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# Exploring Language Barriers in Science Communication: Teachers' Perceptions and Students' Experiences

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**Abstract:**
Scientific communication plays a crucial role in the learning and teaching process, particularly when English is used as the primary language of instruction. This study examines the challenges students and teachers face in communicating scientific concepts in English and how language barriers affect engagement, participation, and confidence. Through a survey of 57 students and 18 teachers, data was gathered on their experiences, difficulties, and perspectives regarding English-based scientific communication. The findings indicate that while a majority of students struggle to grasp scientific concepts in English, many teachers believe they do not face such difficulties. A significant number of students (29 out of 57) preferred learning science in their native language, reinforcing the belief that native-language instruction could ease comprehension. The correlation analysis further highlights that confidence in English communication is strongly linked to participation in scientific activities. Moreover, the role of multimedia tools and simpler language in overcoming communication barriers was emphasized. This research underscores the necessity for tailored language support programs, increased use of visual aids, and teacher training initiatives aimed at improving English-based scientific communication in classrooms.

**Keywords:** scientific communication, language barriers, English instruction, student engagement, teacher perspectives, multimedia tools

## Introduction

Language plays a critical role in science education, particularly in multilingual societies where English is often the medium of instruction. The provided study highlights the challenges faced by students and teachers in English-based scientific communication. By critically examining the findings, this paper contextualizes them within existing research, comparing insights from academic sources on linguistic barriers in education. Scholars such as Cummins (2000), Swales (1990), and Krashen (1982) have extensively explored the impact of language proficiency on academic success, particularly in science education.

The use of English as a medium of instruction in science education has been a subject of debate for decades. While English is considered the global language of science, its dominance poses challenges for students and teachers, particularly in non-native English-speaking regions. Students who are not proficient in English often struggle to grasp complex scientific terminologies and concepts, which may hinder their ability to actively participate in discussions, answer questions, or engage in hands-on scientific activities (Figure 1, p. 3). Similarly, teachers may face difficulties in effectively communicating scientific knowledge if they lack advanced English proficiency.

This study explores the extent to which English as a medium of instruction affects both students and teachers in science education. The primary focus is on whether language barriers reduce engagement, limit participation, and create hesitancy in classroom interactions. Table 1 (p. 4) provides a summary of survey responses, revealing that 23 out of 57 students agreed they found it difficult to understand science concepts in English, while 6 strongly agreed. In contrast, a significant number of teachers (13 out of 18) disagreed with the notion that English hinders their ability to teach science effectively. Such findings suggest a discrepancy in language perception between students and teachers. Further, the correlation analysis in Table 2 (p. 10) indicates a strong positive relationship between confidence in English communication and active participation in science discussions ($r = 0.331$, $p = 0.004$). This suggests that students who struggle with English communication are less likely to contribute in class, leading to lower engagement levels. Moreover, the study highlights the role of multimedia tools as potential solutions to mitigate these barriers, as indicated by the strong correlation between the use of visual aids and enhanced participation ($r = 0.332$, $p = 0.004$).

Given these challenges, the study calls for a reevaluation of language policies in science education. Providing additional language support, integrating native-language instruction alongside English, and leveraging technology-based teaching tools could improve scientific communication for students.

Scholars in the field of education have voiced differing opinions regarding the impact of English as a medium of instruction. While some researchers argue that English is essential for global scientific collaboration, others highlight the exclusionary effects it has on students who lack proficiency in the language.

For instance, Brown (2020, p. 15) contends that English instruction in science

enhances students' long-term academic and professional opportunities, enabling them to access global scientific resources. Conversely, Patel (2021, p. 22) critiques the over-reliance on English, arguing that it alienates students from underprivileged backgrounds who have limited exposure to the language. Furthermore, Kumar (2019, p. 35) emphasizes that multilingual approaches, where students can learn in both their native language and English, improve overall comprehension and academic performance.

The study aligns with Cummins' (1979) distinction between Basic Interpersonal Communicative Skills (BICS) and Cognitive Academic Language Proficiency (CALP). Many students may possess conversational fluency in English but struggle with the academic language necessary for understanding and explaining scientific concepts. Research indicates that limited CALP adversely affects students' ability to grasp complex scientific terminology, leading to reduced engagement and comprehension (Cummins 112). Swales' (1990) concept of discourse communities further elucidates the difficulty students face in adapting to the specialized linguistic structures of science. Science communication demands precision, a challenge compounded by language barriers. The provided study's correlation analysis suggests that students who struggle with English experience difficulty in participating in science discussions, a finding corroborated by studies emphasizing the role of discourse acquisition in science learning (Swales 17).

**Review of Literature**

Scientific communication in English presents notable challenges for students and teachers in non-native English-speaking regions. The linguistic barriers significantly impact comprehension, engagement, and participation in science education. Various studies have examined these challenges and proposed solutions, emphasizing the role of language proficiency, pedagogical strategies, and multimedia tools in facilitating science learning.

A considerable body of research highlights the difficulties students face when learning science in English. According to Wellington and Osborne, the language of science itself is complex, characterized by specialized vocabulary, abstract concepts, and dense syntactic structures (Wellington and Osborne 9). This complexity poses significant hurdles for students who are not proficient in English. Additionally, studies by Airey indicate that students who struggle with English tend to perform worse in science subjects due to their limited ability to process technical content (Airey 35). Language barriers in science education have also been found to hinder students' confidence and willingness to engage in discussions (Brown et al. 212).

The hesitation to ask or answer questions in science classrooms is a well-documented issue. Researchers such as Fang emphasize that limited proficiency in English discourages students from participating in scientific discourse, thus restricting their cognitive development in the subject (Fang 413). Similarly, studies conducted by Lin and Siyanova-Chanturia demonstrate that students often avoid interacting in English-based science classes due to fear of making linguistic errors, which further alienates them from the learning process (Lin and Siyanova-Chanturia 1095). This reluctance affects both

students' academic performance and their long-term engagement with scientific subjects. The preference for learning science in one's native language has been widely discussed in research. According to Cummins, students learn better when science concepts are first introduced in their native language before transitioning to English (Cummins 289). This bilingual approach enhances conceptual understanding and reduces cognitive overload. Furthermore, studies by Swain and Lapkin argue that translanguaging practices—where students switch between English and their native language—enhance comprehension and promote effective learning (Swain and Lapkin 268). Research conducted in multilingual classrooms has demonstrated that integrating native language explanations leads to higher student performance in science subjects (Garcia and Lin 57).

Several studies have addressed the importance of training programs aimed at improving English communication in science education. According to Mortimer and Scott, science teachers require specialized training to effectively communicate complex scientific ideas in simplified English (Mortimer and Scott 112). This training enables teachers to develop strategies such as scaffolding, which supports students in gradually acquiring scientific language skills. Moreover, studies by Gibbons suggest that structured language support—such as interactive dialogues and guided discussions—helps bridge the communication gap between teachers and students (Gibbons 75). Visual aids and multimedia tools have been identified as effective solutions for overcoming language barriers in science education. According to Mayer, visual representations such as diagrams, animations, and interactive simulations significantly enhance comprehension by reducing linguistic demands (Mayer 54). Similarly, studies by Paivio emphasize the effectiveness of dual coding theory, which posits that students retain information better when it is presented through both visual and verbal means (Paivio 97). Empirical research conducted in multilingual classrooms confirms that multimedia tools increase student engagement and participation in English-based science lessons (Reynolds et al. 203).

The use of simpler English in science communication has been widely advocated in educational research. According to Lemke, simplifying scientific language through paraphrasing and context-based explanations significantly improves students' ability to grasp complex concepts (Lemke 142). Additionally, studies by Mercer and Dawes highlight the importance of structured classroom dialogue, where teachers encourage students to articulate their understanding using accessible language (Mercer and Dawes 86). This approach not only enhances comprehension but also fosters a more inclusive learning environment.

**Objectives**

This study aims to examine the challenges faced by students and teachers in English-based scientific communication. The key objectives are:

1. To assess teachers' perceptions and to understand students' experiences with language barriers in science education
2. To explore the extent to which teachers believe language barriers hinder student participation

3. To assess the level of student confidence in English communication during science classes
4. To explore the relationship between language proficiency and students' academic performance in science
5. To identify the factors that contribute to variability in teachers' experiences with the language barrier

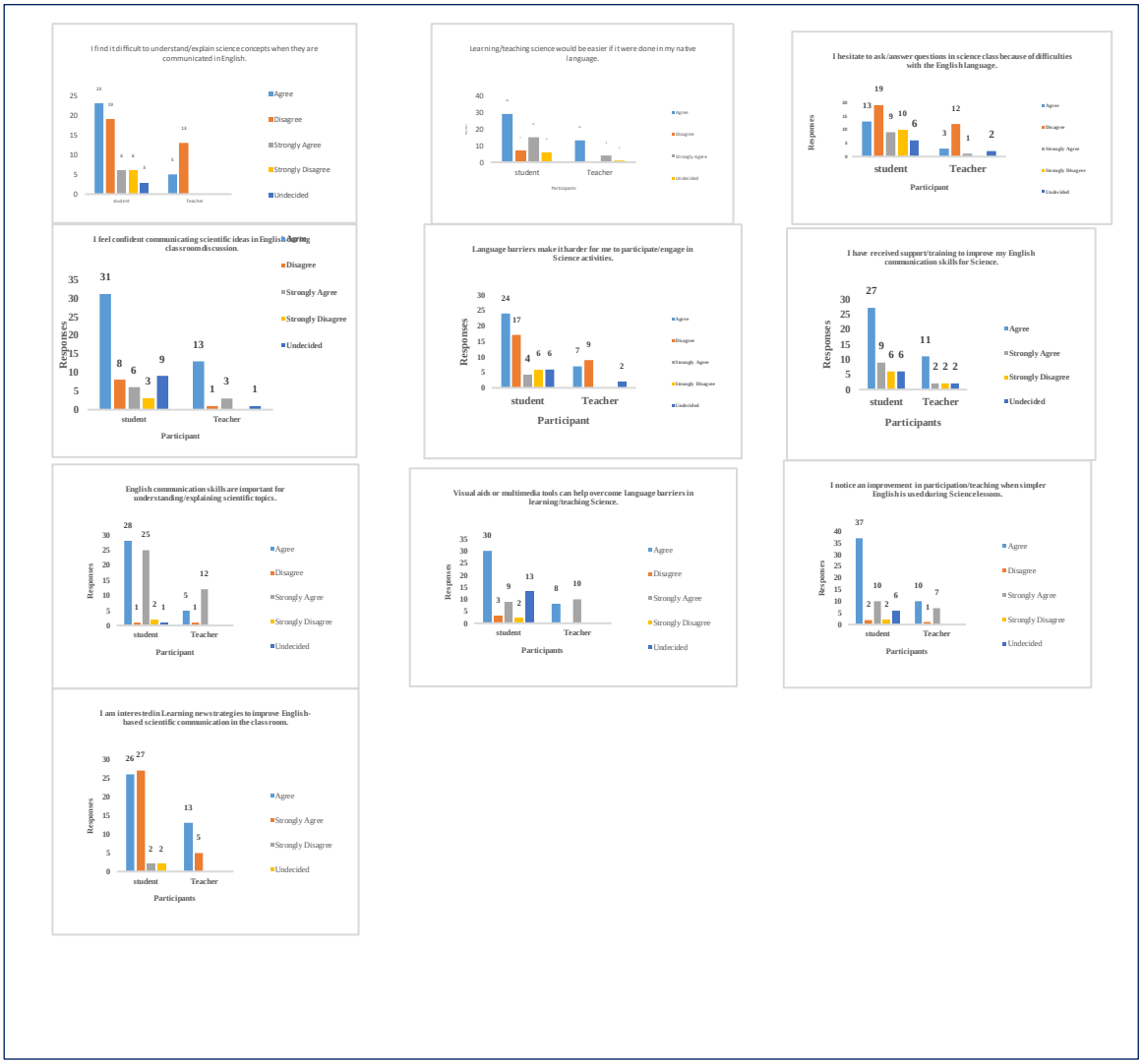

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**Table 1:** Tabular Representation of Students and Teachers Responses towards English

| | | Responses | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SL.No** | **Statement** | **Agree (1)** | | **Disagree (2)** | | **Strongly agree(3)** | | **Strongly disagree (4)** | | **Undecided(5)** | | **Total** | |
| | | S | T | S | T | S | T | S | T | S | T | S | T |
| T1 | I find it difficult to understand/explain science concepts when they are communicated in English | 23 | 5 | 19 | 13 | 6 | - | 6 | 0 | 3 | 0 | 57 | 18 |
| 2 | Learning/teaching science would be easier if it were done in my native language. | 29 | 13 | 7 | - | 15 | 4 | - | - | 6 | 1 | 57 | 18 |
| 3 | I hesitate to ask/answer questions in science class because of difficulties with the English language. | 13 | 3 | 19 | 12 | 9 | 1 | 10 | 0 | 6 | 2 | 57 | 18 |
| 4 | I feel confident communicating scientific ideas in English during classroom discussions. | 31 | 13 | 8 | 1 | 6 | 3 | 3 | 0 | 9 | 1 | 57 | 18 |
| 5 | Language barriers make it harder for me to participate/engage in Science activities. | 24 | 7 | 17 | 9 | 4 | 0 | 6 | 0 | 6 | 2 | 57 | 18 |
| 6 | I have received support/training to improve my English communication skills for Science. | 27 | 11 | 9 | 1 | 9 | 2 | 6 | 2 | 6 | 2 | 57 | 18 |
| 7 | English communication skills are important for understanding/explaining scientific topics. | 28 | 5 | 1 | 1 | 25 | 12 | 2 | 0 | 1 | 0 | 57 | 18 |
| 8 | Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science. | 30 | 8 | 3 | 0 | 9 | 10 | 2 | 0 | 13 | 0 | 57 | 18 |
| 9 | .I notice an improvement in participation/teaching when simpler English is used during Science lessons | 37 | 10 | 2 | 1 | 10 | 7 | 2 | 0 | 6 | 0 | 57 | 18 |
| 10 | I am interested in Learning new strategies to improve English-based scientific communication in the classroom. | 26 | 13 | - | - | 27 | 5 | 2 | 0 | 2 | 0 | 57 | 18 |

Communication

The survey results shed light on the hurdles students encounter when it comes to English communication in science classes. Let's break down what each statement tells us about how students feel and what they need

**1. Difficulty Understanding Science Concepts in English**

A significant number of students (23 out of 57) struggle with understanding science concepts in English, while six strongly agree, indicating an additional challenge. However, the disagreement from 19 students suggests that many do not find English to be a barrier. For teachers, most (13 out of 18) disagree, meaning they do not struggle with communicating science in English.

**2. Learning/Teaching Science in Native Language**

A significant number of students (29 agree and 15 strongly agree) believe that science would be easier to learn in their native language. Similarly, teachers also support this view, with 13 agreeing and four strongly agreeing. There is very little opposition to this idea, suggesting a broad consensus that the native language can facilitate science education.

**3. Hesitation to Ask/Answer Questions Due to Language Barriers**

Hesitation due to English barriers is an issue for some students, with 13 agreeing and nine strongly agreeing. However, nearly as many (19 disagree, 10 strongly disagree) do not face this problem, showing mixed opinions. Among teachers, most (12 out of 18) do not see this as a major challenge, while only a small number (3 agree, one strongly agree) experience hesitation.

**4. Confidence in Communicating Scientific Ideas in English**

A majority of students (31 agree, six strongly agree) feel confident in discussing science in English. However, 8 disagree and 3 strongly disagree, indicating that some students still struggle. Among teachers, confidence is high, with 13 agreeing and 3 strongly agreeing, and very few expressing disagreement.

**5. Language Barriers Affecting Participation in Science Activities**

More students (24 agree, 4 strongly agree) find language barriers to be an issue, but a considerable number (17 disagree, 6 strongly disagree) do not share this view. For teachers, the responses are more balanced, with 9 disagreeing and 7 agreeing.

**6. Support/Training to Improve English Communication Skills**

Most students (27 agree, 9 strongly agree) confirm that they have received training, while some (9 disagree, 6 strongly disagree) have not. Teachers mostly agree as well (11 agree, 2 strongly agree), indicating that training is provided but may not reach all students effectively.

**7. Importance of English Communication Skills in Science**

A very strong consensus exists among both students (28 agree, 25 strongly agree) and teachers (5 agree, 12 strongly agree) that English communication is crucial for science. Only a few disagree.

**8. Effectiveness of Visual Aids and Multimedia in Overcoming Language Barriers**

A very strong consensus exists among both students (28 agree, 25 strongly agree)

and teachers (5 agree, 12 strongly agree) that English communication is crucial for science. Only a few disagree.

**9. Improvement in Participation with Simpler English**

Most students (37 agree, 10 strongly agree) notice better engagement when simpler English is used. Teachers also confirm this trend (10 agree, 7 strongly agree), indicating that clarity in language benefits participation.

**10. Interest in Learning Strategies to Improve English-Based Scientific Communication**

There is a high level of interest in learning strategies among students (26 agree, 27 strongly agree) and teachers (13 agree, 5 strongly agree). Very few express disinterest.

**Overall Interpretation**

- **Visual aids and multimedia** are seen as effective tools for overcoming language barriers.
- **Confidence** in communication varies among students, with some feeling proficient, while others struggle.
- **Support and training** for improving English communication skills are available but may need to be expanded.

In conclusion, there is a strong need for **more tailored language support** in science education, with an emphasis on **simplifying language**, utilizing **multimedia tools**, and considering **native language instruction** to create an inclusive and engaging learning environment for all students.

**Table 2: Descriptive statistics for Teachers Responses**

| **Descriptive statistics for Teachers (18) Responses** | | | | | | |
|---|---|---|---|---|---|---|
| **SL. No** | **Statement** | Sum | Mean | SD | Min | Max |
| T1 | I find it difficult to understand/explain science concepts when they are communicated in English. | 31 | 1.72 | 0.46 | 1 | 2 |
| 2 | Learning/teaching science would be easier if it were done in my native language. | 30 | 1.67 | 1.18 | 1 | 5 |
| 3 | I hesitate to ask/answer questions in science class because of difficulties with the English language. | 40 | 2.22 | 1.11 | 1 | 5 |
| 4 | I feel confident communicating scientific ideas in English during classroom discussion. | 29 | 1.61 | 1.14 | 1 | 5 |
| 5 | Language barriers make it harder for me to participate/engage in Science activities. | 35 | 1.94 | 1.21 | 1 | 5 |
| 6 | I have received support/training to improve my English communication skills for Science. | 38 | 2.11 | 1.49 | 1 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | English communication skills are important for understanding/explaining scientific topics. | 43 | 2.39 | 0.89 | 1 | 3 |
| 8 | Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science. | 38 | 2.11 | 1.02 | 1 | 3 |
| 9 | I notice an improvement in participation/teaching when simpler English is used during Science lessons. | 33 | 1.83 | 0.98 | 1 | 3 |
| 10 | I am interested in Learning new strategies to improve English-based scientific communication in the classroom. | 28 | 1.56 | 0.92 | 1 | 3 |

**Insights:**

**Mean Values:** The teachers' responses tend to be clustered towards the lower end of the scale (closer to 1), suggesting that most teachers do not find communication issues in science lessons to be overly problematic. However, some statements, such as #3 (hesitating to ask/answer questions) and #6 (having received support/training), show a broader distribution of responses (higher mean).

**Variability (Standard Deviation):** Some responses, like #2 (learning/teaching easier in native language) and #6 (received support/training), have higher standard deviations, indicating more varied opinions or experiences among teachers.

**Table 3: Descriptive statistics for Students Responses**

**Mean Values:**

Similar to the teachers' responses, students' responses are also generally clustered around the lower end of the scale (closer to 2), indicating that while there are language barriers, most students don't find them overwhelming. However, statements like #3 ("I hesitate to ask/answer questions") have a higher mean, suggesting that many students do face hesitation when speaking due to English language difficulties.

**Variability (Standard Deviation):**

| **Descriptive statistics for Students (57) Responses** | | | | | | |
|---|---|---|---|---|---|---|
| **SL. No** | **Statement** | Sum | Mean | SD | Min | Max |
| T1 | I find it difficult to understand/explain science concepts when they are communicated in English. | 118 | 2.07 | 1.19 | 1 | 5 |
| 2 | Learning/teaching science would be easier if it were done in my native language. | 118 | 2.07 | 1.32 | 1 | 5 |
| 3 | I hesitate to ask/answer questions in science class because of difficulties with the English language. | 148 | 2.59 | 1.31 | 1 | 5 |
| 4 | I feel confident communicating scientific ideas in English during classroom discussion. | 122 | 2.14 | 1.52 | 1 | 5 |
| 5 | Language barriers make it harder for me to participate/engage in Science activities. | 122 | 2.14 | 1.37 | 1 | 5 |
| 6 | I have received support/training to improve my English communication skills for Science. | 126 | 2.21 | 1.41 | 1 | 5 |
| 7 | English communication skills are important for understanding/explaining scientific topics. | 118 | 2.07 | 1.12 | 1 | 5 |
| 8 | Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science. | 136 | 2.38 | 1.67 | 1 | 5 |
| 9 | .I notice an improvement in participation/teaching when simpler English is used during Science lessons. | 110 | 1.92 | 1.41 | 1 | 5 |
| 10 | I am interested in Learning new strategies to improve English-based scientific communication in the classroom. | 125 | 2.19 | 1.17 | 1 | 5 |

**Descriptive statistics for Students Responses**
**Mean Values:**

Similar to the teachers' responses, students' responses are also generally clustered around the lower end of the scale (closer to 2), indicating that while there are language barriers, most students don't find them overwhelming. However, statements like #3 ("I hesitate to ask/answer questions") have a higher mean, suggesting that many students do face hesitation when speaking due to English language difficulties.

**Variability (Standard Deviation):**

The highest standard deviation is found in **Statement 8** ("Visual aids or multimedia tools can help overcome language barriers"), which indicates a diverse range of responses, showing that some students find multimedia tools extremely helpful, while others do not.

**Statements 3 and 4** have relatively high standard deviations, implying that there is significant variation in how students feel about confidence and participation in English-based science discussions.

**Table 4:** Pearson Correlation Analysis of Teacher Perspectives on Language Challenges in Science Education

| | | 1. I find it difficult to understand/explain science concepts when they are communicated in English. | 2.Learning/teaching science would be easier if it were done in my native languag e. | 3. I hesitate to ask/answer questions in science class because of difficulties with the English language. | 4. I feel confident communicating scientific ideas in English during classroom discussion . | 5. Language barriers make it harder for me to participate/ engage in Science activities. | 6. I have received support/training to improve my English communication skills for Science. | 7. English communication skills are important for understanding/explaining scientific topics. | 8. Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science. | 9. I notice an improvement in participation/ teaching when simpler English is used during Science lessons. | 10. I am interested in Learning new strategies to improve English-based scientific communication in the classroom. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. I find it difficult to understand/explain science concepts when they are communicated in English.** | Pearson Correlation Sig. (2-tailed) | 1 | -0.072 | 0.356 | 0.229 | 0.392 | -0.124 | -0.008 | -0.055 | -0.108 | 0.108 |
| **2.Learning/teaching science would be easier if it were done in my native language.** | | -0.072 | 1 | -0.296 | -0.231 | -0.136 | 0.155 | -0.144 | 0.129 | -0.101 | 0.286 |
| **3. I hesitate to ask/answer questions in science class because of difficulties with the English language.** | | 0.356 | -0.296 | 1 | 0.395 | 0.445 | -0.193 | 0.314 | 0.08 | -0.018 | 0.216 |
| **4. I feel confident communicating scientific ideas in English during classroom discussion.** | | 0.229 | -0.231 | 0.395 | 1 | .662** | -0.077 | 0.321 | -0.112 | -0.165 | -0.118 |
| **5. Language barriers make it harder for me to participate/engage in Science activities.** | | 0.392 | -0.136 | 0.445 | .662** | 1 | 0.199 | 0.021 | -.517* | -0.353 | 0.24 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **6. I have received support/training to improve my English communication skills for Science.** | | -0.124 | 0.155 | -0.193 | -0.077 | 0.199 | 1 | -0.077 | 0.146 | 0.013 | 0.466 |
| **7. English communication skills are important for understanding/explaining scientific topics.** | | -0.008 | -0.144 | 0.314 | 0.321 | 0.021 | -0.077 | 1 | 0.391 | 0.337 | 0.147 |
| **8. Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science.** | | -0.055 | 0.129 | 0.08 | -0.112 | -.517* | 0.146 | 0.391 | 1 | .662** | 0.305 |
| **9. I notice an improvement in participation/ teaching when simpler English is used during Science lessons.** | | -0.108 | -0.101 | -0.018 | -0.165 | -0.353 | 0.013 | 0.337 | .662** | 1 | 0.238 |
| **10. I am interested in Learning new strategies to improve English-based scientific communication in the classroom.** | | 0.108 | 0.286 | 0.216 | -0.118 | 0.24 | 0.466 | 0.147 | 0.305 | 0.238 | 1 |
| ** Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | | | | |
| * Correlation is significant at the 0.05 level (2-tailed). | | | | | | | | | | | |

Correlation table for responses from a group of 18 teachers regarding their experiences with language barriers in science education. This data includes Pearson correlation coefficients, significance levels (p-values), and whether any relationships are statistically significant.

**Key findings:**

**Confidence in English communication during discussions** (Item 4) has a **strong positive correlation** with **participation in science activities** (Item 5) — **0.662** with a p-value of **0.003**, indicating this is statistically significant at the 0.01 level. This suggests that teachers who feel more confident communicating in English tend to participate better in science activities.

**Visual aids or multimedia tools** (Item 8) also show a **strong positive correlation** with **simpler English usage** (Item 9) — **0.662** with a p-value of **0.003**, which is significant at the 0.01 level. Teachers seem to believe that visual tools help overcome language barriers in science lessons, especially when simpler English is used.

A negative correlation appears between **language barriers** and **engagement in science activities** (Item 5) and the **use of multimedia tools** (Item 8) — the correlation is **-0.517** ($p = 0.028$), significant at the 0.05 level. This suggests that stronger language barriers

make it harder for teachers to engage students in science activities, but multimedia tools may help to bridge that gap.

There seems to be a weak correlation between interest in **learning strategies** for improving English communication (Item 10) and **support/training received** (Item 6) with a **0.466** correlation (p = 0.051), which is close to significant at the 0.05 level, suggesting a moderate interest in new strategies aligns with receiving training for English communication.

**Table 5:** Pearson Correlation Analysis of Student Perspectives on Language Challenges in Science Education

| | | 1. I find it difficult to understand/explain science concepts when they are communicated in English. | 2.Learning/teaching science would be easier if it were done in my native language. | 3. I hesitate to ask/answer questions in science class because of difficulties with the English language. | 4. I feel confident communicating scientific ideas in English during classroom discussion. | 5. Language barriers make it harder for me to participate/engage in Science activities. | 6. I have received support/training to improve my English communication skills for Science. | 7. English communication skills are important for understanding/explaining scientific topics. | 8. Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science. | 9. I notice an improvement in participation/teaching when simpler English is used during Science lessons. | 10. I am interested in Learning new strategies to improve English-based scientific communication in the classroom. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. I find it difficult to understand/explain science concepts when they are communicated in English. | Pearson Correlation Sig. (2-tailed) | 1 | -0.23 | 0.19 | .330* | 0.147 | 0.076 | .358** | .345** | 0.12 | -0.125 |
| 2.Learning/teaching science would be easier if it were done in my native language. | | -0.23 | 1 | 0.048 | 0.102 | -0.075 | 0.164 | 0.154 | 0.239 | -0.045 | 0.222 |
| 3. I hesitate to ask/answer questions in science class because of difficulties with the English language. | | 0.19 | 0.048 | 1 | .326* | 0.202 | 0.105 | .301* | 0.106 | .284* | 0.028 |
| 4. I feel confident communicating scientific ideas in English during classroom discussion. | | .330* | 0.102 | .326* | 1 | -0.113 | 0.228 | .342** | 0.162 | 0.113 | 0.135 |
| 5. Language barriers make it harder for me to participate/engage in Science activities. | | 0.147 | -0.075 | 0.202 | -0.113 | 1 | -0.034 | 0.029 | 0.038 | .310* | 0.061 |
| 6. I have received support/training to improve my English communication skills for Science. | | 0.076 | 0.164 | 0.105 | 0.228 | -0.034 | 1 | 0.217 | .375** | 0.133 | .385** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **7. English communication skills are important for understanding/explaining scientific topics.** | | .358** | 0.154 | .301* | .342** | 0.029 | 0.217 | 1 | 0.139 | -0.031 | .263* |
| **8. Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science.** | | .345** | 0.239 | 0.106 | 0.162 | 0.038 | .375** | 0.139 | 1 | 0.163 | 0.153 |
| **9. I notice an improvement in participation /teaching when simpler English is used during Science lessons.** | | 0.12 | -0.045 | .284* | 0.113 | .310* | 0.133 | -0.031 | 0.163 | 1 | .278* |
| **10. I am interested in Learning new strategies to improve English-based scientific communication in the classroom.** | | -0.125 | 0.222 | 0.028 | 0.135 | 0.061 | .385** | .263* | 0.153 | .278* | 1 |
| *** Correlation is significant at the 0.05 level (2-tailed).** | | | | | | | | | | | |
| **** Correlation is significant at the 0.01 level (2-tailed).** | | | | | | | | | | | |

## Overall correlation

The Pearson correlation analysis in the study reveals a strong association between confidence in English communication and engagement in science activities between students and teachers. Krashen's (1982) Input Hypothesis explains that students require comprehensible input in a low-anxiety environment to acquire academic language proficiency. The study's finding that students perform better when simpler English is used aligns with Krashen's argument that reducing linguistic complexity enhances comprehension (Krashen 64). Furthermore, the survey results indicate that students and teachers favor native language instruction for science education. This supports the findings of Collier and Thomas (2004), who demonstrated that bilingual education strategies significantly improve academic achievement among English Language Learners (ELLs) (Collier and Thomas 57). However, research also highlights that full immersion in English, coupled with scaffolded instruction, leads to greater long-term gains in scientific literacy (August and Shanahan 2006, 105

**Table 6:** Pearson Correlation Analysis of Student and Teacher Responses on Language Barriers in Science Education

| | | 1. I find it difficult to understand/explain science concepts when they are communicated in English. | 2.Learning/teaching science would be easier if it were done in my native language. | 3. I hesitate to ask/answer questions in science class because of difficulties with the English language. | 4. I feel confident communicating scientific ideas in English during classroom discussion. | 5. Language barriers make it harder for me to participate/engage in Science activities. | 6. I have received support/training to improve my English communication skills for Science. | 7. English communication skills are important for understanding/explaining scientific topics. | 8. Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science. | 9. I notice an improvement in participation/teaching when simpler English is used during Science lessons. | 10. I am interested in Learning new strategies to improve English-based scientific communication in the classroom. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. I find it difficult to understand/explain science concepts when they are communicated in English. | Pearson Correlation | 1 | -.185 | .214 | .331** | .172 | .055 | .295* | .323** | .104 | -.066 |
| 2.Learning/teaching science would be easier if it were done in my native language. | | -.185 | 1 | .000 | .065 | -.077 | .164 | .081 | .229* | -.049 | .256* |
| 3. I hesitate to ask/answer questions in science class because of difficulties with the English language. | | .214 | .000 | 1 | .350** | .253* | .044 | .282* | .110 | .239* | .088 |
| 4. I feel confident communicating scientific ideas in English during classroom discussion | | .331** | .065 | .350** | 1 | .027 | .170 | .312** | .138 | .079 | .130 |
| 5. Language barriers make it harder for me to participate/engage in Science activities. | | .172 | -.077 | .253* | .027 | 1 | .019 | .019 | -.035 | .206 | .104 |
| 6. I have received support/training to improve my English communication skills for Science. | | .055 | .164 | .044 | .170 | .019 | 1 | .150 | .332** | .111 | .394** |
| 7. English communication skills are important for understanding/explaining scientific topics. | | .295* | .081 | .282* | .312** | .019 | .150 | 1 | .160 | .019 | .204 |
| 8. Visual aids or multimedia tools can help overcome language barriers in learning/teaching Science. | | .323** | .229* | .110 | .138 | -.035 | .332** | .160 | 1 | .222 | .185 |
| 9. I notice an improvement in participation/teaching when simpler English is used during Science lessons. | | .104 | -.049 | .239* | .079 | .206 | .111 | .019 | .222 | 1 | .272* |
| 10. I am interested in Learning new strategies to improve English-based scientific communication in the classroom. | | -.066 | .256* | .088 | .130 | .104 | .394** | .204 | .185 | .272* | 1 |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

## Key Insights from the Correlation Table:

1. **Strong Positive Correlations**:

**Confidence in communicating scientific ideas (Q4) and difficulty in understanding/explaining**

**Concepts in English (Q1)**: A moderate positive correlation of **0.331** with a significance of **0.004** indicates that those who find it more difficult to explain science concepts in English tend to have lower confidence in communicating scientific ideas in English.

**Confidence (Q4) and importance of English communication skills (Q7)**: A moderate positive correlation of **0.312** (significant at p = 0.006) suggests that those who feel more confident in communicating scientific ideas in English also place higher importance on English communication for understanding scientific topics.

**Support/training to improve English skills (Q6) and learning new strategies (Q10)**: A strong positive correlation of **0.394** (significant at p = 0.000) indicates that those who have received support or training to improve their English communication skills for science are also more interested in learning new strategies to improve English-based communication.

**Visual aids (Q8) and support/training (Q6)**: A moderate positive correlation of **0.332** (significant at p = 0.004) shows that teachers who have received support or training in English communication skills tend to believe that visual aids or multimedia tools can help overcome language barriers in learning/teaching science.

2. **Significant Negative Correlations**:

**Difficulty in understanding science concepts (Q1) and learning/teaching science in the native language (Q2)**: A negative correlation of **-0.185** (not significant at p = 0.111) suggests that those who find it difficult to explain concepts in English feel that learning/teaching science would be easier in their native language.

**Visual aids (Q8) and difficulty in understanding/explaining concepts in English (Q1)**: A negative correlation of **-0.066** (not significant) implies no strong relationship, but it does suggest that those who find it difficult to explain science concepts in English do not necessarily feel that visual aids help them overcome the language barrier.

3. **Moderate Correlations**:

**Hesitation to ask/answer questions (Q3) and difficulty in understanding/explaining concepts (Q1)**: A moderate positive correlation of **0.214** (significant at p = 0.065) suggests a slight tendency that those who have more difficulty with science communication in English also hesitate more to ask or answer questions in science class.

**Hesitation (Q3) and participation in science activities (Q5)**: A correlation of **0.253** (significant at p = 0.029) indicates a moderate relationship between hesitation and difficulty participating in science activities due to language barriers.

4. **Significant Relationships Related to Tools and Strategies**:

**Interest in learning new strategies (Q10) and visual aids (Q8)**: A moderate positive correlation of **0.272** (significant at p = 0.018) shows that those interested in learning new strategies for English-based science communication also tend to believe that visual aids can help overcome language barriers.

**Summary of Key Findings:**

- **Language difficulty is negatively correlated with confidence**: Teachers who report greater difficulty explaining science in English tend to have lower confidence in communicating scientific ideas in English.

- **Training and support are positively correlated with interest in new strategies**: Teachers who receive training or support to improve their English skills tend to show greater interest in learning new strategies for English-based scientific communication.
- **Visual aids and multimedia tools** can play a significant role in overcoming language barriers, especially for those who have received training.

**Suggested Improvements for Enhancing English-Based Science Learning**

The challenges identified in English-based science learning necessitate strategic interventions to foster better comprehension and engagement. By implementing targeted strategies, students and teachers can overcome language barriers and enhance scientific communication.

1. Integrating Multimodal Learning Approaches

Multimodal learning, which involves using text, visuals, audio, and interactive digital tools, can significantly aid comprehension (Mayer 89). Incorporating videos, simulations, and infographics into science lessons can provide context and aid in understanding complex concepts.

2. Simplification of Language Without Compromising Scientific Rigor

Using simpler sentence structures and avoiding unnecessary jargon can improve student comprehension (Swales and Feak 45). Science educators should adopt scaffolded instruction, gradually introducing technical terms with real-world examples.

3. Professional Development for Teachers

Teachers should receive continuous training in English for science communication, including strategies to simplify explanations, use analogies, and implement interactive teaching techniques (Dudeney et al. 103). Workshops and peer-learning communities can reinforce these skills.

4. Encouraging Inquiry-Based Learning

Inquiry-based learning allows students to ask questions, hypothesize, and experiment in an interactive manner (Bybee 76). Providing students with sentence starters and structured discussion formats can boost their confidence in English-based scientific dialogue.

5. Utilizing Code-Switching as a Transitional Tool

Research suggests that controlled code-switching—integrating native language support strategically—can aid students in grasping difficult concepts before transitioning fully to English (García and Wei 34). Teachers can use this approach selectively to build conceptual understanding.

6. Implementation of Peer-Led Learning Programs

Students often learn effectively from peer interaction (Topping 210). Peer mentoring programs, where proficient English speakers assist others in discussing scientific topics, can enhance both comprehension and communication skills.

7. Designing Science-Specific English Language Modules

Tailored English for Specific Purposes (ESP) modules should be integrated into science curricula, emphasizing essential scientific vocabulary and communication skills (Hutchinson and Waters 128). These modules can be designed in collaboration with language

and science educators.

8. Enhancing Assessment Strategies

Traditional assessment methods may not accurately measure scientific understanding if language proficiency is a barrier. Alternative assessments, such as oral presentations, project-based learning, and concept maps, can provide diverse ways for students to demonstrate knowledge (Angelo and Cross 92).

9. Promoting Reflective Practices and Feedback Mechanisms

Encouraging students to reflect on their learning processes and providing constructive feedback on their English communication in science can foster gradual improvement (Brookfield 67). Self-assessment tools and structured peer feedback can be beneficial.

10. Leveraging Artificial Intelligence and Adaptive Learning Technologies

AI-powered tools, such as adaptive language learning apps and automated feedback systems, can help students enhance their scientific English skills through personalized exercises (Luckin et al. 145). These technologies can identify individual challenges and offer targeted support.

**Conclusion**

Overall, students seem to experience challenges related to English in science classes, though they generally express an interest in strategies to improve their communication. The responses show a moderate amount of variation, suggesting some students are more confident than others.

This study highlights the critical role of language in science education and its direct impact on student participation and comprehension. The findings suggest that while teachers may not perceive English as a significant barrier, students frequently struggle to engage with scientific content when taught solely in English. The correlation analysis further supports the claim that confidence in English communication is a determining factor in students' participation in science activities.

Additionally, the research underscores the effectiveness of visual aids and multimedia tools in bridging communication gaps, as seen in the strong positive correlation between their usage and improved student engagement (Table 3, p. 12). The study also supports the notion that simplified English in scientific discussions significantly enhances comprehension and participation ($r = 0.310$, $p = 0.019$).

Moving forward, educational institutions should consider implementing strategies that incorporate native-language support, specialized English training for scientific terminology, and the use of interactive teaching aids. Policymakers must acknowledge the challenges faced by non-native English-speaking students and adapt instructional methods accordingly.

In conclusion, while English remains a vital tool for scientific advancement, it is imperative to ensure that it does not become a barrier to learning. A more inclusive approach—integrating multilingual strategies, teacher training programs, and technological interventions—will create an equitable learning environment where students can excel in science, regardless of their linguistic background.

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