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MAPPING ENGLISH SKILLS REQUIRED FOR TEACHING PHYSICS IN BILINGUAL CLASROOMS: A SURVEY

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ABSTRACT

This study aims to identify the English language skills required for effective physics teaching in bilingual classrooms and to address the limited evidence on how English proficiency supports content delivery in Indonesian EMI settings. There is a gap between teachers' language preparedness and the demands of the classroom since many teachers still struggle with both receptive and productive abilities, despite the fact that English is being used as a medium of instruction more and more. A descriptive quantitative survey was employed, involving 51 physics teachers and pre-service teachers who completed a 40-item Likert scale questionnaire measuring listening, speaking, reading, writing, and professional development needs related to bilingual instruction. The findings show that writing had the lowest mean score (3.46), while listening had the highest mean score (3.75), followed by reading (3.74) and speaking (3.58). These results imply that in bilingual physics classrooms, receptive skills take precedence over productive skills. The study finds that in order to boost teachers' confidence and classroom efficacy in EMI-based instruction, teacher education programs should integrate English language development with physics pedagogy and build listening and reading competencies.

Keywords: Bilingual Classroom, English Language Skills, Physics Teaching, Teacher Professional Development, Teacher Training

INTRODUCTION

This present study emphasizes, through a comprehensive survey, what the necessary English language competencies are for effective teaching of physics in bilingual classrooms. As Rahman (2022) said, English is an international language and widely used as a standard means of communication. Science is only one of several professions where its importance is continuously growing. As a result, having a strong command of this language becomes essential, especially for educators. One strategic step toward fusing language and science for effective instruction in bilingual environments is to make English an essential component of physics classes.

However, most physics teachers in Indonesia still find it difficult to acquire the required English competence for effective bilingual teaching. In such cases, both English and Indonesian are used within one classroom, following approaches such as Content and Language Integrated Learning (CLIL) or English Medium Instruction (EMI) (Breeze, 2014). Even in these situations, though, instructors frequently struggle with fluent speaking, which hinders their ability to communicate in the classroom due to issues with vocabulary, sentence construction, and conversation flow (Muniroh, 2022). This implies that many Indonesian physics professors still struggle with everyday school English.

English considerably advances students' knowledge and concepts in physics and international scientific discourse, according to earlier research. English's function is to support scientific communication, encourage professional growth, and open the door for lively scientific debates. Hence, engaging physics students with English can be said to enhance not only conversational skills but also cognitive capacities in both subjects, which is central to success at school and relevant to possible future professional needs (Qamariah, 2024). On the other hand, insufficient mastery of vocabulary will doubtless cut one off from obtaining proper knowledge in physics and verbally presenting what is academically known about it (Samosir, 2014). Therefore, teaching and assessment in Science, Technology, Engineering, and Mathematics (STEM) subjects should include support given for comprehending vocabulary, as opposed to identification.

Although the importance of English is acknowledged, there is a gap between the expected level of proficiency a physics teacher is supposed to possess and the actual skill. Research has shown that there is a significant difference between the perceived importance of English skills and perceived ability among teachers, in particular for online learning.According to TOEFL scores, low English proficiency is linked to lower digital literacy in addition to restricting access to all English-language digital resources (Hadiyanto, 2023). According to Butler (2004), many teachers' lack of English competence affects their confidence and gets in the way of using effective teaching techniques. In the same vein, Mengiste (2025) highlighted that insufficient mastery of English by teachers makes them lose self-confidence during teaching in English.

Empirical evidence from recent surveys underlines the urgent need for special English language training, tailored to teachers' professional needs. Numerous research conducted in various contexts, including Vietnam, indicate that in order to enhance English as a Foreign Language (EFL) education, basic English proficiency and teaching methods need to be improved. As a result, the majority of teachers enroll in English for

Specific Purposes (ESP) classes without any prior training, and the necessity for comprehensive training programs is particularly pressing considering the existing shortcomings. Physics taught in English involves much more than proficiency in English; there is a need for teaching strategies that encourage positive student engagement.

Teachers play a big role in influencing students' attitudes toward learning English, and good lessons can create a productive and joyful classroom atmosphere. The mastery of physics content backed by a rich vocabulary in English is necessary to articulate your ideas clearly. This is similar to findings in other disciplines, such as medical education, where the development of Pedagogical Content Knowledge (PCK) is considered central in overcoming both linguistic and cultural difficulties encountered during EMI. In other words, listening, speaking, reading, and writing are indispensable skills that a teacher should provide in order to effectively achieve bilingual education.

The development of these mutually reinforcing skills is crucial in all contexts and must be considerately encouraged in school curricula in order for the overall progress of learners' language acquisition to take place (Salikhova, 2021; Nan, 2018). ESP frameworks contribute by prioritizing, on the one hand, the need to mold language teaching to the particular academic and professional needs of learners. This should always relate to an emphasis on practical language use associated with the discourse of the respective disciplines to which it pertains (Sulistio, 2016; Rahman, 2022).

In the context of the CLIL approach, which emphasizes the integration of language and content learning to facilitate more natural language acquisition through subject-based instruction (Ramos, 2014; Yasuda, 2019), this study aims to examine the English language skills required for effective physics teaching in bilingual classrooms. The research is guided by the following questions concerning which English language competencies are most essential for bilingual physics instruction, how challenges in CLIL based physics teaching are experienced by teachers, and how limited English proficiency may pose professional risks in bilingual educational contexts. Through this focus, the study seeks to provide a clearer description of required language competencies and support strategies for strengthening teachers' professional development.

RESEARCH METHOD

This study employed a descriptive, quantitative survey design that allows for objective and measurable data collection from the participants about their ability and perception of using English in bilingual physics instruction; it provides an appropriate

approach to identifying trends and levels of language proficiency among teachers and prospective teachers working in bilingual learning environments. In this context, the descriptive quantitative survey is a non-experimental quantitative strategy in which structured survey instruments are used to collect numerical and categorical data that describe participants' characteristics, perceptions, and abilities so that patterns, distributions, and associations can be identified and reported (Creswell, 2012).

This study involved a total of 51 participants, consisting of 22 pre-service physics teachers, 11 in-service physics teachers, and 18 students who had experience learning in bilingual classrooms. This composition was intended to represent varying levels of involvement and experience in bilingual physics teaching contexts. Participants were selected through purposive sampling from the Physics Education study program at Syarif Hidayatullah State Islamic University Jakarta, an institution that implements and prepares future teachers for bilingual instruction. The number of participants was considered adequate for descriptive quantitative analysis, as it allowed for stable statistical representation while capturing diverse perspectives related to the use of English in bilingual physics teaching.

The English language skills used in the physics lessons in the bilingual educational setting were measured by a 40-item Likert-scale questionnaire, ranging from 1 = Strongly Disagree to 5 = Strongly Agree. The instrument was developed based on three theoretical frameworks: Salikhova (2021) and Nan's (2018) Four Language Skills Framework; Sulistio (2016) and Rahman's (2022) notion of English for Specific Purposes; and Ramos' (2014) and Yasuda's (2019) CLIL principles. A language expert evaluated the questionnaire for content validity, theoretical alignment, and linguistic clarity. The evaluation confirmed that the instrument was appropriate for assessing English language proficiency in bilingual physics instruction and aligned with the theoretical frameworks used.

Data collection was done by designing and validating the questionnaire, successfully administering the instrument via Google Forms, recruiting participants for 2 weeks, organizing responses, and securely storing them for academic purposes. The online mode of conduct provides for wide accessibility, effective data management, and ensures the confidentiality of the participants.

Frequencies and mean scores for each of the skill components were calculated from the data gathered and were presented in tables to show the perceived importance of each English language skill. The analysis procedure provided the researchers with an

objective summary of the participants' perceptions and determined which of the English skills were considered vital for bilingual physics instruction.

FINDINGS AND DISCUSSION

Findings

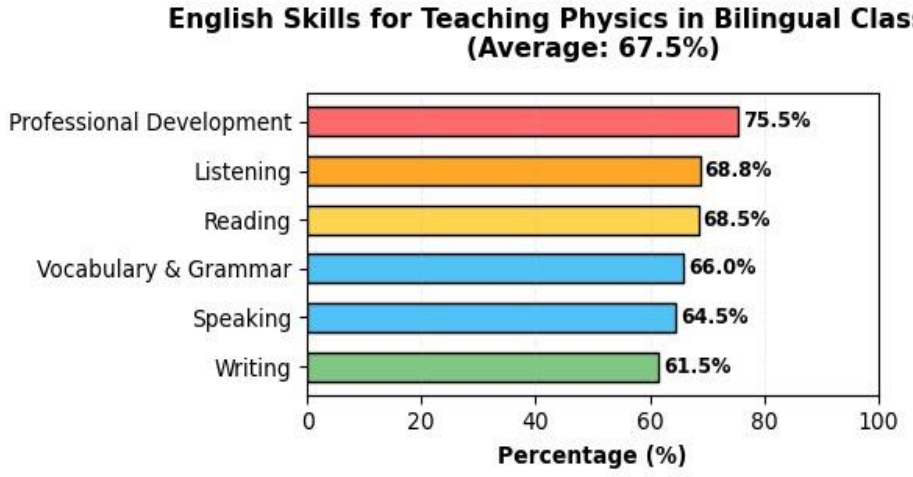
Table 1. Mean Scores of English Skills Required for Teaching Physics in Bilingual Classrooms

Skill Area	Mean Score	Percentage (%)	Level of Importance
Professional Development	4.02	75.5%	Very High Need
Listening	3.75	68.8%	Most Important
Reading	3.74	68.5%	Very Important
Vocabulary & Grammar	3.64	66.0%	Important
Speaking	3.58	64.5%	Important
Writing	3.46	61.5%	Fairly Important

Source: Authors' results

Table 1 shows that professional development received the highest level of importance, followed by listening and reading as the most prioritised English skills in bilingual physics teaching. Meanwhile, writing was rated as the least important skill among the respondents. To facilitate clearer comparison across skill areas, the data are also presented in a diagram.

Figure 1. Mean Scores of English Skills Required for Teaching Physics in Bilingual Classrooms



Source: Authors' results

The diagram visually illustrates the relative differences among English skill areas, highlighting the dominance of professional development, listening, and reading over speaking and writing.

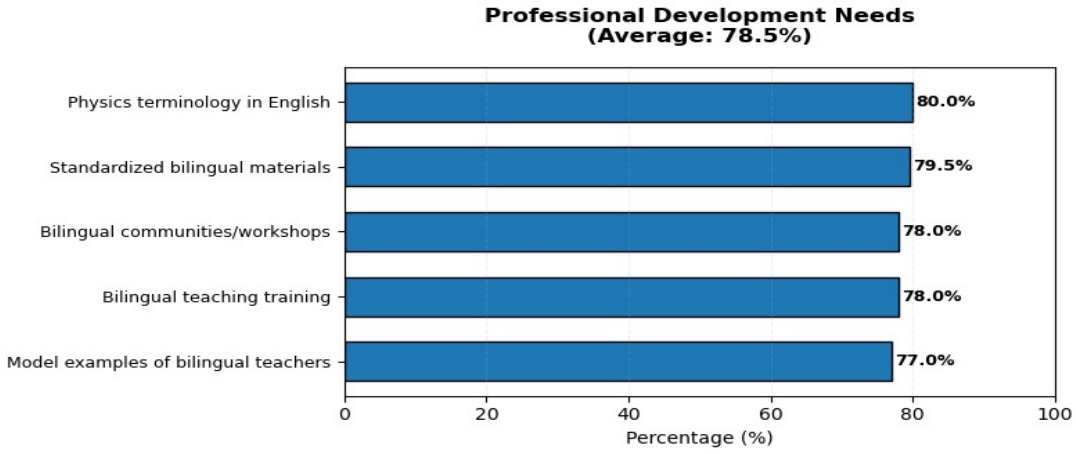
Table 2. Professional Development Needs

Aspect	1	2	3	4	5	Total	Mean	Percentage (%)
Learning physics terminology in English	1	1	8	17	24	51	4.20	80.0%
Having access to standardized bilingual teaching materials	1	1	9	17	23	51	4.18	79.5%
Attending bilingual teaching training	1	2	8	18	22	51	4.12	78.0%
Joining bilingual communities or workshops	1	2	9	17	22	51	4.12	78.0%
Having model examples of bilingual physics teachers	1	2	10	17	21	51	4.08	77.0%

Source: Authors' results.

Table 2 summarises the participants' professional development needs related to bilingual instruction. The data indicate a consistently high demand for training and structured learning resources to support the use of English in physics teaching. To enhance clarity, the data are also presented in a diagram.

Figure 2. Professional Development Needs



Source: Authors' results

The diagram visually emphasises the prominence of professional development needs, showing that training and resource support are perceived as essential for bilingual physics instruction.

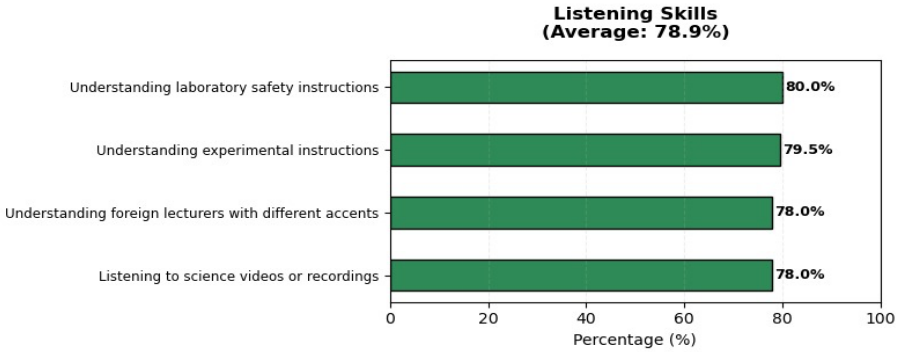
Table 3. Listening Skills

Aspek	1	2	3	4	5	Total	Mean	Percentage (%)
Understanding laboratory safety instructions	1	2	11	20	17	51	3.98	80.0%
Understanding experimental instructions	1	3	13	22	13	51	3.84	79.5%
Listening to science videos or recordings	1	3	11	21	15	51	3.82	78.0%
Understanding foreign lecturers with different accents	2	8	18	14	9	51	3.31	78.0%

Source: Authors' results

Table 3 outlines the mean scores for listening-related skills. The results indicate that participants perform better in understanding classroom and laboratory instructions, while comprehending different English accents is perceived as more challenging. To support clearer comparison among listening skill indicators, the data are also presented in a diagram.

Figure 3. Listening Skills



Source: Author's results

The diagram highlights variations in listening sub-skills, showing stronger performance in instructional comprehension compared to accent recognition.

Table 4. Reading Skills

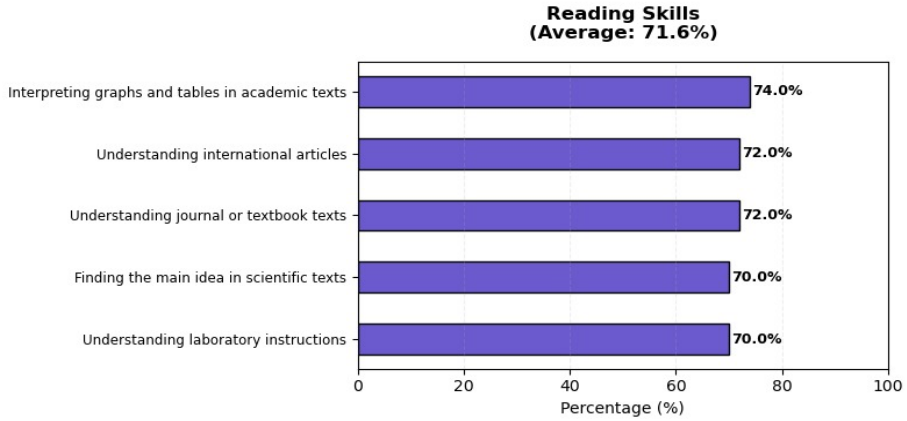
Aspect	1	2	3	4	5	Total	Mean	Precentage (%)
Interpreting graphs and tables in academic texts	1	2	12	19	17	51	3.96	74.0%
Understanding journal or textbook texts	1	3	12	19	16	51	3.88	72.0%
Understanding international articles	1	3	13	18	16	51	3.88	72.0%

Understanding laboratory instructions	1	4	13	18	15	51	3.80	70.0%
Finding the main idea in scientific texts	1	4	13	18	15	51	3.80	70.0%

Source: Authors' results

Table 4 reports the results for reading skills. The findings show that participants are more confident in interpreting visual information and academic texts, while identifying main ideas in scientific passages remains an area that requires improvement. To facilitate clearer comparison across reading skill indicators, the data are also presented in a diagram.

Figure 4. Reading Skills



Source: Authors' results

The diagram illustrates variations in reading sub-skills, highlighting stronger performance in visual interpretation compared to extracting main ideas from scientific texts.

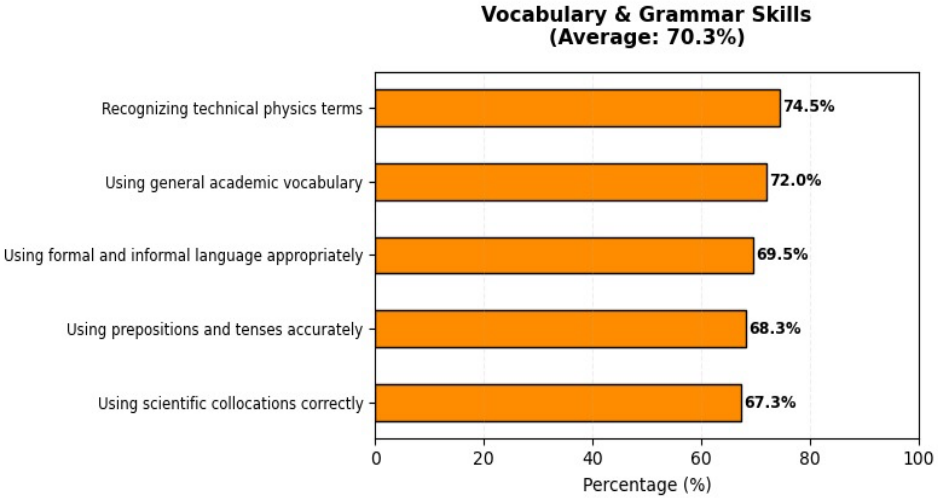
Table 5. Vocabulary & Grammar Skills

Aspect	1	2	3	4	5	Total	Mean	Precentage (%)
Recognizing technical physics terms	1	2	11	17	18	51	3.98	74.5%
Using general academic vocabulary	1	3	13	17	16	51	3.88	72.0%
Using formal and informal language appropriately	1	3	15	17	15	51	3.78	69.5%
Using prepositions and tenses accurately	1	4	16	18	14	51	3.73	68.3%
Using scientific collocations correctly	1	4	16	16	13	51	3.69	67.3%

Source: Authors' results

Table 5 describes the participants' vocabulary and grammar abilities. The results indicate that recognition of technical physics terminology is the strongest aspect, whereas accurate grammatical usage and scientific collocations require further development. To support clearer comparison among indicators, the data are also presented in a diagram

Figure 5. Vocabulary & Grammar Skills



Source: Authors' results

The diagram emphasises stronger mastery of technical vocabulary compared to grammatical accuracy and collocation use.

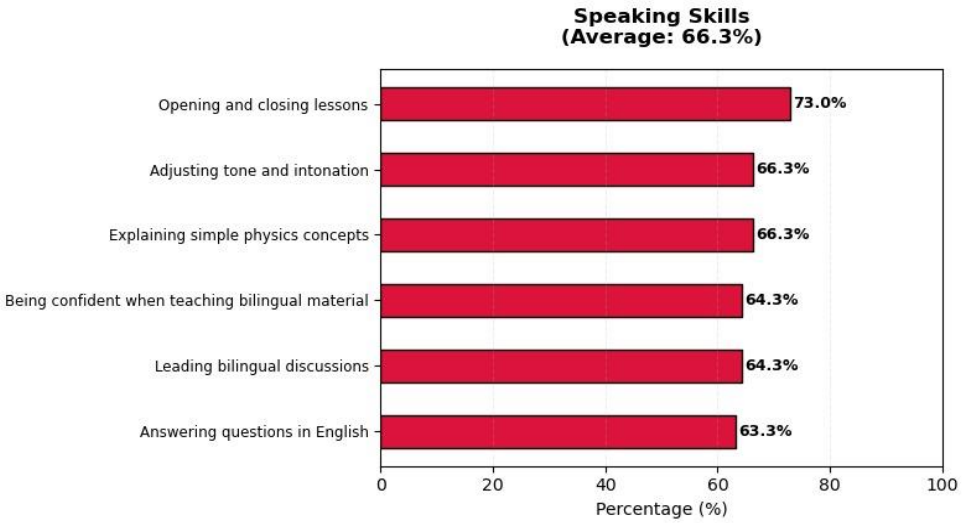
Table 6. Speaking Skills

Aspect	1	2	3	4	5	Total	Mean	Precentage (%)
Opening and closing lessons	1	3	11	20	16	51	3.92	73.0%
Explaining simple physics concepts	2	4	13	18	14	51	3.65	66.3%
Adjusting tone and intonation	1	3	14	18	15	51	3.65	66.3%
Leading bilingual discussions	1	6	15	17	12	51	3.57	64.3%
Being confident when teaching bilingual material	1	5	16	17	12	51	3.57	64.3%
Answering questions in English	2	5	14	18	12	51	3.53	63.3%

Source: Authors' results

Table 6 presents the results for speaking skills. The data suggest that participants are more comfortable with basic classroom communication, while tasks requiring fluency and spontaneous responses remain challenging. To allow clearer comparison across speaking skill indicators, the data are also presented in a diagram

Figure 6. Speaking Skills



Source: Authors' results

The diagram highlights differences in speaking performance, showing higher confidence in basic communication than in fluent and spontaneous interaction.

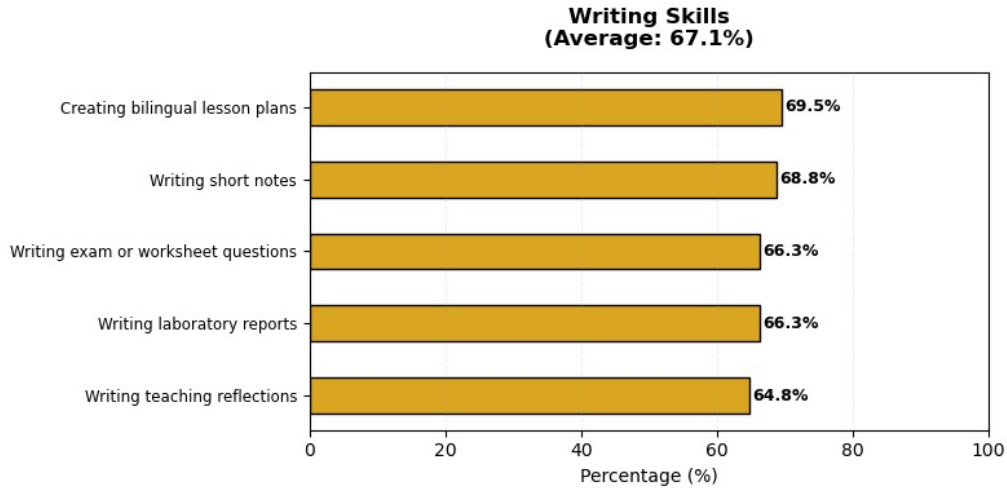
Table 7. Writing Skills

Aspect	1	2	3	4	5	Total	Mean	Precentage (%)
Creating bilingual lesson plans	1	4	14	18	14	51	3.78	69.5%
Writing short notes	1	4	15	17	14	51	3.75	68.8%
Writing laboratory reports	2	4	14	17	14	51	3.65	66.3%
Writing exam or worksheet questions	1	5	14	17	14	51	3.65	66.3%
Writing teaching reflections	2	5	15	16	13	51	3.59	64.8%

Source: Authors' results

Table 7 summarises writing-related skills. The results indicate that participants perform better in producing short written materials, whereas reflective and more complex academic writing tasks are perceived as more demanding. To enhance clarity in comparing writing indicators, the data are also presented in a diagram.

Figure 7. Writing Skills



Source: Authors' results

The diagram shows lower performance in complex academic writing compared to simpler written tasks.

Discussion

The findings of this research are presented to address the research question and achieve the study's objectives. Based on the questionnaire responses, the English skills most needed for teaching physics in bilingual classrooms are receptive skills particularly listening (3.75) and reading (3.74). Speaking (3.58) ranks next, while writing (3.46) is identified as the least emphasised skill. This pattern suggests that bilingual physics teachers depend more on understanding instructions, texts, and English-based materials than on producing spoken or written language.

These results are consistent with the CEFR framework, which emphasises that receptive skills form the basis for productive language use. They also agree with Qamariah's (2024) research, which says that listening and reading are significant for understanding scientific ideas and appropriating access to physics materials that are usually only in English. Teachers who have better skills in receiving information are more ready to understand complicated science texts, follow along in class discussions, and help students understand the material in both languages.

However, the lower speaking and writing scores can be explained by the Communicative Competence Theory proposed by Canale & Swain. According to them, good oral and written communication requires appropriate use of language, fluency, good vocabulary, and confidence in interaction. Many Indonesian teachers claim that their main concerns are pronunciation, grammar, and grammatically correct sentences. This

makes them feel less confident when teaching in English. This is similar to what Yusuf (2024) and Setiawan (2019) found, as they noticed that teachers often struggle to stay fluent and confident when using English during lessons.

A noteworthy pattern appears in several items that share identical mean scores. In speaking skills, explaining simple physics concepts and adjusting tone and intonation both scored 3.65, indicating that teachers perceive these tasks as equally challenging. Tone and intonation play an important role in bilingual classrooms because they help highlight meaning and clarify abstract physics ideas. Meanwhile, leading bilingual discussions and feeling confident although teaching bilingual material both scored 3.57, showing related challenges when it comes to interacting evenly and feeling confident in the classroom. This can be understood through Krashen's Affective Filter Hypothesis, which explains that stress and worry about making mistakes can slow down how well someone performs in a language.

Likewise, in writing skills, writing laboratory reports and creating exam or worksheet questions each scored 3.65, reflecting comparable levels of difficulty in both academic and instructional writing. These tasks require precision in scientific terminology, grammatical accuracy, and clear structural organisation, in line with Academic Writing Competence Theory.

Overall, the findings reinforce key principles of CLIL/EMI, which emphasise the integration of language and subject content in bilingual education. Results indicate that there is a significant gap between linguistic demands of EMI and the actual proficiency level in English of physics teachers. Hence, professional development training should be holistic, addressing both receptive skills and productive skills, required in classroom communication, explanation, and material preparation.

However, several prior studies present results that do not fully support those found in this study. For example, Fitriati and Rata (2018) argue that speaking is the most urgent skill in EMI classrooms because it has to be applied by the teachers in explaining concepts, answering questions, and directly interacting in English. This is contrary to the present study, which places speaking below listening and reading. In addition, Moody (2022) found that writing is highly essential for bilingual teachers, as they are required to produce lesson plans, reports, assessments, and written feedback in English. This differs from the findings of the current study, which indicate that writing is the least emphasised skill among respondents.

These differences show that the importance of different language skills can

change based on the classroom setting, what the school expects, and how much English is used in teaching. Even so, the results of this study show that teachers need better training that combines improving their English language skills with teaching physics. By strengthening both listening and speaking skills, teachers can explain content more clearly and help students be more involved in lessons taught in English.

CONCLUSION

This study concludes that listening and reading are the most essential English skills for teaching physics in bilingual classrooms, as both receptive skills achieved the highest mean scores. Speaking and writing skills were perceived as lower in priority, which may indicate that the teacher relies more on comprehension-based abilities to support content delivery in EMI settings. These findings address the research gap by identifying which English skills are most needed in bilingual physics instruction and providing empirical evidence of teachers' actual proficiency levels.

The practical implications of these findings include that teacher training programs ought to focus on strengthening listening and reading skills while gradually integrating productive skills, which then may support more effective bilingual instruction. The use of self-reported questionnaire data from participants enrolled primarily in physics education programs limits the generalisability of this study to all EMI teaching contexts. Hence, future research is suggested to add classroom observations and interviews with a broader range of schools to obtain richer data on teachers' real-time language use and challenges related to bilingual physics teaching.

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