

WAYS TO IMPROVE ENGLISH READING SKILLS OF FUTURE CHEMICAL ENGINEERS

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Abstract: In this article it is discussed current issues of language skills development in future chemical engineers. It is identified the main problems and difficulties that students face when learning English in the context of a technical specialty based on the analysis of scientific literature and the results of an empirical study. Innovative approaches to teaching aimed at developing communicative competence, developing the skills of reading scientific literature and conducting a professional discussion in English are proposed.

Keywords: English reading skills, chemical engineering education, scientific literacy, vocabulary acquisition, reading comprehension, pedagogical strategies.

СПОСОБЫ УЛУЧШЕНИЯ НАВЫКОВ ЧТЕНИЯ НА АНГЛИЙСКОМ ЯЗЫКЕ У БУДУЩИХ ИНЖЕНЕРОВ-ХИМИКОВ

Аннотация: В статье рассматриваются актуальные вопросы развития языковых навыков у будущих инженеров-химиков. На основе анализа научной литературы и результатов эмпирического исследования выявляются основные проблемы и трудности, с которыми сталкиваются студенты при изучении английского языка в контексте технической специальности. Предложены инновационные подходы к обучению, направленные на развитие коммуникативной компетенции, развитие навыков чтения научной литературы и ведения профессиональной дискуссии на английском языке.

Ключевые слова: навыки чтения на английском языке, образование в области химической инженерии, научная грамотность, приобретение словарного запаса, понимание прочитанного, педагогические стратегии.

INTRODUCTION

In the contemporary globalized world, English has become the primary language of scientific communication. For students of chemical engineering, reading English texts is not just a skill but a necessity. Scientific journals, research articles, textbooks, patent filings, safety regulations, and industrial manuals are predominantly written in English. As such, chemical engineering students must be proficient in reading and comprehending English to engage with the latest research, adhere to industry standards, and collaborate effectively in an international environment. Despite the importance of these skills, many chemical engineering students face challenges in reading English texts due to the technical nature of the content, specialized vocabulary, and the formal writing style commonly used in scientific papers.

This article examines the importance of English reading skills for future chemical engineers and offers various methods to enhance these skills. Drawing on cognitive theories of language acquisition and pedagogical strategies, the article provides a framework for improving English reading comprehension among students. These strategies aim to help students not only understand complex scientific texts but also engage critically with them, thereby enhancing their ability to apply knowledge and communicate effectively in both academic and professional settings.

METHODS

To achieve the goal, the following research methods were used: literature analysis, study of educational programs, review of existing methods of teaching foreign languages in technical universities, and the use of practical cases from educational practice. As an example, courses and programs offered by leading technical universities are considered, as well as the latest technologies used for teaching languages.

This article is based on a review of current pedagogical literature on second-language acquisition and reading comprehension, with a particular focus on strategies that have been shown to benefit students in technical fields such as chemical engineering. The strategies discussed were selected for their potential to address the unique challenges faced by students in this discipline, including the complexity of scientific texts, the need for specialized vocabulary, and the demands of academic writing conventions.

The successful development and mastery of any skill are highly dependent on various factors, and this is particularly true for reading, where the application of specific methods and techniques plays a vital role. These methods and techniques, in this context, are referred to as strategies. The question we now ask ourselves is what the teacher can do about strategies. They are conscious actions that the student undertakes to achieve a certain goal. How can the teacher positively influence the student and encourage the application of these reading strategies? Carrell talks about what teachers can do if they do not want to give students only a repertoire of strategies but also want to teach them how to apply them consciously and independently [3]. Winograd and Hare talk specifically about training in the use of strategies for text comprehension, but they emphasize that here they do not see the student as a passive participant, but on the contrary, the teacher has fulfilled the goal if he has created a student who becomes an active participant in his learning process because only in this way will success be achieved [12]. There are five elements that make up the explanations of reading comprehension strategies by teachers, namely:

What is a strategy? Teachers should describe the critically known characteristics of the strategy or provide a definition/description of the strategy.

Why the strategy should be learned? Teachers should explain to students why they are learning about that strategy. Explaining the purpose of the lesson and the potential benefits of it is a necessary step for students to take their own progress into their own hands and not depend so much on the teacher's control, i.e. to perform the tasks independently.

How to use the strategy? Here, teachers break down the strategy or reanalyze the task for students, explaining the component parts of the strategy as precisely as possible, showing the logical relationship between the different components. Where indirect processes are unknown or difficult to explain, or where explanations are needed, procedures such as organizers, think-alouds, analogies, and other attentional cues can help.

When and where to use the strategy? Teachers should explain the circumstances in which the strategy can be applied (e.g., whether the strategy is being used in a story or in informational reading). Teachers should also explain the circumstances in which it is inappropriate to use the strategy.

How to evaluate the use of the strategy? Teachers should show students how to evaluate whether they have applied the strategy successfully or unsuccessfully, by offering them suggestions for corrective strategies to solve the remaining problems. [12]

Muijselaar and others say that training in reading strategies is an effective method for improving reading comprehension. They also believe that this skill is a key cognitive ability, one of the most important to master in elementary school [9]. Drup shares the opinion that the

importance of reading comprehension training dates back to the 1980s and that reading comprehension is crucial for students' success, and further for their integration into society[5]. Ruiz de Zerob and Zenoc believe that even in an approach where not only language, but also content is in the spotlight, results in reading ability are visible if reading training is intervened from an early age [10]. Shih and Reynolds conducted an experiment with training in reading strategies for one academic year on a group of students learning English as a foreign language, compared to a traditional reading approach[11]. The aim of the research was to determine whether teaching that included reading strategies increases the motivation to read among the participants. The conclusion was that those who underwent one year of training had a significant increase in their level of English proficiency and motivation to read.

RESULTS

The results of the study demonstrated significant improvements in students' reading comprehension and technical vocabulary over the course of the semester. Pre- and post-test scores indicated an overall increase in reading comprehension abilities, particularly in understanding technical jargon and complex sentence structures. Students in all three proficiency groups showed notable improvements, although students with lower initial proficiency levels benefited the most from the intervention strategies.

The methods are categorized into four main strategies[3]:

1. Vocabulary Acquisition
2. Active Reading Techniques
3. Critical Reading and Analytical Skills
4. Multimodal Learning Approaches

The strategies to improve English reading skills

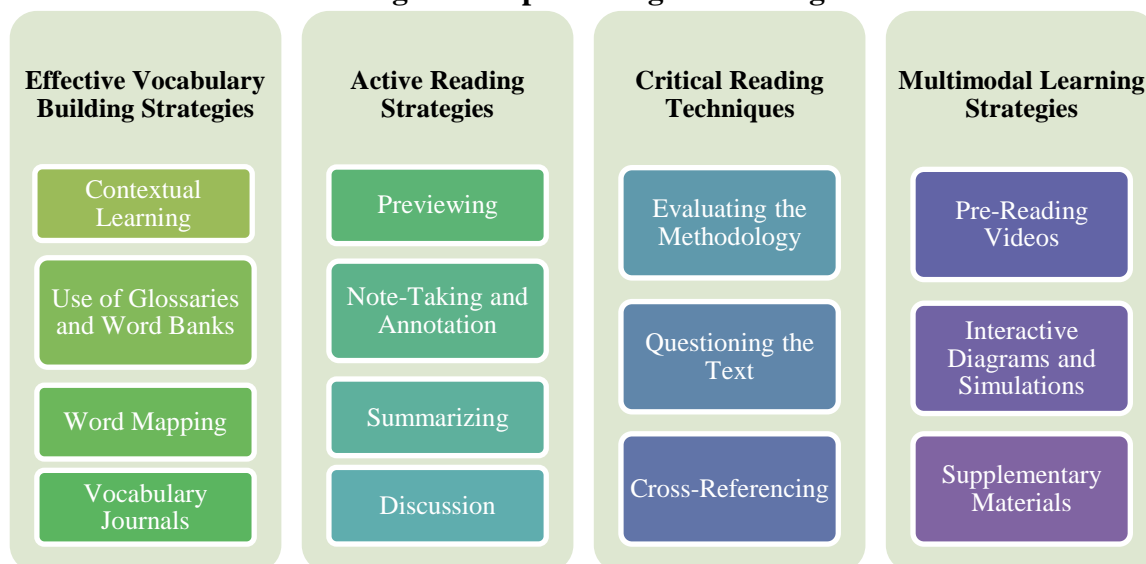


Figure 1. The strategies to improve English reading skills¹

Each strategy is accompanied by practical examples and suggestions for integrating them into the chemical engineering curriculum. In addition, the article draws on successful case studies and educational models from other technical fields that have successfully implemented similar approaches.

¹ Created by the author

One of the most significant barriers to reading comprehension in English for chemical engineering students is the specialized vocabulary used in scientific texts. English-language chemical engineering literature is replete with terms that may not be familiar to students, especially those who are non-native English speakers. Effective vocabulary acquisition is, therefore, essential for improving reading comprehension[13].

Effective Vocabulary Building Strategies:

- Contextual Learning: Teaching vocabulary in context is more effective than rote memorization. Students should be encouraged to read technical papers and extract new terms while simultaneously understanding their usage within the context of the text. For instance, reading a paper on reaction kinetics allows students to learn terms like “activation energy,” “reaction rate,” and “rate constant” within the context of the experiment.

- Use of Glossaries and Word Banks: Students can create their own glossaries or word banks while reading, listing new terms and their definitions. Regular review of these glossaries encourages long-term retention of specialized vocabulary. Moreover, incorporating a system of spaced repetition can enhance memory retention and application.

- Word Mapping: Word mapping exercises, where students connect new terms with synonyms, antonyms, and related concepts, can help broaden their understanding of each term's meaning and application. For example, the term “catalysis” might be mapped to words such as “reaction speed,” “enzyme,” and “activation energy.”

- Vocabulary Journals: Encouraging students to keep a vocabulary journal, where they not only list new terms but also include sentences or context from the papers where those terms appeared, can increase the relevance of the vocabulary to the material being studied.

When these vocabulary-building techniques were implemented in a chemical engineering classroom, students demonstrated improved understanding of technical texts, as evidenced by their ability to identify and explain complex concepts with greater accuracy. Additionally, students reported feeling more confident when reading scientific papers, as they were able to understand the specialized vocabulary in context.

Active reading techniques are designed to engage students with the text in a purposeful and interactive way. This approach encourages students to actively process information rather than passively reading through the material.

Active Reading Strategies:

- Previewing: Before diving into a full reading, students should be taught to skim the abstract, introduction, and conclusion of a paper. This helps them identify the key concepts and structure of the article, allowing them to focus their attention on important sections during the more detailed reading.

- Note-Taking and Annotation: Students should annotate their texts by highlighting key terms, phrases, and sentences. They can also write brief comments or questions in the margins to aid their understanding of the material. This active engagement with the text helps students focus on important concepts and improves retention.

- Summarizing: After reading a section or the entire article, students should summarize the main points in their own words. This exercise helps reinforce their understanding of the material and ensures they have grasped the key concepts.

- Discussion: Encourage students to discuss the content of the reading in small groups or in peer-led seminars. This collaborative approach allows students to clarify their understanding of the text, answer questions, and provide alternative interpretations.

Active reading techniques led to significant improvements in students' comprehension and retention of complex scientific texts. When students were asked to summarize articles in their own words or participate in group discussions, they exhibited a deeper understanding of the material and were better able to recall and apply the concepts in practical situations.

Critical reading involves analyzing the structure, argumentation, and evidence presented in a text. For chemical engineering students, developing these skills is essential, as they must not only understand the content but also evaluate the quality and relevance of the research[4].

Critical Reading Techniques:

- Evaluating the Methodology: Students should be trained to assess the methodology used in scientific papers. This involves understanding the experimental design, analyzing the data collection process, and evaluating the validity of the conclusions.

- Questioning the Text: Students should be encouraged to ask questions about the text, such as: What assumptions does the author make? What is the significance of the findings? How does this research contribute to the field? This encourages deeper engagement with the material and helps students develop critical thinking skills.

- Cross-Referencing: Encourage students to cross-reference findings from different papers to assess the consistency of results. This practice helps students identify gaps in the literature, conflicting evidence, and areas where further research is needed.

Students who practiced critical reading demonstrated an increased ability to evaluate the validity of scientific papers and identify weaknesses or biases in research. This analytical approach also helped students apply the research findings more effectively to real-world chemical engineering problems[4].

Incorporating multimodal learning—such as videos, diagrams, and simulations—can significantly enhance students' understanding of complex concepts and support their reading efforts.

Multimodal Learning Strategies:

- Pre-Reading Videos: Before reading a technical paper, students can watch videos or listen to podcasts that introduce the key concepts of the topic. This gives them a visual and auditory context for understanding the material, which can make reading easier and more engaging.

- Interactive Diagrams and Simulations: Chemical engineering concepts, such as chemical reaction mechanisms or fluid dynamics, can be challenging to understand through text alone. Interactive diagrams, process flowcharts, and simulations can help students visualize complex systems and better understand the theoretical concepts presented in papers.

- Supplementary Materials: Offering supplementary materials, such as textbook chapters, online modules, or podcasts, can provide additional context and explanation for the topics covered in the readings.

The integration of multimodal learning approaches helped students better grasp complex concepts and reinforced their reading comprehension. When students were exposed to videos or simulations before reading, they reported feeling more confident in understanding the texts and were able to follow along with the material more effectively.

DISCUSSION

The strategies presented in this article demonstrate that improving English reading skills for future chemical engineers requires a multifaceted approach. This approach includes several key components, such as vocabulary acquisition, active reading techniques, critical reading practices, and the incorporation of multimodal learning methods. Each of these elements plays a

crucial role in developing strong reading skills. When these strategies are effectively integrated into the curriculum, students are much better prepared to understand and engage with the complex scientific and technical texts they will regularly encounter throughout their academic and professional careers.

The application of these strategies within the field of chemical engineering education not only boosts students' reading comprehension but also equips them with the critical skills they need to navigate the professional challenges they will face as engineers. As students develop a deeper and more nuanced understanding of English-language scientific literature, these methods help foster a more robust academic foundation. This, in turn, supports the creation of well-rounded, highly skilled engineers who are competitive in the global job market. Such engineers will possess the ability to engage thoughtfully with the latest scientific research, collaborate with peers from diverse international backgrounds, and contribute to groundbreaking advancements within the chemical engineering field. Ultimately, by strengthening students' ability to read and comprehend complex texts, these strategies lay the groundwork for them to become leaders and innovators in the global engineering community.

CONCLUSION

Improving English reading skills is crucial for the academic and professional success of future chemical engineers. Through the strategic implementation of vocabulary-building exercises, active reading techniques, critical thinking strategies, and multimodal learning, educators can help students overcome the challenges of reading complex scientific texts. These methods not only enhance reading comprehension but also prepare students for effective communication and collaboration in the global chemical engineering community. By fostering these skills, we can ensure that future chemical engineers are well-equipped to engage with the vast body of knowledge that drives innovation in the field.

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