

NEEDS ANALYSIS OF ENGLISH FOR SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (ESTEM) FOR MATHEMATICS STUDENTS

Sabrina Maudi Rajab^{1*}, Dini Andriani¹, Akira Fitri¹, Ulan Sari¹

¹English Education Department, Tarbiyah and Teacher Training Faculty, Universitas Islam Negeri Alauddin Makassar, Indonesia

*Email: finafinasabrina@gmail.com

Abstract

English has become an essential requirement for students in Science, Technology, Engineering, and Mathematics (STEM) fields, including Mathematics, due to the dominance of English in academic literature and professional communication. This study aims to analyze the English learning needs of Mathematics students in the Faculty of Science and Technology, UIN Alauddin Makassar, particularly the 2023 cohort, within the framework of English for Science, Technology, Engineering and Mathematics (ESTEM). The study employed a needs analysis approach using a questionnaire distributed to 14 Mathematics students. The questionnaire explored students' target needs, learning needs, lacks, wants, learning preferences, professional communication needs, and learning environment using a 1–5 Likert scale. The findings indicate that students frequently use English for academic purposes such as reading scientific texts, accessing learning resources, and writing reports. However, they still face difficulties, especially in academic writing, oral communication, and listening comprehension. Students also expect ESTEM courses to provide discipline-specific materials, technical vocabulary, practical learning activities, and digital learning resources. Overall, the results highlight the importance of designing ESTEM materials that are aligned with the real academic and professional needs of Mathematics students.

Keywords: Needs Analysis; ESTEM; English for Mathematics; STEM Education; English for Specific Purposes

INTRODUCTION

In the era of globalization and rapid scientific development, English has become a fundamental requirement for university students, especially those in STEM fields. Mathematics students frequently engage with international literature, research papers, and learning resources written in English, making English proficiency essential for academic success (Flowerdew, 2013). The English for Science, Technology, Engineering and Mathematics (ESTEM) approach emphasizes equipping learners with language skills that are directly relevant to scientific and mathematical contexts.

Hutchinson and Waters (1987) argue that an effective language program must be based on a thorough needs analysis, as each academic discipline requires different linguistic competencies. In STEM fields, students are expected to comprehend academic texts, write analytical reports, and communicate professionally in both academic and industrial settings (Dudley-Evans & St. John, 1998). Richards (2001) also highlights that identifying learners' needs is a crucial step in designing a suitable and meaningful language curriculum.

For Mathematics students, English is particularly important for reading scientific journals, understanding technical terminology, writing mathematical reports, and delivering

academic presentations. Hyland (2006) emphasizes that learners in STEM disciplines require explicit instruction in academic genres such as research articles, abstracts, and scientific presentations. Despite the importance of English, many students still encounter challenges in mastering these skills.

Therefore, this study focuses on conducting a needs analysis to identify the specific English learning requirements of Mathematics students from the Faculty of Science and Technology, UIN Alauddin Makassar, particularly those from the 2023 cohort. The results of this analysis are expected to serve as a foundation for designing effective ESTEM learning strategies and materials that are relevant to students' academic and professional contexts.

METHOD

This research employed a quantitative descriptive research design using a survey research method. This approach was selected to systematically identify and describe the linguistic needs of Mathematics students within the English for STEM (ESTEM) framework. By utilizing a survey, the researchers could gather precise numerical data to evaluate the participants' necessities, lacks, and wants.

The participants of this study consisted of 14 students from the Mathematics Department, Faculty of Science and Technology, at Universitas Islam Negeri (UIN) Alauddin Makassar. The respondents are from the 2023 cohort. These participants were selected because they are currently at a stage in their academic journey where English proficiency is increasingly required to access technical materials and international literature.

The primary instrument for this study was a structured questionnaire adapted from the Needs Analysis framework by Hutchinson and Waters (1987). The questionnaire was specifically designed to cover eight comprehensive areas of information:

1. Professional information about learners: Their academic background and field of study.
2. Personal information about learners: General demographic data.
3. Learners' English language information: Their current perception of their English proficiency.
4. Learners' lacks: Identifying the gaps in their language skills.
5. Language learning information: How the students prefer to learn the language.
6. Professional communication information: Needs related to communication in a professional STEM context.
7. Learners' needs from the ESP 1 course: Specific expectations from their English for Specific Purposes course.
8. Environmental situation: The physical and academic environment where the learning takes place.

The items were measured using a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Data were collected through an online Google Form to facilitate ease of access for the respondents. The researchers distributed the survey link to the students' communication groups. Each participant was given clear instructions to ensure the validity of the responses. A total of 14 completed questionnaires were collected and verified for further processing.

The data were analyzed using descriptive statistical techniques. The analysis focused on calculating the frequency and percentage distribution of the responses for each indicator. This technique allowed the researchers to determine the most dominant patterns regarding

students' necessities, lacks, and wants. The results are visualized through charts and tables to provide a clear quantitative foundation for the discussion.

RESULTS AND DISCUSSION

RESULTS

This section presents the research findings obtained from 14 respondents of the Mathematics Department (2023 cohort) and provides an in-depth analysis based on the Needs Analysis framework.

Target needs refer to what the learner has to know in order to function effectively in the target situation. The data regarding students' necessities are presented in Table 1 below.

Table 1. Target Needs (Necessities)

Statement	1	2	3	4
I often use English in my study or work activities.	0 (0%)	0 (0%)	12 (85.7%)	0 (0%)
I need English to write reports, papers, or official correspondence.	1 (7,1%)	1 (7,1%)	4 (28.6%)	7 (50%)
I need English to read and understand professional or academic texts.	0 (0%)	1 (7,1%)	3 (21.4%)	7 (50%)
I will use English regularly in my future profession.	0 (0%)	1 (7,1%)	3 (21,4%)	5 (35,7%)
The English I need must include technical vocabulary or vocabulary specific to my field.	0 (0%)	0 (0%)	2 (14,3%)	7 (50%)

Lacks refer to the gap between the learners' target proficiency and their actual current proficiency. The following table identifies these gaps based on the students' self-assessment.

Table 2. Language Lacks (Current Competence)

Statement	1	2	3	4
My cultural background influences the way I learn English.	0 (0%)	4 (28,6%)	6 (42.9%)	2 (14,3%)
I am taking this course to improve my English skills for my studies or work.	0 (0%)	2 (14,3%)	4 (28,6%)	5 (35.7%)
I have had a positive experience learning English before.	0 (0%)	1 (7,1%)	8 (57,1%)	1 (7,1%)
I hope this course will help me communicate better in my field.	1 (7,1%)	1 (7,1%)	1 (7,1%)	8 (57,1%)
I enjoy learning English and consider it important.	0 (0%)	1 (7,1%)	1 (7,1%)	7 (50%)

Wants refers to what the learners themselves feel they need or desire from the language learning process, including their preferred methods and environment.

Table 3. Learning Wants and Preferences

Statement	1	2	3	4
My speaking skills are good enough for everyday conversation.	0 (0%)	1 (7,1%)	5 (35,7%)	7 (50%)
I can understand lectures, presentations, or conversations in English.	1 (7,1%)	1 (7,1%)	7 (50%)	4 (28,6%)
I am able to read and understand academic or professional texts in English.	1 (7,1%)	1 (7,1%)	9 (64,3%)	2 (14,3%)

This section describes students' difficulties in writing and speaking English, particularly in academic and professional contexts, as a basis for improving instructional design.

Table 4. Writing and Speaking Difficulties

Statement	1	2	3	4
My writing skills are not yet sufficient to produce reports or academic papers.	0 (0%)	3 (21,4%)	3 (21,4%)	5 (35,7%)
I have difficulty speaking English fluently in academic or professional contexts.	1 (7,1%)	2 (14,3%)	3 (21,4%)	5 (35,7%)
I have difficulty understanding native English speakers.	1 (7,1%)	1 (7,1%)	7 (50%)	3 (21,4%)

This section explains students' learning styles and preferences regarding English learning methods and media, including the use of digital media and collaborative learning.

Table 5. Learning Styles and Media Preferences

Statement	1	2	3	4
I learn better through discussion and group work.	0 (0%)	2 (14,3%)	3 (21,4%)	6 (42,9%)
I have difficulty speaking English fluently in academic or professional contexts.	1 (7,1%)	1 (7,1%)	2 (14,3%)	3 (21,4%)
I often use videos, apps, or the internet to learn English.	1 (7,1%)	0 (0%)	2 (14,3%)	3 (21,4%)
I need to use polite and formal English when speaking with my boss or clients.	0 (0%)	2 (14,3%)	1 (7,1%)	5 (35,7%)

This section discusses students' needs to master English communication skills that are relevant to their field of study and professional demands.

Table 6. Professional Communication Needs

Statement	1	2	3	4
I need to understand how professionals in my field interact using English.	0 (0%)	0 (0%)	5 (35,7%)	5 (35,7%)
I need to learn how to communicate professionally in my field.	0 (0%)	1 (7,1%)	4 (28,6%)	7 (50%)

This section examines students' expectations of the English course, particularly in supporting effective communication and ensuring the relevance of learning materials to their field of study.

Table 7. Learning Expectations

Statement	1	2	3	4
I hope this course will help me communicate effectively in my field.	1 (7,1%)	1 (7,1%)	1 (7,1%)	8 (57,1%)
I want this course to focus on skills that are relevant to my studies/work.	0 (0%)	1 (7,1%)	4 (28,6%)	7 (50%)
I want practical material that is relevant to the workplace.	0 (0%)	1 (7,1%)	4 (28,6%)	6 (42,9%)

This section evaluates students' perceptions of the learning environment and course organization as supporting factors in the English learning process.

Table 8. Learning Environment and Course Organization

Statement	1	2	3	4
The classroom environment supports the English learning process well.	0 (0%)	0 (0%)	6 (42,9%)	5 (35,7%)
I want this course to focus on skills that are relevant to my studies/work.	0 (0%)	2 (14,3%)	3 (21,4%)	6 (42,9%)
The English class schedule fits my study time.	0 (0%)	1 (7,1%)	7 (50%)	4 (28,6%)

DISCUSSION

The results of the questionnaire show that Mathematics students frequently rely on English in their academic activities. A total of 85.7% of respondents selected scale 3, indicating fairly frequent use of English, while 14.3% selected scale 5, indicating intensive use of English in accessing learning resources. This finding supports Anthony (2018), who states that STEM learners depend heavily on English-language materials to understand theoretical and mathematical concepts.

In terms of academic reading, 50% of students rated the need at scale 4 and 21.4% at scale 5, demonstrating that reading scientific texts is a crucial skill. Academic writing was also identified as an important need, with 50% of respondents rating it at scale 4. From a professional perspective, 35.7% rated English as very important and another 35.7% as

important, indicating that English is considered essential for future scientific careers. Technical vocabulary was similarly emphasized, with 50% rating it important and 35.7% rating it very important, in line with Hyland's (2006) emphasis on academic vocabulary in ESP and ESTEM contexts.

Despite recognizing the importance of English, students still face significant challenges. Academic writing emerged as the most difficult skill, with 35.7% rating their difficulty at scale 4 and 21.4% at scale 5. This finding supports Hyland (2013), who notes that academic writing is one of the most complex skills for university students. Speaking skills were also problematic, as 35.7% reported difficulty speaking fluently during presentations or discussions. Listening comprehension posed challenges as well, with 50% selecting scale 3 and 21.4% selecting scale 4, indicating difficulties in understanding native speakers or academic audio materials. Reading academic texts was considered moderately difficult, with 64.3% selecting scale 3.

Despite recognizing the importance of English, students still face significant challenges. Academic writing emerged as the most difficult skill, with 35.7% rating their difficulty at scale 4 and 21.4% at scale 5. This finding supports Hyland (2013), who notes that academic writing is one of the most complex skills for university students. Speaking skills were also problematic, as 35.7% reported difficulty speaking fluently during presentations or discussions. Listening comprehension posed challenges as well, with 50% selecting scale 3 and 21.4% selecting scale 4, indicating difficulties in understanding native speakers or academic audio materials. Reading academic texts was considered moderately difficult, with 64.3% selecting scale 3.

Regarding learning needs, students showed a strong preference for digital learning resources and hands-on activities. A total of 57.1% rated scale 5 for digital resources such as videos and online tools, supporting Nation's (2007) argument that multimedia integration enhances language learning. Hands-on learning was also highly valued, with 50% selecting scale 5. Group learning was preferred by many students, with 42.9% selecting scale 4, suggesting that collaborative learning supports their learning process.

Students also highlighted the importance of professional communication skills, such as writing formal emails, preparing scientific reports, and delivering academic presentations. This is reflected in 57.1% selecting scale 4 for professional communication needs. In terms of expectations, students believe that ESTEM courses should support their academic performance and prepare them for future careers, as shown by 50% selecting scale 4 and 35.7% selecting scale 5. The learning environment was generally supportive, with access to digital devices, internet, and online references, which Richards (2001) identifies as a key factor influencing learning success.

Overall, the findings indicate that Mathematics students require an English learning approach that focuses on academic reading, academic writing, technical vocabulary, and professional communication, while addressing challenges in writing, speaking, and listening.

CONCLUSION

Based on the needs analysis conducted with 14 Mathematics students from the Faculty of Science and Technology, cohort 2023, it can be concluded that English plays a significant role in both academic activities and future professional aspirations. Students frequently use English to read scientific texts, access online resources, and complete academic tasks.

However, they still experience difficulties, particularly in academic writing, oral communication, and listening comprehension.

Students expect ESTEM courses to provide discipline-specific materials, authentic academic tasks, technical vocabulary, and opportunities for professional communication practice. Therefore, ESTEM curriculum design should be closely aligned with the specific language needs of Mathematics students.

Suggestions include integrating structured academic reading practice, strengthening academic writing instruction, enhancing technical vocabulary development, providing more oral communication opportunities, using digital and multimedia resources, applying task-based and collaborative learning approaches, and aligning course content with real professional communication needs.

ACKNOWLEDGMENT

The authors would like to express their appreciation to the lecturer of the English for Science, Technology, Engineering and Mathematics (ESTEM) course for guidance and feedback during the writing of this paper. The authors also thank the Mathematics Students of the Faculty of Science and Technology, UIN Alauddin Makassar, cohort 2023, for their participation and cooperation in providing the data for this study.

REFERENCES

- Anthony, L. (2018). *Introducing English for Specific Purposes*. Routledge.
- Belcher, D. (2006). English for specific purposes: Teaching to perceived needs and imagined futures. *TESOL Quarterly*.
- Brown, H. D. (2009). *Principles of Language Learning and Teaching*. Pearson.
- Dudley-Evans, T., & St. John, M. (1998). *Developments in English for Specific Purposes*. Cambridge University Press.
- Flowerdew, J. (2013). *Academic Discourse*. Routledge.
- Hyland, K. (2006). *English for Academic Purposes*. Routledge.
- Hyland, K. (2013). *Writing in the University: Education, Knowledge and Reputation*. Routledge.
- Hutchinson, T., & Waters, A. (1987). *English for Specific Purposes: A Learning-Centered Approach*. Cambridge University Press.
- Nation, I. S. P. (2007). *The four strands*. Innovation in Language Learning and Teaching.
- Nation, I. S. P., & Macalister, J. (2010). *Language Curriculum Design*. Routledge.
- Richards, J. C. (2001). *Curriculum Development in Language Teaching*. Cambridge University Press. The committee refers to the guidelines provided by the American Psychological Association (APA) for writing and formatting academic papers. For instance, as appears below.