Ministry of Education and Science of the Republic of Kazakhstan
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Application of CLIL teaching methods in chemistry lessons

MASTER'S DEGREE DISSERTATION

7M01502 – Chemistry

Kaskelen, 2025

Faculty of Education and Humanities
Department of Pedagogy of Natural Sciences

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ABSTRACT

This dissertation explores the use of the CLIL (Content and Language Integrated Learning) method in chemistry classes, focusing on its impact on students` academic performance and teachers` perceptions of its implementation in the classroom. The main research question of this study is: "how does the use of CLIL methods affect students` performance in chemistry and how do teachers perceive their use in the classroom?" approach was used to use mixed methods that combined quality interviews with seven teachers with CLIL experience and quantitative data from pre-and post-test tests conducted on experimental and control groups in three different schools. Data sources included academic databases such as Scopus, Research Gate, and Google Scholar.

The results show that the effectiveness of CLIL varies depending on the educational context, student motivation, and pre-impact on CLIL. In school 1, where CLIL was newly introduced and motivation was high due to the preparation for the national test, students showed a significant improvement in post-test scores. School 2 (IB school) has shown moderate but statistically significant advances, indicating that CLIL can improve understanding of the subject even when the knowledge of the content is initially low. On the contrary, the 3rd school (Lyceum) showed the least improvement, which is probably due to the high base performance and previous experience of CLIL. However, achievements in all schools were statistically significant, confirming the overall positive impact of CLIL on students ` achievements in chemistry. The study concludes that while CLIL can be a powerful learning approach, its effectiveness depends on the specific learning environment and student background.

Key words: *CLIL method, content and language integrated learning, glossary, working with English text, chemistry teaching.*

АҢДАТПА

Бұл диссертация химия сабақтарында CLIL (Content and Language Integrated Learning) әдісін қолдануды зерттейді, оның оқушылардың үлгеріміне әсеріне және мұғалімдердің оны сыныпта қолдану туралы түсінігіне ерекше назар аударады. Бұл зерттеудің негізгі зерттеу сұрағы: "CLIL әдістерін қолдану оқушылардың химиядағы үлгеріміне қалай әсер етеді және мұғалімдер оларды сыныпта қалай қолданады?"CLIL тәжірибесі бар жеті мұғаліммен сапалы сұхбаттарды және тестілеуге дейін және одан кейін алынған сандық деректерді біріктіретін аралас әдістерді қолдану тәсілі қолданылды. тесттен кейінгі сынақтар үш түрлі мектепте эксперименттік және бақылау топтарында өткізілді. Деректер көздері Scopus, Research Gate және Google Scholar сияқты академиялық мәліметтер базасы болды.

Нәтижелер CLIL тиімділігі білім беру контекстіне, оқушылардың мотивациясына және CLIL-ге алдын ала әсер етуіне байланысты өзгеретінін көрсетеді. Жақында CLIL енгізілген және ұлттық тестілеуге дайындыққа байланысты мотивация жоғары болған № 1 мектепте оқушылар тестілеуден кейін айтарлықтай жақсарғанын көрсетті. 2-мектеп (IB мектебі) орташа, бірақ статистикалық маңызды жетістіктерді көрсетті, бұл CLIL мазмұны туралы білім бастапқыда аз болса да, тақырыпты түсінуді жақсарта алатынын көрсетеді. Керісінше, 3-ші мектеп (лицей) ең аз жақсартуды көрсетті, бұл жоғары базалық көрсеткіштерге және CLIL-дің бұрынғы тәжірибесіне байланысты болуы мүмкін. Алайда, барлық мектептердегі жетістіктер статистикалық тұрғыдан маңызды болды, бұл CLIL-дің оқушылардың химиядағы жетістіктеріне жалпы оң әсерін растайды. Зерттеу CLIL оқытудың тиімді әдісі бола алатынына қарамастан, оның тиімділігі оқушының нақты оқу ортасы мен біліміне байланысты деген қорытындыға келеді.

Түйін сөздер: *CLIL әдісі, мазмұны және тілдік интеграцияланған оқыту, глоссарий, ағылшын тіліндегі мәтінмен жұмыс, химияны оқыту.*

АННОТАЦИЯ

В этой диссертации исследуется использование метода CLIL (Content and Language Integrated Learning) на уроках химии, особое внимание уделяется его влиянию на успеваемость учащихся и восприятие преподавателями его применения в классе. Основной исследовательский вопрос этого исследования заключается в следующем: "Как использование методов CLIL влияет на успеваемость учащихся по химии и как учителя воспринимают их использование в классе?" Был использован подход к использованию смешанных методов, который сочетал качественные интервью с семью учителями, имеющими опыт работы с CLIL, и количественные данные, полученные до и после проведения тестирования. послетестовые тесты проводились в экспериментальной и контрольной группах в трех разных школах. Источниками данных были академические базы данных, такие как Scopus, Research Gate и Google Scholar.

Результаты показывают, что эффективность CLIL варьируется в зависимости от образовательного контекста, мотивации учащихся и предварительного воздействия на CLIL. В школе № 1, где CLIL был введен недавно и мотивация была высокой из-за подготовки к национальному тестированию, учащиеся показали значительное улучшение результатов после тестирования. Школа 2 (IB school) продемонстрировала умеренные, но статистически значимые успехи, что указывает на то, что CLIL может улучшить понимание предмета, даже если знания о содержании изначально невелики. Напротив, 3-я школа (лицей) продемонстрировала наименьшее улучшение, что, вероятно, связано с высокими базовыми показателями и предыдущим опытом CLIL. Однако достижения во всех школах были статистически значимыми, что подтверждает общее положительное влияние CLIL на успеваемость учащихся по химии. В исследовании делается вывод о том, что, хотя CLIL может быть эффективным методом обучения, его эффективность зависит от конкретной учебной среды и образования студентов.

Ключевые слова: *метод CLIL, интегрированное обучение содержанию и языку, глоссарий, работа с английским текстом, преподавание химии.*

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LIST OF ABBREVIATIONS

CLIL – Content and Language Integrated Learning
4C – Content, Communication, Cognition, Culture
ANCOVA – Analysis of covariance
CBI – Content-Based Instruction
DLEX – advancement of teaching foreign languages
EFL – English as a Foreign Language
EHEA – European Higher Education Area
FL – foreign language
FLT – Foreign Language Teaching
IB – International Baccalaureate
IBSE – Inquiry-Based Science Education
ICT – Information and Communication Technologies
L – Lyceum
OQPT – Oxford Quick Placement Test
PAR – Participatory action research
STEM – Science, Technology, Engineering, and Mathematics

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INTRODUCTION

Content and Language Integrated Learning (CLIL) is an educational approach that combines the teaching of subject content with the learning of a foreign language. Originally developed in Europe to promote multilingualism and interdisciplinary skills, CLIL is gaining increasing attention in science education, especially in subjects such as chemistry that benefit from contextualized learning and visual representation. In the constantly developing education system, innovative approaches to improving the learning experience of students are constantly being sought. Integrated content and language learning (CLIL) is one of the pedagogical approaches used in a wide variety of disciplines, including the teaching of Natural Sciences. Coyle, Hood and Marsh (2010) have presented CLIL as a dual - focused educational approach in which an additional language is used for learning and teaching of both content and language. That is, in the teaching and learning process, there is a focus not only on content, and not only on language. Each is interwoven, even if the emphasis is greater on one or the other at a given time.

CLIL refers to various teaching methods and programs that integrate language and skills, often based on reading or listening texts. These methods aim to teach subject content through one or more additional languages, such as bilingual programs, content-based instruction, foreign languages across the curriculum, dual language programs, immersion programs, plurilingual programs, and modular CLIL. CLIL teachers should have a good command of the foreign language, knowledge of the first language of learners, expertise in the content area, and a deep understanding of the cognitive, sociocultural, and psychological elements of foreign language learning. CLIL is a learning system that allows students to acquire subject-specific knowledge, developing both content and language skills. This methodology has been widely used in hanging education in various subjects.

The 4C Framework, developed by Coyle, is a widely used model in Europe and Germany for planning CLIL lessons. It outlines four competences: Content, Cognition, Communication, and Culture. Content focuses on conveying subject-specific knowledge and methods, while Cognition focuses on autonomous problem-solving and evaluation of results. Communication is crucial in foreign language learning, with special attention paid to communication within the group. Culture aims to appreciate and appreciate other cultures. Other models and methods connected to the 4C Framework include Meyer`s CLIL Pyramid and Coyle`s Language Triptych.

1.Language of learning

Is the language necessary for learners to access basic concepts and skills in meaningful context? It is subject-specific and includes key vocabulary phrases, describing,defining,explaining, and using future conditional tenses.

2. Language for learning

Is the language needed in a foreign language context, requiring strategies to help students' complete tasks such as pair work, cooperative group work, asking questions, debating, enquiring, and thinking? It is subject-compatible and includes presenting evidence, writing research reports, project work, and arguments/disagreements.

3.Language through learning

Is linked to active student engagement in using the language and thinking. Effective learning requires active involvement in language and thinking, which cannot be predicted in advance. Emerging language needs to be captured by the teacher, but it is difficult to predict beforehand. Examples of emergent language include dictionary skills, recycling discussion skills, extending presentation skills, using feedback, and questioning answering.

Relevance of the study

By continuously combining language and content, contributing to a holistic understanding of both the subject and language skills, CLIL promotes students to overcome language difficulties thanks to its specialized vocabulary and concepts of a complex scientific discipline such as chemistry. This approach not only helps to understand chemical principles, but also increases students' ability to communicate effectively in the language of science. In general, CLIL in chemistry is ideal for achieving scientific literacy. At the same time, it can be said that it may be more suitable for achieving this goal than the current scientific curriculum: firstly, global scientific discourses take place only in English, which makes English competence a vital skill. The lessons aimed to build intercultural knowledge, develop intercultural communication skills, improve language competence, develop multilingual interests, and provide opportunities to study Chemistry through different perspectives. They allowed learners more contact with the target language, complemented other subjects, and diversified classroom practice methods. The lessons focused on various skills such as questioning, organizing, sharing ideas, planning, predicting, estimating, observing, summarizing, reading, making decisions, and making choices. The bottom-up model was used to support individual learning, considering various intelligences and learning ways. The lessons were designed to bridge existing curricular and disciplinary boundaries, creating a more integrated learning environment and energizing disciplines in new ways. The lessons with CLIL built intercultural knowledge and understanding, developed intercultural communication skills, and increased learners` motivation and confidence in both the language and the subject.

Inclusion in the CLIL teaching provides students with opportunities such as improving general and specific language competencies, preparing for future learning and or working life, developing multilingual interests and attitudes, diversifying methods and forms of teaching and learning, and increasing interest.

Aim and objectives of the study

Aim:

This dissertation work is aimed at studying the special application of CLIL teaching methods in the context of Chemistry Lessons. CLIL methods in teaching chemistry integration into chemistry lessons provides teachers with a promising way to solve the dual problem of content and language acquisition. By developing an environment where language and chemistry meet, students help deepen their scientific knowledge by honing their language skills. It is assumed that, having studied the use of CLIL in chemistry education, it becomes clear that this innovative

approach has great potential for the development of comprehensively developed individuals who deeply understand both the language and the science that shapes our world. CLIL classes focus on content, supporting language learning and subject mastery. The methodology consists of support poles to facilitate students` language and taxonomy to engage them in various tasks. Support can be oral, procedural, or teaching tools like graphic organizers, visuals, or multimedia.

Objectives:

The purpose of the presented study is to determine the effectiveness of subject-language integrated learning among high school students through the theoretical development, scientific justification and experimental study of methods of teaching high school students in English on the basis of a subject-language integrated approach. The pedagogical experiment conducted on secondary school students in the study was aimed at identifying the formation of language skills as a result of working with terminology, a glossary, a text in English and calculations in subject-language integrated learning. CLIL technology has a deep knowledge of chemistry and students' ability to process information, which prepares them for higher-level thinking skills and improves cognitive development. This research work is a comprehensive study of the CLIL methodology and familiarization with the experience of the world. The study of effective methods of teaching English with the integration of students into the study of chemistry, the development of a lesson plan, its application in education. Determination of the level of quality of mastering the subject of Chemistry by comparing the results of the study. Study the difficulties and obstacles that arise in the process of applying the CLIL method to propose ways to solve them.

Research Questions:

1. What are the perceptions and experiences of chemistry teachers regarding the use of the CLIL method in secondary schools?
2. What is the impact of implementing the CLIL (Content and Language Integrated Learning) method on students' academic achievement in secondary school chemistry classes?
3. How does the academic performance of students taught using the CLIL method in three different schools compare?
4. How does the academic performance of students taught using the CLIL method differ from that of students taught using the traditional method in the same school?

Research hypothesis

Using the CLIL method in chemistry lessons significantly improves student academic performance and engagement compared to traditional teaching methods.In general, CLIL in chemistry seems to be ideal for achieving scientific literacy. At the same time, it can be said that it may be more suitable to achieve this goal than the current scientific curriculum: first, global scientific discourses take place exclusively in English, which makes English competence a vital skill participate in these discourses. In addition, intercultural competence is an important prerequisite for participating in the aforementioned discourses and participating in national and global communities

as a whole. There are two kinds of CLIL: CLIL is a teaching and learning approach that focuses on subject content, focusing on both content and administrative implications. A strong version of CLIL favors subject concepts and skills in the language being taught, while a soft version focuses on language. A language-driven approach involves foreign language classes using more content than typical programs, or using didactic units that make greater use of subject-based content. In chemistry classes at CLIL, we must provide the opportunity to apply and develop 4 language skills: Speaking, Listening, Reading and writing. In accordance with this, to identify the achievements of students in the effective application and implementation of CLIL methods in teaching the discipline, to summarize theoretical material on the topic, to draw up a lesson plan for comparing the results. Conducting research work on the topic, making sure that the use of CLIL by students in the study of chemistry is an effective method.

The significance of the study

The implementation of the CLIL approach in Kazakhstan has led to several achievements, including increased motivation, improved prospects, and improved teacher qualifications. The motivation of students to learn a foreign language (FL) has increased significantly, and teaching STEM subjects in English has had a positive impact on the future of teachers. CLIL also improved the pedagogical skills of teachers, made it possible to develop new teaching methods and independently master English. However, problems such as English proficiency, online learning, CLIL teaching, trilingual education and lack of teaching materials have been identified. The main problem is the lack of proficiency in English among teachers who have difficulties in communicating subject material in English. The study showed that CLIL should be used in classrooms with in-depth study of English to address these issues and improve students English proficiency. Teachers had difficulty organizing classes and delivering content through the pillars in CLIL. Utilities for English courses and CLIL training for teachers were unsatisfactory, with some participants unhappy with the results due to language shortages. The study also showed that teachers attended only 72 hours of CLIL training, in which most of the CLIL concepts were not explicitly stated. This indicates the need for teacher training to develop communication skills in English and prepare teachers for the implementation of the CLIL approach. The high pace and irregular implementation of trilingual education policies, along with the lack of educational materials due to the CLIL approach, pose challenges. More research is needed to address these issues and improve the overall online learning experience.

The considered literature states that CLIL has a great role in enriching chemistry knowledge with the development of linguistic competence and interdisciplinary thinking. However, its success largely depends on the careful training of teachers, the use of technology and the careful integration of both content and language. More targeted research is needed to develop evidence-based CLIL strategies specifically designed for chemistry classrooms. Gulyas et.al. (2015) notes that the CLIL approach may be a widely used approach in teaching that combines substance and dialect to advance the linguistic and Scholastic advancement of

substudents. It promotes a deep conceptual understanding through disciplinary conversations, especially in the teaching of chemistry, where complex logical thoughts are often problematic. CLIL also develops collaborative learning and intercultural competence among students through the use of meaningful tasks in the remote dialect. This intrigue approach is consistent with the instructive goals of the 21st century, which reflect the integration of information ranges and the formation of various abilities. Lower Saxony's educational programs are used as demonstrations to create lesson plans. In any case, problems arise in its execution, such as the need for appropriate instructional materials and bilingual instructors. To address these issues, the collaboration of teachers, educational module engineers and directive bodies is necessary to create and maintain professional development activities in the field of chemistry adapted to CLIL. Despite these challenges, CLIL is an imperative and valuable strategy for teaching chemistry in a remote dialect, promoting a deeper understanding of chemical concepts, promoting dialect abilities, and promoting co-learning. In order to fully understand the potential benefits of CLIL in the chemical manual, it is necessary to request and speculate in advance.

LITERATURE REVIEW

1.1. Using CLIL in students ` understanding

Content-based learning has been implemented for some time. More recently, a method that demonstrates the relationship between language and subject learning is called Content and language Integrated Learning (CLIL). It is used for teaching school topics or parts of subjects in order to simultaneously develop content with integrated language learning. Children receive substantial language support to facilitate learning, and the subject chooses the vocabulary, language structures, and functions that will be taught in relation to the material. But CLIL differs depending on the situation. A strong or hard version is content-driven, with the main emphasis being on the subject matter and associated academic abilities. A weak or soft variant is more language-driven since it places more of an emphasis on language acquisition. 48 Modify exercises from other curricular areas 45 Select and organize relevant stuff. You must have specific criteria in order to select and organize relevant stuff. Activities that form a logical learning sequence must also be prepared. Content selection and planning can be done to support your course book, align with the curriculum, or create a stand-alone content-based unit of work. The duration could range from a single class to a half-term. Regardless of the goal and duration, the most important factors to take into account are the content`s age-appropriateness as well as the possible interest and motivation of the kids. Additionally, you must assess your language and thinking abilities as well as the ratio of linguistic and cognitive difficulty. Another factor is how much of the content offers new ideas or expands on what the kids already know.

Figueiredo and Henriques (2024) examine the practices of Content-Based Instruction (CBI) through the perspectives of foreign language teachers, providing insights from an authentic classroom setting in a language laboratory. This study investigates how individualized hypersensory resources and the Content and Language Integrated Learning (CLIL) methodology may be used in elementary English instruction. The study, which was carried out during a supervised teaching practice, sought to determine how English language instruction may include students` experiences and knowledge from home, school, and cultural settings. Some people refer to primary ELT programs that incorporate a content-based learning component as "soft" or "weak" variants of CLIL. This is due to the fact that the content`s fundamental justification is that it offers a framework for language practice based on a language curriculum. A soft variant of CLIL may also dilute the scope of the subject vocabulary and associated academic language and abilities taught. Content-based learning makes learning English interesting and challenging, regardless of the educational environment. Additionally, it fosters children`s academic and communication abilities in fun and interesting ways. My main recommendations for content-based learning are as follows: 45 Select and organize relevant content; 46 Change up the skills and practice exercises; 47 Encourage comprehension of the language and topic; 48 Modify activities from different. Additionally, you must assess your language and thinking

abilities as well as the ratio of linguistic and cognitive difficulty. Another factor is how much of the content offers new ideas or expands on what the kids already know.

Nevertheless, content-based learning remains a valuable method for making the learning of English both engaging and intellectually stimulating in a variety of educational settings. It also supports the development of students' academic and communication skills in a fun and interactive way. Based on this approach, my main recommendations for the implementation of content-based learning are as follows:

- Select and organize relevant content;
- Vary skills and practice tasks;
- Promote comprehension of both language and content;
- Adapt activities from a variety of sources.

In addition, teachers should continually evaluate both the linguistic and cognitive demands of the tasks, as well as their own language use and thinking strategies. It is also important to consider whether the content introduces new ideas or builds on students' prior knowledge.

This essay describes a technical secondary school in Jesi, Italy, and the teaching environment there. The school decided to apply for a project called English 4 U supported by the Marche Region since research in L2 has shown that pupils are motivated when they use it as a tool for communication and when they perceive the reason for acquiring a language. Our school was able to use the CLIL technique to create an English-language Chemistry course as a result of this initiative. Once a week, the students in groups of fifteen received afternoon classes in the Chemistry Laboratory with two professors. The classes that taught the pupils to "think" in two languages-their native tongue, Italian, and their second language, English-promoted the encouraged the growth of their conceptualization and thought processes. Many exercises using various tools were carried out during the lectures to increase student engagement, active involvement, and self-expression. Students who used CLIL to memorize chemistry benefited from noteworthy participation, participation, and socialization, as well as the development of dialect and multicultural attention. In addition, they used the target dialect in important situations. When students have a high level of interest and information in the subject, the inspiration for remembering the dialect increases, as the dialect becomes an expressive means of communication instead of drawing conclusions on its own. CLIL (which combines substance and dialect teaching) improves this training as part of the association between the existing educational program and Scholastic specialties. Thus, it develops a deep integration of learning and revives subject areas with a restored mind and inspiration. Pavisic (PhD) explores the potential of CLIL as a viable approach to teaching chemistry, emphasizing its ability to combine subject matter with dialect learning. Shabdenova (N. D.) also considered the use of CLIL in auxiliary schools in Astana and noticed its positive effect on both subject Information and dialect abilities of students. By expanding these Scholastic interests, CLIL fosters cross-cultural data trading and builds students ' ability to understand and communicate around the world. Most importantly, it fully enhances students ' inspiration, confidence, and the subject's interaction with language.This article talks about the author's study of the absorption of a substance in the CLIL

(teaching substance and dialect coordinates) course, which was held at an auxiliary school in the Polish city of Radom.

The study involved a group of Polish students studying chemistry in English as part of a school curriculum. The results of the study confirm the idea that teaching non-linguistic subjects in a foreign language does not interfere with students' learning and can even improve their overall learning experience. The consider authoritatively appears that conceptual understanding is critical for outside dialect procurement, particularly when learning complex subjects like chemistry. It moreover presents clear procedures for understudies who battle with a moment dialect. The article opens with a comprehensive survey of existing investigate on the viability of CLIL-based instruction. This hypothetical establishment sets out the organize for a depiction of the test plan, taken after by a nitty gritty examination of the discoveries. The report concludes with intelligent experiences and last perceptions based on the down to earth usage of the approach. Inquire about by Gregorczyk (2012) authoritatively appears that learning scholastic substance through an outside dialect does not prevent comprehension. It is obvious that this will improve cognitive engagement and progress generally learning results.

Being able to converse fluently in English has been a struggle for many young people and older people in recent years, when learning foreign languages in school was less frequent. However, if you lack this competency, it has become a requirement in several positions nowadays and might limit your chances and block doors. Because of this, the educational system has come to the realization that action must be taken as soon as feasible and at the base of the issue. Since the 1990s, other efforts have been created in Europe, although CLIL is the most well-known. Programs for Integrated Language and Content Learning have been developed and put into use in many educational settings around the globe. Although a great deal of study has already been done on various facets of these programs and in various situations, much more is soon to be conducted in order to enhance the approach.

Garcia Tapias (2016) explores the integration of substance and dialect coordinates (CLIL) teaching methodologies as part of mid-level teaching in Chemistry at the European Institute in Bellwitge, Catalonia. Asking about it aims to assess how CLIL strategies affect both students ' understanding of chemicals and their mastery of the English dialect. The consideration included the improvement and execution of two pedantic units in English in Chemistry Lessons. Students participated in various exercises, counting tests and creating logical blurs that aimed to improve both understanding of the subject and dialectal aptitude. Ask about the pre-and post-test tests, questionnaires, and self-assessment apparatus used to evaluate the results, which focus on content information, vocabulary protection, and students ' perceptions of distance learning language. The news shows that while several students initially faced difficulties due to the use of English, many details promoted the understanding of logical concepts and expanded the inspiration. The Thinker concluded that CLIL could be a viable approach to teaching science, promoting both subject authority and dialect development.

By using a language other than the native language to learn and teach the content of a particular academic topic in a foreign language, bidirectional education is achieved using the method of integrated content and language learning (CLIL). This study is based on a 9th grade chemistry course taught in English in one of the best secondary schools in Bulgaria. There is a correlation between students' previous mastery of a foreign language and the level of skill in it. In addition, the approach to the study of chemistry before and now was studied. The importance that students attach to language integration through meaningful learning was demonstrated by the opinions of participants that more laboratory classes should be conducted and scientific ideas should be conveyed in their native language. Bianco and Andonova (2020) present a case study on the use of content and language Integrated Learning (CLIL) in teaching chemistry in Eastern Europe, examining its effectiveness in improving both subject knowledge and language skills. Students were interested in using different teaching methods in the classroom. Group projects that require students to present their chemistry assignments in English to the class are seen both as a creative opportunity to present their work in a new and scientific way in a foreign language, and as a test of their verbal communication abilities. This fosters a continuous motivation to acquire language skills and a desire for scientific literacy. This study confirms a point of view that has received little attention in the field of CLIL-the importance of language integration through subject learning. These discoveries highlight the importance of reintroducing dialect to substance research. Think of proponents of a corrected approach that takes into account the phonetic foundations of students and develops an intuitive, practical learning experience.

The book discusses the problems of mastering the content of the chemistry course based on integrated content and language learning (CLIL) and presents high-level scientific work. The topic of the dissertation is relevant and relevant in the framework of modern research in the theory of language education. The main research issue expressed and discussed in the dissertation confirms that all attempts to implement CLIL should be evaluated, so that the book inspires Foreign Language teachers and contributes to a better understanding of the nature of CLIL (Nawrot-Lis, 2019). It offers an in-depth study of how substance and dialect coordinates (CLIL) teaching affects students ' understanding of chemistry when instructing on an external dialect. This study is based on experimental studies conducted in purely lower auxiliary schools, comparing student performance in chemistry classes taught through English (CLIL) with those taught in the local language. The book begins by describing the hypothetical institutions of CLIL, talking about its beginnings, improvements, and the viability of its techniques. At this point, it is included in the control study plan, listing the strategies used to study the purchase of items among additional students. The results show that although CLIL presents certain difficulties, it does not prevent students from learning complex logical concepts. In fact, the integration of dialect and substance learning can increase cognitive activity and develop understanding of the subject. This work is especially important for teachers and analysts interested in bilingual teaching, as it provides practical experience in the implementation of CLIL in science subjects and contributes to improving understanding of its impact on substance learning.

This final thesis employs the CLIL technique to teach Chemistry to English language learners. It is split into two halves. The theoretical section addresses the CLIL approach itself, providing a brief overview of its historical evolution and the current thinking behind its use in the Czech Republic. The thesis also presents the fundamental ideas behind this approach, as well as its variations, benefits, and drawbacks when applied to education.

The use of CLIL in chemistry has been examined by Vojtková and Pytlíková (n.d.), highlighting its potential benefits for language and content learning. The topic of appropriate content selection, various scaffolding approaches, and evaluation kinds are also covered in the theoretical section. The practical section outlines a five-week sequence of CLIL classes that incorporate various activities related to the subject matter and are designed to spark teens` interest.

Examined is the examination of the use of CLIL in integrated Chemistry in English education for Peter the Great St. Petersburg Polytechnic University students (entry-level courses for engineering majors). Reflected are the evaluations of the creation of CLIL programs at Russian universities and the appraisal of the CLIL approach in postsecondary education. The effectiveness of the CLIL method in helping students build their professional and cross-cultural abilities is shown in the current study by combining Chemistry in English, a foreign language, with Chemistry in Russian, the official language. Along with the cognitive issues for students enrolled in entry-level courses, the formative assessment of the qualitative appraisal of the CLIL approach`s effect in Chemistry instruction on the accomplishment of necessary skills is taken into account. Beginning with entry-level courses, a sufficient rise in students` summative assessments through the use of a bilingual approach in CLIL implementation enables the development of professional communication capabilities. In order to prepare students for the labor market in the future, cross-cultural and professional competences must be achieved via the integration of science, industry, and education in the modern world. The creation of collaborative initiatives between various colleges and enterprises, the expansion of academic mobility, international collaboration in global economics, and the tendencies toward the establishment of multicultural media in a future global society are all linked to the integration processes. Gorelova (2019) discusses the implementation of the CLIL approach in teaching chemistry at technical universities, highlighting its potential to enhance both subject knowledge and language proficiency. Subsequently, in the" organization to look great " section, it is very important to develop modern, advanced training programs that use remote dialects. This applies to English dialect training programs that use a dialect widely used in the scientific world and across world borders. It should be known that the use of these programs in post-secondary education has been very effective in teaching Multicultural Media in various higher education institutions, using different strategies and advanced achievements. The CLIL (teaching substance and dialect coordinates) methodology is one of the most advanced inventive approaches in higher education. The article talks about an investigation into the use of unused and ancient achievements in teaching English in chemistry. Nurdilaeva, Baisalov and Adam (2020) reflect on the use of substances and language structures (CLIL) taught in

the lessons of school assistants in chemistry in Kazakhstan. In chemistry teaching, a "consideration", " CLIL approach" or "comprehensive teaching of substance and dialect" aimed at studying how inclusivity in English teaching affects students 'understanding of the subject and ensuring their safety was considered in order to expand students' interest in chemistry and expand their understanding of a number of traditional methods of organization. As part of the chemistry course, special attention was paid to the inspiration of students, the level of information and the information of the English dialect. The authors used a combination of traditional instructional methodologies and CLIL strategies based on concept, glossary work, English-Language compilation, and computational methodologies. They conducted surveys and instructional meetings to explore the breadth of these approaches. Discoveries emerged that the use of CLIL not only increased students ' interest in chemistry, but also increased their aptitude for English slang.

In particular, working with phrases and notes in English expanded the students ' inspiration and contributed to a deeper understanding of the topic. This thought promotes an emerging body of research that supports the integration of dialectal and substance learning, demonstrating that CLIL can be a successful approach in teaching science to promote both subject authority and dialectal advancement. The practice of integrating chemistry and English on the basis of a new curriculum was researched, as well as innovative techniques to teaching chemistry in the English language classroom were examined. For the purpose of using CLIL technology in the classroom, terminology, glossaries, English-language-based text work, and mathematical methodologies were chosen. Surveys of the students and a pedagogical observation were conducted during the chemistry session to assess the efficacy of the use of CLIL technology. The survey`s findings demonstrated the efficacy of teaching chemistry in English. Using chemical terminology in the classroom improved student interest in the topic while working on terminology and glossary. The foundation of the CLIL approach is the integration of language into the subject matter, which enables students to acquire language proficiency in addition to topic knowledge.

This essay seeks to draw attention to a few of the problems that are becoming increasingly prevalent as educational institutions and authorities across Europe give increased thought to the Content and Language Integrated Learning (CLIL) option. The European Commission and the Council of Europe, two European organizations that encourage CLIL-based learning, as well as the numerous European projects that have been funded to investigate the various difficulties involved, are only two of the reasons why there is interest in this learning environment. CLIL has to be reevaluated in the same way that the use of new information technologies in education has forced educators to reevaluate the procedures and methods of teaching and learning. A new learning and teaching environment is what CLIL is.

Coonan (2007) provides a basic examination of the issues and thoughts related to reading content and dialect coordinates (CLIL), especially in the Italian environment. Kunan emphasizes that although CLIL significantly guarantees the improvement of both the dominance of things and the ability to dialect, its effective implementation requires careful organization and adaptation to neighboring learning

environments. Kunan noted that CLIL covers a wide range of bilingual learning models, ranging from full flooding programs to fractional integration of dialects. This adaptation allows you to customize the CLIL in different instruction settings, but at the same time requires specific definitions to ensure stable use. A notable issue is the requirement for instructors who are capable in both the subject and target dialect. In many instructional circles, counting Italians, there is a need for dual-skilled instructors who can disrupt the successful delivery of CLIL programs. Kunan emphasizes that in the case of CLIL, the purchase of dialects should not be accidental. Without reinforcing the goal, students may struggle with both understanding the substance and developing the dialect. Thus, it is very important to coordinate dialectal areas in substance classes. Cunan's work shows the bulk of the instructors' attentiveness and flexibility as part of the fruitful performance of the CLIL. It proposes that qualified professional development programs combine training in self-expression strategies and procedures to correct dialectal and Content Learning. But the true meaning of CLIL may go unnoticed or underestimated, and this problem may simply be perceived as a change in the language environment. Of course, this is only one problem; the choice of language has a significant impact on many areas, including politics. In fact, if the CLIL is to be fully integrated into the education system, it must have a specialized function in the national language policy, the local education authority, the school and the general education program. The purpose of this study was to evaluate the efficacy of scientific literacy teaching materials on the subject of The Nature of Matter that are based on Content and Language Integrated Learning (CLIL). Content, Cognition, Communication, and Culture are the four CLIL pillars that are integrated into the teaching materials for this subject. Scientific literacy, which was assessed in this study, included three components: conducting scientific experiments, interpreting data, and evaluating and planning scientific research. Sheilawati, Roubini, and the Yento Firm (2020) are exploring the effectiveness of CLIL-based educational materials on the nature of matter, focusing on their impact on improving scientific literacy. This study evaluated an experimental methodology on one hundred students from three schools where chemistry is taught in English. Purposive sampling was used to choose the students. To collect the data, we used tests on students' scientific literacy and questionnaires asking them to comment on them. The result of the N-Gain literacy rate analysis was 57%, which indicates that this educational material is very effective in improving the scientific literacy of students. The students' responses to the study materials were rated as "very good". This study shows that CLIL-based educational materials on the nature of matter have a positive impact on students' scientific literacy.

Papaja (2012) explored the crucial role of student attitudes towards the success of integrated content and Language Learning (CLIL) programs. The aim of the study is to understand how students' perceptions and beliefs about CLIL affect their participation, motivation, and learning outcomes. The request for this showed that over time, students develop a favorable mood for learning in a foreign dialect. Many students who were initially skeptical described in detail how they were inspired and active in the process of adapting to the CLIL approach. The study examined the factors

that shape students' attitudes towards CLIL, including their previous language learning experience, perceived subject difficulties, and classroom environment.

The results showed that the positive attitude of students towards CLIL was significantly associated with increased motivation, active participation, and improved academic performance. Perceiving CLIL as a valuable and exciting approach to learning, the students showed great enthusiasm and willingness to participate in classroom activities. It does not thoroughly study the known changes in the dialectal features of the English language, especially in scientific vocabulary and understanding, which is explained by the integration of dialectal and substantive study. In contrast, negative attitudes towards CLIL, such as anxiety, fear of failure, or self-doubt, were associated with decreased motivation and academic performance. The author emphasizes the need for satisfactory feedback tools, such as teacher training and resource availability, to facilitate effective implementation of CLIL.

Papaja (2012) explores the impact of students' attitudes towards content and language integrated learning (CLIL), focusing on how this attitude affects learning outcomes in CLIL classrooms. The study highlights the importance of creating a supportive learning environment that promotes language learning and a positive attitude towards content. It was found that strategies such as having specific learning goals, support, teamwork, and teacher motivation play a crucial role in shaping students' positive attitudes. Papaja concludes that student behavior plays an important role in overcoming CLIL programs. Positive judgments can improve learning outcomes, while negative and difficult situations can hinder progress. Teachers should consider student attitudes when planning and executing CLIL curricula. The study showed teachers the need to consider students' individual learning styles, previous knowledge, and potential challenges to ensure successful implementation of CLIL. Papaja suggested that taking into account the views and considerations of students in the design and teaching of CLIL curricula can increase student engagement and motivation.

This study is a continuation of a study examining the complex relationship between students' attitudes, motivation, and learning outcomes in the context of CLIL.

Future research will explore the impact of specific CLIL learning strategies on student attitudes and identify best practices for gaining positive learning experiences. Papaji's research provides valuable information to educators seeking to optimize CLIL implementation and ensure the success of their programs.

By understanding the crucial role of student attitudes, teachers can create a positive and supportive learning environment that promotes engagement, motivation, and academic success in CLIL classrooms.

The study highlights the importance of a student-centered approach at CLIL, in which teachers actively encourage positive attitudes and take into account students' individual needs in order to maximize the benefits of this integrated learning approach.

1.2. Using of the CLIL method in the classes of Chemistry

There has been a noticeable surge in programs and initiatives pertaining to bilingual education in recent years. Numerous of these programs are already offered at

both mandatory and optional levels in a variety of educational contexts. Higher education levels are currently seeing this trend, though. The establishment of the European Higher Education Area (EHEA) and the evolving needs of the knowledge-based society are the two main drivers of this trend.

Several strategies have been used to implement these multilingual programs. The Content and Language Integrated Learning (CLIL) project is one of the most popular. The European Platform for Dutch education and the University of Jyväskyla in Finland are credited with coining this phrase in 1994 (Fortanet-Gómez and Ruiz-Garrido 2009; Marsh). They contend that both approaches are learner-centred and underscore the utilize of true materials that reflect real-world dialect utilize. Their investigation absolutely appears the significance of needs investigation in CLIL settings. It recommends that techniques from ESP can be viably exchanged to CLIL settings to way better address students` phonetic and content-specific needs. It is evident that this point of view highlights the versatility of CLIL over different instructive spaces, counting science and innovation. It is described as "a dual-focused educational approach in which the goal is to promote both content mastery and language to pre-defined levels by using an additional language for the learning and teaching of both content and language" (Maljers et al, 2010).

This structure is based on the basic 4Cs CLIL - content, communication, cognition and culture, combining them with the four central components of learning: The crossing point of these measurements comes about in a 4x4 network comprising 16 markers, each speaking to a particular perspective of viable CLIL hone.

Each of the 16 indicators serves as a central point for the study and regulation of CLIL guidelines. To appear: Content-cognition: assesses how the subject is taught in such a way as to improve high-level consideration skills. Language-communication: evaluates the use of dialect to encourage important interaction and conversation within the classroom. Integration-Culture: examines how social parameters in subject learning are coordinated to improve students ` understanding around the world. Using the CLIL grid as an asymptomatic apparatus, teachers can distinguish traits and regions for changes in their learning skills. Through the methodological analysis of each indicator, instructors can develop methods aimed at improving both dialect ability and the dominance of objects among students.

Since 2002, the number of postsecondary English-taught programs has increased. Even so, they still far outperform studies carried out in earlier educational phases, and more empirical research must be produced in order to obtain a trustworthy summary of the outcomes of its use at universities.

The current study is being conducted at the University of Almería, where a groundbreaking plan to promote plurilingualism is being created to incorporate other languages, mostly English, into various university courses. It centers on an English-taught Chemistry course where the instructors supplemented their English education using a variety of multimodal ICT-related materials. The resulting instructional resources were a few English-language films, with English subtitles, that the course instructors had recorded to describe the procedures for the laboratory practice.

Ramiro and Perez (2013) explore the use of ICT tools in higher education CLIL lessons, focusing on their innovative application in a chemistry lab to enhance both teaching and learning outcomes. The creation of these materials for Chemistry laboratory practices, according to the results, greatly aided in the accomplishment of the course goals. Unexpectedly, it raised the students` interest in and engagement with the course. These findings demonstrate the value of these multimodal tools in assisting with the teaching of foreign languages and laboratory-based Chemistry techniques.

There are rising worries over the capacity of students learning science using a topic and Language Integrated Learning method (CLIL) to engage fully in a rich classroom discourse and acquire topic knowledge. The deficiency of knowledge on science development in CLIL environments through classroom discourse led us to concentrate on the inquiries made by educators in upper secondary CLIL biology classes. Our goal was to ascertain how these queries affected the learning possibilities related to science material. To investigate and comprehend the intricacies of teacher-student relationships, a multiple-case study approach was put into practice. Three case studies, two in Germany and one in Italy, each with a separate school where CLIL senior secondary science courses were watched and audio recorded, were used to gather data. A mixed techniques approach to discourse analysis was used to examine transcripts of classroom discussions. Results imply that a teacher may foster the development of science language and science comprehension via the thoughtful use of questions. By dividing thinking processes and language production into more manageable chunks, questioning based on students` responses has been shown to improve topic knowledge and reduce the linguistic burden on CLIL students.

Furthermore, students only demonstrated a higher degree of cognitive engagement when they were able to contribute to class discussions with longer responses than single utterances. Teachers were seen adopting and supporting translanguaging strategies, or the flexible use of more than one linguistic code, to enable pupils to actively engage in the classroom discourse. Teachers also posed language-related queries that encouraged students to comprehend and use disciplinary language.

Tagnin and Ní Ríordáin (2021) explore how building science through questions in CLIL classrooms enhances both content knowledge and language skills, highlighting the importance of inquiry-based learning in STEM education. The study`s observed questioning strategies provide a means for academics and practitioners to comprehend content access concerns in upper secondary CLIL science classes. In order to avoid oversimplifying the subject, we advise STEM teachers working in CLIL contexts to avoid oversimplifying the language requirements placed on pupils. Practical solutions are suggested to enhance both cognitively and linguistically productive questioning in STEM CLIL courses, therefore reducing language barriers.

Kofou, Philippides, and Gavriilidou (n.d.) discuss the experimental teaching of sciences in the English language through the CLIL approach, focusing on its effectiveness in enhancing students` language and subject knowledge. The adoption of innovative and creative practices and teaching methods in education, and specifically in Foreign Language Teaching (FLT), is made possible by several factors, including

curriculum modifications, Council of Europe decisions, the growing recognition of the value of language learning and the growth of multilingualism and multiliteracy, and, in the case of Greece, Ministry of Education decisions (Law 3966) regarding Model and Experimental Schools. In this context, during the academic year 2015–2016, the English, Chemistry, and Physics teachers at the 2nd Experimental Senior High School of Thessaloniki implemented Content and Language Integrated Learning (CLIL) in the units on chemical compounds and reactions for Chemistry and Newton`s Laws for Physics. The summative evaluation and the questionnaire, which follow the four Cs of CLIL, demonstrate that language use does not impede students` comprehension of the subject matter; on the contrary, it helps them improve their language proficiency. According to the Council of Europe`s (2006) directives, the Greek educational system is constantly changing with regard to teaching and learning foreign languages. This encourages the development of critical competencies like intercultural awareness, metacognitive skills, and foreign language communication. These competencies are a result of the demands of the contemporary world, which include the multicultural and multilingual environment of Europe and the growing likelihood that young people will work or reside abroad. In light of this, the Unified Curriculum for Foreign Languages was updated to meet the requirements of a global citizen capable of mediating and communicating across linguistic, social, and cultural divides.

Simultaneously, the Model and Experimental Schools are encouraged to apply differentiated learning and experimental techniques, as well as to advance educational research in partnership with university departments. Content and Language Integrated Learning (CLIL) was created in response to the aforementioned developments as well as the growing trend of the CLIL approach in Europe. Its goals are to improve students` performance in the foreign language create flexible and varied learning experiences at school, and integrate the teaching of a foreign language with other curriculum subjects. In English, French, Spanish, and Italian high schools, cooperative and constructive approaches, student centrality, information and communication technologies (ICT), and laboratory tasks are used to conduct scientific activities. This page explains these activities. In a bilingual setting, students integrate and restructure their information regardless of language, conceptual, or scientific background.

Schietroma (2019) explores innovative STEM Lessons by integrating CLIL and ICT into multicultural classrooms and discusses how these approaches improve teaching in different educational institutions. The think of subtle elements is the execution of STEM lessons taught in English, French, Spanish and Italian, emphasizing the flexibility of CLIL in multilingual classes. Chietroma emphasizes the use of positive and useful techniques, fostering student-centered learning and peer collaboration. The integration of ICT tools was intuitively encouraged and interfered with learning meetings, which helped both understand things and master dialects. By adjusting the classes according to bloom`s scientific classification, this approach aims to improve the ability to think at a higher level, developing a deeper understanding of logical concepts. The Think about program used a combination of development and summary assessments, portfolios and rubric counts to assess the progress of both substance information and dialect acquisition. Chietroma concludes that the integration

of CLIL and ICT into STEM instruction does not improve understanding of the subject, but also develops phonetic competence and intercultural attention among students. The goal of the integrated content and language learning (CLIL) strategy is to foster integration, foster the development of critical European competences, and raise motivation. STEM experiments, group projects, and project-based learning strategies were used to teach chemistry. Students interacted online, created digital tools, and played games on PCs, iPads, and smartphones. Positive outcomes improved motivation and created a favorable perception of chemistry. Positive outcomes improved motivation and created a favorable perception of chemistry. Control classes, on the other hand, did not create multimedia goods and did not profit from extra lab time or from inverted and virtual classrooms. Through the use of their native tongue, multilingual interaction, and the development of their cognitive abilities in simulated and realistic scenarios, CLIL`s programs have been beneficial in encouraging migrant literacy and integration.

One of the European Union`s main educational objectives has always been to promote language variety in instruction and training. The 1990s saw the rise in use of the acronym CLIL (Content and Language Integrated Learning) as the most common word for this type of instruction. Programs for CLIL are becoming more and more frequent in elementary and secondary school these days, however there have only been a few recorded instances of CLIL in higher education thus far. This study details the creation, application, and assessment of a general chemistry module for engineers in the 2014–2015 school year. The Bilbao Industrial Technical Engineering School offers this subject. It is available in Spanish, Basque, and, as of right now, English. Handouts were provided for the English group in addition to the lecture materials. These worksheets were meant to be used as CLIL exercises.

Pupils were required to complete many surveys. One at the start of the session to assess their prior knowledge of English, and another at the conclusion to examine the challenges they encountered while completing the module, as well as any recommendations for improvement. Students enrolling in this program had high or very good language certifications and English proficiency, according to the first survey findings. Their goals of being more employable in the future and becoming more fluent in English drove them. According to the poll completed at the end of the semester, there were no significant barriers to completing the course. Their proficiency in English can be the cause of this. In addition, some students found some degree of difficulty in the same word group. All students said that using handouts was helpful, thus it appears that creating unique content specifically for the English module group was sufficient. New exercises were offered and the vocabulary element was emphasized in response to these findings and the recommendations of the students.

Zubitur and Sánchez (2016) discuss the implementation of an English module in higher education, presenting a CLIL initiative as an example of integrating content and language learning. Conversely, a second survey was given to students enrolled in the same module but receiving teaching in Basque. The objective was to ascertain whether the English-driven module offer was widely known and whether they would be prepared to enroll in an English-language module in the future.

In the module, half of the CLIL strategy was used, students presented tasks in English after communicating with this substance in Basque. This approach allowed students to start with a deeper understanding of the subject, more recently using their information in English, encouraging both substance dominance and dialect maturation. Two studies were conducted. The main target students took part in a module taught in English, studying their competencies in the English dialect and collecting criticism about their participation in CLIL. In the Moment review, students were able to master one module in Basque, noting their attentiveness to the choices taught in English and their desire to participate in such modules in the future. The study showed that about 60% of students can study in English, and about 40% reach B2. Students often reacted strongly to CLIL activity, noticing a change in their capabilities in English and an increase in the ability to use dialectal inclinations in a particular subject context. Tasks were considered acceptable when faced with difficulty, and participation was considered useful for learning both dialect and substance. This question highlights the potential of CLIL strategies in higher education, especially in the context of bilingual learning. By skillfully joining dialectal and substantive learning, teachers can enhance the phonetic abilities of students without compromising the understanding of the subject. The characteristics of integrating integrated teaching of inorganic chemistry in English with the CLIL approach are examined in this paper. The content and language integrated learning (CLIL) approach was examined in an online learning environment to help students improve their language and subject-matter proficiency. First-year students in the B012 Chemistry Teacher Training Program group had online inorganic chemistry lessons for the control group and the experimental group utilizing the CLIL approach. For the experimental work, students were chosen non-randomly depending on their subject level and English proficiency through admission control work.

The consider watched that understudies effectively taken part within the learning process, exhibited expanded intrigued within the subject, and extended their lexicon with English chemical wording. The analysts utilized errands planned agreeing to the 4Cs (Substance, Communication, Cognition, and Culture) system, which encouraged a comprehensive approach to joining dialect and substance learning. The study noted the special need for methodological manuals for the harmonization of substance and dialect in higher education institutions (ICLHE), presented the requirements for improving specialized materials and training for teachers. Asking about it promotes the development of articles on CLIL hones in non-English-speaking countries, highlighting the potential benefits and challenges of implementing such strategies in science courses in higher education.

The pedagogical experiment employed the mathematical statistics approach to verify the representativeness of the sample and to validate the reliability of the acquired results. The study used mathematical statistics to confirm the reliability of the results and confirmed the hypothesis of the study using the student`s t-test method. The study focuses on the use of CLIL technology with English terminology, glossary and text aimed at developing students' language competence. The effectiveness of using these tools was evaluated through a student survey. The study found that students interest in

the CLIL method increased, which had a positive impact on the learning process (Nurdillayeva & Zhuman, 2021).

This work focuses on the context of content-language integrated learning (CLIL), where learning objectives are merged with material and L2 is utilized for instruction (for overviews of CLIL, see e.g. Dalton-Puffer, Nikula & Smit, 2010; Dalton-Puffer, 2011). This study investigates the hands-on activities that secondary students in Finland participate in during English-taught CLIL science classes (chemistry and physics). The guiding assumption is that, due to the content-based nature of CLIL classrooms, language learning in these settings is best approached as the acquisition of academic and subject-specific vocabularies, genres, and knowledge construction strategies. This assumption has been supported by prior systemic functional research, in particular. This post will focus on the opportunities that come with doing practical activities to use and acquire language related to the topic matter.

Consideration of learning as social, contextual, participatory, and interactional is another perspective that is influenced by sociocultural and language socialization orientations towards language learning in particular (e.g., Duff and Talmy, 2011, Lantolf, 2000, Lantolf and Thorne, 2006, Zuengler and Cole, 2005). This perspective is best examined by paying close attention to how CLIL students and teachers use language and engage in negotiations to reach shared understandings. Zuengler and Miller (2006: 40) analyzes the advancing ideal models in moment dialect procurement (SLA) investigate. They highlight the evolving identity between cognitive approaches focused on internal mental forms and sociocultural approaches that emphasize a part of social interaction and social context in dialect learning. They argue that dialect learning is not only intrinsic cognitive training, but is also deeply embedded in social skills and social situations. This section is adjusted to substance standards and dialect coordinate learning (CLIL), where the dialect is acquired through significant interaction with the subject substance in a true context. In the case of the CLIL, this sociocultural approach assumes that learning takes place during the participation of sub-students in subject exercises, using dialect as a means of communication and Information Development. Such an approach develops both phonetic competence and understanding of the topic, reflects the coordinate nature of CLIL methodologies. note that the views of linguistic socialization, in particular, emphasize the relationship between language and cultural studies. Beyond the broad educational and academic culture, such cultural learning in CLIL classrooms also relates to what are known as subject-cultures, i.e., the necessity for learners to integrate socially and linguistically into different subject-cultures. Language use in practical tasks will be examined in this article, with a focus on subject-specific and cultural language.

Recent research has highlighted the role of ICT tools in supporting the introduction of CLIL in chemistry. Martínez-Soto & Prendes-Espinosa (2023) conducted a systematic review showing that digital platforms, modeling and multimedia resources increase engagement and understanding in teaching science at CLIL. Such tools can eliminate gaps in the language by providing visual explanations and interactive elements. The survey shows that integrating ICT tools into CLIL approaches can improve dialect distance learning by providing intelligence and

limiting resources. Despite the advantages, ponder, effectively combining ICT with CLIL methodologies, highlighted issues such as asset requirements and inadequate teacher training. The authors noted the need for more experimental thinkers to study the long-term impact of ICT integration on CLIL and to create comprehensive training programs for educators. On the other hand, learning is not treated in terms of trying to pinpoint final learning goals, but rather in terms of the kinds of learning chances that practical circumstances seem to provide. As previous studies on conversation analysis and language learning (referred to as CA-for-SLA) have shown, even if interactional data might show participant orientations toward learning materials and learning, confirming what constitutes it can be more difficult to attest to what exactly constitutes learning in an encounter. Examining CLIL classroom tasks through the lens of subject-specific language is crucial, not only for learners and their growing linguistic repertoires but also for teachers and how they might highlight subject-specificity. Rather than being language teachers, CLIL instructors in the European setting are often topic teachers. Despite the alleged dual emphasis on language and content, CLIL is typically content-driven, with instructors emphasizing their responsibilities as subject teachers and language`s frequently ambiguous function (e.g. Dalton-Puffer, 2011). Dalton-Puffer characterizes CLIL as an instructive approach where substance subjects are instructed through an outside or moment dialect, regularly in settings where the classroom is the essential environment for dialect introduction. This positions CLIL between conventional outside dialect instruction and inundation instruction. The article examines the pressure between lower-level enlightenment traits and top-down consideration orders as part of CLIL appropriation, especially in European contexts where multilingualism may be the goal of the approach. Dalton-Puffer noted the proposal of the CLIL inquiry to move on to explanatory and classroom exams, starting with a review of specific cases, reflecting the development of this area and steps towards the formation of hypothetical foundations. The article emphasizes the need for a strong hypothetical institution for CLIL, suggesting that future investigate focus on harmonization practices derived from related phonetics, teaching, and subject-specific teaching methodology to improve the relationship between dialect and substance learning. Dalton-Puffer`s work is crucial in surrounding CLIL as an energetic and context-sensitive instructional approach that highlights both its potential benefits and the challenges to its implementation.

Nikula (2015) considers practical tasks in CLIL science classrooms, emphasizing that these activities serve as opportunities for both the use of subject language and for learning. Nikula emphasizes that in the case of CLIL, the dialect is not only a means of conveying the subject, but also additionally formed and created by intuition inherent in a particular subject. This dual part of the dialect develops deep communication and understanding of students. His research shows that in the case of CLIL, intuitively taught audiences often involve the use of complex dialects, where students and teachers explore the relationship between the conventional dialect and scientific narratives. This direction helps to form both phonetic ability and mastery of the substance. Nikula`s work adapts to the sociocultural assumptions of learning, indicating that the development of knowledge in CLIL classrooms can be a

collaborative training that affects both social intellectual and social contexts. These knowledge snippets contribute to a detailed understanding of how CLIL strategies can be implemented in a viable way to improve both dialect security and Content Learning. The main argument of this article, which focuses on subject-specific language, is that given their unique role in helping students connect with the genres and registers of their subjects, the role of CLIL teachers in Language Teaching should be considered differently from that of Foreign Language teachers. (for example, Llinares, etc.)., 2012) The book uses the SFL system to analyze how dialect abilities in CLIL classes work, emphasizing the part of dialect in building scientific information. He studies the CLIL class as an intellectual environment in which the development of dialect and substance occurs simultaneously, highlighting the importance of the interaction between the teacher and the student. The authors approach specific classes and registers using completely different scientific disciplines, showing how phonetics reflects the subject-specific learning. The book deals with evaluation strategies in CLIL, and the reputation of the substance is also, support approaches that also evaluate dialect proficiency. This comprehensive exam provides valuable pieces of knowledge for teachers and analysts interested in combining dialect and Content Learning.

The writers of this paper took into account the problems associated with evaluation in language-and content-integrated learning. In Kazakhstan, all secondary school classrooms will employ the new approach for assessing learning outcomes beginning with the 2019–2020 school year. To attain the effectiveness of studying the subjects in English in a comprehensive school, certain adjustments to the way the educational process is organized in the classroom, modifications to the methods of organizing and defining the objectives, assessments of learning outcomes, the selection of teaching materials, and the fusion of the subject matter and language learning process are required.

Zhetpisbaeva et. all (2018) addressing assessment issues in content and language Integrated Learning (CLIL) with a focus on the challenges and strategies for evaluating both subject content and language acquisition. The authors conducted a study to study the experience of CLIL assessment among instructors who taught biology, chemistry, physics and other disciplines in the Karaganda region. Creating a framework for language learning goals for CLIL was the primary responsibility for monitoring the development of language abilities and evaluating them. Teachers described in detail the lack of appropriate devices and strategies to correctly assess the dialect aptitude of students in the context of CLIL. There was a need to prepare instructors to evaluate both content information and dialect capabilities at the same time, which led to difficulties in implementing robust assessment strategies. The Thinker noted the need to create an assessment framework that harmonizes subject matter, Scholastic dialectal possibilities, and cognitive abilities develop dubbing to the exact degree in CLIL programs. This study highlights the importance of satisfactory education and the willingness of teachers to improve assessment skills in CLIL conditions, providing an effective assessment of both dialect acquisition and substance authority. Hamidawi, Amiz, and Gorjian (2016) examined the impact of the CLIL method on teaching reading comprehension to high school students and noted its potential benefits in

improving language skills in secondary education. The study showed that students participating in CLIL programs show significant advances in responsible and useful vocabulary information compared to their peers in non-CLIL situations. By expanding vocabulary acquisition, CLIL`s doublers showed much better results in comprehension tasks, suggesting that the integration of substance and dialect learning contributes to general dialect acquisition. Experts used a numerical query on the plan, using preliminary and subsequent tests to assess the development of vocabulary and study the comprehension abilities of participants. These discoveries adapt to broader research showing that CLIL can be a viable way to enhance dialect abilities through the contextualized and meaningful use of dialects. This study looked at how content and language integrated learning, or CLIL, influenced the reading comprehension skills of Iranian EFL students. Seventy high school students between the ages of twelve and fourteen who study in language schools were randomly selected. To determine the level of qualification, they took part in the Oxford rapid Placement Test (OQPT). High achievers and poor achievers were the two groups into which the students were placed based on their placement exam results. After that, students completed a reading comprehension pre-test. The high level and low level groups were split into two subgroups, experimental and control, based on their pretest results. While the control group of high and low achievers received instruction through rigorous reading, the experimental group of high and low achievers received instruction using CLIL. They conducted a reading comprehension post-test following 10 therapy sessions. The Independent Samples t-test was used to compare the high and low achievers in order to assess the efficacy of the CLIL approach.

The results revealed a considerable difference between high and poor achievers` before and post-test scores. The CLIL approach may have an impact on reading comprehension students who do well or poorly.

Any dual-focused educational setting where the additional language is employed as a medium for teaching and learning non-linguistic subject is referred to as content and language integrated learning (CLIL). It is dual-focused as language or subject-specific material may get the majority of attention. The combination of chemistry and German language instruction is the main topic of a dissertation project that employs the case study methodology. There aren`t many teaching resources accessible for these combination of academic courses. As a result, we are committing to developing, confirming, and refining appropriate CLIL materials and activities in accordance with design-based research methodologies. Teachers` choices and the materials` practicality will determine how best to adapt them.

Currently, the dissertation project considers and analyzes the results of the study of activities aimed at combining science, primarily chemistry-activities aimed at teaching the German language in the ninth grade of high school. The study of action focused on how students' preferences for science courses (physics, chemistry and biology) and foreign languages (especially German) changed, as the components of CLIL were included in the curriculum. It was implemented as a cross-arrangement of the educational Test between the two language groups. Checking student portfolios and

repeated survey surveys were the main methods used to determine the popularity of the specified subjects.

Sochorova and Bilek (2019) discuss the possibilities and limitations of the use of CLIL in chemistry education, especially by studying activities for the introduction of chemistry content in German lessons. It from the action study, it became clear that students were attracted to the use of chemical experiments and other lessons related to chemistry in teaching German. The study found that the initial levels of dialect language proficiency of students completely influenced the compliance of the CLIL program. Students with a higher level of ability in English achieved much better results, while students with a lower level of ability faced greater difficulties. The individuals of the teachers described in detail the difficulties in adapting to the CLIL strategy, especially in regulating the transport of substances with dialect instruction. This highlighted the requirements for special training and return to instructors. The authors recommend that for effective CLIL implementation, the educate program should focus on teacher training, ensuring that students learn the dialect correctly, and adjusting students' dialect abilities to meet the requirements of the CLIL approach. Asking about it contributes to the understanding of common sense issues and thoughts when performing the CLIL in higher education. The results showed an increased interest in German among students. This shift may have been influenced by additional variables as well. Our experience of incorporating CLIL components into the manual is a solid foundation for our future actions. Alrabah and Wu (2017) investigated the impact of content and language Integrated Learning (CLIL) on college students writing competence and attitude towards English. The study involved students enrolled in the CLIL English course, where the subject content was delivered in English. About 80 students' percentage describes in detail the changes in the ability to compose both at the sentence level (for example, accentuation and capitalization) and after the sentence level (for example, the organization of transitions and the use of moving words). The students showed very positive behavior in relation to all approaches to the CLIL course and took a favorable approach to this instructional approach. Ponder used five focus group interviews and an online study to gather information, the exam exceeded expectations to calculate standard deviations using Microsoft, and interest. The results suggest that CLIL may be a viable strategy for enhancing compositional competence and developing a positive attitude towards dialect learning among college students. In addition, the review reflects the requirements for a specialized instructor who is preparing to meet the demands of CLIL courses and assigns longitudinal reports to monitor student progress over time. The researchers tried to assess whether CLIL could improve writing skills and develop a positive attitude towards writing in English. The study employed a mixed-methods approach, combining quantitative data from writing assessments and qualitative data from student surveys and interviews. The results showed a significant improvement in students' writing competence after attending the CLIL course. The students demonstrated grammatical rules, increased vocabulary, and overall consistency in writing.

The study also showed that students' attitudes towards writing in English have changed significantly. Students reported an increase in self-confidence, a decrease in

difficulty, and enjoyment of completing subscription tasks. The integration of content and language in CLIL seems to provide a meaningful context for teaching and practicing writing in the language. The students found CLIL's approach useful and relevant, which led to increased motivation and active participation in writing. The study focuses on the potential of CLIL as an effective pedagogical tool for developing written competencies and forming a positive attitude towards writing in a second language.

Alrabah and Wu (2017) The CLIL English Course explores how college students develop writing competence and a positive attitude, focusing on its impact on both language skills and student performance. The researchers suggested that CLIL's success lies in its ability to create a language learning environment in which language skills are developed along with meaningful knowledge. The study suggests further study of the implementation of CLIL in various educational contexts and disciplines. Future research may explore the long-term impact of CLIL on writing skills and explore design optimization strategies for teaching CLIL writing curricula.

The research by Alraba and Wu provides important information for teachers who seek to improve their writing skills and develop a positive attitude towards writing for second language learners.

Lopez Mesa et al. (2014) investigated the use of integrated content and language learning (CLIL) in teaching physics and chemistry to high school students. The research aims to examine the effectiveness of CLIL in improving students' understanding of scientific concepts while developing English language skills. The CLIL section focused on the topic "matter and its properties", combining the concepts of physics and chemistry with English language teaching. The researchers have developed a number of activities and tasks that require students to use English to communicate, work together, and explore scientific concepts. The implementation of CLIL methods is based on the extended inspiration of the students, as they considered this approach to be energetic and allows them to remember both the subject and the English language. Students illustrated progress in the dialectal bias of the English language, especially in areas such as vocabulary acquisition, comprehension, and logical construction through the context-rich environment provided by CLIL. The CLIL approach has contributed to the improvement of high-level thinking skills and the improvement of collaborative learning, as students participate in exercises that require basic thinking, problem solving and teamwork. The influence of things in English not only achieved dialectal ability, but also broadened students' social attitudes and increased their view of the world as a whole. López Mesa`s proposal demonstrates the adequacy of CLIL in creating an immersive learning environment that also develops subject Information and dialectal abilities, planning doublers for a multilingual and interconnected world. The study employed a quasi-experimental design, comparing the learning outcomes of students in the CLIL group with those in a traditional science instruction group. Findings revealed that students in the CLIL group demonstrated significant gains in both their scientific knowledge and English language proficiency. CLIL students exhibited improved understanding of key physics and chemistry concepts related to matter and its properties. In the study, they improved

their English vocabulary, grammar and communication skills. Demonstrates the potential of CLIL as an advanced approach to interdisciplinary learning and language acquisition in scientific education. The integration of content and language into the CLIL unit provided students with a meaningful context for the use and use of language. Thus, students began to actively participate in practical activities, experiments and joint tasks in English.

The study showed that CLIL was able to create a student-centered and interactive learning environment, increasing motivation and activity. The researchers propose to further study the implementation of CLIL in different natural science disciplines and assessment levels. Future research could explore the long-term impact of CLIL on students ' learning outcomes in the natural sciences and languages.

López Mesa et al. (2014) explore the application of CLIL (Content and Language Integrated Learning) to a physics and chemistry unit, discussing its potential to enhance both subject knowledge and language proficiency. Research contributes to the growing body of evidence supporting the effectiveness of CLIL as a pedagogical approach for integrating language and content learning in science education.

While CLIL has been widely studied in general science and biology, its application in chemistry remains understudied. Few studies investigate long-term effects, differentiated learning strategies, or how CLIL affects students` conceptual understanding of chemical processes.

1.3. Creating the CLIL unit plan for chemistry lessons

To integrate linguistic form into their language system, learners must be encouraged to process it as well. When the teacher specifically calls the students` attention to specific formal characteristics of the language, it promotes the processing of form in the EFL environment. The majority of the time, learners may not feel the need to be vigilant and pay attention to language forms because they are frequently decontextualized and meaningless (Schmidt, 1990). Within the setting of Substance and Dialect Coordinates Learning (CLIL), Schmidt`s Taking notes Speculation has noteworthy suggestions. CLIL situations, where subject substance is instructed through a remote dialect, give wealthy, contextualized input. Agreeing to Schmidt`s hypothesis, for learners to advantage etymologically from CLIL, they must deliberately take note the dialect shapes displayed amid substance instruction. This highlights the importance of planning CLIL classes, not because they are in-depth students in the subject, but because they focus their attention on the dialect structures used, which encourage them to develop and master dialects in depth. In summary, Schmidt`s 1990 work highlights the need for cognitive attention in dialect teaching, advertising important practices on how CLIL can be organized to improve both substance information and dialect acquisition. Students, if they are inspired by the relationship itself, are more involved in form-function analysis in the case of CLIL. This is because they will have to focus on the form to understand the material. Marsol (2015) explores learning English in CLIL and EFL classes, comparing the experience of two elementary schools. However, a guide. However, in a class where the content is given in a second or foreign language, the emphasis on the form is not always provided. The research centers are aimed at

primary school students who have reached the age of eight, studying their presentation in English using the EFL and CLIL methods. The review showed that although both approaches led to the formation of critical vocabulary, the CLIL guidelines opened dubbing in a wide range of words, taking into account theoretical and specialized vocabulary, thus comprehensively improving their lexical information. Marsol`s discoveries demonstrate the adequacy of CLIL in the development of vocabulary improvement, especially in terms of the depth and complexity of dialect use. Asking about the harmonization substance and how dialect learning can improve students' phonetic competence contributes to understanding.

Gulyas et.al. (2015) investigated the CLIL model, which combines the objectives of teaching CLIL and science to show how both language and science are being learned in one common concept. The demonstration emphasizes the energy of collaboration between dialect learning and subject substance, suggesting that learning chemistry through an external dialect can enhance phonetic and logical competencies. This approach is at the heart of the European Union`s goal to ensure that every citizen can speak at least two dialects to expand their native language, thus promoting multilingualism and worldwide communication skills. By using this demo, teachers can create an immersive learning environment, in IT, students communicate with logical content in a remote dialect and then progress in their dialect abilities, expanding their understanding of chemistry. This show serves as an effective system for teachers seeking to perform CLIL in scientific research, describing the potential benefits of coordinating dialect and substance learning. This model of CLIL in chemistry allows the goals of the two fields to be integrated into the CLIL chemistry divisions, and this model has seemed suitable for achieving scientific literacy. The idea of integrated content and language learning, or CLIL, may contribute to the EU`s language goal-each person must speak at least two languages in addition to their native language. Chemistry is now not often taught as a CLIL subject in Germany; this may be due to the obvious differences between the goals of teaching science and learning foreign languages. This article presents a model that combines scientific educational goals with CLIL, which shows how language acquisition and scientific learning goals can be promoted within a single integrated idea. This article presents a project that combines the CLIL (content and language Integrated Learning) and IBSE (research-based science education) methodology to engage students in scientific practice and foreign language communication. The project "chemistry, CLIL and IBSE" aims to create a spectroscopy lesson using ITC tools, combining the CLIL and ISBE methodologies.

The IBSE approach encourages young people to engage in scientific topics, acquire scientific research skills, and experience a culture of science research through active leading experiments. IBSE is a five-stage methodology for teaching scientific disciplines, offered in Grasp Further and Go-Lab authoring environments. It includes activities, materials, and interactions for teachers and learners, focusing on teaching aims, basic competences, evaluation, and facilities in each lesson plan.

The Graasp platform allows students to conduct personalized scientific experiments with online laboratories in pedagogically structured and wooded educational institutions. Clotilde and Andrea (2016) examine the integration of CLIL

(Content and Language Integrated Learning) and IBSE (Inquiry-Based Science Education) methodologies in a chemistry learning unit, discussing their impact on student engagement and learning outcomes. The chosen theme emphasizes content, and the CLIL methodology forces non-native students to engage in English, using English to read, write, and speak. The discoveries propose that combining CLIL with IBSE techniques can make an energetic learning environment where understudies effectively take part in logical investigation whereas making strides their dialect aptitudes. This approach not as it were upgrades substance information but moreover cultivates basic considering and communication capacities in a remote language. The authors are both chemist students at the language center of the University of Calabria. The study proposed a project work that combines CLIL and IBSE methodologies to involve them in activities such as observation, exploration, use of computer equipment, data processing and reflection. The inquire about centers on a chemistry unit outlined to instruct spectroscopy, pointing to lock in understudies in both logical request and remote dialect utilize. The review deals with the use of data and communication innovation (ICT) devices to encourage this coordination approach, contributing to the simultaneous development of dynamic learning and dialect. Teaching the discipline CLIL-educational games for improving the educational process: Physics and chemistry in secondary education Rodriguez et al. (2014) a study of the use of educational games to improve the teaching-learning process of CLIL subjects with a special emphasis on physics and chemistry in secondary education. The Thinker emphasizes the use of various learning activities such as hot potato, scratch and What2Learn to stimulate the learning process in the CLIL settings. The integration of these intelligent devices has shown that students are more motivated and active to learn, making the learning experience more energetic and enjoyable. The study suggests that the use of instructional diversions can lead to a better understanding and preservation of logical concepts, as well as, improved dialectal bias in the target language. This study highlights the potential benefits of combining innovation and intelligent strategies in CLIL programs to create a more engaging and engaging learning environment.

This study suggests an experience that combines the flipped classroom methodological model with the addition of foreign language instruction to support the development of linguistic and transversal abilities in three areas of the University of Huelva`s Chemistry degree program (Spain). The use of this technique in various didactic units for every topic is part of our proposal. The method is developed over the course of four distinct phases, beginning with the programming of the experience; developing the teaching materials for their development based on the students` independent work; and culminating in classroom work and the resolution of any doubts that arise. This teaching-learning process has been implemented successfully all around the world. One of the most important and ongoing goals is the advancement of teaching foreign languages (DLEX) is a component of university education.

This goal serves two purposes: first, to increase the prospective university graduate`s level of internationalization in preparation for their personal and professional lives; second, to get a deeper understanding of the subject matter of each degree in conjunction with the acquisition of a second language. Thus, instruction in a

language other than the student`s mother tongue can help pupils acquire transversal abilities concurrently with foundational knowledge, mostly by raising their level of language proficiency. Furthermore, from an institutional perspective, the implementation of Content and Language Integrated Learning (CLIL) can enhance university teaching`s competitiveness. Additionally, university education needs to support the development of proactive, self-assured, individuals who possess curiosity, initiative, and inventiveness and who can see the need of striking a balance between work and reward. To satisfy students who are evolving together with society, the educational system has to support both learning new things and teaching in novel ways. Although crucial, cognitive skills alone are insufficient; in addition, transversal abilities like creativity, critical thinking, and communication, as well as important attitudes like self-assurance, zeal, persistence, and acceptance of change, must be developed from a young age. The "master class" is currently the most widely used and conventional teaching approach in university settings, one that we may assume to have been implemented for the most part. "A teaching time entirely or primarily occupied by the continuous exposition of a lecturer" is one way to characterize this. In general, students only listen and take notes, however they occasionally get the chance to ask questions or take part in brief discussions (Angelo 1990, Isaza-Restrepo 2005, Sanchez 2013). This kind of teaching methodology, when used and or abused, has led to a problem with student attitude in the classroom: the student attends class, but because everything is focused on speech and the material is typically presented as a PowerPoint presentation, the student`s attention is not on the teacher`s explanations. Along with a general lack of desire, this also adds to an increase in absenteeism as the school year goes on. Therefore, it`s critical to support a work style that motivates students and enables them to fulfill the requirements of a degree program by helping them acquire the skills they need in each topic. It may be argued that the "flipped classroom" approach to education is the best suitable for implementing a teaching-learning strategy that integrates the two previously described ideas of independent student growth and foreign language instruction.

This pedagogical model was put into practice by Bergmann and Sams (2012). Instead of using the time of the course to address and give homework after a while, students are guided by the recommendations for doing homework and apply the knowledge gained as part of the course classes. Classroom time is used for dynamic learning meetings, develops deeper understanding and cooperation between students. Teachers can draw personal attention by meeting students' special needs and encouraging content dominance. Although the flip-class show was not originally characterized by teaching content and dialect coordinates (CLIL) in intelligence, its standards can be reliably included in the CLIL settings. By conveying the subject substance in the external dialect of the course and using the course time to practice intuitive dialect skill and substance, teachers can improve both their dialect ability and understanding of the subject. It uses class time and teacher experience to support and improve other processes of knowledge and practice in the classroom. It temporarily moves the work of some educational processes outside the classroom. This methodology offers a thorough approach that combines constructivist and direct

teaching methods, enhances, improves the conceptual understanding of students and their interest and interest in the course material. An inverted classroom learning strategy involves students working independently on tasks prepared in advance by the teacher (Jordan et al., 2014). Anyway, Jordan J. there is a corresponding article "content-based learning, substance-based and dialect coordinate learning: a comparison" written by et al. Distributed in dialect education in 2014. This article analyzes the characteristics of the content-based manual (CBI) and CLIL to explore their similarities and contrasts. The authors explore how both approaches reflect dialect learning combined with substance learning, but they have different uses and focus. This study provides some knowledge of the hypothetical foundations and simple uses of the two strategies, which contributes to understanding how dialect and substance can be successfully combined in instructional settings. This approach improves student learning by changing the role of teacher and student (Jimenez, 2013). This book summarizes key examinations and experimental considerations on the hypothetical and viable prospects of CLIL, examining its viability in improving dialect competence through substance learning. This volume covers the commitments of various analysts, providing a comprehensive diagram of CLIL`s impact on different instructional contexts. This is because students begin to study the material outside of class and deepen it during face-to-face classes with the support of the teacher and discussions from other students. This has a direct impact on how students learn and assimilate content.

Ruiz et al. (2021) explore the use of flip-class learning in organic chemistry in the context of content and language Integrated Learning (CLIL), focusing on its effectiveness in Higher Education. The survey showed that CLIL programs are associated with significant changes in students' ability to write dialects at a distance, especially in their communicative abilities and phonetic accuracy. Although the acquisition of dialects was obvious, the effect on the acquisition of subject substances was less pronounced, indicating that making adjustments between the learning of substances and dialects remains a difficult task. A well-known idea about the prevalence of digital queries to focus on phonetic results is that little attention is paid to substance learning. The authors noted the need for a longitudinal study to study the long-term effects of CLIL on both dialect and substance learning in a variety of instructional contexts. This audit highlights the importance of regulating substance and dialect learning in CLIL programs and encourages comprehensive thinking to fully ensure its effectiveness. This study recognizes that both ordinary chemistry and CLIL chemistry sessions rely on the same regulatory rules, but it also emphasizes the continued need for innovative school chemistry curriculum in Germany. Participatory action research (PAR) and state-of-the-art curricular innovation research should be paired for successful curricular innovation. A network of cooperating multilingual chemistry professors does not exist. In order to find potential subjects that might serve as springboards for innovation, a requirements analysis and the creation of a database on CLIL chemistry in Germany are carried out. Teachers of bilingual chemistry across Germany were the target audience for the requirements analysis that focused on their requests for bilingual teaching materials. There is an open portion

and a closed component to the questionnaire. North Rhine-Westphalian CLIL biology instructors were also involved. Brunnert, Tausch, and Bohrmann-Linde (2020) the study shows that several important areas in the curriculum of biology and or chemistry are highly demanded by the respondents. Particular attention is paid to substances that facilitate photosynthesis and respiration. The supply of bilingual biology in NRW and bilingual chemistry in Germany was the subject of the creation of a relevant database. One creative theme was chosen with the aid of the survey. Teachers will be chosen for PAR based on this. Moreover, the teachers` replies have supported present efforts toward the production of multilingual chemistry teaching materials.

English-language science instruction has emerged as a critical requirement for Vietnamese education in recent years. Teaching science courses in English still confronts numerous challenges for a variety of reasons, despite being tested in high schools for bright children and highly qualified schools with experienced teachers and good students. The most difficult one of them would be choosing a suitable teaching strategy. Even pupils who excel in science disciplines sometimes lack confidence when it comes to English. Conversely, those who are fluent in another language tend to have a phobia of science and lack specialized terminology related to science. Because it can combine both science knowledge and English proficiency, the Content and Language Integrated Learning (CLIL) method to teaching science subjects has great application potential in this context. English-language science instruction has emerged as a critical requirement for Vietnamese education in recent years. The application of the CLIL approach in designing chemistry lesson plans for high school students has been studied by Hoang and Ha (2019), who highlight its potential to improve educational outcomes in both language and science education. Teaching science courses in English faces many challenges for many reasons, although it has been tested in high schools for capable children and highly qualified schools with experienced teachers and good students. "Consideration" describes the Core standards of CLIL, highlighting its dual orientation to substance and language, as well as its potential to create a more limited and viable learning environment. The authors propose to combine an organized approach to planning plans for Chemistry Lessons based on CLIL, methods that combine dialect learning with logical content. An educational test exam, conducted in Higher Education and the School of Natural Sciences, is presented, which illustrates the use and results of CLIL in the classroom on the ground.

This thought contributes to understanding the feasibility of CLIL in non-Western educational institutions, especially in Vietnam, where the emphasis is on bilingual education. The most difficult of them is to choose a suitable training strategy. Even students who excel in science sometimes have low self-confidence when it comes to English.

In contrast, those who are fluent in another language are prone to science phobia and do not have specific terminology related to science. Since it can combine both scientific knowledge and English proficiency, the content of teaching science

subjects and the method of language Integrated Learning (CLIL) have great applied potential in this context.

Education professionals must take many factors into account when creating CLIL programs in order to create a curriculum that effectively improves students' language and understanding of the subject. When constructing general and theoretical concepts of the CLIL curriculum, Coyle et al. The "4Cs Framework "(2010) and" Richards " (2013) model of various training program design processes can serve as primary reference points. However, the practical aspect is not only in the case of curriculum changes, timely developments or educational reforms to meet current needs, it should also be taken into account when two or more teachers work together in the CLIL program. An ongoing PhD project by Dalton-Puffer (2013) on a CLIL science course at an Austrian high school that uses the structure of cognitive discourse functions (also known as CDFs) as a planning principle for a language and content integrated curriculum is used to illustrate these issues in this article. It alludes to the subject or information that students study, which is conveyed through an external dialect. The center aims to ensure that this item is relevant and important to students. This includes the use of the remote dialect as a means of teaching and conveying thoughts. It emphasizes the advancement of dialectal bias, which is important for successful communication in scholastic and real-life contexts. This refers to the cognitive forms included in learning, such as basic consideration, problem solving and higher-order improvement, taking into account aptitudes. This allows students to master the content and language in depth. This component is aimed at the development of intercultural attention and understanding. It includes the study of social conditions and attitudes, promoting consideration of differences, and planning doubles for citizenship around the world. It is planned that the 4Cs system will be adaptive and versatile, suitable for different levels of study and disciplines. It serves as a tool for teachers to organize and update CLIL classes, organized and comprehensively covered, ensuring the simultaneous perception of content information, dialect ability, cognitive improvement and social attention.

In CLIL, educational modules begin with a curriculum plan that combines the content and dialect components. This approach emphasizes the simultaneous progress of subject Information and dialect acquisition. Training includes the selection of compliance guidance materials, the organization of exercises that stimulate both the acquisition of content and the maintenance of dialect safety, and the implementation of assessment techniques that assess both aspects. CLIL is aimed at improving the cognitive abilities of students, taking into account the main points, and the scientific possibilities of dialects are realized by immersing them in the content transmitted by a distant language. This system provides an organized approach to planning CLIL programs that combine content and dialect learning. The goal of the project is to demonstrate how CDFs can be used in the design of training programs for CLIL environments. Prior to the start of training, a number of curriculum objectives were developed regarding the language acquisition of students. The EFNS language component aims to improve students` language proficiency in general and content-

related areas, facilitate understanding of basic thematic discourse, and enable students to enroll in university-level research courses in English (Hasenberger 2018).

The mandatory improvement of CLIL educational programs requires a corrected integration of content and dialect areas, ensuring the simultaneous adaptation of both areas to encourage comprehensive learning. The article emphasizes the importance of transforming hypothetical systems into noteworthy teaching procedures, emphasizing the need for teachers to adapt and implement these models in a viable way in their specific educational institutions. Collaboration between teachers, especially between substance and dialect instructors, is essential for the effective implementation of CLIL programs. Shared organization and shared understanding improve the coherence and consistency of the curriculum.

This mindset promotes continuous conversation about CLIL, linking hypothetical concepts to viable educational methods, advertising to teachers the most important pieces of knowledge aimed at actualizing CLIL in their classrooms.

The purpose of this study is to present the basis and model for teachers ` fluency in English in teaching chemistry. Writers define the three-component structure of training as a complex personal education, consisting of positive motivation (attitude) to the process being implemented, the ability to plan and implement what is actually planned, the skills to evaluate and change., and knowledge of subject-methodological and linguistic content in their integration. Babich and Shakirova (2020) examined a detailed description of the approach used in the training of pre-service teachers for their readiness to teach chemistry in English. The system, the formation of competencies, methods of socio-constructive and personal activity are the basis for the construction of the model. The study in question looks at how combining the CLIL and IBL approaches can improve the viability of education when planning prior services for chemistry teachers. It talks about the issues and procedures involved in combining Content Learning with dialect learning, which indicates the promotion of both subject skills and dialect skills. The study highlights the potential benefits of this coordination approach in creating a more energetic and successful learning environment for future educators. This consideration contributes to a continuous conversation about inventive learning strategies in multilingual and multicultural instruction settings.

The theory of the link between thinking and speech by L.S. Vygotsky, BICS/CALP, serves as its theoretical and methodological foundation. J. Cummins, the speech activity theory, the scaffolding theory, and the taxonomy of learning objectives in Bloom`s cognitive domain. The article lays out the specific skills required of pre-service teachers, the prerequisites for their preparation, and the pedagogical concepts that underpin instruction. The fundamental teaching strategies for the optional course "Learning and Teaching Chemistry in English" are explained in depth. They are based on the combination of two cutting-edge teaching philosophies: inquiry-based learning (IBL) and content-and-language integrated learning (CLIL). Despite its advantages, CLIL in chemistry faces a number of difficulties. Studies such as Banegas (2012) and Perez-Canyado (2018) indicate the need for advanced training, as many chemistry teachers are not sure if they teach in a

second language. There are also recurring issues related to curriculum alignment, limited resources, and difficulty in evaluation. Banegas emphasizes the need for comprehensive educator improvement programs that address both content and dialect learning. It considers the challenges facing teachers, calculates the requirements for specialized training and the adjustment of teaching methods to successfully combine content and dialect teaching. The article highlights the importance of continuous professional achievement and intellectual excellence to overcome these challenges and increase the adequacy of CLIL programs.

A longitudinal study carried out in Spain with more than 1,000 students studying more than 1,000 CLIL and about 1,000 English as a remote dialect (EFL) in more than 53 schools shows that teaching in CLIL leads to significant advances in L1 and substance learning outcomes.

In advanced training, a combination of basic topics and dialects is becoming increasingly important, especially in multilingual situations. The CLIL approach (the study of basic topics and dialects is coordinated) is becoming increasingly important due to its ability to improve understanding of subjects and develop skills beyond the study of dialects. This study points to the need to study how CLIL affects students' academic achievement and improved speaking in chemistry lessons. It highlights issues such as lack of resources, different dialect abilities, and insufficient instructor training that schools face when implementing CLIL. The aim is to assess how much CLIL improves students' chemistry knowledge and English proficiency compared to traditional strategies. Based on the review, the following research questions were indicated.

METHODOLOGY

2.1 Research design and approach

Content and Language Integrated Learning (CLIL) is an educational approach in which students learn a subject, such as chemistry, with the help of a foreign language. CLIL is an effective method that promotes the development of academic education along with communicative competence, combining both the subject matter and the goals of language learning. This method is used in other multilingual countries and improves language acquisition without reducing the content of the curriculum. The deep study of science with the help of CLIL opens up new opportunities and sets new challenges. Chemistry includes academic terms, scientific concepts, and complex reasoning, making it a rich field of integration of language and content. Using CLIL in chemistry lessons can deepen students' understanding by encouraging them to discuss, communicate, and contextualize scientific terms in a foreign language. This process not only enhances language learning, but also enhances scientific literacy. Previous research has shown that CLIL can positively influence students' motivation, engagement, and academic performance. Studies (e.g. Coyle, 2007; Mehisto, 2008) emphasise that CLIL promotes deeper learning and improves both language competence and subject understanding. Coyle`s work highlights the importance of integrating CLIL inquiry about into the broader field of bilingual education in order to enhance its viability and relevance in various learning contexts. The creators explore how dialect and content learning can be effectively combined, providing examples of CLIL applications at the primary, auxiliary, and professional levels. Their work serves as a comprehensive guide for teachers who want to gain knowledge and apply CLIL methods in various educational institutions. Together, both works have contributed to the development and understanding of CLIL by promoting hypothetical systems and practical experiences that influence CLIL research and improvement today.

A pedagogical experiment is a scientific approach to changing the pedagogical process under well-defined conditions. A pedagogical experiment is conducted to confirm the effectiveness of a teaching method or a predictive theory. A pedagogical experiment can be conducted in a classroom, several classes, a group of students, or even in a school, depending on the purpose. Research can be short-term or long-term.

A pedagogical experiment begins with the preparation of a research hypothesis and the preparation of an experimental plan. Then, following the planned plan, it consisted of analyzing the conclusions, taking the results. The pedagogical experiment is based on the theoretical foundations of integrated content and language learning (CLIL), which combines subject learning and language learning. This approach is being used in scientific education to increase the activity of students, develop language skills and a deep understanding of the subject. The experiment was conducted to study how CLIL methods affect students ' performance in chemistry and how teachers perceive their effectiveness in a specific learning environment. In addition, some studies point to issues such as increased cognitive load and the need

for additional teacher training, especially in technical disciplines such as chemistry. Based on this theoretical basis, this experiment is intended to differentiate how effectively CLIL can be used in the secondary chemical education system. The aim of the experiment is to evaluate both student performance and teachers ' attitudes, thus forming a balanced assessment of the practical impact of CLIL in the classroom. Pedagogical experiment is a scientific method used in education to test hypotheses, determine the effectiveness of teaching methods, and improve learning experience. Therefore, this study contributed to this study by examining how CLIL methods affect students ' academic success in chemistry and examining the experience, challenges and recommendations of teachers through quality interviews and content analysis.

Combining quantitative and qualitative results, this study focused on providing a deeper and more practical understanding of the role of CLIL in scientific education. By comparing quantitative achievement data with qualitative teacher assessments, this study provides a comprehensive assessment of the pedagogical value of CLIL in teaching chemistry in secondary schools. This study examines the use of content and language Integrated Learning (CLIL) in chemistry education in schools of various levels in the context of high school 10 th grade. Despite its effectiveness in language education, there is a lack of empirical research on its effect on chemical indicators, which has been held in our own ordinary schools. The study combines quantitative data with qualitative feedback from teachers to provide a holistic view of the impact and effectiveness, challenges and recommendations of the CLIL approach in scientific education. Combining statistical results with personal experiences and observations in the classroom, the study shows both measurable progress and contextual nuances that affect student learning and participation.

The proposed CLIL-based curriculum was aimed at combining the development of both subject knowledge and academic language proficiency. English is primarily used as a means of communicating scientific terminology, task instructions, and comments on content, accounting for about 30% of classroom communication. The targeted use of English is aimed at familiarizing students with international scientific vocabulary and language structures related to chemistry. At the same time, Kazakh remains the main language of instruction, which is used to give a deep conceptual understanding and support students in the full assimilation of complex scientific ideas, which takes up about 70% of the study time. To further improve the assimilation of the material, students were offered visual aids such as bilingual diagrams and technological maps, which allow students to establish linguistic and cognitive connections between the two languages. In addition, students will be actively encouraged to participate in discussions, group work, and reflective activities using both English and Kazakh. This bilingual interaction aims to improve their understanding, increase cognitive flexibility, and promote the natural integration of content and language skills. The CLIL methodology is based on the 4Cs Framework developed by Do Coyle, which includes:

Table 2.1.1 *4C Framework*

Component	Application to Redox Reactions
Content	Mastery of subject matter, including discipline-specific knowledge, concepts and skills.
Communication	Developing the language skills necessary to learn and express subject content, with an emphasis on real-life communication.
Cognition	Engaging in higher-order thinking processes such as analysing, evaluating and creating to deepen understanding of both language and content. An integral component of CLIL is the Language Triptych, which describes the multifaceted role of language in learning. Language of instruction: Specific vocabulary and grammatical structures necessary for understanding and mastering new material. Language for learning: The language needed to participate effectively in classroom activities, including discussions, instructions and collaborative tasks. Language for learning: Emergent language that develops as learners interact with content and peers, fostering deeper cognitive interactions.
Culture	Real-world applications in technology and environmental science (e.g. corrosion, electrochemistry in batteries, biological redox processes)

2.2 Data collection

The main question based on this study is: "How does the use of CLIL (content and language integrated learning) methods affect students' performance in chemistry and how do teachers perceive their use in the classroom?". To find an accurate answer to this question, an additional questions considered the study was conducted in two directions, including the academic effectiveness of CLIL in improving student learning outcomes and the practical experience of teachers using this method in real classroom settings. For a comprehensive study of this problem, a combined research method was used, combining quantitative and qualitative approaches. This methodological combination was chosen to provide a more complete and comprehensive understanding of the impact of CLIL on secondary Chemical Education.

Qualitative data was collected through semi-structured interviews on classroom observations by teachers. These tools provided rich contextual information on how CLIL influenced lesson passing, classroom interaction, student motivation, and perception of academic performance. This format of the interview ensured the consistency of the questions asked to all participants, as well as the opportunity to delve into personal experiences, ideas and perspectives. Each interview lasted about

30-40 minutes and was carefully planned to collect opinions and suggestions on the effectiveness of the method, the difficulties in its implementation and its practical application in the context of Chemistry Education, based on the teachers ' experience of CLIL to this day. Questions that prompted teachers to interview:

1. What impact does CLIL have on students` performance in chemistry compared to traditional teaching methods?
2. What difficulties do students face when teaching chemistry with CLIL?
3. What are the experiences, challenges and recommendations of chemistry teachers regarding the use of CLIL?

A thematic content analysis was performed to analyze the data. The responses were grouped according to the following key topics:

- The importance of CLIL in teaching chemistry,
- The usefulness and effectiveness of CLIL methods,
- Difficulties in implementation,
- Difficulties in teaching students,
- Recommendations for the effective use of CLIL.

The personal nature of the interview facilitated a personal and open dialogue, encouraging participants to talk in detail about their experiences and give detailed answers. As part of the quality data collection process, semi-structured face-to-face interviews were conducted from seven chemistry and physics teachers who were already using a content and Language Teaching (CLIL) approach integrated into their teaching practices. All interviews were recorded in audio recording with the consent of the participants to ensure that their answers were presented accurately and fully. The records were carefully transcribed and translated into written text to prepare the data for systematic analysis. This process helped maintain the richness and integrity of teachers ' views and ensured that valuable information was not lost during the explanation. The text was encrypted and the data was analyzed through thematic analysis, which included encoding and categorizing the content to identify duplicate patterns and key themes. This analytical approach made it possible to obtain meaningful information about the implementation of CLIL in Chemical Education, expected benefits and contextual issues. The results of these interviews provided important qualitative support for the overall assessment of the CLIL methodology in the study.

Quantitative data was collected through pre-and post-test tests to assess significant progress in student performance in chemistry as a result of the implementation of CLIL. These tests made it possible to analyze academic performance and compare different school conditions. Questions pre and post the test are taken from the website of the National Testing Center. The questions were previously used in the national unified testing of chimes in English and they are validity. To assess the effectiveness of CLIL (content and language Integrated Learning) in Chemical Education, a quasi-experimental research method was used, in which 6 classes took part: with experimental and control groups. This method made it possible to compare the learning outcomes of students in different learning environments while preserving the natural environment in the classroom. The entire

group also underwent pre-and post-test tests to evaluate their conceptual understanding of chemistry, with particular attention to chapters on redox reactions and atomic structure. The experimental group was trained using the CLIL methodology, which supports the tasks of subject vocabulary and communicative learning, using targeted methods for constructing frameworks, combining the content of chemistry with the development of the English language. In contrast, the control group was taught using traditional teaching methods, teaching was conducted only in the students' native language, and there was deliberately no focus on comprehensive language teaching. The use of standardized test tools before and after the intervention provided a reliable basis for assessing changes in student performance and served as the basis for determining the object of study and selecting participants in experimental and control groups. These groups were comparable in age, prior knowledge of chemistry, and general English proficiency, which ensured the intrinsic validity of the experiment plan. This methodological approach allowed the researcher to determine the influence of the CLIL approach on the results of the study of chemistry and draw important conclusions about its effectiveness in real class conditions. Covariance analysis (ANCOVA) was carried out using a specific program to assess the impact of the CLIL approach on low learning outcomes in chemistry Jamovi.org conducted in the software application.

This was chosen to account for any initial contradictions in strategy execution prior to the actual outcome and to provide a more accurate assessment of the impact on learning. As part of the ANCOVA analysis: this test takes place after serving as a subordinate variable indicating the victory of students after the application of the new method. It has been some time since the recently obtained scores were included in the test within the covariates, which made it possible to correct the results after the test depending on the level of initial information. This explanatory approach made it possible to compare the results that occur after testing between the control and test groups, as well as measurable observations of the contradictions in recent testing. The emergence of ANCOVA had a significant impact on the exact implementation of the CLIL learning strategy in comparing the results obtained in chemistry, which led to the fact that the use of CLIL had a positive effect on learning outcomes.

During the expansion, the amount of effect generated in ANCOVA was very important, indicating that the observed contrast is not important from the measurable point of view, but also from the point of view of the guide. This includes: an ANCOVA outline table in which real significance levels (p-values) and impact values (p-values for illustration) appear. fractional calculated arrival time squared), negligible mean points that appear to be balanced midpoints for each group after accounting for Covariant opposites, and rare comparisons used to reflect pairwise opposites between the test and control groups were evaluated. This allows the viability of the CLIL strategy to be returned reliably experimentally in improving advances within the framework of Chemical guidance.

It was aimed at increasing the reliability of research conclusions through the process of aggregating data comparing and verifying results from multiple sources. This approach allowed us to take into account both quantitative academic results and

the subjective, human aspects of CLIL implementation, which allowed us to more fully understand its effectiveness and the context in which it thrives.

To establish the theoretical basis of this study, a comprehensive review of the relevant literature on about 50 topics was carried out. For research purposes, data was systematically collected from several reputable academic databases and research platforms. In particular, Scopus, Research Gate and Google Scholar were used as the main tools for identifying and accessing high-quality peer-reviewed publications. These platforms provided a wide range of academic resources, including journal articles, conference proceedings, doctoral dissertations, and Research reports on the use of integrated content and language learning (CLIL) methodologies in Chemistry Education at the middle and advanced levels.

When choosing sources, we were guided by specific criteria, including the relevance of the topic, the novelty of publications, methodological rigor and reference to 35 literary sources based on their contribution to understanding the pedagogical value of CLIL in the field of natural sciences. The same collected literature that not only provided the conceptual and theoretical basis for the study, but also helped identify important gaps in the study. In particular, these include the lack of localized research in the context of Kazakhstani education and a limited amount of empirical evidence confirming the effectiveness of CLIL in content-specific areas such as chemistry.

The information obtained from the considered literature played a huge auxiliary role in the formation of the overall research plan. They served as the basis for formulating research questions, justifying the use of a mixed approach, and developing data collection tools, including guidelines for conducting diagnostic tests, structured control protocols, and semi-structured interviews. This comprehensive and methodological review of the literature ensures that the study is based on modern academic discourse and meets internationally recognized standards of Educational Research.

2.3 Participants

2.3.1 Teachers (interview from teachers)

Qualitative content analysis has been applied to interview transcripts to systematically interpret the data. The answers were encoded thematically, and repeating ideas were identified as key concepts. Then each code was analyzed based on its frequency, in particular, on the number of participants who noted it, and expressed as a percentage of the total number of teachers surveyed (N=7). These teachers were selected through a targeted selection based on their direct participation in the teaching of CLIL-based chemistry. The participants were teachers from 4 different schools and 2 universities with experience in teaching from 3 to 15 years. Such diverse experience made it possible to approach the implementation of the CLIL approach from different points of view. All teachers who participated in the study voluntarily agreed to participate in the surveys. Before the start of the surveys, they were informed about the objectives of the study and were confident in the

confidentiality and anonymity of their answers. Each participant received a written informed consent. This process made it possible to structurally compare the generally accepted opinions of teachers on various aspects of the implementation of CLIL. The integration of subject coding with frequency analysis made it possible to create its own methodological triangulation, combining the depth of qualitative analysis with the main quantitative indicators. This mixed methods strategy provided both practical prospects and measurable models for the use of CLIL in chemistry education. This contributed to a holistic understanding of the phenomenon under study, linking the life experience of teachers with broader trends and observations.

2.3.2 Students

The study was conducted in three different educational institutions, each with unique characteristics and learning priorities. In the first school, two groups of students from the school with the Kazakh language of instruction took part, which were engaged in a great focus on chemistry and targeted preparation for the unified national exam (UNT): control and experimental. Both groups underwent pre-and post-testing procedures to assess the effects of CLIL-based interventions. The second object of the study was the International Baccalaureate (IB) school, where English is the main language of instruction. Given that the school pays special attention to international educational standards and fluency in English, one class was chosen as an experimental group. After the intervention, data was collected before and after the test to assess changes in subject knowledge and language competence of students. The third school was a highly successful Lyceum, known especially for its academic achievements in chemistry and English. One class was assigned here as an experimental group, and preliminary and subsequent testing was carried out, as in other schools. The results of about 100 students in 6 classes who participated in the study from schools were considered. Involving schools with different language and academic knowledge, the study aims to gain a broader understanding of the effectiveness of the CLIL methodology in different educational contexts. A comparative analysis of the data of these three schools provided valuable insight into how contextual factors such as language of instruction, academic orientation, and institutional priorities influence the results of CLIL implementation in chemistry education. The integrated content and Language Teaching Methodology (CLIL) was systematically applied in experimental groups of all three participating schools. In cases where experimental and control groups were included, a comparative analysis of the results before and after the test made it possible to directly assess the impact of CLIL on students ' performance in chemistry. This intra-school comparison allowed a controlled assessment of the effectiveness of the method in expanding both content knowledge and language skills in comparison with traditional teaching. Academic performance of these groups, based on preliminary training- post-intervention assessments were compared with each other to determine how institutional and linguistic variables such as teaching method, curriculum type, and academic direction affect the success of CLIL implementation. The study, which includes in-Group and interdepartmental comparisons, aims to gain a deeper understanding of the

pedagogical value and contextual effectiveness of CLIL in secondary Chemical Education. This approach has contributed to a comprehensive analysis of how CLIL works in different school environments, thus contributing to an increase in the number of studies on its practical application in teaching the Natural Sciences.

Table 2.3.2.1 *Information about school*

School	**CLIL experience**	**English level**	**Chemistry level**	**Number of Students**
School 1 (Kazakh school)	New to CLIL	Lower	High	34
School 2 (IB school)	New to CLIL	High	Medium	30
School 3 (Lyceum)	Already using CLIL	High	Medium	30

2.4. Research Procedure

Combining quantitative and qualitative methods, the study offered a comprehensive analysis of the effectiveness of CLIL in the context of teaching chemistry. The answers given by teachers to interview questions clearly explained how CLIL is implemented in a specific classroom environment, which pedagogical strategies are effective and what problems arise during learning. This qualitative component played a key role in enriching general conclusions. It reflected the professional experience, practical knowledge and pedagogical reflections of teachers, which complemented the statistical results and contributed to a more detailed and contextually informed understanding of the role of CLIL in chemistry education. The results of quantitative analysis showed significant progress in CLIL-related learning, and qualitative results allowed a deeper understanding of the reasons for these results. The procedure included the following steps:

1. Preparatory stage: Work on the study began with the selection of schools of interest, where the CLIL strategy is effectively implemented in chemistry classes. The research work was explained to the school organization and students. After a while, pre-test and post-test tasks were compiled to evaluate students ' chemistry information. As part of the expansion, a direct meeting with semi-structured questions was organized to collect quality information from instructors.
2. Selection of participants: The study involved three secondary schools selected based on similar academic performance and the availability of CLIL-trained teachers. It was attended by 10th grade students, their chemistry teachers and the school administration. Students in the experimental (CLIL) and control (traditional) groups were given a preliminary test to assess their initial level of knowledge in chemistry. Pretest guaranteed that any post-test improvements could be attributed precisely to the teaching method used.
3. Preliminary testing: Implementation of the CLIL program for 6-8 weeks, the CLIL approach was taught in separate classes, in which the chemistry content was presented in English. The teachers used specially designed CLIL lesson plans that include language support strategies. The control groups followed the

traditional method of teaching in the national language. A preliminary chemistry test was conducted to assess the basic knowledge of all students. An additional test was conducted after the intervention to assess the students` performance in chemistry. The results of the preliminary and subsequent tests were compared using ANOVA to identify the initial differences.

4. High-quality data collection was carried out Semi-structured interviews were conducted with teachers and students to gain insight into the CLIL experience. The observation data in the classroom and interviews were analyzed thematically.
5. The data obtained were summarized to draw conclusions about the impact of the CLIL method on chemistry education. Based on the results obtained, recommendations were prepared for teachers and policy makers.

2.5 Data analysis

The data analysis process was conducted systematically to address research issues and evaluate the effectiveness of the CLIL approach in chemistry education. Quantitative data analysis Quantitative data was collected through pre- and post-test tests conducted among students from three different schools, each representing a different approach to learning (CLIL and non-CLIL). The following steps were taken to analyze the data: Descriptive statistics Averages, standard deviations, and frequency distributions were calculated to summarize student results during pre- and post-test testing in all groups. Checking assumptions Before performing logical statistics, assumptions about normality, uniformity of variances, and linearity were tested using Shapiro-Wilk, Levene`s criterion, and scatter plots, respectively. ANCOVA (Covariance analysis) To compare the results after testing in three schools, the ANCOVA method was used, which takes into account the results before testing as a covariant. This analysis helped determine whether the differences in grades after testing were related to the teaching method (CLIL or traditional) rather than the initial knowledge of the students. Tests after testing in cases where significant differences were found, post-Bonferroni tests were performed to determine which specific groups differed from each other. Data was collected through classroom observations and semi-structured interviews with students and teachers. The analysis included the following steps: Decoding and familiarization with the materials All interviews were transcribed verbatim. The recordings made during the classroom observations were analyzed and systematized. Coding and categorization The data was encoded using thematic analysis. The source codes were grouped into categories related to teaching strategies, student engagement, language development, and content comprehension.

The results obtained from qualitative data were compared with quantitative results to gain a complete understanding of the impact of the CLIL method. Integration of quantitative and qualitative data The final stage of data analysis included the integration of quantitative results (student performance and statistical significance) with qualitative results (student and teacher experience).

RESULTS

3.1 Findings of interviews from teachers

3.1.1 Perceptions and experiences of chemistry teachers regarding the use of the CLIL method in secondary schools

Interviews were conducted with seven chemistry teachers who are implementing CLIL (Integrated Learning of Content and Language) into their teaching practice. The qualitative data obtained during these interviews were analyzed and distributed across key thematic areas. The summary table presents teachers` opinions on the importance and difficulties of using CLIL in chemistry teaching.

The tables show: the frequency of mentions the percentage of teachers who mentioned a specific topic or ideas calculated based on the total number of participants (N = 7) to show the proportion of teachers who share the opinion of each of them. This analysis reflects the general opinion of teachers about the effectiveness of CLIL, its advantages for understanding the content and language development, as well as the challenges faced during implementation, such as students` language proficiency and material adaptation.

Table 3.1.1.1 *Importance of using CLIL in chemistry*

Importance of using CLIL in chemistry	frequency	percentage
Language skills	7	100%
In context	6	85,7%
Scientific (chemical) terms	6	85,7%
More information	4	57%
Academic language	3	42,8%

The table shows the conclusion on the accumulated results regarding the importance of using the CLIL strategy in teaching chemistry. the results of the meeting with seven teachers on CLIL (Integrated Content and Language Learning) are presented. These results show several key benefits associated with the use of CLIL in chemistry classes, which are recognized by participants.

The advancement of linguistic aptitude was recognized as the main imperative advantage, the importance of which was demonstrated by all 7 instructors (100%). This suggests that CLIL contributes to improving students ' language competence with closer subject information. Training in the designation and understanding of logical (chemical) terms was noted by 6 instructors (85.7%) each, demonstrating CLIL's firm commitment to making chemistry more appropriate and accessible through contextualized learning and the provision of a specific vocabulary. It was noted by 4 instructors (57%) that more information will be available in English, which showed that CLIL allows students to learn by using a wide range of sources, taking into account external dialects. The scientific improvement of the language was noted by 3 instructors (42.8%), indicating that, despite being vital, this calculation is considered

somewhat less imperative than the others. The results show that chemistry instructors widely value CLIL, especially for its influence on dialect development and understanding of the subject in a contextualized and coordinated way.

Table 3.1.1.2 *The issues on Usefulness of CLIL methods in Chemistry*

The issues on the Usefulness of CLIL methods in Chemistry	**frequency**	**percentage**
Modern methods, tools	6	85,7%
Complex topics	5	71,4%
Subject knowledge	5	71,4%
Group (projective) work	5	71,4%
Increase interest(motivation)	4	57,1%

This table provides brief responses from seven CLIL staff (Substance and Dialect Learning Coordinates) regarding the acceptability of CLIL strategies in chemistry education. This information points to the main areas where the instructors found the CLIL approach to be the most viable. It is very important that six out of seven instructors (85.7%) are known for using advanced strategies and tools as the biggest advantage of CLIL. This discovery shows that this approach effectively contributes to the provision of inventive teaching methods and mechanical tools in chemistry lessons. During the expansion, five instructors (71.4%) were known to teach complex topics, develop information on the topic and collect it as critical preferences, or distinguish between the sufficiency of venture work. It also shows that group work, active activities, and student-to-student discussion contribute to deeper content provision and promote dual collaboration through student-centered intellectual learning. In addition, four instructors (57.1%) believe that this is a way to help students increase interest and inspiration. Although this approach is systematically less pronounced compared to other advantages, it still demonstrates the positive impact of CLIL on student participation. In general, the reactions obtained clearly indicate that CLIL is considered as an effective educational approach in the context of chemistry teaching. The emphasis on advanced devices, dynamic teaching methodologies, and the integration of dialect and discipline seems to promote both the educational mechanism and student interaction within learning.

Table 3.1.1.3 *Difficulties in Introducing CLIL into Chemistry*

Difficulties In Introducing CLIL into Chemistry	**frequency**	**percentage**
Student acceptance	7	100%
Different level of language	6	85,7%
Subject content	5	71,4%
language barriers	4	57,1%
lack of resources	2	28,6%

This study included a targeted analysis of the problem that arose when the teacher introduced CLIL (a comprehensive study of language and language) in Chemistry Lessons. They were conducted through semi-structured interviews with key CLIL teachers and the results were presented in the table below. According to the results of the study, the most important factor is the admission of all 7 graduates (100%). This is due to the fact that teachers not only show interest in teaching with the help of CLIL, but also support it, forming its educational value. A significant obstacle noted by 6 teachers (85.7%) was differences in the level of language proficiency of students. This discrepancy creates difficulties in effectively presenting the material and ensuring that all students understand it equally. The complexity of the content of subjects, especially chemistry, was reported by 5 teachers (71.4%), reflecting the need to simplify abstract and technical topics in a way that matches students` language skills. 4 teachers (57.1%) highlighted language barriers, emphasizing that limited proficiency in a foreign language can further complicate both understanding and active communication in the classroom. Finally, 2 teachers (28.6%) noted a lack of appropriate educational resources, pointing to the limited availability of CLIL-adapted chemistry materials, which increases the learning burden. In general, the responses emphasize that language factors and student readiness are the most serious challenges in implementing CLIL in chemistry lessons. Although resource constraints are mentioned less frequently, they remain a significant issue that needs to be addressed to support broader and more effective implementation of the CLIL methodology.

Table 3.1.1.4 *Student difficulties in studying chemistry through CLIL*

Student difficulties in studying chemistry through CLIL	frequency	percentage
feedback	7	100%
Student support	7	100%
Through practice	7	100%
Speech problem	5	71,4%
Subject knowledge	4	57,1%

This table presents the views of seven CLIL (Content and Language Integrated Learning) teachers on the difficulties students face when studying chemistry within CLIL. The results highlight a few key areas where students typically struggle and need additional support.

Feedback, student support and learning through practice were mentioned by all 7 tutors (100%). This suggests that students studying Chemistry with CLIL benefit greatly from ongoing feedback, structured support systems, and practice sessions to help them learn both the language and the subject.

Speech problems were reported by 5 teachers (71.4%), indicating that many students have difficulty verbalizing chemical concepts in a foreign language, which may limit class participation and oral assessments.

Subject knowledge problems were reported by 4 teachers (57.1%), indicating that some students have difficulty fully understanding chemistry content when it is taught in a non-native language.

These results emphasize the importance of interactive teaching, supportive learning environment and language development when using CLIL in chemistry. The results also suggest that while content comprehension is important, communication skills and adequate academic support play an equally important role in student success.

Table 3.1.1.5 *Recommendations for the effective use of CLIL in Chemistry*

Recommendations for the effective use of CLIL in Chemistry	frequency	percentage
Language developmwnt	7	100%
Interactive methods	6	85,7%
Internet resources	5	71,4%
Scientific research	5	71,4%
Teachers profiency development	5	71,4%

The table summarizes the recommendations of seven CLIL (Content and Language Integrated Learning) educators for effective implementation of CLIL in chemistry education. The data reflect the key strategies that teachers believe are necessary to improve teaching and learning outcomes in the context of CLIL. All 7 teachers (100%) unanimously recommended the development of language skills, emphasizing the crucial role of systematically improving students` foreign language skills in conjunction with chemistry content to ensure better understanding and communication. Interactive teaching methods were emphasized by 6 teachers (85.7%), pointing out the importance of engaging students in active participation, group work, and hands-on learning to improve both language use and subject understanding. The use of internet resources, integration of research and teacher professional development were emphasized by 5 teachers (71.4%). These responses indicate that teachers see the benefits in: Using online tools and digital content to support learning. Encouraging students to engage in real-world research, which enhances subject knowledge and use of academic language. Improve their own language and methodological skills to deliver CLIL-based lessons effectively.

Overall, the recommendations emphasize a balanced focus on language support, innovative teaching strategies, resource integration, and ongoing professional development to maximize the benefits of CLIL in chemistry teaching. Overall, the survey data indicates that teachers consider CLIL to be a highly effective and valuable approach to teaching chemistry. They emphasized that CLIL not only promotes the development of students` speech, especially academic and scientific vocabulary, but also promotes a deeper and more contextualized understanding of complex chemical concepts. In any case, CLIL has been found to be a fruitful method, even though it has caused certain difficulties in integrating chemistry with the language. Teachers have repeatedly noted that contradictions in the dialect status of students, resistance to modern strategies, and the level of dialect abilities can interfere with viable use. During the expansion, they noted the need for more alignment of adjusted learning materials, intuitive devices, and assets for CLIL-based learning. During the meeting, it should be noted that the training and continuous professional development of instructors is very

important for the formation of the confidence and competence necessary for compulsory education at CLIL. In addition, instructors set rules such as setting time for lesson planning, access to multilingual materials, and collaboration between subject instructors and external dialect instructors. In conclusion, although CLIL provides important opportunities to advance the teaching of chemistry through the combination of dialect teaching and substance, its robust application usually depends on several basic support tools. They include continuous professional development of instructors, the creation of a reliable double support system, and the improvement of instructional materials that are carefully adapted to a specific instruction setting. Without attention to these methods, the potential of CLIL to create important and viable training meetings may not be fully realized.

3.2 Results of the test conducted in the pedagogical experiment

3.2.1 Comparison of the performance of CLIL students in three different schools

For the study on the influence of CLIL on student performance in chemistry, the placement of standardized tests in experimental and control groups was carried out. These tests were planned to experimental group students ' understanding of the content of the chemistry course and their ability to apply basic concepts in problem-solving scenarios. The components of the test included different questions, such as many answer questions, only one correct answer question, and tasks to solve identification and contextual questions, which were regulated by the chemistry educational modules to ensure compliance with the learning objectives. Preparation for testing was carried out in two stages: preparatory tests were carried out at the beginning of thinking, more recently at the beginning of the school period, to assess the initial information and important scientific progress of students.

At the end of the thinking phase, additional tests were carried out to assess the compliance of the CLIL approach with the success of students in understanding the subject. This testing convention provided a clear system for studying changes in scholastic performance of students and comparing CLIL learning strategies with traditional approaches to teaching. The test questions used in this thinking were taken from the English-language database of the National Testing Center. These questions are part of the standard test tasks that have been fully tested and are often used in national exams, which guarantees a high level of unbreakable quality. Given that these questions were planned to reliably study a wide range of Scholastic inclinations and information in different instructional parameters, they were considered suitable for this consideration. The unshakable quality of the tests is confirmed by their indicated adequacy in conducting assessments at the national level, which guarantees an accurate assessment of visible information and abilities. Testing was carried out in agreement with the standard method of reducing any bias or illegality in preparation for testing. Both preparatory testing and subsequent testing were conducted in a controlled classroom environment, which ensured that all participants received the same knowledge and were promoted to familiarize themselves with the materials. The tests

were conducted by the researcher to maintain consistency and prevent possible variations in the conduct of the tests. As for the assessment, the tests were evaluated based on a predefined heading, which defined clear criteria for each type of question (multiple choice, short answer, and problem solving tasks). Multiple choice questions were evaluated automatically, while short-answer and problem-solving assignments were evaluated using a scoring system that took into account the correctness, clarity of explanation, and application of relevant chemistry concepts. Then, the scores obtained on both the preliminary and subsequent tests were used to calculate the increase in knowledge of each student and compare the academic performance of the experimental group (training was conducted using the CLIL approach) and the control group (training was conducted using traditional methods). This method of conducting tests and scoring ensured the reliability and consistency of the results, providing reliable data for analyzing the impact of the CLIL teaching method on student performance in chemistry.

The description of the descriptive statistical table of the pre-test and post-test results of the experimental groups in the three schools is as follows in the table 3.2-1.

Table 3.2.1.1 *Descriptive statistical data of the pre-test and post-test result*

	1preScore	**1postScore**	**IBpreScore**	**IBpostScore**	**LpreScore**	**LpostScore**
N	17	17	15	15	15	15
Mean	77.4	88.2	72.3	79.0	80.0	84.0
Median	75	90	70	80	80	85.0
Standard deviation	7.93	6.36	9.42	8.28	6.27	5.73

This bar chart, known as "average test scores before and after testing in one school," visually compares the average performance of students before and after the CLIL intervention in three schools.

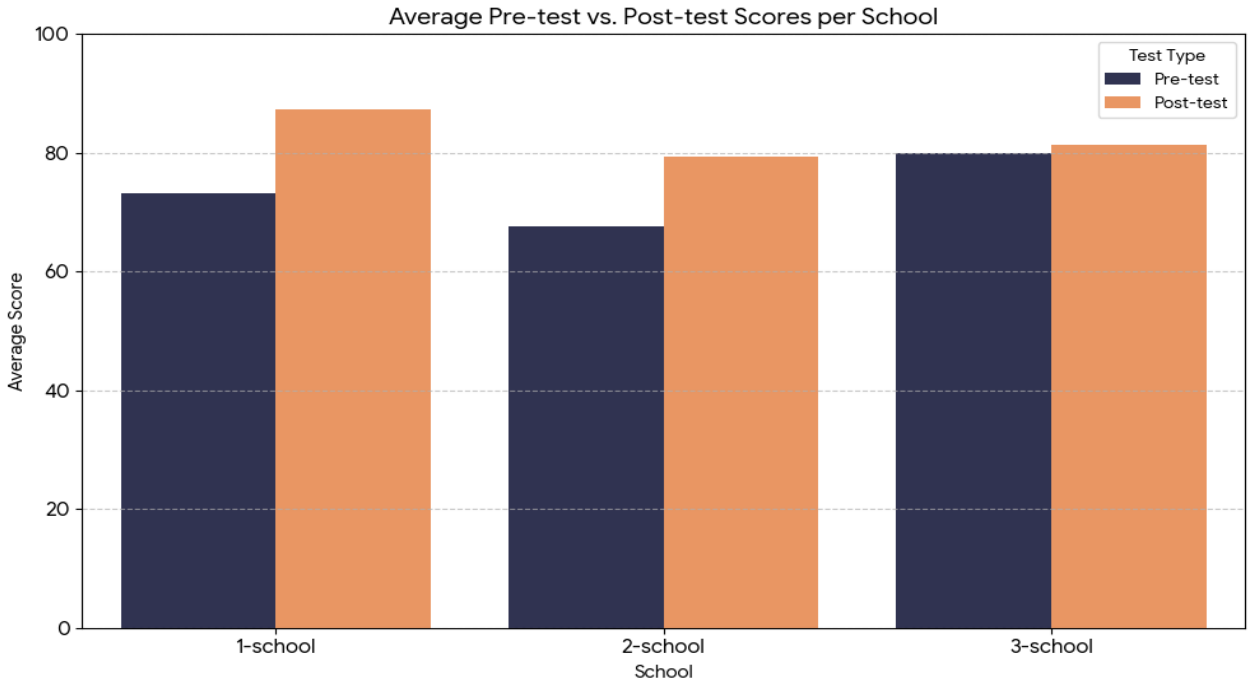

Figure 3.2.1.1 *Average Pre-test vs. Post-test Scores per School*

The performance of students taught using the CLIL method was compared in three different schools. During the intervention, the pre-test and post-test scores for each school were analyzed to assess the progress of students.

In school 1, the pre-Test score was 77.4, which increased to 88.2 in the post-test period. This indicates that after the CLIL intervention, students ' scores began to increase accordingly.

In school 2, students also showed an increase in their academic performance. The pre-Test average score was 72.3, which increased to 79.0 in the post-test period, indicating an overall improvement. Although the increase in points is slightly less than in school 1, the results show a positive effect of the CLIL method.

In school 3, the pre-Test score was 80.0, an improvement to the post-test score of 84.0.Although the initial performance of students in school 3 was higher than in the other two schools, the observed performance was modest.

Overall, the results show that the CLIL method had a positive effect on student performance in all three schools and improved to varying degrees. The greatest progress was observed in the 1st School, followed by the 2nd and 3rd.

3.2.2 The impact of the introduction of CLIL on the academic achievement of students in High School Chemistry Lessons

The ANCOVA analysis showed that both the results before the test and the group assignments had a significant impact on the students` results after the test. After accounting for the initial differences in chemistry knowledge, the students in the experimental group (who studied using CLIL) scored significantly higher than the students in the control group.

Results – School.1 (Kazakh school)

The ANCOVA analysis suggests that both the initial pre-test score and the group assignment significantly impact the post-test scores. Crucially, even after accounting for pre-test differences, the groups show a significant difference in their post-test performance.

Table 3.2.2.1 *ANCOVA result of School-1*

ANCOVA - 1postScore					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
1preScore	249	1	249.1	6.07	0.019
Group	587	1	586.6	14.30	<.001
Residuals	1271	31	41.0		

ANCOVA was conducted to assess the impact of CLIL (Content and Language Integrated Learning) on students` results after testing, as well as to monitor their academic performance before testing. The analysis showed that the results before the test had a statistically significant impact on the results after the test, $F(1, 31) = 6.07$, $p = 0.019$, indicating that the students` prior knowledge significantly influenced their subsequent academic performance. It is important to note that the group variable was also statistically significant, $F(1, 31) = 14.30$, $p < 0.001$, which suggests that participation in the CLIL program had a significant positive impact on student results after testing, even after adjusting for initial differences in academic performance. Given the significant influence of the group factor in ANCOVA, follow-up comparisons were conducted to examine the specific differences between the experimental (CLIL) and control groups. In this case, a simple comparison of the two groups was carried out in order to directly examine the impact of the CLIL approach on traditional learning.

Results – School.2 (IB)

The results of ANCOVA show that the CLIL method significantly improved the performance of students in the IB school. Despite the students being fluent in English, their advances in chemistry still benefited from CLIL, suggesting that combining content helped improve understanding. The increase in productivity, although statistically significant, was moderate, which may be due to the fact that the English language was fluent, but the initial level of subject knowledge was low.

Table 3.2.2.2 *ANCOVA result of School-2*

ANCOVA - IBpostScore					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
IBpreScore	1923	1	1922.9	120.6	<.001

Table 3.2.2.2 ***(Continued)***

Group (3)	184	1	184.4	11.6	0.002
Residuals	430	27	15.9		

ANCOVA was conducted to assess the impact of CLIL intervention on post-IB school test results, taking into account pre-test results. The results of the preliminary testing had a significant impact on the results after testing ($F(1.27) = 120.6$, $p < 0.001$). In addition, the group variable was significant ($F(1, 27) = 11.6$, $p = 0.002$), indicating that the CLIL approach had a statistically significant positive effect on student academic performance in the context of IB.

Results – School.3 (Lyceum)

At Lyceum, although the increase in achievement was statistically significant, it was small compared to other schools. This result can be explained by the high baseline performance of students who were accustomed to CLIL-based learning and demonstrated a high level of content and language proficiency from the very beginning.

Table 3.2.2.3 *ANCOVA result of School-3*

ANCOVA - LpostScore					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
LpreScore	527.7	1	527.7	48.74	<.001
Group (5)	49.2	1	49.2	4.55	0.042
Residuals	292.3	27	10.8		

To study the impact of CLIL intervention on post-test results in the third school, an ANCOVA analysis was performed based on pre-test results. The results obtained before testing were significantly predictive of the results after testing ($F(1.27) = 48.74$, $p < 0.001$). In addition, the group factor had a significant impact ($F(1, 27) = 4.55$, $p = 0.042$), which indicates that the CLIL method had a positive effect on students` results in these conditions.

3.2.3 Differences in academic performance between CLIL and traditional methodologists in the same school

The results of this study show that the CLIL (content and language integrated learning) method has a significant positive effect on students ' academic achievement in chemistry compared to the traditional teaching method in the same school. Post-hoc analyses showed clear evidence that CLIL students consistently outperformed their peers, who were taught in traditional ways in all three schools. The CLIL method was more effective than the traditional method in each school, contributing to higher academic performance in chemistry. The degree of improvement varied in different schools, but the general pattern affirms that CLIL can be a valuable teaching strategy to improve student performance in chemistry in high school.

Results – School.1 (Kazakh school)

Table 3.2.3.1 *Post Hoc Comparisons of School-1*

Post Hoc Comparisons - Group							
Comparison							
Group		**Group**	**Mean Difference**	**SE**	**df**	**t**	**$p_{bonferroni}$**
Experiment	-	Control	8.31	2.20	31.0	3.78	<.001
Note. Comparisons are based on estimated marginal means							

A subsequent comparison using the Bonferroni correction revealed a statistically significant difference between the experimental and control groups. The experimental group outperformed the control group with an average difference of 8.31 points ($t(31) = 3.78$, $p < 0.001$) based on estimated limit values. This result confirms the positive impact of CLIL on student academic performance.

The ANCOVA analysis confirms that the use of the CLIL (Content and Language Integrated Learning) method in school 1 had a statistically significant and positive effect on students` performance in chemistry. After monitoring the initial knowledge of students (pre-test scores), the results show that students in the experimental group trained according to the CLIL method scored significantly higher than those in the control group. The average difference between the groups is 8.31 points, combined with a very important p-value ($p < .001$), emphasizing that this improvement is unlikely to be due to chance. This confirms the hypothesis that CLIL can be especially effective when introduced into a new and highly motivated student environment. In addition, a significant pre-test covariate effect ($p = 0.019$) indicates the role of students' primary education levels in their final performance. Despite this, the experimental group still showed a clear advantage, showing that CLIL added value that could only be expected from prior knowledge. These results indicate that CLIL was introduced in this context: Improves language and subject learning, Especially effective when students are motivated by external goals (for example, university entrance exams), And CLIL shows strong educational potential in situations where it is not yet a common part of learning.

Results – School.2 (IB)

Table 3.2.3.2 *Post Hoc Comparisons of School-2*

Comparison							
Group (3)		**Group (3)**	**Mean Difference**	**SE**	**df**	**t**	**$p_{bonferroni}$**
Experiment	-	Control	4.96	1.46	27.0	3.40	0.002
Note. Comparisons are based on estimated marginal means							

Subsequent analysis with the Bonferroni correction showed a significant difference between the experimental and control groups at the IB school. The experimental group scored higher, with an approximate average difference of 4.96 points (t (27) = 3.40, p = 0.002), indicating a positive effect of the CLIL intervention.

The ANCOVA results show that the introduction of the CLIL (content and language integrated learning) method at the IB school has resulted in a statistically significant improvement in students' chemistry scores after testing. The experimental group was ahead of the control group by an average difference of 4.96 points (p = 0.002), even after observing the pre-test indicators (F = 11.6, p = 0.002). This shows that CLIL has been effective in improving students learning outcomes if students have a high level of English proficiency. Although the improvement observed is moderate compared to school 1, it is still noticeable given that students may have started with a low level of subject knowledge typical of chemistry. Positive results highlight the benefits of combining content and language, even for students with a high level of language, by providing meaningful contexts and supporting cognitive interaction with the subject.

These results confirm the idea that CLIL can be successfully adapted to different educational environments. In this case, the IB school`s emphasis on fluency in English may have contributed to the smooth integration of CLIL, while guidance focused on scientific concepts enabled academic growth by delivering language-rich content.

Results – School.3 (Lyceum)

Table 3.2.3.3 *Post Hoc Comparisons of School-3*

Post Hoc Comparisons - Group (5)						
Comparison						
Group (5)	**Group (5)**	**Mean Difference**	**SE**	**df**	**t**	**$p_{bonferroni}$**
Experiment	Control	2.57	1.20	27.0	2.13	0.042
Note. Comparisons are based on estimated marginal means						

Subsequent analysis adjusted for Bonferroni revealed a significant difference between the experimental and control groups in the third school. The experimental group scored higher, with an approximate average difference of 2.57 points (t(27) = 2.13, p = 0.042), indicating a positive effect of the CLIL intervention.

Although the increase in performance at the Lyceum was statistically significant, it was significantly less compared to the other two schools. This simple improvement can be attributed to higher levels of basic performance by students, both in subject knowledge and English proficiency. Since CLIL was included in their regular teaching, these students became familiar with this method and may have adapted over time to its cognitive and linguistic requirements. This result shows that the marginal benefits of CLIL can be reduced in educational institutions where the method is already well established and students have reached a level of performance. In such contexts, in the

early stages of CLIL implementation, there is often no novelty effect, which contributes to an increase in motivation and learning success. These results are in line with broader studies that show that CLIL is most effective when implemented in an environment that represents an important pedagogical innovation and where students still develop both language and content acquisition. In contrast, in higher education institutions such as Lyceums, where both content and language competence are high, CLIL can serve as a maintenance strategy rather than a transformational one, with a gradual rather than significant benefit.

A comparative analysis clearly shows that the effectiveness of the CLIL (Content and Language Integrated Learning) method varies significantly depending on the educational context, student motivation, and pre-impact of CLIL-based learning. In school 1, which was newly included in the CLIL experimental group, Students showed improvement in post-test scores. This group not only benefited from the integration of language and content, but was also highly motivated due to the school`s emphasis on preparation for the Unified National Testing (UNT). A significant increase in productivity indicates that the initial implementation of CLIL, combined with strong subject motivation, creates optimal conditions for academic improvement. Although the 2nd school (IB school) had a high level of English proficiency, their initial subject knowledge of chemistry was relatively low. The use of CLIL has led to moderate but statistically significant advances, indicating that while language skills are a valuable asset, combining content through CLIL can help build subject understanding even when knowledge of content begins at a simple level. The 3rd school (Lyceum) showed the least improvement of the three. The students there had extensive experience in CLIL and scored high base scores in both English and chemistry. This shows that the marginal benefits of CLIL are declining in an environment where it is already successfully integrated and where students are already performing at a high level. However, the improvement was still statistically significant, confirming CLIL`s, albeit limited, contribution.

This comparative analysis shows the significant importance of contextual factors, including: Pre-impact on CLIL Subject education, Language acquisition Student motivation and educational goals These variables affect the degree of effectiveness of CLIL and should be carefully considered when planning its implementation in various educational institutions. In conclusion, CLIL is more effective when it is strategically implemented, tailored to the needs of students, and provided with motivational and academic training. Thus, its implementation should not be uniform in all schools, but rather be adapted to a specific learning environment in order to achieve maximum results.

DISCUSSION

This chapter interprets and discusses the key findings of the study in relation to the four research questions and the existing body of literature. The purpose is to provide a deeper understanding of how the CLIL (Content and Language Integrated Learning) approach affects chemistry education in multilingual high school settings in Kazakhstan. By combining qualitative data from teacher interviews with quantitative results from pre- and post-tests, this mixed-methods study offers a comprehensive analysis of CLIL's educational impact.

The discussion is structured around the four central research questions:

1. Teachers' perceptions of the CLIL method in teaching chemistry;
2. The influence of CLIL on student motivation and participation;
3. Differences in academic performance between students from different schools using CLIL;
4. Comparative performance of CLIL and traditional groups within the same school.

The findings are compared with international studies to contextualize the results and explore their implications for policy, teacher training, and future classroom practice. Overall, this chapter seeks to identify the strengths, challenges, and practical considerations associated with the implementation of CLIL in science education.

1. Teachers' Perceptions of CLIL in Chemistry Education

Seven chemistry teachers implementing the CLIL method were interviewed to explore their perspectives on its application in high school chemistry. The results revealed a dual perception: optimism about student engagement and learning outcomes, and concern about practical barriers.

Teachers unanimously praised CLIL's ability to increase student attention, foster bidirectional learning, and create more interactive and engaging lessons. Several participants emphasized that using English for scientific explanations encouraged students to think critically and reinforced subject understanding through the repetition and reformulation of content in two languages.

However, teachers also expressed frustration with substantial challenges. The most frequently cited obstacles were differences in students' English proficiency, a steep learning curve for educators unfamiliar with CLIL strategies, high training requirements, and the lack of accessible bilingual teaching resources. These concerns echo the findings of Hashmi (2022), who conducted a study on EFL teachers in Saudi Arabia. Hashmi noted that while educators recognized CLIL's potential for improving student outcomes, they were hindered by insufficient professional training and limited institutional support. This reinforces the conclusion that for CLIL to be sustainable, ongoing support and professional development are essential.

Chura and Anklevich (2018), who examined the CLIL experience of primary school teachers in Poland, similarly observed enthusiasm regarding student motivation, yet highlighted increased workload and a dearth of ready-to-use materials as serious limitations. In the present study, Kazakhstani teachers described a comparable burden in lesson planning and material preparation. Despite the differences in educational level and country, the overlap in findings underscores the importance of providing

comprehensive support structures particularly in resource development and collaboration among teachers.

Overall, the qualitative data confirm that while the CLIL method is appreciated for its pedagogical strengths, its success heavily depends on adequate teacher preparation, contextual adaptation, and access to well developed resources. These findings align with the international literature, reinforcing that the challenges are not unique to one region or school type, but systemic and thus require strategic solutions.

2. The impact of CLIL implementation on students' achievements in chemistry in secondary school.

The results of the quantitative analysis strongly suggest that the introduction of the CLIL method has a positive effect on students' performance in chemistry in secondary school. The ANCOVA results showed statistically significant differences between the experimental (CLIL) and the control (traditional) groups after adjusting the results of the preliminary testing. In all three schools included in the study, students who studied using the CLIL approach consistently outperformed their peers who studied using traditional methods.

The most noticeable improvement was noted in School No. 1, where the difference in results after testing between the CLIL groups and the traditional group was the greatest. This suggests that, with effective implementation, CLIL can significantly improve students' understanding of complex scientific content, even in a multilingual learning environment. In schools 2 and 3, the results also showed favorable outcomes for CLIL students, although to a somewhat lesser extent. These differences can be explained by differences in teacher training, CLIL experience, or the availability of resources and support materials. The second research question focused on the influence of CLIL on student motivation and participation in chemistry lessons. Interview data and classroom observations revealed that the CLIL method significantly boosted student engagement. Teachers observed that students were more attentive, curious, and communicative, particularly during lessons that incorporated visual aids, real-life applications, and interactive elements such as group work or experiments.

Many teachers reported that students felt empowered by using English in meaningful ways not just learning vocabulary, but discussing chemical processes and explaining phenomena in a second language. This aligns closely with Banegas (2012), who studied CLIL in Argentinean high schools and found that students were more motivated when language was used as a tool for accessing meaningful content, rather than an isolated subject.

In this study, CLIL-based pair work and bilingual discussions during practical tasks were frequently cited as key moments when students became more confident and participatory. Teachers noted that these activities encouraged students to express themselves and take academic risks, contributing to a supportive, low-anxiety learning environment. These benefits were evident across all three schools, although their intensity varied depending on students’ prior English proficiency.

Interestingly, motivation and participation remained high even in schools where students had lower English skills. When CLIL lessons were well-scaffolded with clear

visuals, adapted language input, and supportive teacher-student interaction students responded with enthusiasm. This observation supports the inclusive potential of CLIL, as highlighted by Coyle, Hood, and Marsh (2010), who argue that with the right strategies, CLIL can meet the needs of diverse learners and promote both language acquisition and cognitive development.

However, the success of CLIL depends heavily on several factors, including teacher training, educational materials, and school support. While the data clearly demonstrates the benefits for learning, it is important to understand that proper implementation requires systematic training and planning. When these conditions are met, CLIL can become a powerful tool for improving students' academic performance in natural subjects such as chemistry.

3. Comparing Academic Performance Across Schools Using CLIL

The third research question investigated the impact of CLIL on student academic performance in three different schools. The results of the ANCOVA and post hoc analyses provided robust evidence that students in the CLIL groups outperformed their peers in the traditional instruction groups across all three schools.

In School 1, the most significant improvement was observed. CLIL students showed an average gain of 11.25 points from pre- to post-test, compared to only 2.94 points in the traditional group. The final difference of 8.31 points ($p < .001$) underscores the transformative potential of CLIL. This may be attributed to factors such as experienced CLIL instructors, consistent use of bilingual materials, and high student motivation.

In School 2, a statistically significant difference of 4.96 points ($p = .002$) was recorded. Although the effect size was smaller than in School 1, the CLIL group still demonstrated superior learning outcomes. Potential moderating factors may include less developed CLIL infrastructure or weaker English proficiency among students, yet the positive trend remained evident.

School 3 showed a smaller but still statistically significant difference (2.57 points, $p = .042$). While the CLIL approach led to improved performance, the effect was more moderate. Teachers in this school reported less familiarity with CLIL, limited access to tailored teaching resources, and a more heterogeneous classroom environment-all of which may have reduced the method’s impact.

These results align with the findings of Amirbek and Nurdilaeva (2023), who found that students learning chemistry through CLIL achieved better assessment results and showed higher motivation. Similarly, Satayev et al. (2022) reported improved academic outcomes in biology when CLIL was used, especially with team teaching between subject and language educators. Though this study did not use such collaboration, the consistency in improved academic performance across content areas suggests that CLIL’s benefits are stable and transferable.

In summary, the academic performance data from all three schools strongly support the efficacy of CLIL. While contextual variables influenced the magnitude of improvement, the overall trend of superior post-test performance in CLIL groups underscores the method’s academic value.

4. Differences Between CLIL and Traditional Methods Within the Same School

The final research question aimed to analyze differences in academic outcomes between CLIL and non-CLIL groups within the same school. Pre and post-test comparisons offered insight into how each teaching method influenced learning outcomes under comparable starting conditions.

In School 1, both groups began with similar baseline knowledge, but the CLIL group showed significantly higher gains. The dramatic post-test difference highlights the effectiveness of integrating language with content instruction when paired with skilled implementation.

School 2 displayed similar patterns: equivalent starting points, but larger improvements in the CLIL group. This suggests that even when challenges such as lower language proficiency exist, well-executed CLIL instruction can enhance academic learning beyond traditional methods.

School 3, while showing the smallest difference, still demonstrated the advantage of CLIL. Given the limited experience of teachers and smaller availability of materials, the results suggest that even minimal CLIL implementation can yield measurable benefits.

These comparisons confirm that CLIL is not only viable across different institutions but consistently more effective than traditional instruction in fostering both content mastery and student confidence. The improvements across schools suggest that even in less ideal settings, CLIL can be adapted to suit local needs and still achieve meaningful academic gains.

Conclusion of Discussion Chapter

The four research questions explored in this study provide strong and converging evidence that CLIL is a promising method for enhancing chemistry education in multilingual contexts. Teachers confirmed the method's value, especially in promoting engagement and active learning, while also highlighting structural challenges that need to be addressed. Students were more motivated and better able to participate when language learning was embedded into meaningful subject content. Statistically significant improvements in post-test performance across all three schools confirm CLIL's academic advantages over traditional instruction.

However, the study also makes clear that the success of CLIL depends on several key factors: teacher preparation, availability of resources, and the degree of alignment between language instruction and subject content. These findings point to the importance of institutional support, professional development, and material development to ensure sustainable implementation.

Overall, CLIL in high school chemistry classrooms offers a powerful tool to advance both scientific understanding and language proficiency. With the right support systems in place, it can be a transformative approach for secondary education in Kazakhstan and beyond.

CONCLUSION

The purpose of this study is to investigate the application of CLIL (Content and Language Integrated Learning) in chemistry classrooms, focusing on how this approach improves both students` understanding of chemistry concepts and their language skills in English. The purpose of the study is to evaluate the effectiveness of CLIL in enhancing students` scientific vocabulary, problem-solving ability, and overall engagement with the subject matter, and to explore the challenges and benefits of integrating language learning with content learning in the chemistry classroom. Using a mixed-methods approach, the study aims to evaluate the effectiveness of CLIL in increasing students` academic vocabulary, problem-solving ability, and overall engagement in the course. The study will combine qualitative data, including teacher interviews and classroom observations, with quantitative data from student assessments, such as the Prendes post-test, to provide a comprehensive analysis of the challenges and benefits of integrating language learning with content instruction in the chemistry classroom. The results confirm the initial hypothesis that the greatest improvements will occur in the experimental group of the Kazakh-language school. In this school, students had a strong fundamental knowledge of chemistry and were highly motivated due to the pressure of preparation for the Unified National Testing (UNT). The introduction of CLIL introduced a new and more attractive approach, resulting in significantly increased post - test scores. This shows that when motivation is high and meaningful knowledge is solid, CLIL can significantly improve both language acquisition and understanding of the subject.

Students from the International Baccalaureate (IB) school also showed improvement after the CLIL intervention, but only moderately. This result may indicate a higher level of proficiency in English and preliminary familiarization with international teaching approaches, and also indicate that their basic subject knowledge may be lower compared to students of Kazakh-speaking schools. However, the results show that CLIL has been effective in supporting linguistic and academic growth. In contrast, Lyceum students included in the CLIL curriculum for some time showed only a slight increase in test results. This may be due to the fact that they have a high initial level in both English and chemistry, which indicates the effect of the ceiling. Although there are few successes, stable performance confirms that a stable connection with CLIL supports long-term academic stability and language development.

The Lyceum, where CLIL was included in the curriculum and where students had high basic competencies, showed a modest but statistically significant improvement. This suggests that although CLIL remains useful in highly effective, experienced environments, its most obvious effect occurs when it is first introduced, especially in cases where students have motivational and fundamental knowledge of the subject. These results show the importance of considering the pre-emptive impact on CLIL, the academic training of students and their motivational context when implementing integrated language-content approaches in scientific education.

These results show that CLIL is not a universal method. Its effectiveness is closely related to the educational environment, the language and content training of students, and their level of activity or motivation. The most important advances occur

when the CLIL is just being introduced, in which case the students are more satisfied but still develop their language skills. In cases where the CLIL is already well established or students perform at a high level, improvements may be less impressive, but may still be important to maintain performance and strengthen bilingual competence. Overall, this study shows the potential of CLIL to improve both content acquisition and language development in secondary chemistry education. For educators and policymakers, these results highlight the importance of carefully considering the school context when implementing CLIL. Future research may continue to explore long-term effects, differences in other science disciplines, and how teacher training can affect the success of CLIL-based learning. The results of the interview show that teachers see many advantages in using the CLIL (integrated content and language learning) method in chemistry classes, as well as some difficulties. Most teachers agreed that CLIL is important because it helps students improve their English while learning chemistry. They also said that it is useful in teaching difficult topics, using modern methods and increasing student motivation. At the same time, teachers reported some difficulties. The biggest difficulty is that students have different levels of English, and when teaching in another language, it can be difficult to understand the subject itself. Teachers also noted language barriers, lack of resources, the need to increase experience and support. In cases where students often have difficulty speaking English, understanding scientific terms, and mastering both the subject and Language, teachers said that students learn best when they receive feedback, support, and experience during the lesson. To improve the effectiveness of CLIL, teachers have proposed several recommendations. They believe that it is important to focus on language development, use interactive and practical methods, use useful online materials, encourage research and support teachers learning in both English and CLIL methods. In conclusion, the interviews show that CLIL can do a good job in chemistry if teachers and students are properly supported. With proper planning, resources and training, CLIL helps students improve both their knowledge of chemistry and English at the same time.

The results of the study showed how combining language learning with the content of a chemistry course can lead to a holistic understanding of both the subject and the language. This CLIL can not only help students understand scientific concepts more effectively, but also communicate these concepts in a second language, enhancing their overall scientific literacy. In the course of the study, we came to the conclusion that CLIL can be more widely integrated into scientific curricula, since the results of the experimental group are positive. Schools and educational institutions can adapt teaching methods in a way that promotes both discipline and language acquisition by offering students an integrated educational process. The results highlight the need for specialized training for chemistry teachers who want to implement CLIL, teachers will need guidance on language-specific teaching methods, and this may prompt the development of advanced training programs focused on CLIL methodology. It can be shown that CLIL increases student engagement, making chemistry lessons more relevant and interactive. If students can see the application of language and chemistry skills in the real world, their motivation can increase, leading to improved academic

performance in both subjects. Research shows that students improve their language skills, especially scientific vocabulary, and the ability to have a scientific conversation in a natural, content-based environment. In addition, we faced difficulties in implementing CLIL, such as training students, teachers, or the need for additional resources at different levels of language proficiency. This indicates the need to develop strategies or recommendations to solve problems.

Recommendation

Future ponders ought to include a more extensive extend of schools and a bigger number of members to extend the unwavering quality and pertinence of the discoveries. Expanding the length of the CLIL intercession would offer assistance to investigate its long-term effect on understudy learning. It is critical to supply focused on CLIL preparing programs for instructors to make strides their capacity to coordinated subject substance and language instruction successfully. There's also an ought to create chemistry educating materials particularly outlined for the CLIL setting to way better bolster both instructors and understudies. To address the challenges confronted by understudies with lower dialect capability, extra framework methodologies and separated learning approaches ought to be executed. Future inquire about seem advantage from a longitudinal plan, taking after understudies over a few a long time to watch maintained scholarly and language development. Including other partners such as understudies, guardians, and school chairmen in future ponders would give a more comprehensive understanding of the CLIL approach's affect. At last, the utilize of different appraisal apparatuses, counting performance-based errands and portfolio assessments, is suggested to get a more total picture of students' learning results.

In conclusion, Integrated Content and Language Learning (CLIL) represents a valuable opportunity to enrich chemistry education while contributing to students` cognitive and linguistic development. By combining subject knowledge with language learning, CLIL promotes deeper understanding, develops critical thinking skills, and helps to master scientific terminology both in the language being studied and in the subject area. However, its successful implementation requires careful planning, as well as the teacher`s knowledge of the language and content of the subject and the availability of appropriate support materials. This study convincingly proves that CLIL, if carefully adapted to the conditions of the educational process, can serve as an effective pedagogical strategy in natural science education. It highlights the potential benefits for students not only in mastering chemical concepts, but also in improving language skills, which are crucial for academic success in a globalized world. Future research should further explore how CLIL can be adapted to different educational institutions and disciplines, allowing it to remain a dynamic and inclusive approach to teaching and learning.

SHORTCOMINGS AND LIMITATIONS

This consider was constrained by a generally little test estimate and was conducted in as it were many schools, which confines the generalizability of the discoveries. The term of the CLIL mediation was brief, making it troublesome to evaluate long-term impacts on students' scholarly and dialect improvement. A few instructors included within the think about needed adequate CLIL-specific preparing and assets, which may have impacted the adequacy of the strategy. Moreover, the variety in students' English capability levels postured challenges in conveying the substance consistently over all bunches. An encourage restriction was the deficiency of CLIL-adapted educating materials and chemistry course readings, which may have compelled the execution prepare. At long last, the subjective information collected from instructor interviews may be subject to inclination, as members might have been affected by individual viewpoints or the want to display their work emphatically.

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APPENDICES

Appendix 1

Long Term Plan Section: 10.1 The redox process **Date:** **Class: 10**	**School: LLP "Kurasnt Bilim Group"** **Teacher`s name: Yntymakkyzy Kamshat** **Number of participants:** **Number of non-participants:**
Lesson Topic	The redox process
Learning objectives achieved in this lesson (link to curriculum)	10.2.3.1. compilation of redox reaction equations by electronic Ionic balance; 10.2.3.2. compilation of redox reaction equations by semi-Ionic reaction
Lesson Objectives	All students: determination of redox reactions with the indication of oxidation states; Most: to give an example of balancing redox reactions by the electronic balance method; Some students: semi-Ionic reaction, compilation of redox reaction equations by the method of electron-Ionic balance; For children with needs: knowledge of the concepts of oxidation state, oxidation, reduction
Evaluation criteria	Student, - determines the redox reactions, indicating the oxidation states; - gives an example of balancing redox reactions by the electronic balance method; - compiles the equations of the redox reaction by the method of semi-Ionic reaction, electron-Ionic balance; For children with needs: knows the concepts of oxidation state, oxidation, reduction

Language goals	Reduction, Reducing Agent, Oxidation, Oxidation-reduction (redox) reaction, Oxidizer, Electron Students be able to: Oxidation numbers help keep track of which atoms are oxidised or reduced. The oxidising agent is reduced and the reducing agent is oxidised.
Instilling values	Redox reactions are followed by changes - atoms gain or lose electrons. The oxidising agent is reduced and the reducing agent is oxidised.
Interdisciplinary ınections	Biology, mathematics, physics
ICT application skills	Presentation for the lesson, interactive board, kahoot, youtube
Primary education	Prior knowledge/skills: 1. What are oxidation numbers and why are they useful? 2. What is the redox reaction? 3. What happens when an atom loses and gains electrons?

Lesson progress

Planned stages of the lesson	Planned activities in the lesson	Resources
Beginning of the lesson Organizational stage 5 minutes	"To arouse interest." 1. greeting 2. check of readiness for classes 3. "compliment" method to create a positive atmosphere 4. Division into 3 groups according to the "Golden Pen" method: Group 1. Oxidizing substances Group 2. Reducers Group 3. Oxidation states 4. students are given an evaluation sheet in the form of a timetable for the educational program.	

Middle of the lesson The" Think-pair-share " method. 10 minutes	**Task 2** Pair work • $Fe_2O_3 + 6HCl = 2FeCl_3 + 3H_2O$ • $Fe_2O_3 + H_2 = 2FeO + H_2O$ • $2Fe + 6HCl = 2FeCl_3 + 3H_2$ • $FeCl_3 + 3KOH = Fe(OH)_3 + 3KCl$ Which of the reactions are redox? Please explain the answer. **Types of Redox Reactions (Oxidation and Reduction)**	You can watch a useful video at the link: https://youtu.be/5wGBPp7w8xM Scan me!
3 minutes	A moment of refreshment. Through the" charge acquisition " method Students stand in a circle and hold each other`s hands. The beginner squeezes the hand once, squeezes it twice in a round, and finally squeezes it three times. It is necessary to return to the beginner depending on how many charges he himself sent during the turnover.	
A task aimed at functional literacy Method "brainstorming" 10 minutes	**Task 3.** **Experiment video viewing** Azamat was going to experiment with Apple and lemon juice. He cut the Apple in half and put it in a flat dish with the cut side. A slice of Apple was dripped with lemon juice. After a while, it was noticed that the part "protected" by lemon juice remained white, and the "Clean" part of the Apple darkened.	

Type of Redox Reaction	Description	Example
Combination (Synthesis)	Two or more reactants combine to form a single product	$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
Decomposition	A compound breaks down into two or more simpler substances	$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g$
Displacement (Single Replacement)	One element replaces another in a compound	$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$
Disproportionation	A single substance is both oxidized and reduced in the reaction	$Cl_2(g) + H_2O(l) \rightarrow Cl^-(aq) + ClO^-(aq) + 2H^+(aq)$

Fixing the stem 10 minutes End of lesson Reflection Method " two stars, one wish 2 minutes	 Question: Why does the "Clean" part of the Apple look and what idea can be suggested? Playing the game "Kahoot" on the internet using the data used in the lesson and the information provided in the textbook In order to summarize the lesson, students write their attitude to the lesson, reflection on the sticker	

Differentiation - How do you plan to support your students more? What challenge do you plan to give to high ability students?	**Assessment - How do you plan to test students` level of learning?**	**Compliance with safety and health regulations**
Differentiation can take the form of selected tasks, expected results from a particular student, personalized support for the student, selection of learning materials and resources taking into account the individual abilities of students (Gardner`s theory of total intelligence).	In this section, you will write down the methods you use to assess what students have learned during the lesson.	Health-saving technologies. Tonic moments and types of active activities. Safety rules applicable to this lesson

Differentiation can be applied at any stage of the lesson, taking into account the rational use of time.		
Reflection on the lesson Are the lesson objectives/learning goals set correctly? Have all students achieved the OM? Why, if it doesn`t deliver? Was differentiation carried out correctly in the lesson? Were the time periods of classes maintained? What were the deviations from the lesson plan, why?	Use this section to give your feedback on the lesson. Answer the questions about your lesson in the left column.	

Appendix 2

Interview Importance of using CLIL in chemistry

1) How do you think combining language learning with content such as chemistry will benefit the overall learning experience of students?

2) in what ways does CLIL improve students ` understanding of complex scientific concepts?

3) can you share examples where CLIL has had a significant positive impact on students ` understanding or retention of Chemistry?

4) How does the use of CLIL in chemistry classes contribute to the development of both academic language skills and subject knowledge of students?

5) How do you start implementing CLIL in teaching students? With what percentage ratio do you enter the language?

The usefulness of CLIL methods in chemistry

1) How do you find that CLIL methods help students make abstract or complex chemistry topics more accessible?

2) can you describe any strategies or actions that effectively combine language and chemical content?

3) How does the use of CLIL in chemistry classes affect student engagement and engagement?

4) Do you think CLIL will help students relate real situations to Theoretical Chemistry? Can you give an example?

5) from your experience, do students seem to develop better language skills when learning chemistry through CLIL compared to traditional methods?

Difficulties In Introducing CLIL Into Chemistry

1) What difficulties do you face when implementing CLIL methods in chemistry class, both in terms of content delivery and in terms of Language Teaching?

2) Do chemistry classes have any specific problems with classroom management when trying to combine both language and content?

3) How to solve language barriers that can prevent students from understanding chemistry topics?

4) Do you encounter resistance from students or colleagues when using CLIL in chemistry classes? If so, how to overcome it?

5) How do you strike a balance between the content of teaching chemistry and ensuring that students understand linguistic aspects?

Difficulties of students in studying chemistry through CLIL

1) what specific difficulties do students face, especially those who do not speak the language of instruction, when learning chemistry through CLIL methods?

2) Do students struggle more with the CLIL language component or the chemistry content itself? How do you support them in overcoming these difficulties?

3) How do you assess whether students are struggling with language problems or understanding chemistry concepts?

4) How do you help students with weak language skills but strong in Chemistry?

5) What feedback did you receive from students about their experience in chemistry classes taught using CLIL methods?

Recommendations for the effective use of CLIL in Chemistry

1) what best practices or strategies did you find most effective in teaching chemistry with CLIL?

2) How do you ensure that both language development and knowledge in Chemistry are given the same importance in your classes?

3) can you provide any specific resources or tools that have helped you successfully implement CLIL in chemistry classes?

4) How can teachers be better trained or supported to effectively integrate CLIL into subject teaching, especially in subjects such as chemistry?

5) what changes would you propose to make to improve the inclusion of CLIL in chemistry classes, both in the curriculum and in teacher training?

Appendix 3

Prɵ-test (Structure of atoms)

Instruction: to choose one correct answer from the four answer choices you are given assignments are given.

1.A series in which the nonmetallic property increases over a period

A. N ⟹ C ⟹ Si
B. S ⟹ P ⟹ B
C. Si ⟹ Be ⟹ O
D. B ⟹ N ⟹ O

2. Low energy value of Electron orbital

A. 4s
B. 2s
C. 1s
D. 3s

Instruction: you need the basis of the context. Of the four answers offered in the context, one is correct. The multiple-choice tests are read carefully and answered correctly.

Structure of the atom

An atom consists of a positively charged nucleus and negatively charged electrons. The order number in the periodic table of chemical elements proposed by D. I. Mendeleev corresponds to the value of the charge of the atomic nucleus of a given element. The atomic nucleus consists of positively charged protons and uncharged neutrons. Isotopes are formed because the number of protons equal to the nucleus charge of each atom of an element is constant, while the number of neutrons is variable. For example, carbon found in nature consists of two isotopes: 12 C, 13 C. Also, the radioactive isotope 14 C has been found in the atmosphere. The number of neutrons in these isotopes is 6,7,8.

3. Atomic construction?

A. Proton, electron, neutron
B. Nucleus, proton
C. Nucleus, electron.
D. Nucleon, proton

4. Isotope is?

A. same atomic mass, different number of neutrons
B. same number of protons, different number of neutrons
C. same number of protons, same atomic mass.
D. another chemical element with the same number of neutrons

5. Atomic aluminum construction?

A. (13p,13n)13e
B. (13p,13e)13n
C. (13p,27n)13e
D. (13p,14n)13e

6. Natural isotopes of sodium are found in 22 Na-1% and 23 Na-99%. Calculate the average relative atomic mass of sodium.

A. 22
B. 23

C. 22, 99

D. 23,05

7. The natural isotopes of manganese 53 Mn and 55mn have an average relative atomic mass of 54.938. In what proportion (%) does the 55mn isotope occur in nature?

A. 3,1%

B. 96,9%

C. 53,47%

D. 46,53%

Instruction: you will be given tasks with the correct answer to determine the correspondence.

Score: 2 points if you choose two correct answers from a match.

1 point if you chose the correct answer from a match.

0 points if you chose two or more correct answers from one match.

8. Match the given subjects and the definition

1. Nucleons

2. Isotones

A. are *atoms of different chemical elements* which differs in the chemical property but has the same physical property.

B. *either of the subatomic particles, the proton and the neutron*, constituting atomic nuclei.

C. are nuclei that contain the same number of neutrons but differ in their number of protons

D. *distinct nuclear species (or nuclides) of the same chemical element.*

9. Match the given subjects and the definition

1. describes the distribution of orbitals in a nuclear magnetic field

2. the energy level of the electron and determines the size of the atomic orbital

A. Principal Quantum Number (n)

B. Angular Momentum Quantum Number (l)

C. Magnetic Quantum Number (m_l)

D. Spin Quantum Number (m_s)

Instruction: you will be given tasks with one or more correct answers. One or multiple-choice quizzes have a maximum of three correct answers.

10. Regular fraction (s)

A) Fe2+

B) Fe3+

C) Cl−

D) Cl+

E) Na+

F) Na0

11. Released by beta particle irradiation.

A) positron

B) photon

C) neutron

D) nucleon

E) Proton
F) electron

Appendix 4

Post-test (The redox reactions)

Instruction: to choose one correct answer from the four answer choices you are given assignments are given.

1. Hydrogen is a compound with a negative oxidation degree

A) CaH2

B) PH3

C) H2O

D) H2S

2. Acid with the highest oxidizing properties

A) HClO3

B) HClO4

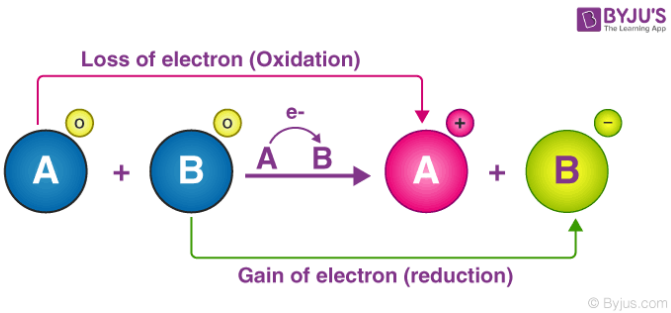
C) HClO2

D) HCl

Instruction: you need the basis of the context. Of the four answers offered in the context, one is correct. The multiple-choice tests are read carefully and answered correctly.

REDOX REACTION

All important processes in the world involve this redox process. Redox reactions are most common in nature. Respiration, photosynthesis, metabolism and other processes are redox reactions. Reactions in which the atoms in the reactants change the degree of oxidation during the chemical reaction are called redox reactions.



The change in oxidation degree indicates what happens when electrons are not exchanged between the reacting atoms. The process of transferring the electrons of the molecule or ion of the reactants atom is called oxidation. In oxidation, the degree of oxidation increases. The reacting atoms are said to be reducing the process of attaching electrons of molecules or ions. In reduction, the degree of oxidation decreases. Atoms, ions, or molecules that give up their electrons during a chemical reaction are said to be reducing agents, and atoms, ions, or molecules that attach their electrons are said to be oxidizing agents. Redox reactions are used to make substances important in chemistry and engineering such as pure metals, ammonia, alkali, and acids.

3. Restoration process

A) $S^{-2} \rightarrow S^{0}$

B) $S^{+4} \rightarrow S^{+6}$

C) $S^{+4} \rightarrow S^{0}$

D) $S^{-2} \rightarrow S^{+4}$

4. The oxidation numbers of iron in compounds correspondingly are

A) +3 and +2

B) +2 and +5

C) +2 and +4

D) +2 and +3

5. The sum of all the coefficients in a reaction equation:

$$KBrO + XeF + H\,O \rightarrow KBrO + Xe + HF$$

A) 10

B) 14

C) 9

D) 7

6. The oxidation state of sulfur in oleum is

A) +6

B) +5

C) -2

D) +4

7. A Group IA metal of mass 19.5 g reacts with 50 mL of water to 5.6 L (g. g) of hydrogen gas reduced. Mass fraction of the resulting hydroxide in solution (%)

A)28.5

B)39.6

C) 40.6

D) 46.7

Instruction: you will be given tasks with the correct answer to determine the correspondence.

Score: 2 points if you choose two correct answers from a match.

1 point if you chose the correct answer from a match.

0 points if you chose two or more correct answers from one match.

8. Match the redox reaction with the type of

1. 4KClO3 ⟶ 3KClO4 + KCl

2. 2H2O (g) ⟶ 2H2 (g) + O2 (g)

A. Combination

B. *Decomposition*

C.Displacement

D. *Disproportionation*

9. Match the oxidizing agent with the reducing agent

1. Oxidizing agent

2. *Reducing agent*

A. Na_2SO_3

B. H_2SO_4

C. H_2SO_3

D. H_2S

Instruction: you will be given tasks with one or more correct answers. One or multiple-choice quizzes have a maximum of three correct answers.

10. Calcium nitrate, formula of barium nitride, degree of oxidation of nitrogen in the compound

A) Ba(NO3)2
B) Ca3N2
C) Ca(NO3)2
D) Ba3N2
E) +5, —3
F) +3, +5

11. Iron characteristics

A) a moderately active metal
B) p-element
C) oxidation degrees +2, +3
D) very active metal
E) d-element
F) f-element