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Communication Skills in Science Learning Over the Period 2022-2024: A Bibliometric Analysis

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Abstract. This research aims to examine the types of documents, author keywords, country contributions to communication skills in science learning, and potential future research topics related to communication skills. The researchers conducted a literature review using bibliometric analysis, utilizing Mendeley Desktop and Vosviewer to visualize the data. Data sources were obtained from the Scopus database, which found 85 articles out of 4342 documents using the term "communication skills in science learning" from 2022 to 2024. The Vosviewer results identified seven clusters on this topic. The research findings on communication skills in science learning can help scholars comprehend global trends in the field and offer direction for future investigations.

INTRODUCTION

Communication represents a reciprocal interaction process between individuals, involving the transmission and reception of messages. Communication skills encompass both verbal and written abilities [1], [2]. The effective communication achieves predefined indicators of communicative proficiency [3]. In the realm of education, effective learning occurs when there is intensive communication and interaction between teachers and students [4]. Optimal communication during the learning process, particularly between teachers as educators and students as learners, is crucial [5]. Elementary school students, classified within the developmental phase of childhood, have a valuable opportunity to improve their language proficiency. Effective learning in education hinges on intensive communication and interaction between teachers and students [6].

Verbal and written communication skills are pivotal indicators of students' readiness to face life's challenges [7]. These skills are not only essential for cultivating critical thinking but also for constructing long-term concepts for life [8]. In the teaching-learning process, especially in science education, students play a crucial role in enhancing

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communication skills [9]. Hence, it is imperative to cultivate communication skills to prepare students for their future careers. Communication is a vital element in science education, as students need to convey their findings through various forms of representation, such as charts, diagrams, tables, images, or graphs, and to articulate their discoveries clearly (Sari et al., 2023).

Researchers have conducted several studies to develop students' communication skills. Their findings indicate that implementing student worksheets in teaching can enhance communication skills, resulting in improvements ranging from inadequate to good (Melinda & Zainil, 2020; Sari & Soenarno, 2018). Additionally, researchers have applied various instructional models to cultivate scientific communication skills [13], [14]. Despite several studies focusing on developing communication skills, comprehensive research on communication skills in science education remains limited. Hence, researchers conducted a bibliometric analysis to examine the research trends on communication skills in science education from 2022 to 2024.

METHODS

The data initially obtained from the Scopus database amounted to 4342 documents. Afterward, the data underwent filtering based on communication skills in science education, publication years (2022-2024), document types (articles and conference papers), source types (journals and proceedings), publication stages (final), and language (English). Following filtration, 85 articles remained. Subsequently, the data underwent visualization using VOSviewer software. VOSviewer software served as the bibliometric analysis tool to visualize the network in terms of keywords [15], [16].

RESULT & DISCUSSION

The VOSviewer analysis resulted in three visualizations, with Figures 1 and 2 showing the network visualization.

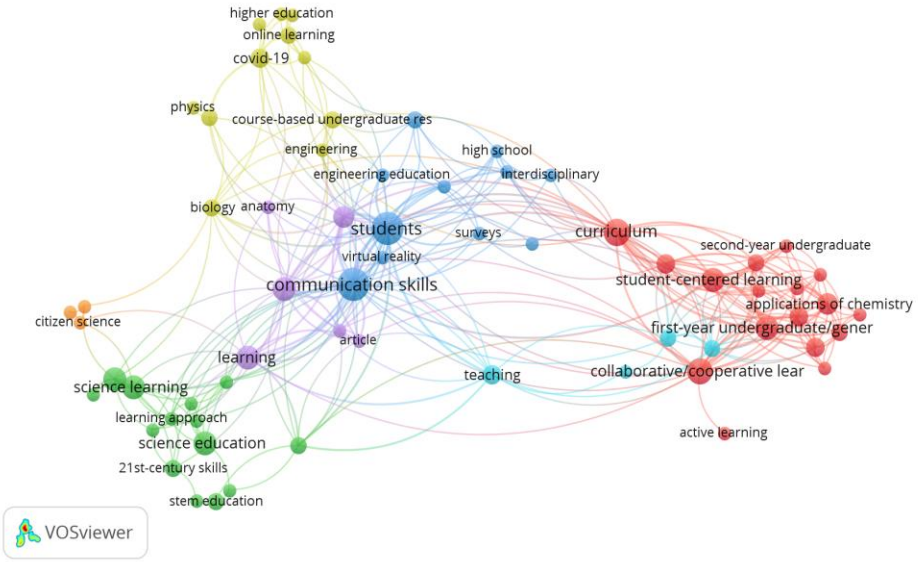

FIGURE 1. Network visualization of communication skills in science education co-occurrence analysis.

Based on Figure 1, there are 66 identifiable items distributed across 7 clusters, each marked with a different color: red, green, blue, yellow, purple, orange, and light blue. Each cluster represents the research development of communication skills in science education, as detailed in Table 1.

TABLE 1. Research development of each cluster

No	Cluster	Number of Items	Keywords
1	Red	17	upper-division undergraduate, student-centered learning, second-year undergraduate, quantitative analysis, problem solving/decision making, laboratory instruction, internet/web-based learning, interdisciplinary/multidisciplinary, inquiry-based/discovery learning, general public, first-year undergraduate/general, curriculum, communication/writing, collaborative/cooperative learning, applications of chemistry, analytical chemistry, active learning
2	Green	14	systematic review, sustainable development goal, stem education, scientific investigation, science process skills, science learning, science education, pre-service science teachers, learning approach, higher-order thinking skills, e-learning, discourse, 4c skills, 21st-century skills
3	Blue	11	Writing, virtual reality, surveys, students, science communication, presentation skills, interdisciplinary, high school, engineering education, distance learning, communication skills
4	Yellow	11	Stem, physics, pandemic, online learning, higher education, graduate students, engineering, covid-19, course-based undergraduate research experience, case study, biology
5	Purple	6	Learning, humans, human experiment, education, article, anatomy
6	Light Blue	4	undergraduate research, teaching, professional development, model
7	Orange	3	scientific literacy, learning outcomes, citizen science

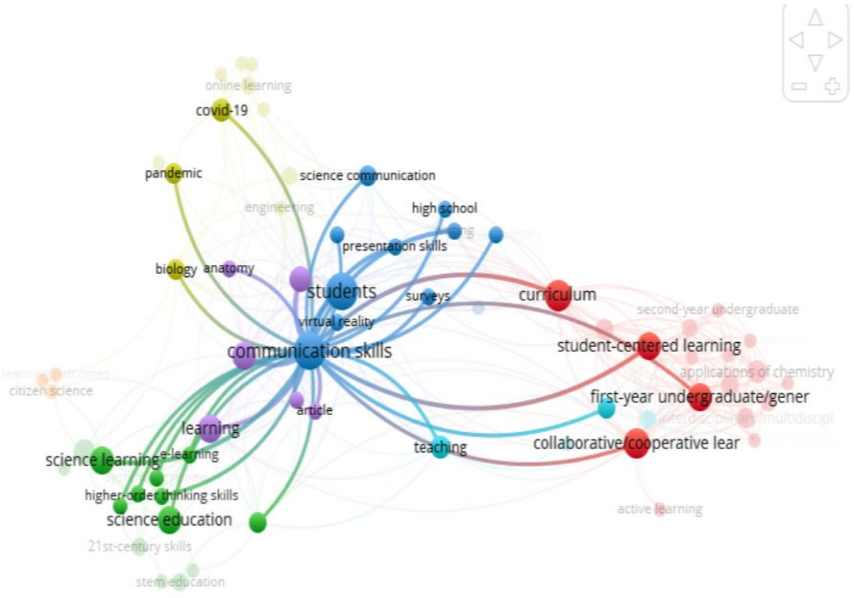

FIGURE 2. Communication skills network visualization

Figure 2 illustrates research on communication skills linked with the blue cluster, covering various topics namely virtual reality [17], students [18], high school [19], presentation skills [20], surveys [21], science communication [22]. Additionally, communication skills are associated with the red cluster, including curriculum [23], student-centered learning [24], first-year undergraduate/general [25], [26], collaborative/cooperative learning [27]. Communication skills are also associated with the green cluster, including science learning [28], e-learning [29], higher-order thinking skills [30], science education [31], STEM education [32], learning approach [33]. Communication skills, notably in teaching, are associated with the light blue cluster [18]. Furthermore, communication skills are associated with the purple cluster, covering topics such as learning [34], humans [35], human experiment [36], education [37], article [38], anatomy [39]. Finally, communication skills are associated with the yellow cluster, encompassing topics such as

covid-19 [40], pandemic [41], biology [42]. The visualization results using VOSviewer provide network visualization of communication skills in science education, as depicted in Figures 3 and 4.

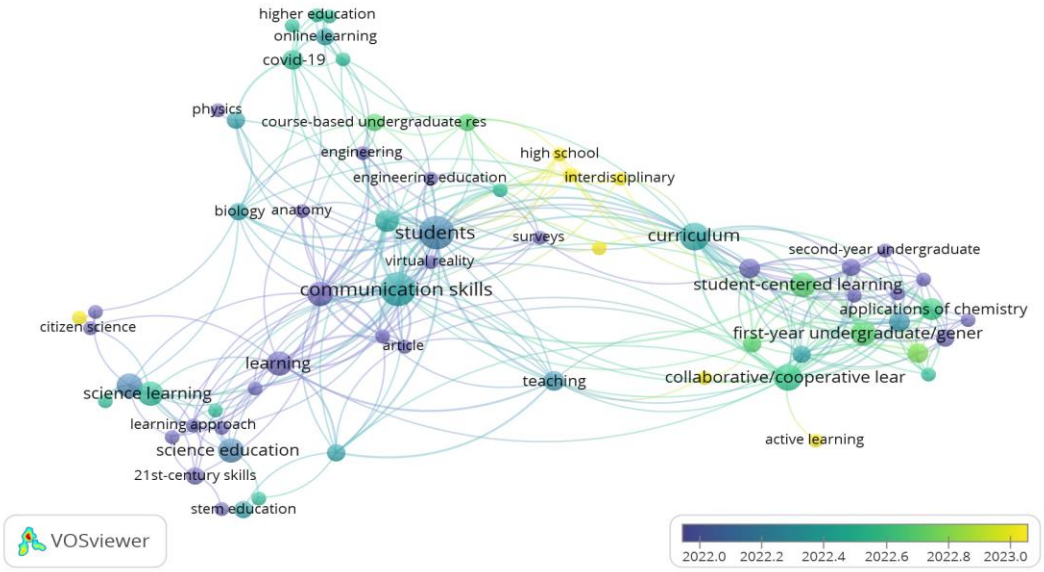

FIGURE 3. Overlay visualization of communication skills in science education.

Figure 3 shows that communication skills in science education are mainly associated with high school [43], active learning [44], interdisciplinary [45], learning outcomes [46].

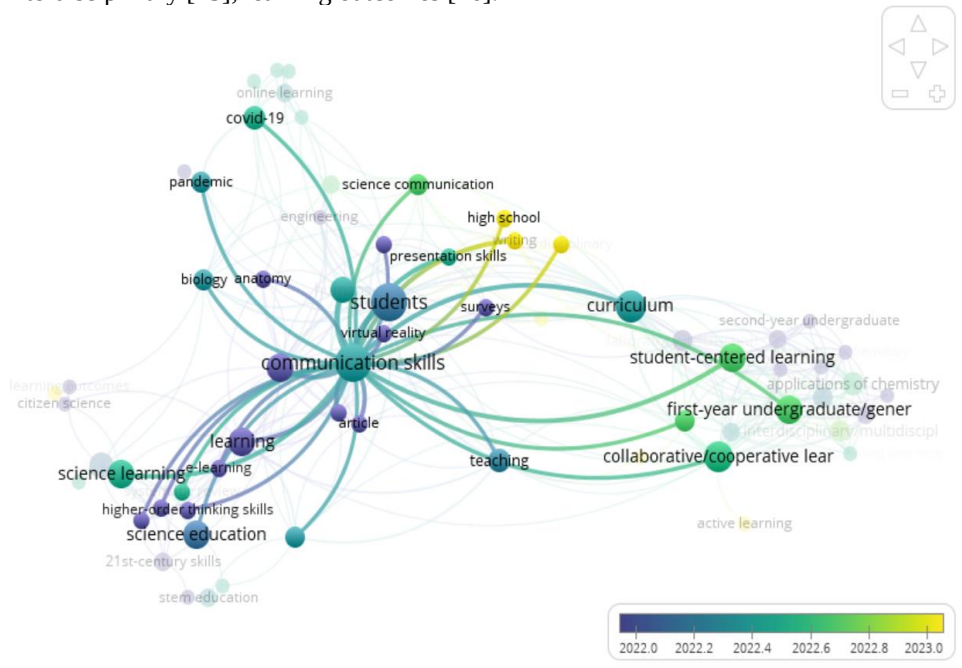

FIGURE 4. Overlay visualization of communication skills

Figure 4 shows a significant link between communication skills and high school [47], writing [48] and interdisciplinary [45]. The analysis findings reveal that communication skills in science learning encompass a range of topics, as elaborated in Table 2.

TABLE 2. The implementation of communication skills in science learning.

No	Physics Topic	Frequency	No	Physics Topic	Frequency
1	Ecology Concepts	3	15	Investigative Structure of Physics	1
2	Digestive System	1	16	Mechanics I	1
3	Biodiversity	1	17	Dynamic Physical Models	1
4	Comparative Vertebrate Anatomy	1	18	Science Learning	2
5	Systematic Engineering of New Organisms	1	19	Laboratory Teaching	4
6	Ecosystem Competence	1	20	Hybrid STEAMER Learning	1
7	Biochemistry	1	21	Scientific Concepts	4
8	Socio-scientific Issues	4	22	4C Skills	2
9	Scanning Electron Microscopy (SEM)	1	23	STEM (Science, Technology, Engineering, Mathematics)	11
10	Properties of Particulate Matter	1	24	Elementary School Science	2
11	Introduction to Chemistry	1	25	Science Process Skills	6
12	Electrochemistry STEM Lab	1	26	Principles of Scientific Communication	2
13	Analytical Chemistry Laboratory	4	27	Non-specific	26
14	Climate Change and Energy	1			

According to Table 2, it is evident that the application of communication skills in science learning, as researched, is predominantly nonspecific, with a frequency of 26 articles. In biology, researchers extensively discuss communication skills within the context of ecological concepts, with a frequency of three articles [49], [50]. In chemistry, the focus of communication skills lies more commonly on socio-scientific issues [51] and analytical chemistry laboratories [52], [53], with four articles each. Articles discussing communication skills in physics equally cover topics such as climate change and energy [54], the investigative structure of physics [55], mechanics I [56], and dynamic physical models [57]. For science subjects overall, communication skills are more extensively discussed in STEM topics, with a frequency of 11 articles [58].

CONCLUSION

Research on communication skills in science learning is evolving every year. Visualizing the trend of research on communication skills in science learning from 2022 to 2024 reveals the emergence of seven clusters. The findings of this research can assist academics in understanding global trends in research on communication skills in science learning and provide guidance for future research. This analysis offers a solid starting point for future research on communication skills in science learning.

REFERENCES

1. J.M. Carr, J. Chem. Educ. **90**, 751 (2013).
2. F. Noor and M.G. Ranti, Math Didact. J. Pendidik. Mat. **5**, 75 (2019).
3. S. Handayani, S. Masfuah, and L. Kironoratri, Edukatif J. Ilmu Pendidik. **5**, 2240 (2021).
4. H. Hasanah and M.N. Malik, Cypriot J. Educ. Sci. **15**, 1295 (2020).
5. I.W. Ningsih, A. Widodo, and A. Asrin, J. Inov. Teknol. Pendidik. **8**, 132 (2021).
6. E.N. Inah, Al-Ta'dib **8**, 150 (2015).
7. S. Wahyuning, in *Pros. SNPS (Seminar Nas. Pendidik. Sains)* (2022), pp. 1–7.
8. S. Zubaidah, Semin. Nas. **6**, 1 (2017).
9. A. Alias and K. Osman, Asia Pacific J. Educ. Educ. **30**, 107 (2015).
10. A.D.K. Sari, S.M. Arfiyani, L.M. Nasution, and S. Nurhasanah, J. Pendidik. Tambusai **7**, 1911 (2023).
11. V. Melinda and M. Zainil, J. Pendidik. Tambusai **4**, 1526 (2020).
12. T.A. Sari and S.M. Soenarno, Pros. Semin. Nas. Jur. Pendidik. Biol. Univ. Negeri Yogyakarta 15 (2018).
13. O.B. Pramesti, S. Supeno, and S. Astutik, J. Ilmu Fis. Dan Pembelajarannya **4**, 21 (2020).
14. I.Y. Rizki, M. Surur, and I. Noervadilah, Visipena **12**, 124 (2021).
15. F. Umar, M. Misbah, F.F. Ekawati, and Y.N. Hanief, J. Phys. Educ. Sport **22**, 2996 (2022).
16. M. Misbah, I. Hamidah, S. Sriyati, and A. Samsudin, J. Eng. Sci. Technol. **17**, 118 (2022).
17. O. Halabi, S.A. El-Seoud, J.M. Aljaam, H. Alpona, M. Al-Hemadi, and D. Al-Hassan, Int. J. Emerg. Technol.

Learn. **12**, 50 (2017).
18. F. Siddiq, R. Scherer, and J. Tondeur, Comput. Educ. **92**–**93**, 1 (2016).
19. H.T. Yudha and B. Mandasari, J. English Lang. Teach. Learn. **2**, 74 (2021).
20. D.A. Mahdi, SAGE Open **12**, (2022).
21. J. Ponto, J. Adv. Pract. Oncol. **6**, 168 (2015).
22. D.J. Welbourne and W.J. Grant, Public Underst. Sci. **25**, 706 (2016).
23. S. Johnson, S. Veitch, and S. Dewiyanti, J. Univ. Teach. Learn. Pract. **12**, 65 (2015).
24. A. Zimmermann, C. Baerwald, M. Fuchs, C. Girbardt, H. Götze, G. Hempel, K. Von Klitzing, and D. Rotzoll, GMS J. Med. Educ. **38**, 1 (2021).
25. P.J. Gehrke, Rev. Commun. **16**, 109 (2016).
26. U. Ramraj and F. Marimuthu, Int. J. High. Educ. **10**, 287 (2020).
27. X. Yang, TechTrends **67**, 718 (2023).
28. K.M. Bonney, J. Microbiol. Biol. Educ. **16**, 21 (2015).
29. K. Sury, K. Wiyono, and S.M. Siahaan, J. Ilm. Pendidik. Fis. **6**, 539 (2022).
30. S.D. Malanog and J.Vi.C. Aliazas, IOER Int. Multidiscip. Res. J. **2**, 164 (2021).
31. M. Barak, Res. Sci. Educ. **3**, 821 (2017).
32. N.C. Siregar, A. Gumilar, and A. Amarullah, Komunika J. Commun. Sci. Islam. Da'wah **7**, 64 (2023).
33. R. Moore, Dent. J. **10**, (2022).
34. P.S. Rao, Alford Counc. Int. English Lit. Journal(ACIELJ) **2**, 6 (2019).
35. A.S. Pattiwael and A.P.A. Id, J. Int. Semin. Lang. Lit. Arts, Educ. **1**, 79 (2019).
36. J. Jiang, C. Chen, B. Dai, G. Shi, G. Ding, L. Liu, C. Lu, and S.T. Fiske, Proc. Natl. Acad. Sci. U. S. A. **112**, 4274 (2015).
37. S. Rüttermann, A. Sobotta, P. Hahn, C. Kiessling, and A. Härtl, Eur. J. Dent. Educ. **21**, 151 (2017).
38. C. van der Vleuten, V. van den Eertwegh, and E. Giroldi, Patient Educ. Couns. **102**, 2110 (2019).
39. M. Hu, D. Wattchow, and D. de Fontgalland, ANZ J. Surg. **88**, 146 (2018).
40. E. Wittenberg, J. V. Goldsmith, C. Chen, M. Prince-Paul, and R.R. Johnson, Patient Educ. Couns. **104**, 438 (2021).
41. R. Abraham, Perspect. Educ. **39**, 57 (2021).
42. M.L. Ilardo and A. Speciale, Int. J. Environ. Res. Public Health **17**, (2020).
43. W.- Yusefni and S. Sriyati, Edusains **8**, 9 (2016).
44. M. Yamin, JISIP J. Ilmu Sos. Dan Pendidik. **2**, (2018).
45. A. Asmar and I.G.P. Suryadarma, J. Pendidik. Sains Indones. **9**, 565 (2021).
46. R. Rizawati, EDUTECH J. Inov. Pendidik. Berbantuan Teknol. **2**, 55 (2022).
47. M. Rosid, J. Edukasi **8**, 23 (2021).
48. R. Sintiawati, P. Sinaga, and S. Karim, J. Nat. Sci. Integr. **4**, 1 (2021).
49. Alfurqan, Z. Trinova, M. Tamrin, and A. Khairat, Tarb. Al-Awlad J. Kependidikan Islam Tingkat Dasar **10**, 213 (2020).
50. M. Mayarni and Y. Yulianti, PENDIPA J. Sci. Educ. **4**, 39 (2020).
51. S. Siska, W. Triani, Y. Yunita, Y. Maryuningsih, and M. Ubaidillah, Edu Sains J. Pendidik. Sains Mat. **8**, 22 (2020).
52. A. Al-Bari and R.K. Saputri, J. Educ. FKIP UNMA **6**, 676 (2020).
53. A. Rahayu, J. Pendidik. Kim. Dan Ilmu Kim. **3**, 1 (2020).
54. M.Y. Syahputra and S. Evanita, J. Pendidik. Dan Konseling **4**, 1766 (2022).
55. W. Fadly and F.A. Mubarak, Pros. Semin. Nas. … (2014).
56. D. Priyasudana and M. Cholik, J. Pendidik. Tek. Mesin UNESA **4**, 34 (2016).
57. E. Aristianti, H. Susanto, and P. Marwoto, UPEJ Unnes Phys. Educ. J. **7**, 67 (2018).
58. I.H. Mu'minah and I. Aripin, Pros. Semin. Nas. Pendidik. **1**, 1496 (2019).