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Modern methodological requirements for developing the professional competence of chemistry students in English

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Abstract: This article is dedicated to teaching English specifically with effective methods to chemistry students. It focuses on teaching language skills that are useful for careers, methods for reading professional texts in English, and issues related to these topics.

Keywords: Teaching English as a Foreign Language in Chemistry, English for Specific Purposes (ESP), Professional Development, Teaching Reading of Professional and Field-Specific Authentic Texts in English.

Introduction: The Republic of Uzbekistan considers producing highly qualified specialists who meet global standards as a core aspect of its national policy (Mirziyoyev, 2017). Since the country gained independence, there has been an increasing focus on learning and teaching foreign languages. Teaching English has become important for preparing future professionals and is key to building graduates' overall cultural knowledge. Learning English is essential for professionals today, as it helps them connect with colleagues worldwide in their field. This enhancement in foreign language skills allows students to access to more information and helps them grow professionally, which raises the social status of the subject "Foreign Language."

The role of English in chemistry is essential, as it's the main language used for communication in the global scientific community. Proficiency in English allows chemistry students and professionals to access a large amount of scientific information, work with colleagues

worldwide, and share their research at conferences. Additionally, many top scientific journals publish only in English, making it vital for researchers to understand the language to keep up with new developments (Safonova, 1996).

Using effective teaching methods is key to helping chemistry students build the language skills they need for their careers. Traditional language classes often don't cover the specific vocabulary and communication skills needed in chemistry discipline. For this reason, focused, career-centered approaches like using authentic (real-world) materials, task-based learning, and group projects can help students learn the language more effectively (Isayeva, 2007). These methods not only improve students' English skills but also develop critical thinking, problem-solving, and communication skills, which prepare them for successful careers in chemistry and related fields (Komarova, 2015).

Literature Review

Using authentic English materials for building professional skills of chemistry students increases their motivation and the quality of knowledge acquisition (Buranov, 1979). More recent studies echo this finding, demonstrating that authentic materials help students contextualize language learning within their specific fields, supporting deeper engagement and practical application (Hyland, 2006; Hutchinson & Waters, 1987). Additionally, another literature emphasizes the effectiveness of discovery-oriented approaches in ESP, particularly for STEM students. Such methods foster independent thinking and the development of active language skills through context-based activities and authentic materials, which better prepare students for professional scenarios (Zhang & Smith, 2021).

English language instruction in this context enhances analytical and critical thinking skills, fosters learning engagement, and enables independent work both individually and in groups (Isaeva, 2007; Dearden, 2014). Studies show that career-oriented instruction supports the variability of educational approaches, strengthens interdisciplinary connections of theoretical and practical nature (Komarova, 2015), and promotes receptivity, productive speech, and creativity (Lyakhovitsky, 1973).

Li and Flowerdew (2020) highlight the significance of teaching English for Research Publication Purposes (ERPP), which not only helps students develop their writing skills but also prepares them for broader research dissemination. This training is essential for students in scientific fields who need to effectively communicate their findings, engage in scholarly discussions, and contribute to academic publications. For chemistry students, this means learning to navigate both specialized language and research presentation skills that are crucial for successful participation in global scientific exchanges. Armer (2011) highlights the value of ESP (English for Specific Purposes) resources, such as Cambridge English for Scientists, in equipping students with context-specific language skills necessary for academic and professional success. Similarly, frameworks proposed by Dudley-Evans and St. John (1998) underscore the importance of designing ESP curricula that integrate discipline-specific terminology and scenarios to foster effective, career-ready language proficiency.

Improving Speech Skills through Professional Skill Development

№	Type of Speech Activity	Program Requirements for Career-Oriented Speech Activities
1.	Speaking Skills	1. Participating in monologue statements, monologue reports, and monologue reflections in discussions about professional and specific educational materials perceived through viewing and reading. 2. Engaging in discussions based on professional educational materials that have been viewed and read. 3. Conducting dialogue exchanges and interviews in professional and specific communication while adhering to the

		norms of linguistic etiquette, starting, leading, and participating in conversations based on the information viewed and read. 4. Asking about, rephrasing, and reconstructing sentences related to professional and specific topics. 5. Preparing brief or detailed information based on the professional and specific information viewed and read. 6. Expressing one's viewpoint based on the information viewed and read about professional and specific topics.
2.	**Listening Comprehension Skills**	1. Listening to and understanding the main content of authentic texts on social-political, professional, and specific topics, utilizing subject-specific vocabulary related to the field of chemistry. 2. Understanding the main content of simple authentic texts on social-political, professional, and specific topics (news, stories). **3.** Understanding essential information required by using subject-specific vocabulary related to the field of chemistry found in authentic texts on social-political, professional, and specific topics.
3.	**Reading Skills**	1. Searching for information in accordance with the tasks set for authentic texts on professional and specific topics. 2. Understanding the main content and essence of simple social-political, popular scientific, and scientific texts, as well as blogs/web pages (advertisements, informational booklets, brochures/prospectuses). 3. Reading and understanding authentic texts on social-political and specific topics using professional vocabulary.

		4. Identifying essential information required from authentic texts on professional and specific topics that contain information and advertisements.
4.	**Writing Skills**	1. Completing authentic forms and templates related to professional and specific fields (questionnaires, visas, etc.). 2. Recording main opinions, reflections, and facts related to professional and specific topics (from video and text formats). 3. Writing a Curriculum Vitae/Resume and recommendation letters needed for job applications. 4. Performing written project tasks (preparing presentations, advertisements, informational booklets, posters, etc.) and drafting scientific articles on professional topics.

As the table shows, building speech skills by focusing on professional skills lays a strong foundation for students to work independently. Students become familiar with practical language forms and standards, noting key ideas and facts about the topics they study. Professional competencies build on their prior foundational knowledge of English, and they continue to grow based on competencies developed during earlier stages of education (Isaeva, O. N., 2007; Komarova, E. V., 2015; Lyakhovitskiy, M. V., 1973).

In line with evolving trends in English for Specific Purposes (ESP), this study aligns with Hyland's foundational concepts (2006) on genre-specific teaching, particularly the importance of using context-relevant materials in language instruction. Hyland's subsequent work (2016) enhances these earlier concepts by introducing expanded, practical applications such as collaborative learning and adaptive feedback mechanisms. This progression highlights the increasing emphasis on integrating interactive and career-oriented elements, supporting the current study's use of authentic materials to foster chemistry students' language and professional skills.

METHODOLOGY

This research uses a combination of methods to examine how English language instruction affects chemistry students' professional skills. Both qualitative and quantitative data were collected through surveys, observations, and assessments to measure students' language progress and engagement. Key approaches included real-world, career-focused language materials, interactive group activities, and the use of authentic chemistry resources. These methods were selected to help students improve their language abilities and understand chemistry content more effectively.

Target Group Description

The target group for this study is students of Fargona State University who are majoring in chemistry. They come from a variety of backgrounds and educational experiences, which creates a rich learning environment.

Location: Fargona, Uzbekistan.

Student Population: Approximately 100 students.

Foreign Languages Department: The department provides a comprehensive curriculum covering both the theoretical and practical aspects of English, with an increasing focus on meeting students' professional needs to build their competencies.

Demographics:

Age Range: The majority of students in this program are

typically between 18 and 25 years old.

Gender Distribution: The gender distribution is relatively balanced, with both male and female students studying chemistry.

Language Proficiency: Students come from diverse linguistic backgrounds, with varying levels of proficiency in English. Many have basic English skills, while a smaller group is at an intermediate level, highlighting the need for targeted teaching strategies to improve language skills (Tulanboyeva, 2023).

Cultural Context: Located in a region with a rich cultural heritage, the university's environment shapes students' views on education and professional growth. The integration of English language instruction within the chemistry curriculum not only meets the academic needs of the students but also prepares them for global scientific community.

This demographic profile highlights the need for effective teaching methods tailored to the unique backgrounds and needs of chemistry students, helping them build professional competencies in English.

Types of Authentic Texts and Resources Used in Teaching

In developing the professional competence of chemistry students through English language instruction, a variety of authentic texts and resources were used to improve learning outcomes. These resources are categorized as follows:

General Chemistry Textbooks: Standard textbooks, such as Chemistry: The Central Science, which offer foundational knowledge in chemistry and introduce essential concepts and terminology (Brown et al., 2018).

English for Specific Purposes (ESP) Textbooks: Textbooks like Cambridge English for Scientists by Tamzen Armer are specifically designed for students in scientific fields, focusing on language skills within a scientific context. This resource integrates language learning with scientific concepts, helping chemistry students develop the specific English skills needed for professional communication and comprehension (Armer, 2011).

Educational Websites: Platforms like Khan Academy and Coursera offer helpful resources for learning chemistry. Khan Academy has clear video lessons on basic topics such as atomic structure, chemical reactions, and thermodynamics, along with practice quizzes to check understanding. Coursera provides courses that cover areas like organic and inorganic chemistry and lab techniques. Both platforms let students study at their own speed, so they can review difficult topics as needed. This flexibility makes these resources useful for students who want to learn on their own or reinforce what they learn in class (Khan Academy, 2023; Coursera, 2023).

Videos and Documentaries: Resources like The Mystery of Matter and instructional videos on YouTube visually demonstrate complex chemical processes, making abstract concepts more accessible and understandable (PBS, 2015).

Lab Manuals: Authentic laboratory manuals were used to help students learn scientific terminology and procedures, preparing them to communicate effectively in a lab settings (Beran, 2018).

Integrating these authentic texts and resources into the curriculum helps students to develop both their professional competencies in chemistry and their English language skills. This comprehensive approach allowed students to engage deeply with the language and key concepts in their field.

Teaching Strategies

In teaching English within the context of chemistry, methods were designed to develop both language and professional skills, ensuring that students could apply these language skills directly in their field. Key strategies included:

Career-Oriented Language Learning

This approach focused on real-world applications by adapting language exercises and discussions to chemistry-specific situations. Students practiced presenting research, participating in simulated lab meetings, and discussing chemical processes in English. This method aimed to prepare students for future roles in academic and professional settings where English is essential for collaboration and information exchange (Brown, 2010).

Interactive and Collaborative Learning

Interactive techniques, such as small group discussions, role-plays, and peer feedback sessions, encouraged students to actively use English in realistic situations. Role-plays simulating lab settings or international conferences allowed students to apply both technical and language skills. (Adams & Newton, 2016). Moreover, collaborative projects fostered teamwork and communication abilities, which are essential for their future careers (Harmer, 2007).

Assessment Tools

To evaluate students' progress and understanding of both English and chemistry content, a combination of formative and summative assessments was used, supported by regular feedback mechanisms. The assessment tools included:

1. Regular Assessments

Weekly quizzes and short written assignments measured students' understanding of the material and highlighted areas for improvement. These assessments covered vocabulary, grammar, and comprehension within chemistry contexts. (Ellis, 2009). Summative assessments, such as end-of-unit exams, offered a cumulative measure of student progress (Lightbown & Spada, 2013).

2. Feedback Mechanisms

Regular constructive feedback was provided, focusing on both accuracy in language use and content comprehension. Peer reviews allowed students to evaluate each other's work critically, while instructor feedback highlighted strengths and areas needing improvement. This consistent feedback encouraged self-reflection and development. Studies indicate that consistent feedback sessions can enhance student performance by helping them recognize their progress in learning (Brown & Abeywickrama, 2010; Boud & Molloy, 2013).

RESULTS

The use of career-oriented language learning and interactive, collaborative methods led to positive outcomes in improving both English language proficiency and professional skills among chemistry students. Key findings include:

1. Improvements in Language Proficiency

Through regular practice in chemistry-related discussions, mock presentations, and focused vocabulary exercises, students demonstrated notable improvements in their language abilities. Data showed that 75% of students significantly progressed in understanding and using technical vocabulary. Additionally, students reported increased confidence in discussing chemistry topics in English, an essential skill for their academic and professional growth (Brown & Abeywickrama, 2010).

2. Increased Student Engagement

Observations showed that students became more active in English-language discussions as they felt more comfortable with using career-oriented language. The interactive approach resulted in high levels of student engagement. Course feedback showed that 80% of students found collaborative activities, such as role-plays and peer discussions engaging and meaningful. Students appreciated role-play scenarios set in lab environments, stating that these activities not only improved their language skills but also helped them see the relevance of English for their future careers (Adams & Newton, 2016).

3. Enhanced Understanding of Chemistry Concepts

By integrating English language learning with chemistry content, students demonstrated a deeper understanding of complex chemistry topics. Practical tasks such as analyzing research articles, participating in simulated lab discussions, and watching subject-specific documentaries allowed students to engage with challenging material in English. End-of-course assessments showed a 25% improvement in comprehension scores, indicating better understanding of topics like chemical processes and experimental procedures. This approach effectively supported students' growth in both academic English and core chemistry knowledge (Harmer, 2007; Ellis, 2009).

These results suggest that career-oriented and collaborative language-learning approaches can support chemistry students in developing both language and technical skills in English. Future studies could expand on these findings by exploring the long-term impact of these methods on students' professional performance.

DISCUSSIONS

The findings of this study highlight that using career-focused language exercises and authentic context-based activities significantly enhances chemistry students' English skills, particularly for professional purposes. Students showed increased confidence in discussing complex chemical concepts in English and higher engagement when learning was directly related to their field. These results are consistent with existing research in English for Specific Purposes (ESP), which suggests that contextualized language instruction is highly effective in simultaneously developing language and professional skills (Hyland, 2016; Dudley-Evans & St. John, 1998). The improvement in students' ability to discuss scientific concepts in English also suggests that authentic tasks and collaborative learning methods can lead to deeper subject-matter understanding, reinforcing the interdisciplinary benefits of ESP-focused language education.

The outcomes of this study suggest several practical applications for the curriculum development and teaching practices within ESP courses for chemistry students. First, combining subject-specific vocabulary and technical discussions into English classes can help students gain the language skills necessary for academic and professional communication in chemistry. Additionally, career-focused methods like lab meeting simulations and research presentations should be emphasized in the curriculum, as these prepare students to apply their knowledge in real-world situations. By centering instruction on the authentic language and scenarios that chemistry professionals experience, language programs can address students' career needs more effectively and provide a comprehensive educational experience.

Despite these promising results, this study had certain limitations. The sample size was relatively small and included participants from only one institution, which may limit the generalizability of the findings to other settings or disciplines. Additionally, reliance on self-reported data regarding students' engagement and understanding introduces potential subjectivity. Future research should include larger, more diverse samples and incorporate objective measures of engagement and proficiency, such as standardized tests or long-term tracking. Further investigation into the types of authentic materials that are most effective for chemistry students, as well as comparative studies across various STEM disciplines, would help clarify the unique language needs of each field.

CONCLUSION

The primary objective of teaching English to chemistry students is to provide the ability to read and understand materials in their field and communicate within the framework of oral and written topics outlined in the curriculum. Modern requirements for enhancing professional competence in chemistry students are grounded in innovative strategies, and English language learning is a multi-step educational process. Through mastering English, students not only gain insights into the culture, history, and traditions of the English-speaking world but also continue to develop their skills within their field of study.

In developing students' professional skills through English, careful selection of language material is essential, considering their school, college, or lyceum language background. English language material selection is a complex process due to the vast range of materials available and limited instructional hours dedicated to English in the field of chemistry. Therefore, only material relevant to future specialists' needs in their chosen profession should be taught. This approach enhances the effectiveness of language learning tailored to students' professional goals, enabling them to use English effectively within their field of study.

Integrating English language instruction into chemistry education is essential for developing students' professional competence in a globalized scientific community. As the language of science, English facilitates access to a vast array of research, collaboration opportunities, and professional discourse. Many scientific publications and conferences are conducted in English, equipping chemistry students with strong language skills is vital for their academic and professional success.

The integration of English language instruction within the chemistry curriculum promotes not only linguistic proficiency but also enhances students' ability to comprehend and communicate complex scientific concepts effectively. By engaging with authentic texts, such as scientific articles, laboratory manuals, and industry reports, students can learn to navigate the specific language and terminology pertinent to their field. This approach helps bridge the gap between theoretical knowledge and practical application, ensuring that students can confidently participate in discussions, write research papers, and present their findings in English.

In summary, the integration of English language instruction in chemistry education is critical for developing professional competence. It empowers students to engage with the global scientific community, enhances their employability, and ensures they can effectively share their contributions to the field of chemistry.

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