, resulting in a refined dataset. Articles accessible through gold open access were included, and only those published in English were considered eligible. Each article suffered eligibility assessment, excluding those that did not mention literacy and numeracy from further analysis. In the end, 68 documents met the inclusion criteria and were selected for detailed review and synthesis.

The preliminary steps in using VOSviewer involved choosing the data source for creating a map. The study opted to read data from bibliographic database files, specifically selecting files from the Scopus database. During the process of selecting the type of analysis and counting method for creating a bibliographic map, the chosen type of analysis was co-occurrence, with the counting method set to full counting and the unit of analysis being all keywords.

In the process of setting a threshold for keyword occurrences in the bibliographic map, the study set the minimum number of occurrences of a keyword at 4. VOSviewer indicated that out of 481 keywords, 22 met the threshold of appearing at least 4 times. During the process of selecting the number of keywords for a co-occurrence analysis, the number of keywords to be selected was set to 22, indicating that all keywords meeting the threshold would be included in the analysis.

Table 1. Selected Keywords

Keyword	Occurrences	Total Link Strength
numeracy	54	122
human	13	98
female	11	89
literacy	31	86
male	10	84
education	16	68
article	8	65
adult	8	64
aged	6	51
health literacy	7	43
humans	6	43
controlled study	4	39
human experiment	4	39
major clinical study	4	35
learning	6	30
curriculum	6	28
reading	4	26
statistics	4	22
quantitative literacy	10	17
quantitative reasoning	6	14
assessment	5	12
social justice	6	11

The analysis and layout settings in VOSviewer were configured to optimize visualization. For normalization, the method used was Association Strength, ensuring accurate representation of the relationships between terms. The layout settings included an attraction value of 2 and a repulsion value of 0, with default values checked to maintain standard configurations. Advanced parameters for layout adjustments were accessible. In the clustering section, the resolution was set to 1.00, with a minimum cluster size of 1, allowing for detailed and fine-grained clustering. The option to merge small clusters was enabled to avoid fragmentation of data points. Similar to the layout settings, advanced parameters for clustering were available. For rotating or flipping the visualization, the degree of rotation was set to 90 degrees. These settings ensured that the visualization was flexible and customizable to meet the specific needs of the analysis.

The analysis of the selected keywords revealed three distinct clusters. Cluster 1 comprises ten items: adult, aged, controlled study, female, health literacy, human, human experiment, humans, male, and reading. These terms are primarily related to demographic factors and health-related

studies. Cluster 2 consists of six items: curriculum, education, learning, literacy, major clinical study, and statistics. This cluster focuses on educational themes and the systematic study of these areas. Cluster 3 includes five items: assessment, numeracy, quantitative literacy, quantitative reasoning, and social justice. This cluster highlights key areas in the quantitative evaluation of literacy and numeracy, as well as the broader context of social justice. Together, these clusters provide a comprehensive overview of the interconnected themes and focus areas within the research dataset.

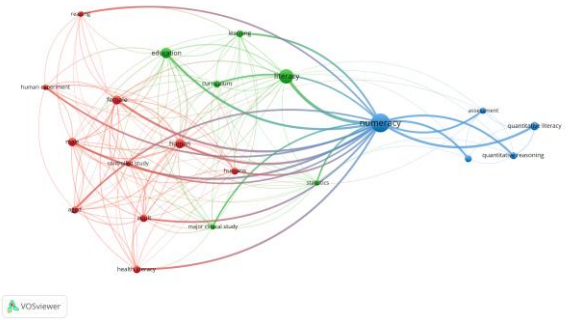

Figure 2. Network Visualization of Keyword Numeracy

Figure 2. numeracy is the central node in the network, indicating its high frequency and strong connections with other keywords. The links between the keywords represent co-occurrences in the dataset, with thicker lines indicating stronger connections. Literacy and education are also significant nodes, showing their importance and interconnectedness within the research themes. Keywords such as quantitative literacy and quantitative reasoning are specifically connected to numeracy, highlighting their relevance in quantitative studies.

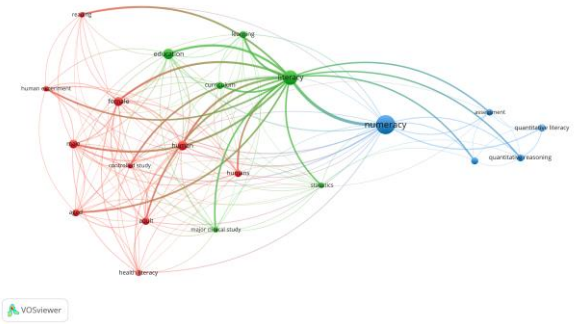

Figure 3. Network Visualization of Keyword Literacy

Figure 3. literacy is the central node in the network, indicating it has the highest frequency and the strongest connections with other keywords. This centrality underscores the importance of literacy within the research dataset and its strong influence on related topics. Literacy has significant connections to keywords such as education, learning, curriculum, and numeracy. These strong connections highlight the integral role of literacy in educational themes and its interrelation with numeracy. The presence of terms like education, learning, and curriculum connected to literacy indicates a strong focus on how literacy is embedded within educational practices and policies. This reflects the emphasis on literacy as a foundational element of education. The connections to keywords such as major clinical study and statistics suggest that literacy is also considered in the context of broader research methodologies and quantitative analyses, highlighting its multidisciplinary relevance. Links to keywords like quantitative literacy, quantitative reasoning, and social justice show that literacy is not only viewed in terms of basic reading and writing skills but also in its broader implications for critical thinking, reasoning, and social equity.

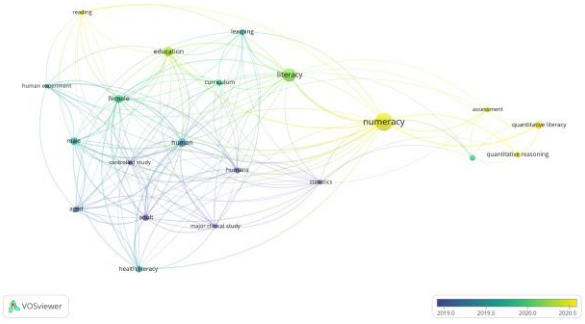

Figure 4. Temporal Network Visualization of Keyword

Literacy and numeracy were the central nodes in the network, indicating their high frequency and strong connections with other keywords. Numeracy is shown in a more recent context (yellow), whereas literacy is connected to slightly older but still recent publications (green).

Numeracy as the central node in the network, highlighting its high frequency and strong connections with other keywords in the dataset. The links between the keywords represent co-occurrences, with thicker lines indicating stronger connections. This visualization underscores the pivotal role of numeracy in the context of innovative teaching strategies aimed at achieving

Sustainable Development Goals (SDGs).

The research aimed to investigate trends in innovative teaching strategies for numeracy and literacy to achieve SDGs goals. Specifically, it explored how these strategies are implemented and their impact on educational outcomes. Numeracy's position as the central node demonstrates its critical role in educational research focused on SDGs. Its strong connections to various keywords indicate that it is a foundational element in innovative teaching strategies. The frequent occurrence of numeracy in the literature suggests that educational researchers and practitioners prioritize numeracy skills, recognizing their importance in developing critical thinking and problem-solving abilities, which are essential for achieving SDG 4 Quality Education.

Literacy and education are also significant nodes, showing their interconnectedness with numeracy. This highlights that effective educational strategies often integrate both numeracy and literacy to enhance overall learning outcomes. The integration of literacy and education with numeracy suggests a holistic approach to teaching, where multiple skills are developed simultaneously, aligning with the comprehensive educational goals outlined in SDGs.

Keywords such as quantitative literacy and quantitative reasoning are specifically connected to numeracy. This connection underscores the relevance of quantitative skills in educational research and practice. The emphasis on quantitative literacy and reasoning aligns with the objectives of SDGs to promote not just basic educational skills but also advanced competencies that enable learners to engage critically with data and complex information.

The strong co-occurrence of numeracy with other educational keywords indicates that innovative teaching strategies often focus on enhancing numeracy skills through various methods, including technology integration, contextual learning, and interdisciplinary approaches. By understanding these connections, educators and policymakers can design and implement teaching strategies that effectively address the educational needs identified in SDG 4.7, which emphasizes equitable and inclusive quality education and lifelong learning opportunities for all.

The analysis of numeracy is not only a central theme in educational research but also a critical component of innovative teaching strategies designed to achieve SDGs. Its strong connections with literacy, education, and quantitative skills highlight the importance of a holistic approach to education that integrates multiple competencies (Citrawan et al., 2024; Jin et al., 2016; MacDonald et al., 2022; Mokgadi & Hove, 2024).

Literacy as the central node in the network, indicating it has the highest frequency and the strongest connections with other keywords. This centrality underscores the importance of literacy within the research dataset and its strong influence on related topics.The research aimed to investigate trends in innovative teaching strategies for numeracy and literacy to achieve SDGs goals. Specifically, it explored how these strategies are implemented and their impact on educational outcomes. The findings from Figure 3 provide significant insights into this investigation.

Literacy's position as the central node demonstrates its critical role in educational research focused on SDGs. Its strong connections to various keywords indicate that literacy is a foundational element in innovative teaching strategies. The frequent occurrence of literacy in the literature suggests that educational researchers and practitioners prioritize literacy skills, recognizing their importance in developing comprehensive educational frameworks, which are essential for achieving SDG 4: Quality Education.

Literacy's strong connections with education, learning, and curriculum indicate its integral role in educational themes and policies. This reflects a comprehensive approach to teaching, where literacy is embedded within various educational practices and strategies. The interrelation between literacy and these keywords highlights that effective educational strategies often integrate literacy development as a core component, aligning with the holistic educational goals outlined in SDGs.

The connections of literacy to major clinical studies and statistics suggest its consideration within broader research methodologies and quantitative analyses. This multidisciplinary relevance indicates that literacy is not only about basic reading and writing skills but also about understanding and engaging with complex information and data. This broad perspective aligns with the objectives of SDGs to promote not just basic educational skills but also advanced competencies that enable learners to critically engage with various types of information and methodologies.

The links between literacy and keywords like

quantitative literacy, quantitative reasoning, and social justice show that literacy is viewed in terms of its broader implications for critical thinking, reasoning, and social equity. By understanding these connections, educators and policymakers can design and implement teaching strategies that effectively address the educational needs identified in SDG 4.7, which emphasizes equitable and inclusive quality education and lifelong learning opportunities for all.

The analysis of literacy is not only a central theme in educational research but also a critical component of innovative teaching strategies designed to achieve SDGs. Its strong connections with education, learning, curriculum, and quantitative skills highlight the importance of a holistic approach to education that integrates multiple competencies (Nedungadi et al., 2024; Reilly & Rees, 2018; Tegeh et al., 2021; Visser et al., 2019).

The findings of this study reveal a critical synthesis of the impact of innovative teaching strategies in numeracy and literacy on achieving SDGs. The results provide substantial evidence of the value of these strategies in improving student learning outcomes, advancing critical thinking skills, and enhancing overall educational quality (Chang, 2023; Mendez-Carbajo et al., 2019; Sikko, 2023; Xin & Yunus, 2020). These innovative approaches have demonstrated improvements in various educational settings, contributing to the broader goals of sustainable development (Bierer & Baedorf Kassis, 2023; Durgunoğlu et al., 2022; Fonseca & Simões, 2014; Taylor et al., 2018).

The novelty of this research lies in its comprehensive analysis of the relationship between innovative teaching strategies and their alignment with SDGs. By systematically reviewing and synthesizing existing literature, the study identifies key areas where innovative strategies have made a significant impact and highlights gaps that require further exploration. This research is particularly valuable for policymakers, educators, and researchers as it offers actionable insights and recommendations for enhancing the implementation and sustainability of these strategies in diverse educational contexts (Abuya et al., 2018; Asmara & Purnomo, 2023; Frith & Lloyd, 2021; Sakurai & Goos, 2023).

The benefits and contributions of this research to science and society are multifaceted. For the scientific community, the study provides empirical evidence and insights into effective teaching strategies that can be tailored to achieve specific SDGs targets (Choi et al., 2022; Dorris et al., 2024; Sawe et al., 2020; Watson et al., 2019). This knowledge can guide future research and innovation in educational practices, fostering a deeper understanding of how to address the complexities and challenges associated with sustainable development (Bakker et al., 2017; Connor, 2020; Geiger & Schmid, 2024; Indefenso & Yazon, 2020; Khajeei et al., 2022). For society, the research underscores the transformative potential of innovative teaching approaches in addressing global educational challenges. By enhancing literacy and numeracy skills, these strategies contribute to the development of critical thinking and problem-solving abilities, which are essential for sustainable development and social equity.

CONCLUSION

The findings underscore the centrality of numeracy and literacy within educational research, highlighting their pivotal roles in innovative teaching methods. Figures 2 and 3 reveal that both numeracy and literacy are critical components of educational strategies designed to enhance student learning outcomes, critical thinking, and overall educational quality. The strong connections of numeracy with keywords such as quantitative literacy and quantitative reasoning, and of literacy with education, learning, and curriculum, emphasize the comprehensive and integrated approach required for effective education aligned with SDG 4. The research contributes significantly by providing empirical evidence and insights into the effectiveness of these strategies, guiding future educational policies and practices. The study also addresses existing gaps by offering recommendations for enhancing the implementation and sustainability of these strategies, thereby advancing global educational agendas aligned with sustainable development goals.

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