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METHODS OF TEACHING CHEMISTRY

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Application of the CLIL method in the classes of Inorganic Chemistry

The article considers the features of applying the CLIL method to integrated teaching of Inorganic Chemistry in English. To develop students' subject and language skills the content and language integrated learning (CLIL) method was studied in the format of online learning. Inorganic chemistry classes for first-year students of B012 Chemistry Teacher Training Program group were conducted in online format for the control group, and for the experimental group using CLIL method. Students were selected not randomly, according to English and subject level for experimental work based on entrance control work. In the pedagogical experiment the method of mathematical statistics was used to confirm the reliability of the obtained results and to prove the representativeness of the sample. The validity of the proposed research hypothesis was proved by Student's *t*-test method. The levels of students' knowledge are summarized in accordance with learning outcomes according to their competencies. During the lesson, work was carried out on the use of CLIL technology with terminology, glossary, and text in English. Students' language competencies were developed when working with texts and questions in English. The effectiveness of working with terminology, glossary, and English text was determined as a result of a survey of students. The article presents comparative indicators of the midterm control results of students in the control and the experimental group during online format teaching. As a result of a comprehensive study an increase in students' interest in the CLIL method was revealed, which had a positive effect on the educational process.

Keywords: CLIL method, Inorganic Chemistry, online format, offline format, content and language integrated learning, glossary, working with English text, competence.

Introduction

Nowadays, education systems are changing the format of teaching in the context of the coronavirus pandemic (COVID-19) and switching to online learning. The new format of education, along with the obvious problems, offers a wide range of opportunities and prospects for change and improvement of education systems. In this regard, the use of traditional methods of teaching English for academic purposes is insufficient in the context of globalization of science and the international exchange of information. Currently, CLIL (Content and Language Integrated Learning) technology is an important form of subject teaching method in English. CLIL is a method of teaching that is widely used at the international level, especially in Europe, as a way to promote language learning. CLIL technology mainly uses English to teach subject content [1].

The use of the CLIL method via integrated learning in English in Higher Education has been studied in several research papers. The authors shared some experience in online teaching of Inorganic Chemistry during COVID-19 outbreak. To help students feel comfortable with online learning they explored different teaching platforms and adjusted online learning methods. During the online class special attention was paid to the topic-oriented learning process. It also encouraged teachers to interact with students and provide timely feedback [2]. In his research U. Reckino studied two pedagogical methods: Content and Language Integrated Learning (CLIL) and Flipped learning. To achieve the main goal the author proposed a guide to the use of Flipped Learning and CLIL to teach the content of lessons for future English teachers at UNAE [3].

A.B. Arynova, D.A. Kassymbekova and Zh.K. Korganbayeva's research works show the integration of all four content and language-integrated elements (content, communication, cognition, and culture) of the

course “Chemistry of the Elements of the Periodic Table”. The course of modeling a lecture with the help of CLIL and the results of the assessment questionnaire is given. The survey questions are aimed at studying the motivation of students to study the course using CLIL technologies. The results showed that students are motivated to the learning process and their vocabulary is enriched with chemical terms [4].

The authors made a three-way comparison of full-time, online, and blended forms of study in the undergraduate course to determine whether there were differences in student academic performance and course satisfaction in different forms [5]. The following article provides an overview of the changes made to the first year of Physical Chemistry Unit. The authors analyzed how they can use this experience to make online learning lessons more effective in the future [6]. J. Fernanda developed a strategic plan for integrated content and language learning (CLIL) at the University of Extremadura (UEx) in Spain for the period of 2014–2018. This event was held in the project “Learn in English”. This paper describes the features and results of this project at the Faculty of Natural Sciences UEx, where three different degrees involved: Physics, Chemistry, and Chemical Engineering [7].

A several studies have shown that CLIL methods, like other linguistic skills, do not pay much attention to writing activities. However, writing is a skill that needs to be improved, especially in higher education, due to its importance in the educational and professional context. In his research M. Ramiro explored the potential for understanding the text genres using the CLIL method to improve writing skills at the University of Spain for students majoring in Chemistry [8]. The article presents the results of experimental testing of the effectiveness of group learning activities of students at Inorganic Chemistry laboratory classes. The results showed that the use of group learning activities of students contributes to the formation of the order, and course on Inorganic Chemistry laboratory sessions [9]. This study aims to understand how a team of teachers implements content and language integrated learning (CLIL) in an online context (cycle 1) as well as action plans (cycle 2) to address the issues identified in cycle 1 while teaching undergraduate groups [10].

The authors of the work considered the content and language integrated method as a relatively new way of learning the language in terms of its effectiveness in the process of teaching terminology [11]. The CLIL method has been shown to improve students' English language skills and significantly increase their motivation through interactive methods [12]. Some works contain the most important facts about the current state of research in the field of bilingual education in Natural Sciences [13]. The authors of the work [14] investigated changing in undergraduate L2 students' performance historical reasoning and how it affected their reading and writing skills in English. The article examines the relationship between course progress, English proficiency, motivation, and academic language skills in the English medium instruction (EMI) University context [15]. The following study presents the results of a study of CLIL teachers' understanding of the pedagogical use of translanguage and the impact of these concepts on pedagogical practice in various trilingual schools in Kazakhstan. Conclusions show that teachers' attitudes towards translanguaging are ambiguous [16]. In his study, K. Frances showed how emotion affects the memory of information [17]. The article describes the study of a model of teaching based on CLIL at the Pedagogical University, designed specifically for the development of professional and communicative competence of students [18]. General Chemistry instructors have faced challenges due to the COVID-19 pandemic as they search to engage students in a new online learning format. The authors analyzed student questionnaires about the issues encountered during the pandemic, instructor reflections, and grade allocations across several sections of General Chemistry (I, II) taught by different instructors [19].

According to the research, CLIL has become a widely used method of language learning and teaching in recent years. However the CLIL method of teaching in the Natural Sciences field and especially for chemistry students is not much investigated.

The purpose of the proposed research is the theoretical development, scientific substantiation, and experimental study of teaching methods in English in Higher Education based on a subject-language integrated approach. In our previous research, a pedagogical experiment conducted on secondary school students revealed the formation of language skills as a result of working with the terminology, glossary, English-based text, and calculations in subject-language integrated learning (CLIL) [20]. In the given study, the effectiveness of subject-language integrated learning was determined among High School students.

Experimental

The pedagogical experiment was conducted among B012 Chemistry Teacher Training Educational Program group first-year students of the Faculty of Natural Sciences of Khoja Akhmet Yassawi International Kazakh-Turkish University.

In order to determine the conditions for integrated learning of the subject and language, a test paper was obtained through the Google form. As a control work, tasks from the educational and methodological manual of Inorganic Chemistry were given in English [21]. It allowed determining the level of students' learning skills in subject content as well as in the English language. The selection of participants is not accidental, as students were selected among the multilingual groups. To describe the main results of the study 20 students were selected for the control group (CG), 16 students for the experimental group (EG). Both groups were taught with the same syllabus content approved for the educational program 6B01512-Chemistry, but a different methodology was used during training. In the CG instruction was given by using the traditional method while in the EG experimental training was carried out. In the EG Inorganic Chemistry course was implemented by the CLIL method of teaching and aimed at developing students' knowledge of the subject content.

Inorganic Chemistry classes were conducted in the traditional classroom teaching format (offline) in the pre-pandemic and from early March 2020 continued remotely online due to the sudden coronavirus pandemic outbreak. Online lessons were taught by MOODLE distance learning system. There were some issues in the initial lessons when quickly switching from the traditional learning format to distance learning. But students have adapted to online classes, as we have been organized training seminars on how to use the new format of the learning system. Lecture materials were implemented in all four areas of the CLIL method: the content of the lecture was clearly explained, communication developed by asking each other questions in English, cognition skills increased by writing chemical reactions and solving problem-based task in English. Also, students evaluated each other's activities during the culture lesson.

According to the syllabus of inorganic chemistry, topics "Nomenclature and classification of inorganic compound", "Atomic structure", "Periodic system and the electronic structure of atoms", "Chemical bond" were studied during offline classroom teaching. Due to the pandemic outbreak from the 8th week of the second semester the topics "Chemical thermodynamics", "The science of solutions", "Theory of electrolytic dissociation", "Hydrolysis of salts" continued in the form of remote online teaching.

The effectiveness of terminology, glossary, lecture materials, working with the English text, and tasks in English was studied by implementing the CLIL method via the teaching of Inorganic Chemistry in English in offline and online formats.

During remote online format distance teaching classes (lectures, seminars) were conducted via ZOOM videoconference. Materials of online lessons (lectures, seminars, assignments, glossaries, control work tasks, tests, etc.) are uploaded to tng.ayu.edu.kz (https://tng.ayu.edu.kz/).

To determine effectiveness of the CLIL method, one of the methods of mathematical statistics in processing results was used the Student's *t*-test. The validity of the proposed research hypothesis was proved by Student's *t*-test method.

Results and Discussion

To test the effectiveness of the CLIL method, the results of control work before and after the experiment were obtained, based on the competencies (Table 1) following the learning results.

Table 1

Competencies following the learning outcomes

Education level	Assigned competencies
Lower level:	Understands the chemical tasks given in English
	Selects and uses appropriate mathematical knowledge in solving problems, but makes incorrect assumptions in the answer to many problems, as a result of which faces a contradiction in proving the answer to the problem
	Only individual parts of the task can be completed due to incomplete assimilation of tasks
Average level:	Understands the chemical tasks given in English, can write a short answer
	Knows how to solve this problem, however, because the english dictionary incorrectly writes reagents and reaction products, has difficulty balancing the reaction
	Can give a concise definition of terms and concepts in English, albeit briefly, in theoretical questions
High level:	Understands the chemical tasks given in English, can write a complete answer to the given problems using the acquired knowledge
	Can analyze data to solve a given problem and justify conclusions
	Can give convincing arguments to theoretical questions due to good knowledge of English

For the first statistical processing of the experimental results the numerical characteristics of the sample mean and sample variance of the main set was used. To determine the effectiveness of the lessons used in the CLIL method, the values of the selected medium obtained as a result of the control work were compared and analyzed.

The sample variance describes the extent to which the given mean values deviate from the individual values.

The results of sample and average sample variance values in the course of control work of the studied groups of students are shown in Table 2.

Table 2

Results of control work performed in the CG and EG groups

Groups		Mastering the CLIL method	
		$\overline{x}$	$\overline{s^2}$
CG	Before the experiment	6.8	2.05
	After the experiment	8.9	2.24
EG	Before the experiment	7.37	2.92
	After the experiment	9.5	2.13

The results obtained before the experiment at the first stage of the sample mean and variance showed that the difference between the results in the CT and ET groups of students was small. And the results of the second assessment after experimental training show that there was a significant change between them. These data show that the CLIL method applied to the experimental group affected the dynamics of student learning outcomes.

The results of the control work obtained at the formation stage of the experiment are shown in Figure 1. The figure below compares the $\overline{x}$ — average values of the control work performed.

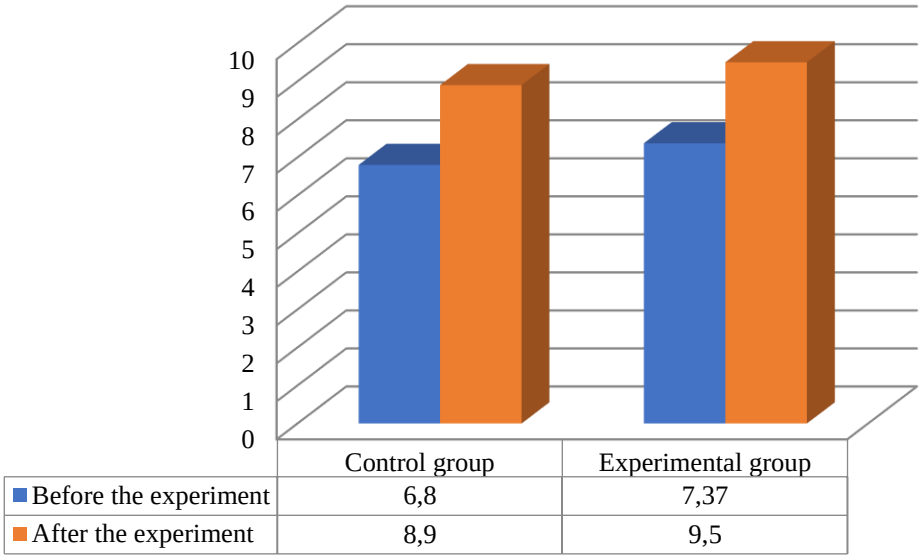


Figure 1. Results of control work obtained before and after using the CLIL method

By comparing the sample average values of the experimental data it is possible to see a significant difference between the beginning and end of the experiment in the EG group.

Table 3 shows that at the initial and final stages of the experiment the level of knowledge of the experimental group increased significantly compared to the control group.

Table 3

Results of measuring the level of knowledge of control and experimental groups before and after the experiment

Education level	Control group		Experimental group	
	Beginning	End	Beginning	End
Low (5–7)	10	7	7	1
Average (8–10)	9	12	8	11
High (11–15)	1	2	1	4

Using the second method of statistical processing of experimental data, the effectiveness of the CLIL method was tested by determining between average values.

To find the exact difference between the statistical average values from each other, we use the Student's *t*-test. Its basic calculation equation is [22]:

$$t = \frac{\left|\overline{x_1} - \overline{x_2}\right|}{\sqrt{\left|m_1^2 + m_2^2\right|}},$$

where, $\overline{x_1}$ is the average value of the variable for the first sample data (at the beginning of the experiment); $\overline{x_2}$ is the average value of the variable for the second sample data (at the end of the experiment); m_1^2 and m_2^2 are integrated indicators of the deviations of the partial values of the two compared sample from their corresponding average values, which are calculated by formula:

$$m_1^2 = \frac{S_1^2}{n_1}; \quad m_2^2 = \frac{S_2^2}{n_2},$$

where, S_1^2 is the sample variance of the first variable; S_2^2 is the sample variance of the second variable; n_1 is the number of students in the first choice, and n_2 is the number of students in the second choice. In our study the number of students at the beginning and end of the experiment was the same.

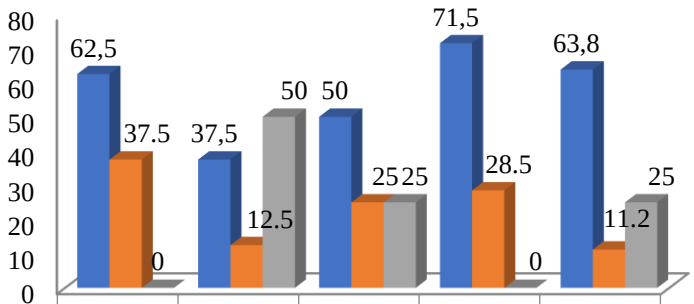
Based on the data, we calculate the value of t_{cw}, the data obtained below describe the control work:

$$t_{cw} = \frac{\left|7.37 - 9.5\right|}{\sqrt{\frac{2.92}{16} + \frac{2.13}{16}}} = 3.78.$$

If we compare the values with the value of the critical distribution of the student, which depends on the number of degrees of freedom, then the probability of error obtained from the error is equal to $f = n_1 + n_2 - 2 = 16 + 16 - 2 = 30$. If $f = 30$, then the critical value, according to a special table, is 3.646. The value of 3.78 is greater than the value of 3.646, so the significance level is less than 0.001. These indicators were higher than the critical value of Student's distribution. The fact that the probability of errors made is equal to or less than 0.01 is sufficient to draw scientifically reliable conclusions, that is, the correctness of the proposed research forecast is proved.

To determine the effectiveness of working with the glossary and the text in English when teaching inorganic chemistry classes in the online format a survey was conducted. The effectiveness of working with a text in the English language in the workshop classes of Inorganic Chemistry during online training was studied in a group work together with the CLIL method. During the seminar sessions a glossary was worked out to improve students' assimilation of English text. Working with the glossary allowed students to better remember definitions related to the topic.

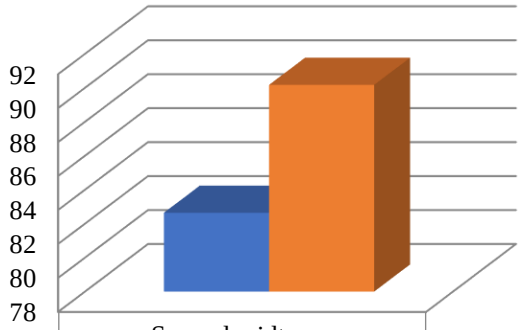
The results of the survey on the effectiveness of working with English text are shown in Figure 2.



	1 question	2 question	3 question	4 question	5 question
Yes	62,5	37,5	50	71,5	63,8
No	37,5	12,5	25	28,5	11,2
I face challenges in answering	0	50	25	0	25

Figure 2. The results of a survey taken during an online lesson
to determine the effectiveness of working with the English text

During the experiment the average result of the second midterm control grades of students of the control group during online training was 86.71, and the average result of the second midterm control grades of students of the experimental group was 90.17 (Fig. 3). This difference means that learning using the CLIL method has shown positive results. Since they are students of the 1st year, they are not trained in direct communication with the teacher and students of the group, it was difficult to immediately get used to the new format. However, in the online format explanatory seminars and consultations were held in ZOOM, and students adapted to the new learning format. As a result, the effective methods used in the lesson and the learning results were positive.



	Second midterm control
Control group	82,64
Experimental group	90,17

Figure 3. Results of the second midterm control grades of students
of the control and experimental groups

Conclusion

The conducted pedagogical experimental work showed the effectiveness of teaching Inorganic Chemistry classes in English based on the subject-language integrated method. As a result of the proposed research, students of the experimental group showed a higher level of language and subject competence in teaching in an online format than in the control group. The positive dynamics of the development of these competencies was characterized by the fact that the teaching of subject knowledge in English is carried out through the use of

certain teaching methods, in particular, the use of terminology and glossary, working with English text, that is, the use of the CLIL method.

References

1 Lopriore L. Reframing teaching knowledge in Content and Language Integrated Learning (CLIL): A European perspective / L. Lopriore // Language Teaching Research. — 2020. — Vol. 24, No. 1. — P. 94–104. https://doi.org/10.1177/1362168818777518

2 Meng Y. High-Quality Inorganic Chemistry Teaching During COVID-19 / Y. Meng, X. Song, Y. Li, Zh. Tan // Journal of chemical education. — 2020. https://dx.doi.org/10.1021/acs.jchemed.0c00874

3 Recino U. Flipped classroom and CLIL to teach English and subject related to teaching practice / U. Recino // 14th International Technology, Education and Developed Conference. — 2020. — P. 96–102. https://doi.org/10.21125/inted.2020.0054

4 Arynova A.B. Presenting lecture materials in English using CLIL technologies / A.B. Arynova, D.A. Kasymbekova, Z.K. Korganbayeva // Bulletin of the University of Karaganda – Chemistry. – 2020. — Vol. 98, No. 2. — P. 105–112. https://doi.org/10.31489/2020Ch2/105-112

5 Yen Sh. Learning online, offline, and in-between: comparing student academic outcomes and course satisfaction in face-to-face, online, and blended teaching modalities / Sh. Yen, Y. Lo, A. Lee // Educ Inf Technol. — 2018. https://doi.org/10.1007/s10639-018-9707-5

6 Duncan A.W. Lessons Learned by Converting a First-Year Physical Chemistry Unit into an Online Course in 2 Weeks / A.W. Duncan, Y. Alexandra, L. Matthys, S. Dino // Journal of chemical education. — 2020. — P. 2389–2392. https://dx.doi.org/10.1021/acs.jchemed.0c00678

7 Alvarez F. Project Learn in English: A CLIL experience at the Faculty of Science of the University of Extremadura / F. Alvarez // Proceedings of the 3rd International Conference on Higher Education Advances. — 2017. — P. 1396–1401. DOI: http://dx.doi.org/10.4995/HEAd17.2017.5656

8 Ramiro M. The use of text genres to improve the quality of writing performance in CLIL university settings / M. Ramiro, M. Perez // 4th international conference on applied social science. — 2014. — P. 381–386.

9 Korshevniuk T. Group learning activities as a condition of implementing competence-based approach to students' inorganic chemistry teaching at university / T. Korshevniuk, O.G. Yaroshenko, O.A. Blazhko, A.V. Blazhko // Bulletin of the University of Karaganda — Chemistry. — 2020. — Vol. 98, No. 2. – P. 122–131. https://doi.org/10.31489/2020Ch2/122-131

10 Kao Y.T. Understanding and addressing the challenges of teaching an online CLIL course: a teacher education study / Y.T. Kao // International Journal of Bilingual Education and Bilingualism. — 2020. — P. 1–20. https://doi.org/10.1080/13670050.2020.1713723

11 Akimova O.V. Content and language integrated learning as an effective method in teaching terminology for translation / O.V. Akimova, N.A. Deputatova // 14th International Technology, Education and Development Conference. — 2020. — P. 6980–6984. https://doi.org/10.21125/inted.2020.1853

12 Lopez V. The effects of Content and Language Integrated Learning in the Physical Education subject in Primary Education / V. Lopez, M.J. Siena-Diaz, S. Gonzalez-Villora // Sportis Sci. J. — 2019. — Vol. 5, No. 3. — P. 562–685. DOI: https://doi.org/10.17979/sportis.2019.5.3.5527

13 Kemper A.K. Bilingual teaching in natural sciences (physics/chemistry) through the foreign language German — Knowledge of a case study in France / A.K. Kemper, H.J. Becker // CHEMKON. — 2016. — Vol. 2, No. 2. — P. 87–89. https://doi.org/10.1002/ckon.201610264

14 Sendur K.A. Historical reasoning in an undergraduate CLIL course: students' progression and the role of language proficiency / K.A. Sendur, J. van Drie, C. van Boxtel, K.J. Kan // International Journal of Bilingual Education and Bilingualism. — 2020. https://doi.org/10.1080/13670050.2020.1844136

15 Rose H. What drives success in English medium taught courses? The interplay between language proficiency, academic skills, and motivation / H. Rose, S. Curle, I. Aizawa, G. Thompson // Studies in Higher Education. — 2019. — P. 1–13. https://doi.org/10.1080/03075079.2019.1590690

16 Karabassova L. Towards translanguaging in CLIL: a study on teachers' perceptions and practices in Kazakhstan / L. Karabassova, X. San Isidro // International Journal of Multilingualism. — 2020. — P. 1–20. https://doi.org/10.1080/14790718.2020.1828426

17 Frances C. The influence of emotional and foreign language context in content learning / C. Frances, A. De Bruin, J.A. Duñabeitia // Studies in Second Language Acquisition. — 2020. — Vol. 42, No. 4. — P. 891–903. https://doi.org/10.1017/S027226311900072X

18 Бырдина О.Г. Формирование иноязычной профессионально-коммуникативной компетенции у студентов педагогического вуза посредством CLIL / О.Г. Бырдина, Е.А. Юринова, С.Г. Долженко // The Education and Science Journal. — 2020. — Т. 22, № 7. — С. 77–100. https://doi.org/10.17853/1994-5639-2020-7-77-100

19 Villanueva O. Adapting to the COVID-19 Online Transition: Reflections in a General Chemistry Sequence Taught by Multiple Instructors with Diverse Pedagogies / O. Villanueva, A. Behkme, J.D. Morris, R. Simmons, Ch. Anfuso, C.M. Woodbridge, Y. Guo // Journal of Chemical Education. — 2020. — Vol. 97, No. 9. — P. 2458–2465. https://doi.org/10.1021/acs.jchemed.0c00752

20 Nurdillayeva R.N. Features of teaching Chemistry in English: continuity of traditional and new technologies / R.N. Nurdillayeva, A.Z. Baisalova, G.O. Zhuman // Bulletin of the University of Karaganda — Chemistry. — 2020. — Vol. 98, No. 2. — P. 113–121. https://doi.org/10.31489/2020Ch2/113-121

21 Inorganic chemistry. Collection of experiments / G.N. Zhylysbayeva, R.N. Nurdillayeva. — Shymkent: Typography Alem, 2017. — 140 p.

22 Sydykov B. Methodology for the development of search and research skills of prospective math teaching in a course on mathematical physics equations / B. Sydykov, S. Daiyrbekova, M. Muratbekova, Zh. Issayeva, M. Burkitbayeva, M. Kavakli, L. Rizayeva

// EURASIA Journal of Mathematics, Science and Technology Education. — 2017. — Vol. 13, No. 11. — P. 7223–7236. https://doi.org/10.12973/ejmste/79047

Р.Н. Нұрділлаева, Г.Ө. Жуман

Бейорганикалық химия пәні сабақтарында CLIL әдісін қолдану

Мақалада бейорганикалық химия пәні сабақтарын ағылшын тілінде кіріктіре оқытуда CLIL әдісін қолдану ерекшелігі қарастырылған. Студенттердің пәндік және тілдік дағдыларын қалыптастыру мақсатында пән мен тілді кіріктіре оқытуда – CLIL әдісі онлайн оқыту форматында зерттелді. В012 Химия мұғалімдерін даярлау білім беру бағдарламасы тобының бірінші курс студенттеріне бейорганикалық химия пәні сабақтары онлайн форматта бақылау тобына дәстүрлі, ал эксперименттік топқа CLIL әдісін қолдану арқылы өткізілген. Эксперимент үшін студенттер кездейсоқ әдіспен емес, кіріс бақылауы негізінде ағылшын тілі мен пәнді білу деңгейі бойынша таңдалды. Педагогикалық экспериментте алынған нәтижелердің сенімділігін растау және іріктеменің репрезентативтілігін дәлелдеу үшін математикалық статистика әдісі қолданылды. Стьюдент *t*-критерий әдісі арқылы ұсынылған зерттеу болжамының дұрыстығы дәлелденді. Студенттердің білім деңгейлері оқытудың нәтижелеріне сәйкес құзыреттіліктерге сай қорытындыланды. Сабақ барысында CLIL технологиясын қолдануда терминология, глоссарий, ағылшын тілінде негізделген мәтінмен жұмыстар жасалды. Ағылшын тілінде берілген мәтін мен сауалдармен жұмыс жасауда студенттердің тілдік құзыреттіліктері дамыды. Терминология, глоссарий, ағылшын тілінде дайындалған мәтінмен жұмыстардың тиімділігі студенттерден алынған сауалнама нәтижесінде анықталды. Сонымен қатар, мақалада бақылау тобы және эксперименттік топ студенттерінің онлайн форматта оқыту кезінде аралық бақылау нәтижелерінің салыстырмалы көрсеткіштері де келтірілді. Жан жақты зерттеу жұмысының нәтижесінде студенттердің CLIL әдісіне деген қызығушылықтары артқаны, білім алу процесіне жағымды әсер еткені айқындалды.

Кілт сөздер: CLIL әдісі, бейорганикалық химия пәні, онлайн формат, оффлайн формат, пән мен тілді кіріктіре оқыту, глоссарий, ағылшын тіліндегі мәтінмен жұмыс, құзыреттілік.

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Применение метода CLIL на занятиях по неорганической химии

В статье рассмотрены особенности применения метода CLIL при интегрированном преподавании занятий неорганической химии на английском языке. С целью формирования предметных и языковых навыков студентов был изучен метод интегрированного преподавания предмета и языка – метода CLIL в формате онлайн обучения. Занятия по неорганической химии для студентов первого курса группы образовательной программы В012 подготовки учителей химии проводились в онлайн формате для контрольной группы традиционно, и для экспериментальной группы методом CLIL. Для эксперимента были отобраны студенты не случайным методом, а по уровню знания английского языка и предмета на основе входного контроля. В педагогическом эксперименте для подтверждения достоверности полученных результатов и доказательства репрезентативности выборки использован метод математической статистики. Доказана правильность гипотезы исследования, предложенного методом *t*-критерия Стьюдента. Уровни знаний студентов обобщены в соответствии с результатами обучения согласно их компетенциям. На занятиях были проведены работы с терминологией, глоссарием, подготовленным текстом на английском языке при использовании технологии CLIL. Языковые компетенции студентов развивались при работе с текстами и вопросами на английском языке. Эффективность работы с терминологией, глоссарием и текстами на английском языке определяли анкетированием студентов. Кроме того, в статье приведены сравнительные показатели результатов промежуточного контроля при обучении студентов контрольной и экспериментальной групп в онлайн формате. В результате всестороннего исследования выявлено повышение интереса студентов к методу CLIL, что положительно сказалось на образовательном процессе.

Ключевые слова: метод CLIL, неорганическая химия, онлайн формат, оффлайн формат, интегрированное обучение предмету и языку, глоссарий, работа с текстом на английском языке, компетентность.

References

1 Lopriore, L. (2020). Reframing teaching knowledge in Content and Language Integrated Learning (CLIL): A European perspective. *Language Teaching Research, 24(1),* 94–104. https://doi.org/10.1177/1362168818777518

2 Meng, Y., Song, X., Li, Y., Tan, Zh. (2020). High-Quality Inorganic Chemistry Teaching During COVID-19. *Journal of chemical education*. https://dx.doi.org/10.1021/acs.jchemed.0c00874

3 Recino, U. (2020). Flipped classroom and CLIL to teach English and subject related to teaching practice. *14th International Technology, Education and Developed Conference*, 96–102. https://doi.org/10.21125/inted.2020.0054

4 Arynova, A.B., Kasymbekova, D.A., & Korganbayeva, Z.K. (2020). Presenting lecture materials in English using CLIL technologies, *Bulletin of the University of Karaganda – Chemistry, 2(98)*,105–112. https://doi.org/10.31489/2020Ch2/105-112

5 Yen, Sh., Lo, Y., Lee, A. (2018). Learning online, offline, and in-between: comparing student academic outcomes and course satisfaction in face-to-face, online, and blended teaching modalities. *Educ Inf Technol*. https://doi.org/10.1007/s10639-018-9707-5

6 Duncan, A.W., Alexandra, Y., Matthys, L., Dino, S. (2020). Lessons Learned by Converting a First-Year Physical Chemistry Unit into an Online Course in 2 Weeks. *Journal of chemical education*. 2389–2392. https://dx.doi.org/10.1021/acs.jchemed.0c00678

7 Alvarez, F. (2017). Project Learn in English: A CLIL experience at the Faculty of Science of the University of Extremadura. *Proceedings of the 3rd International Conference on Higher Education Advances*, 1396-1401. http://dx.doi.org/10.4995/HEAd17.2017.5656

8 Ramiro, MSS., Perez, MDS. (2014). The use of text genres to improve the quality of writing performance in CLIL university settings, *4th international conference on applied social science*, 381–386.

9 Korshevniuk, T., Yaroshenko, O.G., Blazhko, O.A., & Blazhko, A.V. (2020). Group learning activities as a condition of implementing competence-based approach to students' inorganic chemistry teaching at university. *Bulletin of the University of Karaganda – Chemistry, 2(98)*, 122–131. https://doi.org/10.31489/2020Ch2/122-131

10 Kao, Y.T. (2020). Understanding and addressing the challenges of teaching an online CLIL course: a teacher education study. *International Journal of Bilingual Education and Bilingualism*, 1-20. https://doi.org/10.1080/13670050.2020.1713723

11 Akimova, O.V., & Deputatova, N.A. (2020). Content and language integrated learning as an effective method in teaching terminology for translation. *14th International Technology, Education and Development Conference*, 6980-6984. https://doi.org/10.21125/inted.2020.1853

12 Gil Lopez, V., Siena-Diaz, M.J., & Gonzalez-Villora, S. (2019). The effects of Content and Language Integrated Learning in the Physical Education subject in Primary Education. *Sportis Sci J, 5(3)*, 562–685. https://doi.org/10.17979/sportis.2019.5.3.5527

13 Kemper, A.K., Becker, H.J. (2016). Bilingual teaching in natural sciences (physics/chemistry) through the foreign language German – Knowledge of a case study in France. *CHEMKON 23(2)*, 87–89. https://doi.org/10.1002/ckon.201610264

14 Sendur, K.A., van Drie, J., van Boxtel, C., Kan, K.J. (2020). Historical reasoning in an undergraduate CLIL course: students' progression and the role of language proficiency. *International Journal of Bilingual Education and Bilingualism* https://doi.org/10.1080/13670050.2020.1844136

15 Rose, H., Curle, S., Aizawa, I., & Thompson, G. (2019). What drives success in English medium taught courses? The interplay between language proficiency, academic skills, and motivation. *Studies in Higher Education*, 1–13. https://doi.org/10.1080/03075079.2019.1590690

16 Karabassova, L., San Isidro, X. (2020). Towards translanguaging in CLIL: a study on teachers' perceptions and practices in Kazakhstan. *International Journal of Multilingualism*, 1–20. https://doi.org/10.1080/14790718.2020.1828426

17 Frances, C., De Bruin, A., Duñabeitia, J.A. (2020). The influence of emotional and foreign language context in content learning. *Studies in Second Language Acquisition, 42(4)*, 891–903. https://doi.org/10.1017/S027226311900072X

18 Byrdina, O.G., Yurinova, E.A., & Dolzhenko, S.G. (2020). Formirovanie inoiazychnoi professionalno-kommunikativnoi kompetentsii u studentov pedagogicheskogo vuza posredstvom CLIL [Developing Foreign Language Professional-Communicative Competence of Pedagogical University Students by Means Of CLIL]. *The Education and Science Journal. 22(7)*, 77-100. https://doi.org/10.17853/1994-5639-2020-7-77-100 [in Russian].

19 Villanueva, O., Behkme, A., Morris, J.D., Simmons, R., Anfuso, Ch., Woodbridge, C.M., & Guo Y. (2020). Adapting to the COVID-19 Online Transition: Reflections in a General Chemistry Sequence Taught by Multiple Instructors with Diverse Pedagogies. *Journal of Chemical Education, 9(97)*, 2458–2465. https://doi.org/10.1021/acs.jchemed.0c00752

20 Nurdillayeva, R.N., Baisalova, A.Z., Zhuman, G.O. (2020). Features of teaching Chemistry in English: continuity of traditional and new technologies. *Bulletin of the University of Karaganda – Chemistry, 2(98)*, 113–121. https://doi.org/10.31489/2020Ch2/113-121

21 Zhylysbayeva, G.N., Nurdillayeva, R.N. (2017). *Inorganic chemistry. Collection of experiments*. Shymkent: Typography Alem.

22 Sydykov, B., Daiyrbekova, S., Muratbekova, M., Issayeva, Zh., Burkitbayeva, M., Kavakli, M., & Rizayeva, L. (2017) Methodology for the development of search and research skills of prospective math teaching in a course on mathematical physics equations. *Journal of Mathematics, Science and Technology Education, 13(11)*, 7223–7236. https://doi.org/10.12973/ejmste/79047

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