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TEACHING CHEMISTRY IN ENGLISH IN TURKISH UNIVERSITIES: CHALLENGES AND OBSTACLES

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Abstract. *No matter if they are in high school or college, Turkish students have particular challenges when trying to understand chemistry lectures delivered in English. The purpose of this study is to evaluate the difficulties Turkish students have when studying chemistry in English. A survey was administered to Turkish students at a Turkish University, nutrition and dietetics major in order to obtain relevant information. The results showed that 24.6% of students have difficulties learning chemistry in English, and 52.3% of the students are reluctant to give presentations in the chemistry class due to their lack of confidence in the English language. The results showed that the areas of weakness in the English language were conversational skills (78.5%), grammar (75.4%), vocabulary (75.4%), listening (72.2%), and reading (38.5%). Therefore, a considerable percentage of these students (48.6%) take their lecture notes in Turkish, and an overwhelming majority of them (46.2%) think that adding English terminology to textbooks alongside Turkish would help the problem. According to the research, it is possible to increase students' English skills and therefore their understanding of chemistry by employing various teaching strategies. To address communication hurdles in chemistry classes, the study heavily draws on both the Communicative and Natural Approaches.*

Keywords: *Chemistry; learning difficulties; university; English; Türkiye.*

1. INTRODUCTION

Most countries take pride in their native languages, employing them as the primary medium of instruction at all educational levels, including universities. However, certain

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universities in these countries offer scientific programs in English and the national language, granting students the flexibility to choose their preferred language. It is well known that various branches of chemistry are taught across multiple disciplines. When studying chemistry in English, many students, whether at the high school or university level, encounter difficulties with the English language. The student's academic performance in chemistry is affected by the student's level of English language proficiency and the characteristics of chemistry as a scientific field. Students' underperformance in science-related departments at the university level is frequently impacted by the challenges connected with understanding and grasping basic and advanced chemical concepts (Carter & Brickhouse, 1989; Sirhan, 2007). Students occasionally run into problems that have multiple causes that add up over time and can be connected to a lack of appropriate comprehension of fundamental chemistry topics. This frequently happens, especially when students start their undergraduate studies (Osman & Sukor, 2013). Due to a lack of comprehension or a poor grasp of the aforementioned fundamental concepts, a student in this position has difficulty learning advanced chemistry topics (Carter & Brickhouse, 1989). The use of traditional teaching techniques during classroom instruction and the absence of interactive and engaging learning experiences that foster creativity and active student participation are additional factors that contribute to students' low academic performance in chemistry, which results in their disinterest (Sirhan, 2007). Undoubtedly, engaging students' attention, keeping their attention, and fostering interest and passion depend heavily on how academic knowledge is presented. When students are initially introduced to fundamental chemistry ideas, the teachers' insufficient competency and lack of experience in the pre-university phases might also be attributed to other contributing variables (Carter & Brickhouse, 1989; Gabel, 1999). Thus, it is possible to summarize the factors that may contribute to poor academic performance in chemistry as follows: English language competency, the learning environment, the course material, the students themselves, and finally, the teacher's role (Nja et al., 2022; Woldeamanuel et al., 2014).

Millar has divided the issues students face in studying chemistry into two categories: intrinsic, or related to perception or the educational process itself (Millar, 1991; O'Dwyer & Childs, 2017). Numerous investigations have been made into the causes of the difficulties encountered in chemistry education, both in schools and at the university level. These studies have focused on fundamental ideas in key areas such as atoms and molecules, chemical reactions, chemical equilibrium, models and representations of chemical processes, acids and bases, solutions, combustion, electrochemistry, entropy, nuclear chemistry, and the idea of moles (Bennett & Sözbilir, 2007; Graham, 1983; Schurmeier et al., 2011; Sirhan, 2007; Tekin & Nakiboglu, 2006; Uchegbu et al., 2016).

The discrepancy between the language of instruction used during students' school years and at the university level contributes significantly to their sense of disconnection and difficulties in understanding chemistry. Many colleges offer English-taught chemistry and scientific programs, particularly in countries where English is not the primary language. As students move from studying in their native language to being taught in English at the university level, the language barrier may challenge them (Brown et al., 2003; Mann, 2001).

From the pre-university level through undergraduate, graduate, and postgraduate degrees in Turkey, scientific subjects, including chemistry, are frequently taught in Turkish. Nevertheless, some public and private universities give their students the choice of pursuing their degrees in Turkish or English. Students typically need to pass an English proficiency test to study English. Several scientific courses, including but not limited to colleges of science, medicine, veterinary medicine, physiotherapy, biomedical sciences, pharmacy, nutrition, and several engineering professions, require general chemistry as an introductory course (YÖK, 2020).

Turkish and English names for chemical words and concepts differ noticeably. It could be difficult for students who are used to the Turkish language of instruction to learn the English names of scientific elements and compounds. Due to the language barrier, students must make extra effort to learn and recall these terms, concepts, and labels in English. If students already have trouble understanding chemistry, the language barrier worsens their problems (Bennett & Sözbilir, 2007).

This study aims to identify the difficulties that students have understanding chemistry classes in universities, generally and specifically in English language proficiency. Finding the fundamental causes of these problems is the goal. The study also suggests overcoming these learning difficulties by utilizing various instructional strategies.

2. METHODS

Research context

This study focuses on analyzing the difficulties that students have in learning chemistry because of their insufficient English language proficiency. To investigate this further, a 34-question questionnaire was designed and divided into three parts. The first part collected general information about the students, the second part addressed the difficulties faced during their school studies, and the third part covered the challenges experienced at the university level. Additionally, students' experiential observations were also considered to gain insight into the reasons behind these difficulties.

Population and sample

Using the Google Forms platform, two versions of the questionnaire were created: one in Turkish and the other in English language. Students were then given access to the survey link via their university email, giving them the freedom to reply in any language they wished. The survey was specifically given to students enrolled in general chemistry classes in the Department of Nutrition and Dietetics at the College of Health Sciences, Istanbul Gelisim University. Due to the university policy of enabling students to retake classes in which they obtained worse grades, the majority of participants were first- and second-year students, with a lesser number of seniors. The majority of the department's students are female, and there are only a few male students.

Data analysis

After compiling the student replies, the questions were grouped according to their types, and numerical values were given to the available choices for easy analysis. The

software SPSS Version 25 was then used to evaluate the collected data. To draw meaningful conclusions, frequency analysis, percentage analysis, and descriptive statistics were employed.

3. RESULTS

The purpose of this study is to look into the difficulties faced by Turkish-speaking undergraduate students who are learning chemistry in English language. Tables 1 to 4 display the responses that the participants submitted. The research subjects comprised a sample of 65 students from Istanbul Gelisim University's Nutrition and Dietetics Department, within the Faculty of Health Sciences. Among these participants, 4.6% were male, and 95.4% were female. The majority of students (43.1%) were in their first or second year of study. Table 1 shows that a significant majority of students (87.7%) learned chemistry in Turkish during their school years, while only a small proportion (12.3%) learned it in English language. In addition, the results in Table 1 show that the percentage of students who attended public schools (50.8%) is greater than that of students who went to private schools (49.2%). It is crucial to remember that this distribution is not a true representation of Turkey's entire educational system, since public schools are often the preferred choice for most Turkish students (91.2%) (Hurriyet, 2020). The high percentage of Turkish students who studied in private schools at Istanbul Gelisim University may be attributed to its private institution. Students must take a language assessment test to determine their English language proficiency in order to be admitted to a university. Those who pass the exam are qualified to apply to the university and start their studies there. Students who don't achieve the necessary level of language proficiency are nonetheless enrolled in a compulsory English language course and offered the chance to repeat the exam later.

The results show that the majority of students started studying English at an early age, however, only a small proportion (10.8%) starting in kindergarten as shown in Table 1. The majority of students (38.5%) began learning English during elementary school, followed by the preparatory school (27.7%), high school (16.9%), and a few at the university level (6.2%). Even though English is a required subject in public schools, students don't show a lot of interest in it. As a result, due to a lack of interest, students' understanding of English tends to be superficial when they graduate from high school. In public schools, English education normally starts in the second grade of elementary school, but the grade earned in English is not considered (Kirkgöz, 2007, 2014).

Table 1. General characteristics of the participants in this study (n = 65).

Q	Questions		Frequency	Percent
1	Gender	Male	3	4.6%
		Female	62	95.4%
2	Academic Year	First	28	43.1%
		Second	26	40.0%
		Third	6	9.2%
		Fourth	5	7.7%
3	Nationality	Turkish	65	100%
		Non-Turkish	0	0%

4	School Type	Public	33	50.8%
		Private	32	49.2%
5	Language of Instruction	Turkish	57	87.7%
		English	8	12.3%
		Other	0	0%
6	When did you start your study of the English language?	Pre-school	7	10.8%
		Elementary school	25	38.5%
		Preparatory school	18	27.7%
		High school	11	16.9%
		University	4	6.2%

When students were asked about their areas of weakness in the English language, the results showed that conversation skills (78.5%), grammar (75.4%), vocabulary (75.4%), listening (72.2%), and reading (38.5%) were the most often reported problems as shown in Table 2. The students' capacity to learn chemistry in English is thus impacted by these linguistic deficiencies. For instance, a student who has trouble hearing will also have trouble understanding lectures of chemistry, and the same is true for other language abilities.

Table 2. Students' responses on very difficult/none questions (n=65).

Q	Very Difficult n (%)	Difficult n (%)	Moderate n (%)	Little n (%)	None Difficult n (%)	Mean	SD
7	How hard is it for you to express yourself in words?						
	0 (0.0)	6 (9.2)	43 (66.2)	14 (21.5)	2 (3.1)	3.18	0.63
8	What is the level of your grammar difficulty?						
	4 (6.2)	13 (20.0)	32 (49.2)	10 (15.4)	6 (9.2)	3.02	0.98
9	Identify your level of conversational difficulty?						
	7 (10.8)	14 (21.5)	30 (46.2)	11 (16.9)	3 (4.6)	2.83	0.99
10	What is the level of your listening difficulty?						
	1 (1.5)	11 (16.9)	35 (53.8)	10 (15.4)	8 (12.3)	3.20	0.91
11	What level of reading difficulty do you have?						
	0 (0.0)	4 (6.2)	21 (32.3)	21 (32.3)	19 (29.2)	3.85	0.92

Response scale: 1 = Very Difficult; 2 = Difficult; 3 = Moderate; 4 = Little; and 5 = Non-Difficult.

The findings (Table 3) also show that most of students (72.3%) had no trouble comprehending chemistry when it was spoken in Turkish at high school. However, when they switched to studying chemistry in English at the university level, this number considerably declined to 50.8%. Consequently, numerous students encounter challenges comprehending chemistry even when it is taught in their native language (Erman, 2017). As a result, it becomes essential to adopt alternative teaching methods that deviate from the traditional approach, aiming to enhance student engagement and promote better understanding capabilities.

Effective teaching strategies encourage students' interest, zeal, and thirst for information while also promoting their active engagement and dialogue with the instructor.

These techniques support the achievement of curriculum goals and complement students' cognitive processes by taking into account the particular qualities and skills of each individual student (Petrina, 2006; Westwood, 2008; Wilson et al., 2015). Depending on the type of topic they are teaching, teachers must carefully choose their instructional strategies. It is vital to recognize that some topics are primarily theoretical in nature while others are more scientific or experimental. When study materials strongly concentrate rich theoretical content with the only goal of imparting knowledge to the students, problems can occur (Balan & Metcalfe, 2012). It is crucial to recognize that traditional education advocates think only such techniques can properly convey any subject matter. On the other hand, some support the employment of a range of teaching techniques, appreciating their value in raising student motivation, igniting their interest, and fostering a good learning atmosphere in which students actively participate in lessons.

Teachers should choose a teaching strategy that complements the particular subject they are covering. Some instructional strategies, including problem-solving techniques, significantly rely on student involvement and engagement. On the other hand, other teaching strategies heavily focus on the teacher's function, including frontal teaching, in which the instructor primarily stands at the front of the classroom while imparting knowledge to the students and supervising their actions (Balan & Metcalfe, 2012). Additionally, there is a lively exchange of ideas between the instructor and students that is characterized by conversation. The teacher can also start conversations among the students while always occupying the center and directing the conversation. The dialogue and discussion technique is a teaching strategy that involves both the teacher and the student in diverse activities despite the teacher spending a large percentage of the teaching talking time (TTT) (Alozie & Mitchell, 2014). There are instructional approaches that put an emphasis on individualized learning, such as computer-based learning or programmed teaching. Additionally, there are group activities used in collective teaching techniques such presentations, discussions, projects, problem-solving, and thematic units (Petrina, 2006; Westwood, 2008).

Table 3. Students' responses on agree/disagree questions (n=65).

Q	Strongly disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly agree n (%)	Mean	SD
12	Did you have any trouble understanding chemistry during your time in high school?						
	18 (27.7)	29 (44.6)	11 (16.9)	5 (7.7)	2 (3.1)	2.14	1.01
13	Did you have difficulties understanding chemistry when it was written in English?						
	10 (15.4)	23 (35.4)	16 (24.6)	13 (20.0)	3 (4.6)	2.63	1.10
14	Did you find it challenging to follow and comprehend an English-language chemistry lecture?						
	8 (12.3)	23 (35.4)	10 (15.4)	21 (32.3)	3 (4.6)	2.82	1.15
15	During chemistry class, did you find it difficult to write notes in English?						
	4 (6.2)	18 (27.7)	12 (18.5)	20 (30.8)	11 (16.9)	3.25	1.20
16	Do you have trouble understanding English-language chemistry terms and concepts?						
	8 (12.3)	16 (24.6)	12 (18.5)	27 (41.5)	2 (3.1)	2.98	1.13

17	Do you find it difficult to write the English names of chemical elements and compounds?						
	6 (9.2)	13 (20.0)	26 (40.0)	16 (24.6)	4 (6.2)	2.98	1.03
18	Do you find it difficult to compute chemical equations in English?						
	10 (15.4)	29 (44.6)	10 (15.4)	12 (18.5)	4 (6.2)	2.55	1.14
19	Because of your limited English skills, are you reluctant to participate in class discussions?						
	4 (6.2)	13 (20.0)	18 (27.7)	7 (10.8)	23 (35.4)	3.49	1.31
20	Would it be difficult for you to do a chemical presentation if you had to do so in English?						
	2 (3.1)	15 (23.1)	14 (21.5)	15 (23.1)	19 (29.2)	3.52	1.22
21	Do you refrain from actively participating in class discussions for any other reasons outside language barriers, such, say, shyness?						
	10 (15.4)	39 (60.0)	1 (1.5)	10 (15.4)	5 (7.7)	2.28	0.95
22	Do you hold the teacher responsible for your difficulty in comprehending chemistry in English?						
	43 (66.2)	19 (29.2)	3 (4.6)	0 (0.0)	0 (0.0)	1.38	0.57
23	Do you feel happy with your decision to attend an English-speaking university?						
	2 (3.1)	2 (3.1)	24 (36.9)	22 (33.8)	15 (23.1)	3.71	0.96
24	Do you believe Turkish would be a better language to study chemistry in?						
	6 (9.2)	8 (12.3)	11 (16.9)	16 (24.6)	24 (36.9)	3.68	1.33
25	Do you believe that teaching tools make it easier for you to comprehend chemistry in English?						
	0 (0.0)	5 (7.7)	30 (46.2)	27 (41.5)	3 (4.6)	3.43	0.70
26	Do you believe your grasp of chemistry in English at the university would have improved if chemical words were written in English alongside Turkish at the school?						
	14 (21.5)	5 (7.7)	16 (24.6)	28 (43.1)	2 (3.1)	2.28	0.98
27	Do you find chemistry textbooks to be boring?						
	28 (43.1)	30 (46.2)	5 (7.7)	2 (3.1)	0 (0.0)	1.71	0.74
28	Do you believe that you have anxiety about making mistakes and the fear of losing face?						
	8 (12.3)	19 (29.2)	13 (20.0)	21 (32.3)	4 (6.2)	2.91	1.16
29	Do you think you lack the motivation to learn English?						
	1 (1.5)	13 (20.0)	13 (20.0)	13 (20.0)	25 (38.5)	2.45	1.07
30	Do you believe that efforts should be made to enhance oral communication skills?						
	2 (3.1)	0 (0.0)	4 (6.2)	31 (47.7)	28 (43.1)	4.28	0.83
31	Do you believe that the classroom curriculum needs to include more communicative activities?						
	2 (3.1)	2 (3.1)	30 (46.2)	25 (38.5)	6 (9.2)	3.48	0.82
32	Do you believe that practicing your English speaking is necessary in a laid-back classroom environment?						
	0 (0.0)	1 (1.5)	2 (3.1)	39 (60.0)	23 (35.4)	4.29	0.60

Response scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; and 5 = Strongly Agree.

The results show that many students have trouble understanding lecture content that is provided in English, which helps to pinpoint the causes of the difficulties associated with learning chemistry in English. As a result, the proportion of students who find it difficult to take notes in English during the lecture equals to 47.7% as shown in Table 3. Therefore,

63.1% of students used to take notes in Turkish instead while 15.4% of the students sometimes do it as shown in Table 4. The cause might be a lack of confidence in their writing abilities and apprehension about keeping up with the teacher during note-taking in English. As a result, individuals turn to using their mother tongue to take notes. Moreover, a large percentage of students (69.2%) resort to Turkish references to grasp challenging topics instead of relying on English-written references as shown in Table 4.

Table 4. Students' responses on very always/never questions (n=65).

Q	Always n (%)	Usually n (%)	Sometimes n (%)	Rarely n (%)	Never n (%)	Mean	SD
33	Do you take notes in your native language throughout the lecture?						
	15 (23.1)	26 (40.0)	10 (15.4)	9 (13.8)	5 (7.7)	2.43	1.2
34	Do you use materials in your native language to grasp things that are difficult for you to understand?						
	22 (33.8)	23 (35.4)	18 (27.7)	2 (3.1)	0 (0.0)	2.0	0.86

Response scale: 1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Usually; and 5 = Always.

In addition, the survey was conducted among students to inquire about the challenges they face in understanding chemical concepts when they are taught in English. The findings (Table 3) show that more than half of the students (44.6%) had difficulty understanding chemical concepts and terms. The majority of students (46.2%) suggested that the situation may be improved by adding English translations alongside Turkish in textbooks for these terms and concepts. Similar to this, almost one third of the students (30.8%) had trouble writing chemical formulas for elements and compounds. Even though the English and Turkish languages share similarities in certain element and compound names, a considerable number of students encounter difficulties when writing element symbols and chemical formulas. This is a common issue among chemistry students, likely stemming from the lack of gradual progression in the curriculum for this topic throughout the academic years. The problem seems to be exacerbated by focusing on it during one year only, without any reinforcement or repetition in subsequent years (Kirkgöz, 2007). Additionally, (24.7%) of students struggle with chemical calculations, presumably because the quantitative portions of chemistry don't require as much English. Despite these challenges, a substantial number of students (89.3%) do not agree that chemistry materials are boring overall. Furthermore, the majority of students (95.4%) do not attribute the issues to their subject teacher as shown in Table 3, indicating that their English language proficiency is the main cause of the problem.

The study found a link between students' participation in lectures and their overall proficiency in the English language. The findings showed that almost half of the students (46.3%) refrained from actively participating in lectures because of the difficulty of speaking English. When requested to deliver a chemistry presentation in English, a significant proportion of students (52.3%) expressed hesitancy. The students were especially questioned to find out if there were any additional explanations for their lack of participation, such as shyness. It was discovered that the main cause of the students' unwillingness to engage was, in fact, their poor background of the English language, as

reported by 54.4% of the students. In addition, a sizable portion of students (23.1%) said they felt humiliated and uncomfortable because they were afraid of making mistakes when speaking English as shown in Table 3. As a result, it is essential to concentrate on enhancing student engagement in the classroom by employing methods that alleviate their anxiety and also enhance their language and communication abilities (Alcott, 2017).

The communication approach, which is based on the idea of communication proficiency, emphasizes language training that centers on group participation and interactions in the classroom. Studies have shown that people who converse with others about their current activities successfully complete complex cognitive tasks. Peer and group interactions, according to several studies in the field of English as a foreign language (EFL), encourage problem-solving situations in the classroom since they are anxiety-free and help students learn more effectively. In conclusion, communicative assignments give students a chance to engage in meaningful exchanges, which improves the learning environment (Bialystok, 1994; Krashen & Brown, 2007; Simonsmeier, Peiffer, Flaig, & Schneider, 2020).

The results show that a majority of students (56.9%) report satisfaction with their decision to pursue further education in English, despite the difficulties associated with learning chemistry in English as shown in Table 3. This may be due to the idea that learning English opens up more employment options and increases the variety of educational materials available to students. However, unless the learner has a high level of English proficiency, focusing only in Turkish restricts access to resources that are only available in Turkish. Encouraging student participation through the use of various and electronic instructional techniques can help students improve their English language proficiency.

Despite the difficulty of learning English, students have an interest in its learning. However, an overwhelming majority of students (89.8%) suggested that greater emphasis should be given to improving their verbal communication skills. The majority of students (58.5%) also think that more activities are required to promote active engagement in class. The majority of students (95.4%) also understand the value of the lecture environment, especially the value of a quiet environment that promotes good listening conditions as shown in Table 3. Students that have difficulty listening will particularly benefit from this.

4. DISCUSSION AND RECOMMENDATIONS

The findings show how students' levels of knowledge and understanding of chemistry are influenced by their level of English language competence. It's crucial to keep in mind, nevertheless, that knowing English well is not enough to fully comprehend the topic. The abstract nature of numerous chemistry concepts poses additional challenges for students and contributes to their learning difficulty. The study makes several recommendations, including the use of various teaching approaches, in order to improve students' knowledge and understanding levels.

It is crucial to underline that teachers spend a lot less time talking (TTT) than is allotted for students to participate in discussions (STT) (Alozie & Mitchell, 2014; Haliti, 2019). In addition, it's critical to emphasize the teacher's crucial facilitation function. The facilitator's job is to coordinate materials to encourage communication in the classroom, either between the students themselves or between the students and the assignments

they are working on. This function also includes the teacher's duties as an assessor, who evaluates the students' performance. While the instructor actively engages in classroom interactions, he or she must also keep a certain amount of distance in order to successfully supervise the interactions taking place. The teacher takes on the role of a mentor and guide, helping students to complete assignments without offering them pre-made solutions in order to promote autonomous thought (Cardenas, 2013; Dirrigl & Noe, 2014; Haliti, 2019). It is essential for teachers to create a welcoming and encouraging classroom atmosphere that inspires students and boosts their self-confidence. Creating a good rapport with students puts them at ease and encourages relaxation (Sun, Shek, & Siu, 2008). As was already established, the main goal of the communicative approach is to give students the skills necessary to communicate effectively in a foreign language. To achieve this goal, new teaching and learning strategies that go beyond the conventional teacher-centered approach are required. These strategies must also address communication problems pertinent to students' requirements. Through a variety of activities, interactions in the classroom are transformed into social routines that are largely centered on student communication duties.

The following recommendations may help students who are having trouble learning chemistry in English. The university has a crucial responsibility to carefully choose students with strong English language skills, as this significantly impacts their academic success and excellence. Being lenient in the selection process can lead to difficulties for both the students and teachers, potentially resulting in graduates with inadequate language proficiency that may adversely affect their job prospects and the university's reputation. The incorporation of questions from various scientific fields in the English language competency test aims to encourage students to familiarize themselves with scientific terminology before commencing their university studies. Integration of a particular course focused on teaching scientific terminology and concepts that is adapted to each student's chosen area of study at the university into the English language exam preparation program. Students can improve their scientific vocabulary and comprehension prior to starting their university studies by putting these ideas into practice.

In science departments, it is possible to introduce a mandatory English course with a tailored curriculum based on the students' specializations. This would emphasize scientific terminology relevant to their field of study and foster the development of their overall language skills. Additionally, it is advised to adopt the reciprocal teaching approach to actively include students in class discussions. Minimizing direct questioning of students should be encouraged, and instead, fostering an interactive environment where everyone participates is preferable. Teachers are advised to enhance students' language proficiency comprehensively, encompassing reading, listening, speaking, and writing skills. One effective method could be assigning additional tasks like writing short reports, which can significantly aid in the development of their writing abilities.

Students can exchange experiences and develop their language skills by joining English language clubs at the university, and in particular by starting a departmental club that is run by the students themselves. Competent educational authorities are advised to incorporate English translations of scientific terms into local language scientific books. We believe that many students struggle with forgetting chemical element symbols and writing

chemical formulas primarily because this subject is concentrated in one academic year. To alleviate this issue, these topics should be revisited in multiple academic years, enabling students to better memorize and comprehend them.

5. CONCLUSIONS

Undoubtedly, chemistry is one of the most difficult disciplines for students to learn. Since the materials' complexity increases, students frequently experience even greater challenges when making the transfer to the university level. Some Turkish universities offer chemistry programs taught in English, which adds to the learning difficulties for students. This study aims to assess the challenges faced by students navigating the complexities of learning chemistry in a non-native language.

The results showed a strong correlation between students' English language skills and their degree of chemical comprehension and understanding. On the other hand, the students' poor command of the English language had a negative effect on their level of understanding and active engagement in class discussions. The reluctance of almost half of students to participate in chemistry lectures underscores the tangible barriers imposed by language constraints.

The significance of our findings extends beyond the immediate challenges faced by students in English-taught chemistry programs. It serves as a clarion call for educators, researchers, and policymakers to recognize the pivotal role of language proficiency in shaping students' academic experiences. The study underscores the urgent need for a paradigm shift in instructional methodologies, emphasizing the inseparable link between language and scientific education.

The study suggests using a variety of instructional strategies and implementing the Communicative and Natural Approach to solve communication issues in chemistry classes in light of these findings. The Communicative and Natural Approach is rooted in the idea that language learning should be focused on communication and the use of language in real-life situations. Instead of presenting vocabulary items in isolation, they should be integrated into meaningful contexts by using scenarios and examples related to real-world applications of chemistry. Encouraging students to discuss and explain concepts using the newly learned vocabulary fosters communication skills and helps in retaining the terminology. When students are incited to analyze and discuss lecture materials, that promotes language use in meaningful contexts and mirrors the natural language acquisition process. The study claims that implementing group activities, discussions, and projects where students work together and communicate with their peers in the target language to share ideas, discuss findings, and collaborate on solutions enhances both language and scientific communication skills. By combining these instructional strategies with the Communicative and Natural Approach, students experience a classroom environment where language and chemistry knowledge are interconnected, and that consolidates fostering a deeper understanding of both.

This study not only sheds light on the nuanced challenges posed by language barriers in chemistry education but also advocates for transformative measures. Further research is still required toward a future of innovative instructional approaches, and further exploration of strategies that transcend linguistic barriers and optimize the learning experience in chemistry classrooms.

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