An empirical study on the acquisition of content in a CLIL-based chemistry course: A preliminary report

Un estudio empírico sobre la adquisición de contenidos en un curso de química basada en el AICLE: Un informe preliminar

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Abstract
This article presents the findings of an empirical study on the acquisition of content in a CLIL (Content and Language Integrated Learning) course conducted by the author at a middle school in Radom, Poland. The research involved a group of Polish students who learn chemistry through English as part of their school curriculum. The results of the research support an understanding that using a foreign language as a means of teaching non-linguistic subjects does not impair content acquisition—and may actually improve overall learning processes. The research raises questions about the relationship between a foreign language and conceptual knowledge, as well as about the mechanisms that may compensate for the additional difficulties students may encounter while learning content (such as chemistry) through a foreign language. By way of introduction, the article offers an overview of the literature on the effectiveness of CLIL teaching. This theoretical background leads to the description of the experiment, followed by an analysis of its results. The paper ends with conclusions and some final thoughts relating to the experiment.
Key Words: CLIL; chemistry; teaching; second language learning; pedagogy; efficacy.

Resumen
Este artículo presenta los resultados de un estudio empírico sobre la adquisición de contenidos en un curso de AICLE (Aprendizaje Integrado de Contenidos y Lenguas Extranjeras) llevado a cabo por el autor en una escuela secundaria en Radom, Polonia. En la investigación participó un grupo de estudiantes polacos quienes aprendieron química a través del inglés como parte de su currículo escolar. Los resultados de la investigación apoyan el argumento de que el uso de una lengua extranjera como medio de enseñanza de contenidos no lingüísticos no altera la adquisición del contenido—y de hecho puede mejorar los procesos de aprendizaje en general. La investigación plantea interrogantes sobre la relación entre una lengua extranjera y el conocimiento conceptual, así como sobre los mecanismos que pueden compensar las dificultades adicionales que los estudiantes pueden encontrar mientras aprenden contenidos (como la química) a través de una lengua extranjera. A modo de introducción, el artículo ofrece una visión general de la literatura sobre la efectividad de la enseñanza AICLE. Esta base teórica conduce a la descripción del experimento, seguido de un análisis de sus resultados. El artículo finaliza con las conclusiones y algunas reflexiones relacionadas con el experimento.
Palabras Claves: AICLE; química; enseñanza; aprendizaje de una segunda lengua; pedagogía; efectividad.

INTRODUCTION

The definition of CLIL seems to bring many questions to our minds. It is fully understandable that a lot of scepticism may be found both inside and outside the education profession. In fact, a great majority of the fears in relation to CLIL comes from CLIL teachers. A person who begins working with CLIL, sooner or later, is forced to face the real challenge of finding the right balance between content and language. Common sense seems to suggest that students who learn a school subject in a foreign language cannot possibly acquire the same amount of content as their friends learning in a more "traditional" way. The concern seems to be about both coverage and depth. When it comes to the coverage of the material, there is a justified fear that using a foreign language in the classroom may slow down the pace of the lesson, so that less subject matter can be covered. With regard to depth, there is the fear that lower language proficiency may result in reduced cognitive complexity of the subject matter presented and/or learned (Dalton-Puffer, 2007, p. 5). In the light of the facts discussed, it seems to be obvious that parents and teachers often have reservations about this new approach in education.

On the other hand, the research literature on CLIL proclaims that it is a safe and promising way of teaching both the foreign language and a content subject. For instance, consider the results of the immersion programmes in Canada, where English-speaking school students were receiving the majority of their schooling through French. One significant experiment was started in 1965 in St. Lambert. In this case, English-speaking parents were concerned that their children might not reach the level of French that was required in order to find a proper job. As a consequence, they initiated what came to be known as the *early total immersion program* (Lyster, 2007, p 8). Since that time, many further immersion programmes have been introduced in Canada. *Early immersion* starts in the first grade or in kindergarten. Immersion that starts in the third, fourth, or the fifth grade is called *delayed immersion*, while *late immersion* begins in the sixth grade. Taking into consideration the number of the subjects taught in a foreign language, we can distinguish two types: *total* or *partial immersion*. In the case of total immersion, all of the subjects are taught in a second language for the first two years of learning. Partial immersion, on the other hand, includes only chosen subjects and can be introduced after an appropriate language course (Iluk, 2002, p. 68). Evaluation of different types of immersion programmes shows that early immersion and total immersion produce far better results (Ellis, 1994, p. 226).

An immersion class does not emphasise language *per se* but rather focuses on non-language content. There is no ordering when it comes to, for example, grammatical categories. In reality, immersion programmes in Canada have not adopted total de-schooling of language but have tried to put the language learner in a situation where the language is used for real communication rather than simulation. As a consequence, form gives priority to message (Stern, 1998, p. 12).

As one may expect, opponents of the programmes claimed that using the immersion model could have led to the students forgetting their native language or simply that teaching a school subject in a foreign language (for example, French) might be too difficult. However, according to Ellis (1994, p. 227), "French Canadian immersion programmes have shown conclusively that early instruction through the medium of the L2 has no negative effects". What is more, comprehensible input and social reasons have contributed to the success of many immersion programmes. Students taking part in them were able to successfully use French while speaking and writing and even take up their studies in French (Wesche, 2002, p. 361). The programmes developed positive attitudes towards those who speak French and towards their culture. Consequently, students taking part in immersion programmes have less rigid stereotypes concerning the foreign language community and are more aware of the importance of contacts between different ethnic groups (Ellis, 1994, p. 226). The same conclusions can be found in the work of Masih (1999), who claims that, when introducing an immersion programme, the students' first language does not suffer, and there are no long-term deficits in connection to subject matter. He also adds that "there are no negative effects on the students' cognitive development and foreign language proficiency tends to be higher than in comparable LAS classes" (Masih, 1999, p. 19).

The success of Canadian immersion programmes resulted in their subsequent adoption in many parts of North America (Richards & Rodgers, 2001, p. 206). Among the languages used for immersion programmes, the authors mention French, German, Spanish, Japanese, and Chinese. However, what is of crucial significance is the fact that immersion education was an approach that introduced a methodological perspective (Marsh, 2002, p. 56).

Positive findings relating to CLIL may also be found in more recent works. In their latest book devoted to CLIL, Mehisto and Marsh (2008, p. 20) are extremely enthusiastic about the CLIL model and explain that students learning school subjects in a foreign language achieve the same or even better results than their friends learning in a more traditional way, that is, in their native language. Both researchers believe that "far from interfering with content acquisition, CLIL can actually facilitate it" (Mehisto & Marsh, 2008, p. 20).

In recent years, a considerable number of studies have also appeared in Germany and Switzerland with results that provide further empirical evidence for the effectiveness of CLIL teaching. In her article on the acquisition of knowledge in bilingual learning, Stohler (2006, p. 41) firmly states that the teaching of non-linguistic topics in an L2 does not impair the acquisition of knowledge. Her study was conducted at the University of Bern in Switzerland and examined several Swiss schools in which French and German were used as an additional language. The intention was to examine the students' knowledge when they were learning in an L1 and to compare the findings with the results of the L2 teaching arrangement. Thus, classes that taught subject matters in an L1 and classes that taught subject matters in an L2 were videotaped, analysed, and the students' cognitive performance was evaluated. Among the subjects included in the study were history, biology, chemistry, and geography. The final evaluation of the interviews, which examined the students' knowledge of the school subjects, clearly indicated that no significant differences appeared in terms of content learning when the students were taught in either their L1 or an L2.

All of the facts mentioned, as well as subjective observations derived from my own teaching experience, have led me to use of the CLIL approach in my teaching context. Having encountered many reservations on the part of the school administrators, the students' parents, and the students themselves, I was strongly motivated to calm their fears and to conduct research in Polish school conditions. In order to do this, there was a strong and justified need to analyse the phenomenon of bilingual teaching in Poland. It seems that bilingual education in Poland is diversified and cannot be limited to a single model. Teachers apply various techniques and shift their focus between a content subject and a foreign language. A great deal of information about the possible models of bilingual education in Poland can be found in *Profile Report on Bilingual Education in Poland (English)* (Marsh et al., 2008), which presents results of a project coordinated by the National Centre for Teacher Training and Development (CODN) and the British Council Poland and provides an overview of practice in Polish secondary and middle schools which teach partly, or largely, through English (Gajo, 2005; Czura, Papaja, & Urbaniak, 2009). This study identified four curricular models, compared in Table 1.

Table 1. Comparison of four curricular models observed in Polish bilingual classes (Gajo, 2005).

MODEL	Languages used	Focus	Aims
A	mostly English	content and language	teaching the content and developing a high degree of language competence
B	English and Polish (50%: 50%)	content and language	teaching the content and developing a high degree of language competence
C	mostly Polish (English: 10%-50%)	content and language	teaching the content with the limited use of language
D	mostly Polish (English strictly limited)	content	teaching and complementing the content, learning only specific forms of language

In order to provide the best possible CLIL conditions, the researcher chose to use Model A while conducting the experiment. Model A is based on an exclusive usage of English for teaching and learning, while the use of Polish is strongly limited to situations in which there is a need for translation of terminology or brief recapitulation. The model allows the teacher to attend to content and language during CLIL lessons in equal measures. Its main aims are teaching the content as well as developing a high degree of competence in the foreign language.

METHODOLOGY

Context

The research was designed as a qualitative study, and its main aim was to investigate whether CLIL affects content acquisition. The main research question was: *Does using a foreign language in teaching a non-linguistic subject affect content acquisition?* The goal of the research was to compare the test results of the students learning chemistry in English with the results of the students in the other classes who were learning chemistry only in Polish. The test was prepared in the students' native language, Polish (see **App.1, p. 21**).

The experimental group was the English- medium chemistry classroom in one of the middle schools in Radom. The research began in September 2009 and finished in February 2011. During this time, the experimental group was learning chemistry mostly through English. In the Polish educational system the average lesson time is 45 minutes. It is worth adding that for about 30 minutes of each lesson (that is, about 65% of the lesson time), the class and the teacher used English as a medium of instruction. Polish was used only for administering tests, introducing new terms, or homework explanation. There was no single lesson conducted only in Polish during the time of the research. However, homework given to students was partly in English and partly in Polish. As has been noted, for the research model, the researcher chose for Model A shown in Table 1.

There were 32 pupils in the experimental group; however, one of them was absent on the day of the test. At the same time (from September 2009 until February 2011), the remaining 9 classes (235 students) were receiving the same content completely through Polish. The order of the topics presented to the classes may have been different, since they were introduced by different teachers, but the overall material covered during this time was exactly the same, as the students were to take the same test. The material introduced was based on the traditional Polish chemistry curriculum designed for the middle school level. The topics covered during the time of the experiment were as follows:

1. Substances and their chemical reactions,
2. The inner structure of matter,
3. Water and its solutions,
4. Acids,
5. Hydroxides,
6. Salts.

Altogether, 266 pupils in 10 classes participated in the study (including 31 pupils from the experimental group). The participants' native language was Polish. The participants' contact with English was established principally through foreign language classes from elementary grade 1 and onwards. In addition to their CLIL classes, they all had additional EFL lessons. It is vital to add that chemistry was a completely new subject for all of the 266 students participating in the research. In the Polish educational system, chemistry is absent at the primary school level and is introduced at the lower-secondary level as a new subject. This fact helped to avoid the possibility of false results influenced by the participants' previous knowledge. In relation to English itself, the students of the experimental group had to take a placement test before entering the classes. The test results indicated that a majority of the students were at an intermediate level. It is understandable that high language proficiency might help learners overcome at least part of the difficulties in relation to the content taught in the foreign language. However, it cannot completely reduce the challenge of learning a completely new subject (chemistry is considered quite difficult) in the foreign language, and even students who are linguistically advanced have to put considerable effort into learning new material through the foreign language. **This issue will be discussed more deeply in the final part of the article**.

Research Design

In order to generate data and evidence for answering the research question, a set of identical chemistry tests was employed in April 2011 (after almost two years of chemistry teaching). The set was prepared in the students' native language, Polish. In the Polish educational system, middle school level ends with two final exams written in Polish (one of them contains questions related to chemistry) and an additional English test. Since our experimental group would in the future need to deal with chemistry questions in Polish, it seemed logical to examine whether learning chemistry through English caused any deficiencies in the students' content knowledge. Proving the effectiveness of CLIL teaching would reduce the concerns of all people involved in the process of CLIL implementation at our school. The test lasted 40 minutes and contained traditional chemistry tasks based on the school curriculum for the first two years of the middle school level. It consisted of 22 tasks and the maximum possible score was 50 (**see App.1, p. 21**). During the test, the students could not leave their classrooms or use any additional materials. One teacher monitored each group taking part in the test.

As far as the teachers are concerned, it was impossible for the researcher to teach the remaining 9 classes. Consequently, two other teachers were engaged in the research process. They taught chemistry only through Polish. The first teacher (Teacher A) was responsible for the classes marked in the final part with numbers 2, 3, 4 and 5, while the second teacher (Teacher B) worked with the classes marked as 6, 7, 8, 9 and 10. The researcher (Teacher R) taught chemistry through English. Without doubt, such factors as the number of teachers engaged in the study, their teaching methods, and their personal motivations represent a major variables. For many years, there has been an on-going debate about what would be the perfect classroom conditions to support learning, and many researchers have tried to create a portrait of an ideal teacher. Among these, we might mention Rosenshine and Furst (1973, p. 37-72) who identified factors that influence learning processes, including clarity, task orientation, student opportunity, variety, and teacher enthusiasm. As for the clarity factor, this relates to the ability of the student to see, hear, and finally understand the classroom proceedings. Task orientation involves guiding students through the topic and engaging them in task completion. Student opportunity relates to the possibility for a student to engage with the material. This would involve, for example, issues such as student talking time vs. teacher talking time, the adequacy of the materials, the variety of activities, or cognitive engagement on the part of the learners. Another factor here, variety, is understood by the authors as connected with keeping different learning styles in mind. Finally, teacher enthusiasm is surely contagious and makes students more interested in a given topic.

During the study, the researcher could not control the teaching methods applied by the two other participating teachers (Teacher A and Teacher B); nevertheless, each of the three teachers involved in the research process wanted their students to gain the best final results. This is a standard procedure, since, in the eyes of the school administrators, high student results are regarded as a proof of the effectiveness of teaching. What is more, in order to make the tests' results more credible, the CLIL teacher (the researcher) did not take part in the preparation of the tests. In this way, both Teacher A and Teacher B had even a greater chance to prepare their students for the test (since both teachers knew the questions). Such conditions would lead us to expect better results from the remaining 9 classes as compared with the CLIL class.

Materials

In order to briefly present possible solutions adapted by the teachers during the research process, we should now focus our attention on example chemistry activities and discuss the ways of conducting them during "traditional" Polish chemistry lessons and CLIL classes. The teachers conducting lessons only in Polish used the "traditional" methodology of teaching chemistry. In order to explore the true CLIL spirit on a practical level, there was a need for the researcher to analyse and apply the basic elements of both English and chemistry methodology. As far as chemistry is concerned, Kulawik and Litwin (2005, p 5) enumerate the following teaching techniques:

1. Verbal techniques:
    - Description.
    - Lecture.
    - Small talk.
    - Description with the usage of such aids as *realia*, models, tables, graphs.
    - Discussion.
    - Working with materials such as a course book, an activity book, a dictionary, a magazine.
2. Illustrative techniques:
    - Observation of an experiment conducted by a teacher or a student.
    - Observation of materials such as models, tables, graphs, computer programmes.
3. Practical techniques:

- Chemical experiments carried out by students;
- Creating of models;
- Workshop classes;
- Didactic games, etc.

A specific combination of both methodologies (foreign language and content subject) introduces the teacher into the CLIL world. Mehisto and Marsh (2008, p 29) enumerate the following among the core features of the CLIL approach:

1. Multiple focus; for example, supporting language learning in content classes and *vice versa*, supporting reflection on the learning process.
2. Safe and enriching learning environment; for example, used to building students' confidence to experiment with language and content, using routine activities and discourse.
3. Authenticity; for example, using current materials from the media and other sources, letting the students ask for the language help they need.
4. Active learning; for example, students communicating more than the teacher, favouring peer co-operative work;
5. Scaffolding; for example, building on the student's existing knowledge, fostering creative and critical thinking.
6. Co-operation; for example, planning lessons with CLIL and non-CLIL teachers, involving parents in learning about CLIL.

With regards to the activities themselves, Appendix A: English and Polish activities provides a set of examples, each one of which includes:

- the CLIL version of the activity (Teacher R).
- the Polish version relating to the same topic (Teachers A and B).
- a related activity taken from the Polish language final chemistry exam (which relates to the subject of both tasks).

Taken together, the carious examples illustrate different ways of introducing or practising particular chemistry topics. The techniques were adapted by the teachers in order to guide the students through the material and prepare them for the upcoming test.

RESULTS

The final database of results consists of 266 chemistry tests written by the students. Table 2 presents the test results for all of the classes, although scores have been converted into percentages for ease of reference.[1] As has been mentioned, there were 10 classes involved in the study. All of the classes have been identified with numbers from 1 to 10. The CLIL class has been identified with the number 1, and the Polish-language classes have been identified with the numbers 2, 3, 4, and 5 (Teacher A) and 6, 7, 8, 9, and 10 (Teacher B). Figure 1 represents the same results as shown in Table 2, but expressed as summary of percentages. Abbreviations used are as follows:

- *T:R* for the researcher.
- *T:A* for Teacher A.
- *T:B* for Teacher B.

[1] As the maximum possible test score was 50 points, this score would be represented as 100 in Table 2. Conversely, where Table 2 shows a percentage score of 50, this indicates a raw test result of 25 point (out of a possible 50).

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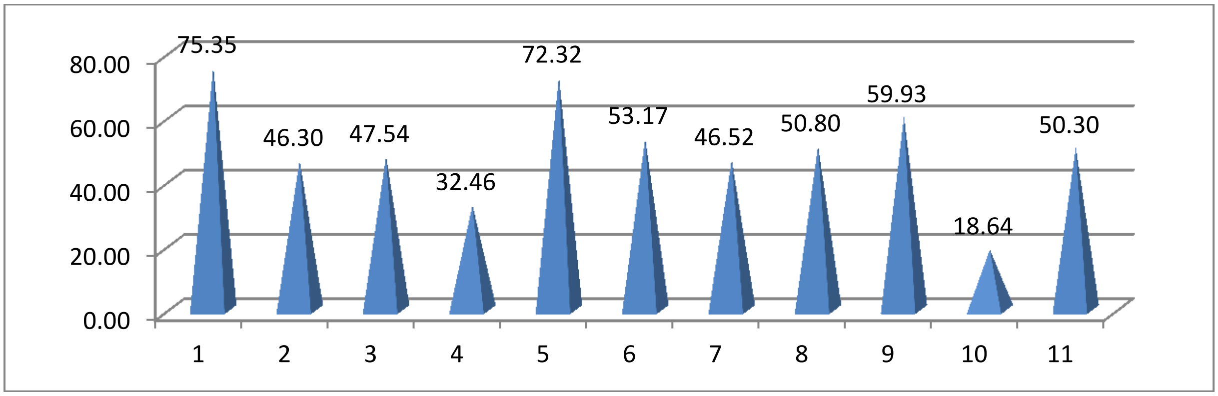
Table 2. Results of final chemistry tests for all classes.

CLASS	1 (T:R)	2 T:A	3 T:A	4 T:A	5 T:A	6 T:B	7 T:B	8 T:B	9 T:B	10 T:B	School result
Student number											
1	70	16	28	36	88	52	40	56	16	13	
2	66	20	16	20	84	40	26	92	32	17	
3	78	42	44	16	88	42	44	24	66	8	
4	98	40	20	16	62	52	52	74	60	17	
5	94	26	56	12	56	56	32	28	62	8	
6	92	32	64	20	76	40	68	76	48	16	
7	100	48	35	82	100	34	52	62	68	21	
8	76	74	50	30	88	80	50	74	28	23	
9	42	56	94	8	50	84	60	76	52	23	
10	70	64	38	20	82	72	58	30	96	32	
11	66	72	76	18	62	92	62	48	78	20	
12	84	54	50	18	90	64	62	48	50	20	
13	88	34	62	28	84	60	60	12	48	24	
14	70	58	56	20	86	66	64	44	28	40	
15	62	12	40	20	18	32	32	28	96	26	
16	76	38	94	16	80	52	44	72	82	26	
17	84	24	84	62	36	16	48	24	44	26	
18	86	46	50	70	52	42	46	84	36	11	
19	92	12	26	48	62	64	44	84	24	12	
20	66	48	48	48	68	24	32	34	82	13	
21	80	48	88	84	82	96	48	24	76	0	
22	84	70	32	42	88	28	26	20	68	14	
23	100	70	20	32	60	70	40	28	76		
24	74	36	32	34	92	76	20	32	78		
25	88	74	20	24	56	8	56	40	96		
26	50	70	12	20	92	48	44	94	64		
27	38	64			88	80	26	46	64		
28	64				66	36		68			
29	56				82	36		36			
30	62				68			66			
31	80				56						
AVERAGE % SCORE	**75.3**	**46.3**	**47.5**	**32.4**	**72.3**	**53.1**	**46.5**	**50.8**	**59.9**	**18.6**	**50.3**

Figure 1. Percentage summary of final chemistry exam result for all classes.



As can be seen, the results provided in Table 2 and Figure 1 strongly suggest that using a foreign language as the medium of non-linguistic subject teaching does not impair content acquisition. The CLIL students, in comparison to their school friends learning chemistry through Polish, did not demonstrate any problems related to content. Moreover, they achieved the highest test results overall. The average score of the CLIL class was 75.35%, while only one non-CLIL class (Class 5). came close to this number, reaching 72.32%. The majority of the classes gained an average score close to 50% or in some cases much less than 50%.

However, in order to analyse the results more thoroughly, we shall now focus on the values of standard deviation for each class. The following table presents the figures starting with the lowest standard deviation.

Table 3. Standard deviation for each class

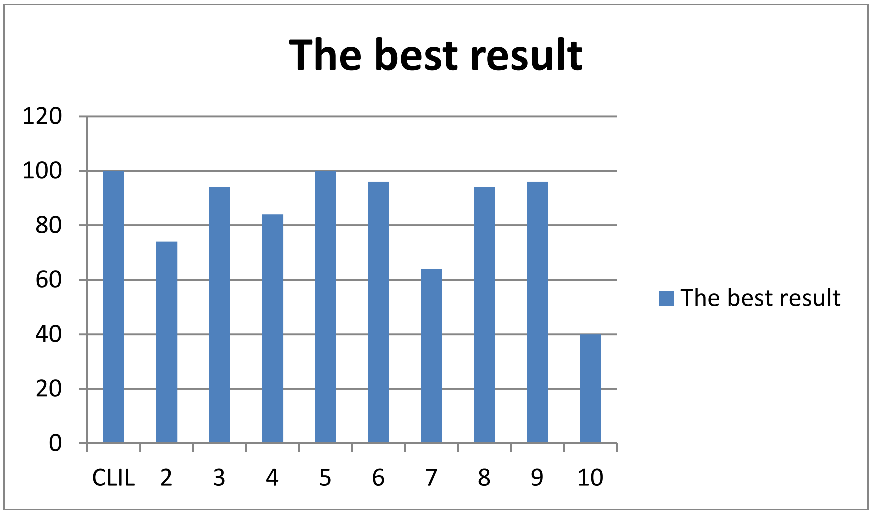
Class no.	Standard deviation (%)	Average score (%)
10	8.8	18.6
7	14.8	46.5
1(CLIL)	16.0	75.3
5	18.6	72.3
2	19.8	46.3
4	21.22	32.4
6	22.6	53.1
9	22.8	59.9
8	24.1	50.8
3	24.4	47.5

The data above indicate that the lowest standard deviation is observed for the weakest class (Class 10) as well as the best-scoring classes (Classes 7 and 1). Low standard deviation figures indicate that the results gained by the students of these three classes did not differ significantly.

Consequently, their level of chemistry knowledge may be considered comparable. On the other hand, a more diversified level of knowledge was observed in Classes 3 and 8 (which had the highest standard deviation figures).

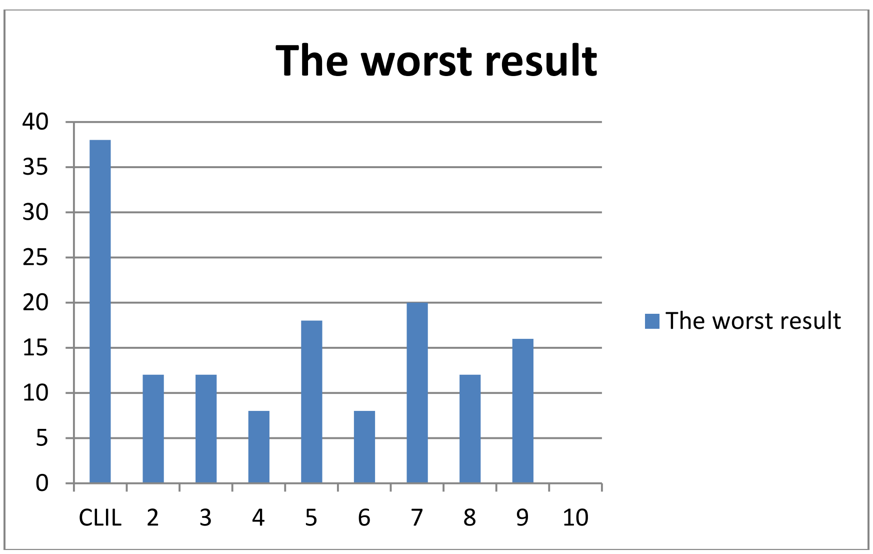
Further analysis of the test scores illustrates that only two students in the experimental CLIL class (Class 1) scored the highest possible number of points (100%); in the Class 5, was student also got this same result. Figure 2 illustrates the highest scores gained in each of the classes studied.

Figure 2. Highest scores by class.



With regard to the lowest scores, in the case of the bilingual class this was 38%. In the remaining classes, the worst scores were 0% (Class 10) and 8% (Classes 4 and 6). Once again, the experimental CLIL class's results seem to be the best among all of the classes tested. Figure 3 presents the lowest results for all of the classes studied.

Figure 3. Worst scores by class.



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As previously mentioned, one could think that the high language proficiency of students in the experimental CLIL class might help these learners to overcome at least part of the difficulties in relation to content taught in the foreign language, which is why we should now try to correlate the test scores with the students' results from their English classes results. Such a correlation might give us a sensible explanation for the study's results regarding CLIL. Table 4 presents the students' English grades as well as the final chemistry test grades; here, percentage scores have been changed into grades according to the following 6-point grading system:

- 95%–100%: 6
- 80%–94%: 5
- 65%–79%: 4
- 50%–64%: 3
- 25%–49%: 2
- 0%–24%: 1

Table 4. Comparison of chemistry and English grades

Student number	Chemistry grade	English grade
1	4	5
2	4	4
3	4	4
4	6	5
5	5	4
6	5	5
7	***6***	***4***
8	***4***	***6***
9	***2***	***5***
10	4	4
11	4	5
12	5	6
13	5	5
14	4	5
15	***3***	***5***
16	4	5
17	5	5
18	***5***	***3***
19	5	5
20	4	5
21	5	4
22	5	4
23	6	5
24	4	4
25	5	5
26	***3***	***5***
27	***2***	***5***
28	***3***	***5***
29	***3***	***5***
30	***3***	***5***
31	5	4

In Table 4, some of the students' grade are shown in ***bold-italics***, these are the results that seem to be especially interesting for the analysis. If we were to link the chemistry test scores with the students' foreign language proficiency, we would expect the best results in the case of the students with the highest English marks. However, Table 4 indicates that there were two groups of the students who do not fit into this explanation. First of all, there were students who had a high English mark but their chemistry test marks were much lower; for example, student numbers 9, 15, 26, 27, 28, 29, and 30. Secondly, there were also students with low English marks who nevertheless performed very well on the chemistry test; for example, student numbers 7 and 18. Such differences prove that high foreign language proficiency does not necessarily guarantee successful content learning in CLIL, as well as that poor foreign language skills do not necessarily lead to problems with content learning.

DISCUSSION

Analysis the results from this study confirms the theoretical and empirical postulates quoted in the Introduction section of this article. It is noticeable that CLIL does not lead to any deficiencies as far as content acquisition is concerned. However, these results have also forced the researcher to ask an additional question: *How is it possible that no negative differences between the students learning chemistry in an L2 and the students learning chemistry in an L1 were found?*

The researcher's subjective theories derived from personal learning and teaching experience suggest that some additional mechanisms must be present in the CLIL classroom. Furthermore, these mechanisms must compensate for the linguistic obstacles that students need to overcome in the CLIL classroom.

Of course, there are various possible solutions that have been adopted successfully by teachers, and these may serve as a means of enabling students to comprehend content more easily. Among these Lyster (2007, p. 60) enumerates the following: speech modifications, multiple examples, using props, graphs, visual aids, or building on students' background knowledge. Stohler (2006, p. 41) states that these strategies appear more frequently in L2 classes than in L1 classes. Before entering the classroom, the researcher would need to anticipate the difficulties that the students might encounter with the introduced content. Among possible obstacles, we could enumerate the following: lack of enough range of foreign vocabulary, complicated chemistry topics, fear of speaking about chemistry in English, students' tendency to use Polish, a lack of materials, or problems with homework. Such predictions forced the author (the researcher) to cooperate with different teachers, rethink her teaching strategies, and apply various changes intended to help the students cope with the new material in the CLIL classroom.

At this point, we may once again recall the characteristic features of CLIL approaches that introduces its own techniques and becomes a specific combination of pedagogical methodologies associated with the teaching of the content subject and the foreign language. To start with, most of the CLIL classes in this study were based on texts adapted from different sources, which is a very common procedure in bilingual teaching and adds authenticity to the lessons. Moreover, the researcher was trying to generate a "friendly" classroom atmosphere, and the students could talk to the teacher about any concerns they had. The students were given handouts with new information and different tasks during each of the lessons. These strategies refer back to the to need for a "safe and enriching environment" in the CLIL classroom. In order to guide the students through complicated chemistry material, the researcher used visual aids, graphs, and charts. The students were also often asked to prepare their own posters or tables as chemistry reference materials. What is more, whenever it was necessary, the researcher used speech modifications and repetitions.

Another important aspect of CLIL approaches is a multiple focus, which is why the researcher sought to stimulate language learning during chemistry classes. New vocabulary was introduced slowly and was clearly articulated. The activities helped the learners to practice all four language skills (reading, writing, listening, and speaking). Moreover, the teacher used English more often than Polish, and the students were encouraged to use English as well. Additionally, building on the students' existing knowledge was a common technique. Brainstorming or recalling useful language by the students was often present in the CLIL classroom. Another strategy, typical for CLIL approaches, was to encourage critical and creative thinking. The students were very often asked to define, classify, combine, or describe a particular phenomenon. Last but not least, it is vital to consider the aspect of active learning in the classroom. It was the researcher's intention to favour peer co-operative work and let the students speak English as often as it was possible.

Proving the direct impact of such mechanisms on the acquisition of content would bring a sensible explanation to the results presented. Still, if the further investigation did not confirm that such compensating factors are directly responsible for the same construction of knowledge as in the case of teaching in L1, the answer could be sought elsewhere. Dalton-Puffer (2007, p. 128) formulates two very important questions: "*How can far the skills be identified independently of their linguistic manifestation?*" and "*How far an explicit focus in the classroom on linguistic manifestations might actually foster thinking skills?*". In such a case, we could hardly suspect that the construction of content knowledge and language learning should not be viewed separately. Rather, this would encourage us to believe that a foreign language used in the classroom is one of the elements in the process of knowledge construction and not just a means for the transport of knowledge. However, in order to prove or reject such theories, more detailed investigations are needed.

The results of this study have encouraged the researcher to plan further research in this area, hopefully be pursued in the nearest future. There are many unresolved matters when it comes to CLIL, and this paper, which should be regarded as a preliminary report, explores only one of many controversial issues in relation to CLIL, with the hope that the results presented will encourage teachers to begin their own adventures with CLIL on a regular basis. There is a great need for teachers to share their experiences and conclusions about possible improvements in the future. To accomplish these goals, all the attempts at introducing CLIL into classrooms should be valued.

REFERENCES

Czura, A., Papaja, K., & Urbaniak, M. (2009). Bilingual Education and the Emergence of CLIL in Poland CLIL in Poland. In D. Marsh, P. Mehisto, D. Wolff, R. Aliaga, T. Asikainen, M. J. Frigols-Martin, S. Hughes, et al. (Eds.), *CLIL Practice: Perspectives from the field* (pp. 172-178). Jyväskylä, Finland: CLIL Cascade Network, University of Jyväskylä. Retrieved from http://www.icpj.eu/?id=22

Dalton-Puffer, C. (2007). *Discourse in content and language integrated learning*. Amsterdam, the Netherlands/Philadelphia: John Benjamins Publishing Company.

Ellis, R. (1994). *The study of second language acquisition*. Oxford, England: Oxford University Press.

Iluk, J. (2002). Nauczanie dwujęzyczne w Polsce na tle międzynarodowych roziązań organizacyjnych. *Języki Obce w Szkole, 6*, 68-76.

Kulawik, J., Kulawik, T., Litwin, M. (2009) *Chemia nowej ery: Podręcznik i ćwiczenia dla gimnazjum*. Warsaw, Poland: Nowa Era.

Kulawik, T., Litwin, M. (2005). *Poradnik metodyczny chemia dla gimnazjum część pierwsza*. Warsaw, Poland: Nowa Era.

Lyster, R. (2007). *Learning and teaching languages through content*. Amsterdam, the Netherlands/Philadelphia: John Benjamins Publishing Company.

Marsh, D. (2002). *CLIL/EMILE - The European Dimension: Actions, Trends and Foresight Potential. Foresight* (pp. 1-204). Brussels. Retrieved from http://ec.europa.eu/education/languages/pdf/doc491_en.pdf

Marsh, D., Zając, M., & Gozdawa-Gołębiowska, H. (2008). *Raport ewaluacyjny - Edukacja dwujęzyczna w Polsce (język angielski)*. Retrieved from http://www.ell.org.pl/sites/ell.org.pl/files/dwuj%C4%99zyczne%20angielski.pdf

Marsh, D., Zając, M., Gozdawa-Gołębiowska, Czura, A., Gapinska, A., Papaja, K., Roda, M. & Urbaniak, M. (2008). *Profile report bilingual education (English) in Poland - Overview of practice in selected schools*, Jyväskylä, Finland/Warsaw, Poland: CODN/British Council Poland.

Masih, J. (1999). *Learning through a foreign language: Models, methods and outcomes*. London, England: Centre for Information on Language Teaching and Research.

Mehisto, P., Frigols-Martín, M. J., & Marsh, D. (2008). *Uncovering CLIL: Content and language integrated learning in bilingual and multilingual education*. Oxford, England: Macmillan Education.

Rosenshine, B., and Furst, N. (1973). Research on teacher performance criteria. In B. Othanel Smith (Ed.), *Research in teacher education: A symposium* (pp. 37-72). Englewood Cliffs, NJ: Prentice-Hall.

Stern, H. (1998). *Issues and options in language teaching*. Oxford, England: Oxford University Press.

Stohler, U. (2006). The acquisition of knowledge in bilingual learning: An empirical study on the role of language in content learning. *VIEWZ: Vienna English Working PaperS*, *15*(3), p. 41-46.

Wesche, M. (2002). Early French immersion: How has the original Canadian model stood the test of time? In P. Burneister, T. Piske, & A. Rohde, (Eds.), *An integrated view of language development* (pp. 357-379). Trier, Germany: WVT Wissenschaftlicher Verlag Trier.

APPENDICES

Appendix A: English and Polish activities

Each example begins with the CLIL version of the activity (Teacher R), followed by the Polish version relating to the same topic (Teachers A and B), and ending with the activity taken from the test (which relates to the subject of both tasks).

Activity 1: Metals and non-metals

CLIL classroom

Using the table below, formulate with your friend some possible properties of metals and non-metals. For example, most metals are solids. (Students have the samples of the elements in front of them).

Name of the element	Physical state	Colour	Scent	Other features	Type of substance
Zinc (Zn)	Solid	Silver-white	-	Metallic lustrate	Metal
Sodium (Na)	Solid	Silver-white	-	Metallic lustrate	Metal
Magnesium (Mg)	Solid	Silver-white	-	Metallic lustrate	Metal
Phosphorous (P)	Solid	Red	Characteristic	No lustre	Non-metal
Sulphur (S)	Solid	Yellow	Characteristic	No lustre	Non-metal
Chlorine (Cl)	Gas	Green	Characteristic	No lustre	Non-metal
Copper (Cu)	Solid	Red	-	Metallic lustrate	Metal

Polish classroom

Discuss with your friend the properties of given substances and complete the table. (Students are given the samples of zinc, sodium, magnesium, phosphorous and sulphur). The teacher helps students with chlorine description.

Nazwa pierwiastka	Stan fizyczny	Kolor	Zapach	Inne cechy	Rodzaj substancji
Cynk (Zn)	Ciało stałe	Srebrno-biały	-	Połysk metaliczny	Metal
Sód (Na)					
Magnez(Mg)					
Fosfor (P)					
Siarka (S)					
Chlor (Cl)					
Miedź (Cu)					

Test

2. Wskaż zestaw symboli chemicznych zawierający tylko symbole chemiczne metali.

A. K, Ca, S, Fe, P
B. Na, Mg, Cu, Pb, Zn
C. Ba, Sn, C, Cl, Hg
D. N, Ne, S, P, Cl

Activity 2: Elements vs. chemical compounds

CLIL classroom

Read the text and answer the questions in the quiz.

Science matters

Most of the universe consists of matter. All matter is composed of basic elements. Elements are substances consisting of one type of an atom. For example pure gold is composed of one type of an atom, gold atoms. When different types of atoms join together they form a compound. For example water is a compound made up of the oxygen atom and the hydrogen atoms. Atoms are the smallest particles into which an element can be divided. Each atom has protons (with a positive charge), neutrons (with a neutral charge) and electrons (with a negative charge). When atoms share electrons they form a chemical bond. In the middle of an atom there is a nucleus surrounded by shells. Electrons move around the nucleus. The last shell is called a valence shell.
Based on: http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookCHEM1.html

Quiz

1. When atoms of one type join together they form:
   a) a neutron
   b) charge
   c) an element
   d) a compound
2. Two or more different atoms bond together to create a
   a) chemical
   b) element
   c) compound
   d) proton
3. One example of a compound is
   a) gold
   b) carbon
   c) water
   d) oxygen
4. Atoms are made up of protons, neutrons and…
   a) electrons
   b) nucleus
   c) matter
   d) shell

e)

5. Neutrons have a ………………….charge
   a) powerful
   b) positive
   c) negative
   d) neutral
6. Electrons move around the …………………..of an atom.
   a) neutrons
   b) protons
   c) nucleus
   d) shells

Polish classroom

Students write down in their notebooks the following definitions dictated by the teacher.

- *Pierwiastek chemiczny*- substancja prosta, której nie można rozłożyć na substancje prostsze.
- *Związek chemiczny*- substancja złożona z co najmniej dwóch różnych, połączonych ze sobą trwale pierwiastków chemicznych.

Students work in pairs and separate the following substances into two groups: elements and chemical compounds:

- miedź, azot, woda, fosfor, sól kuchenna, kwas solny, wapń, sód.

Test

1. Wskaż zestaw, w którego skład wchodzą wyłącznie związki chemiczne.
  A. tlenek magnezu, woda, siarka, chlorowodór
  B. potas, wodór, ołów, mangan
  C. amoniak, tlenek sodu, woda, tlenek magnezu
  D. miedź, siarkowodór, argon, tlen

Activity 3: Electron configuration

CLIL classroom

The activity was based on understanding the following text:

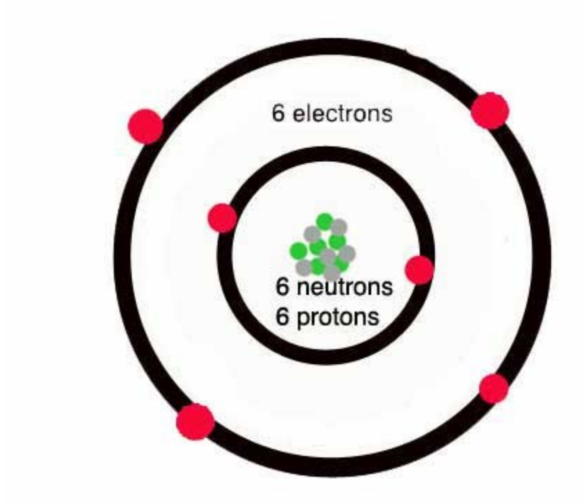
> An atom consists of a nucleus of protons and neutrons, surrounded by electrons. The atomic mass of an element is the combined number of protons and neutrons in the nucleus. The atomic number is the same as the number of protons in the nucleus of an atom of an element, and also the same as the number of electrons surrounding the nucleus. The number of period that an element lies in is equal to the number of shells. The outermost orbital shell of an atom is called its valence shell and the electrons in the valence shell are valence electrons. Valence electrons are the highest energy electrons in an atom and are therefore the most reactive. Each element has a number of valence electrons equal to its group number on the Periodic table.

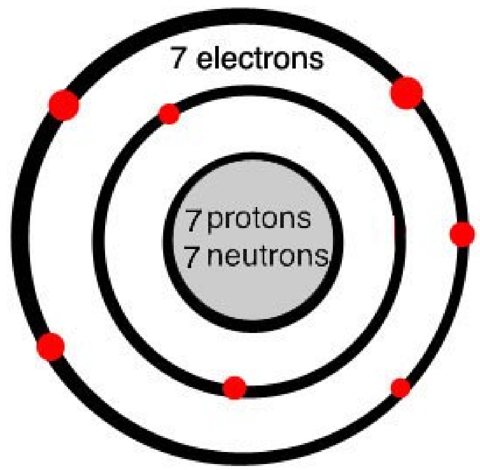
Based on: http://gsearch.sparknotes.com/search?q=electron+configuration

Gregorczyk, B. (2012). An empirical study on the acquisition of content in a CLIL-based chemistry course: A preliminary report. *Latin American Journal of Content & Language Integrated Learning*, *5*(1), 9-32. doi:10.5294/laclil.2012.5.1.2 ISSN 2011-6721

The teacher prepares a set of cards with models of different elements.
Example:

C **N**





1. Tell the students that they are going to work in pairs and draw models of atoms in their notebook.
2. Give each student one card but ask them not to show it to each other.
3. Their task is to listen to a friend and draw a model according to his/ her suggestions. *It has got 6 neutrons and 6 protons in the nucleus. It has got 2 shells. On the first shell it has got 2 electrons and on the second shell it has got 4 electrons.*
4. Having finished their drawings the students look at the periodic tables and define the name of the element in the picture.
5. The students show the cards to each other and check if they guessed correctly.

<u>Polish classroom</u>

The teacher dictates the definitions of the atomic mass and the atomic number to the students. Having written the definitions, the students are asked to define the number of protons, neutrons, and electrons in a carbon atom.

liczba atomowa

Atom pierwiastka chemicznego jest elektrycznie obojętny, zatem w atomie liczba protonów jest równa liczbie elektronów. Liczbę protonów wchodzących w skład jądra atomowego nazywa się **liczbą atomową** i oznacza symbolem **Z**.

Pierwiastek chemiczny jest więc zbiorem atomów o tej samej liczbie atomowej.

Z = ładunek jądra = liczba protonów = liczba elektronów

Liczba atomowa jest jednocześnie liczbą porządkową w układzie okresowym pierwiastków (patrz s. 104.)

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liczba masowa

Liczbę nukleonów, a więc protonów i neutronów wchodzących w skład jądra atomowego, nazywa się **liczbą masową** i oznacza symbolem *A*.

A = liczba protonów + liczba neutronów

Liczby masową i atomową, charakteryzujące atom danego pierwiastka chemicznego, zapisuje się obok symbolu chemicznego pierwiastka w sposób następujący:

liczba masowa = = liczba protonów + + liczba neutronów

$^{A}_{Z}E$

liczba atomowa = = ładunek jądra = = liczba protonów = = liczba elektronów

symbol chemiczny pierwiastka

Liczbę neutronów można obliczyć:
liczba neutronów = *A* – *Z*

Example texts taken from Kulawik, Kulawik, and Litwin (2009).

Test

8. Zaznacz właściwe dokończenie zdania.
Liczba atomowa określa
A. liczbę neutronów w jądrze atomu pierwiastka chemicznego.
B. liczbę protonów w jądrze atomu pierwiastka chemicznego.
C. sumę protonów i neutronów w jądrze atomu pierwiastka chemicznego.
D. sumę protonów i elektronów w jądrze atomu pierwiastka chemicznego.

Appendix B: Polish-language final chemistry exam

Test kompetencji dla klasy drugiej

………

/kod ucznia/

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	1 H wodór 1,008																	2 He hel 4,003	1
2	3 Li lit 6,941	4 Be beryl 9,012											5 B bor 10,811	6 C węgiel 12,011	7 N azot 14,007	8 O tlen 15,999	9 F fluor 18,998	10 Ne neon 20,18	2
3	11 Na sód 22,99	12 Mg magnez 24,305											13 Al glin 26,982	14 Si krzem 28,086	15 P fosfor 30,974	16 S siarka 32,066	17 Cl chlor 35,453	18 Ar argon 39,948	3
4	19 K potas 39,098	20 Ca wapń 40,078	21 Sc skand 44,956	22 Ti tytan 47,867	23 V wanad 50,942	24 Cr chrom 51,996	25 Mn mangan 54,938	26 Fe żelazo 55,845	27 Co kobalt 58,933	28 Ni nikiel 58,693	29 Cu miedź 63,546	30 Zn cynk 65,341	31 Ga gal 69,723	32 Ge german 72,64	33 As arsen 74,922	34 Se selen 78,96	35 Br brom 79,904	36 Kr krypton 83,80	4
5	37 Rb rubid 85,468	38 Sr stront 87,62	39 Y itr 88,906	40 Zr cyrkon 91,224	41 Nb niob 92,906	42 Mo molibden 95,94	43 Tc technet 97,905	44 Ru ruten 101,07	45 Rh rod 102,906	46 Pd pallad 106,42	47 Ag srebro 107,868	48 Cd kadm 112,411	49 In ind 114,818	50 Sn cyna 118,710	51 Sb antymon 121,760	52 Te tellur 127,60	53 I jod 126,904	54 Xe ksenon 131,293	5
6	55 Cs cez 132,906	56 Ba bar 137,327	57 La lantan 138,906	72 Hf hafn 178,49	73 Ta tantal 180,948	74 W wolfram 183,84	75 Re ren 186,207	76 Os osm 190,23	77 Ir iryd 192,217	78 Pt platyna 195,084	79 Au złoto 196,967	80 Hg rtęć 200,59	81 Tl tal 204,383	82 Pb ołów 207,2	83 Bi bizmut 208,980	84 Po polon 208,982	85 At astat 209,987	86 Rn radon 222,018	6
7	87 Fr frans 223,020	88 Ra rad 226,025	89 Ac aktyn 227,028	104 Rf rutherford 261,109	105 Db dubn 262,114	106 Sg seaborg 266,121	107 Bh bohr 264,1	108 Hs has 277	109 Mt meitner 268,1	110 Ds darmstadt 271,1	111 Rg roentgen 272,1	112 Uub ununbi 285	113	114 Uuq ununkwad 289	115	116 Uuh ununheks 289	117	118	7

1. Wskaż zestaw, w którego skład wchodzą wyłącznie związki chemiczne.

A. tlenek magnezu, woda, siarka, chlorowodór
B. potas, wodór, ołów, mangan
C. amoniak, tlenek sodu, woda, tlenek magnezu
D. miedź, siarkowodór, argon, tlen

2. Wskaż zestaw symboli chemicznych zawierający tylko symbole chemiczne metali.

A. K, Ca, S, Fe, P
B. Na, Mg, Cu, Pb, Zn
C. Ba, Sn, C, Cl, Hg
D. N, Ne, S, P, Cl

3. Zaznacz zestaw, w którym podano tylko przykłady zjawisk fizycznych.

A. stapianie parafiny, rozciąganie gumy, spalanie węgla
B. spalanie siarki, rdzewienie żelaza, kwaśnienie mleka
C. spalanie stearyny, rozdrabnianie cukru, zamarzanie wody
D. krzepnięcie wody, rozcieranie grudki soli, stapianie wosku

4. Wskaż przykład mieszaniny niejednorodnej i poprawny sposób rozdzielenia jej na składniki.

A. sól rozpuszczona w wodzie / sedymentacja
B. piasek w wodzie / dekantacja
C. mąka w wodzie / użycie rozdzielacza
D. cukier rozpuszczony w wodzie / sączenie

5. Zaznacz zapis słowny reakcji wymiany.
- **A.** miedź + tlen → tlenek miedzi(II)
- **B.** tlenek miedzi(II) + wodór → miedź + woda
- **C.** tlenek azotu(I) → azot + tlen
- **D.** tlen + węgiel → tlenek węgla(IV)

6. Oblicz, ile metrów sześciennych tlenu znajduje się w klasie o wymiarach 4 m × 6 m × 3 m. Ile to decymetrów sześciennych? Zaznacz poprawną odpowiedź.

A. 15,12 m^3, czyli 1512 dm^3 **C.** 72 m^3, czyli 7200 dm^3
B. 72 m^3, czyli 72 000 dm^3 **D.** 15,12 m^3, czyli 15 120 dm^3

7. Substancje występujące w bezpośrednim otoczeniu człowieka podzielono na trzy grupy. Wskaż substancję, którą zaklasyfikowano **błędnie.**

Pierwiastki chemiczne	**Związki chemiczne**	**Mieszaniny**
siarka miedź węgiel	cukier sól kuchenna powietrze	stal woda morska

A. węgiel **B.** stal **C.** powietrze **D.** woda morska

8. Zaznacz właściwe dokończenie zdania.
Liczba atomowa określa
- **A.** liczbę neutronów w jądrze atomu pierwiastka chemicznego.
- **B.** liczbę protonów w jądrze atomu pierwiastka chemicznego.
- **C.** sumę protonów i neutronów w jądrze atomu pierwiastka chemicznego.
- **D.** sumę protonów i elektronów w jądrze atomu pierwiastka chemicznego.

9. Wskaż liczby protonów, elektronów i neutronów dla atomu izotopu ^{13}C.
A. 6, 6, 7 **B.** 13, 13, 6 **C.** 6, 6, 13 **D.** 7, 7, 6

10. Wskaż masę cząsteczkową tlenku potasu.
A. 55 u **B.** 94 g **C.** 71 u **D.** 94 u

11. Zaznacz sposób odczytywania zapisu 3 H_2.
A. 3 cząsteczki wodoru **C.** 2 atomy wodoru
B. 3 atomy wodoru **D.** 6 cząsteczek wodoru

12. Wskaż wzór sumaryczny tlenku cyny(IV).
A. Sn_4O_2 **B.** SnO **C.** SnO_2 **D.** Sn_2O_4

13. Wskaż zestaw przemian: wody w parę wodną i pary wodnej w wodę.
- **A.** krzepnięcie, skraplanie
- **B.** parowanie, skraplanie
- **C.** sublimacja, resublimacja
- **D.** topnienie, krzepnięcie

14. Zaznacz właściwość wody wynikającą z polarnej budowy cząsteczki.
A. dobrze rozpuszczają się w wodzie tylko substancje stałe
B. dobrze rozpuszczają się w wodzie substancje o budowie niepolarnej
C. dobrze rozpuszczają się w wodzie substancje o budowie polarnej
D. dobrze rozpuszczają się w wodzie wszystkie substancje gazowe

15. Do czterech probówek z wodą dodano niewielkie ilości: 1. – soli kuchennej, 2. – białka jaja, 3. – cukru, 4. – kredy. Wskaż probówkę lub probówki, w których powstał roztwór właściwy.
A. 2 **B.** 1 i 3 **C.** 2 i 4 **D.** 1

16. Zaznacz właściwą interpretację stwierdzenia: stężenie procentowe roztworu chlorku sodu wynosi 20%.
A. W 100 g wody rozpuszczono 20 g chlorku sodu.
B. W 1000 g wody rozpuszczono 20 g chlorku sodu.
C. W 1 l roztworu znajduje się 20 g chlorku sodu.
D. W 100 g roztworu znajduje się 20 g chlorku sodu.

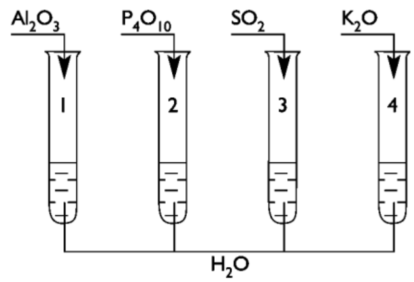
17. Oblicz, ile gramów 5-procentowego roztworu można otrzymać w wyniku rozpuszczenia 1,25 g kwasu bornego w wodzie. 2 p.

18. Zaznacz właściwe dokończenie zdania. Cząsteczki kwasów tlenowych.
A. nie zawierają atomów tlenu, np. kwas chlorowodorowy.
B. zawierają atomy tlenu, np. kwas węglowy.
C. zawierają atomy tlenu, np. kwas siarkowodorowy.
D. nie zawierają atomów tlenu, np. kwas bromowodorowy.

19. Zaznacz opis podanego równania reakcji dysocjacji jonowej.
$H_2SO_3 \xrightleftharpoons{H_2O} 2\,H^+ + SO_3^{2-}$
A. Kwas siarkowy(VI) dysocjuje na kationy wodoru i aniony siarczanowe(VI).
B. Kwas siarkowy(IV) dysocjuje na kationy wodoru i aniony siarczanowe(IV).
C. Kwas siarkowodorowy dysocjuje na kationy wodoru i aniony siarczkowe.
D. Kwas siarkowy(VI) dysocjuje na kationy wodoru i aniony siarczanowe(IV).

20. Oblicz, ile gramów kwasu chlorowodorowego znajduje się w 210 g roztworu o stężeniu 30%.

21. Zapisz numery probówek, w których otrzymano kwasy. Napisz równania reakcji chemicznych otrzymywania 2 p.
kwasów, które zaszły w tych probówkach.



Kwasy otrzymano w probówkach nr: ....
Równania reakcji chemicznych: ....
....

22. Uzupełnij równania reakcji chemicznych.
2p.

...... NaOH + ... $H_2S \rightarrow$ .... + ...
...... ZnO + ... $\rightarrow$ ...... $ZnSO_4$ + ...
...... $Ba(OH)_2$ + ... $SO_2 \rightarrow$ .... + ...
...... Al + ... $\rightarrow$ ...... $AlCl_3$ + ...

BIODATA

Beata Gregorczyk has worked as a teacher at Publiczne Gimnazjum Nr 13 z Odziałami Dwujęzycznymi im. Polskich Noblistów in Radom, Poland since 2010. She completed a Masters and an Engineering Degree in Chemistry at the Technical University of Radom. Later, she received her degree as a teacher, as well as a Teaching English as a Foreign Language qualification, at the Teachers College in Radom. These studies were followed by a BA and then an MA in English Studies at the University of Warsaw. She is currently working as a middle school teacher, teaching English and chemistry through English, and has a strong interest in CLIL approaches.