



## ENGLISH AS THE LANGUAGE OF SCIENCE

**Mateja Sukič Kuzma**

*Primary School Miško Kranjec Velika Polana, Slovenia*

### Abstract

*The development of teaching is as much a living and dynamic process as the development of science and technology. Distance teaching brought new possibilities, new challenges, and the search for new approaches to create an authentic, meaningful, and active learning environment.*

*This paper presents several months of cross-curricular integration of science with English and the use of various online tools to support learning and knowledge acquisition. Cross-curricular integration is not only used as a meeting point of different subjects in one or two lessons but is a multi-month cooperation process in multifaceted learning that complements, upgrades, and enriches knowledge in different subject areas. At the same time, it seeks an appropriate balance between language acquisition and science content.*

*In addition to connecting different subjects and their learning materials, this way of teaching encourages students to learn collaboratively, interact with each other and think critically. It requires students to work at higher taxonomic levels, as they have to understand, evaluate, and analyse the acquired knowledge. Students move from memorizing data to drawing conclusions and creating their own activities.*

*The foreign language is not the goal of learning but a tool with which students discover new content and acquire new knowledge while expanding their vocabulary, enriching and developing language skills, and acquiring professional terminology in a foreign language. This approach encourages students to use resources in different languages and thus develop multilingualism. Additionally, the use of online tools reflects real-life situations and is appropriate preparation for the future.*

**Keywords:** *English, science, cross-curricular integration, active learning environment, use of ICT.*

### Introduction

Teaching is a living and dynamic process that changes, adapts, and upgrades with the development of science and technology. School closure and remote work during the pandemic brought a giant leap in the approach to teaching development, as this was the time when both teachers and students had to redefine the learning process and lay new foundations for a different kind of teaching. Time and environment, which bring new challenges, also offer new possibilities for teaching and being creative. During distance learning, it was also necessary to redefine the interaction between the key participants of the learning process.

### Cross-curricular Integration

Cross-curricular integration represents an integrated didactic approach that includes horizontal and vertical integration of knowledge, content, and learning skills and encourages the independent and active acquisition of learning experiences (Sicherl-Kafol, 2008). Cross-curricular integration is not a new approach; throughout the history of teaching, it has appeared in different forms and names. For many years, the CLIL approach has been present in foreign language lessons based on the cross-curricular integration of the foreign

language and non-linguistic content. The term CLIL (Content and Language Integrated Learning) was introduced by David Marsh from the University of Jyväskylä in Finland (1994) and referred to the integrated learning of content and language. CLIL represents a dual approach to education, as it uses a non-native language to teach non-linguistic content. It means that in the teaching and learning process, the emphasis is not only on the content and not only on the language, but both are intertwined. We can summarize that it is an innovative fusion of both (Coyle, Hood, and Marsh, 2013). In Slovenia and worldwide, cross-curricular integration is referred to by different terms. CLIL is an umbrella term that includes more than a dozen educational approaches (immersion, bilingual education, multilingual education, language bath, and language-enriched programs) (Mehisto, Marsh, and Frigols, 2012).

#### *Levels of Knowledge Acquisition in Cross-Curricular Integration*

Coyle (2002) presents pedagogical integration in the context of the content, cognition, communication, and culture. The listed integration elements represent one of the foundations of CLIL: the 4C framework (content, cognition, communication, and culture). These elements are interdependent in the CLIL concept (Jazbec and Lovrin, 2015). Learning and teaching do not take place in a vacuum, but all the listed elements are interconnected and influence each other.

David Marsh (2000) explains that some students invest a great deal of time and effort in learning the language, practicing grammar, and acquiring vocabulary. The school experience gives these students a solid foundation for using different languages. On the other hand, for many students, the investment of time and effort in language classrooms may have had more disappointing outcomes later in life. It is difficult for them to actively use language as a tool in real-life communication. However, we can divide the cross-curricular integration into two-fold acquisition: the acquisition of knowledge (non-linguistic content) and the acquisition of skills (use of a foreign language). Each acquisition of skills or mastering skills is a long-term process, as the acquired skill must be automated. In cross-curricular integration, the acquisition of knowledge and skills is divided into several layers that intertwine with each other.

**Figure 1**

*Levels of Acquisition (own work).*



When integrating a non-linguistic subject and a foreign language, students acquire knowledge and skills differently, as they must follow three different levels of explanations.

1. Language level

Students learn the basics of a foreign language, acquire vocabulary, and get familiar with grammatical structures while doing the reading and listening comprehension of a text.

2. Professional terminology

Students get to know new professional terminology in a foreign language, connect terms in their mother tongue and foreign languages and match them with the appropriate definition or meaning.

3. Acquisition of new learning material

In addition to understanding a foreign language and gaining professional terminology, students acquire new learning material, discover the laws of nature, and understand cause-and-effect relationships.

David Marsh (2000) compares the integration of content and language in the CLIL approach to using languages to learn and learning to use languages. All three levels of learning are interdependent, as understanding the language affects the acquisition of the subject matter and professional terminology. To the same extent, learning new material in a foreign language expands the vocabulary and increases the mastering of more complex grammatical structures in the foreign language.

Cross-curricular integration and the acquisition of new learning material can be compared to giving directions to illustrate the complexity of the process. It is easy to follow directions if a person knows the location. In the same way, students can easily follow the explanation if they are familiar with the learning material. It is much more challenging

to follow instructions to an unknown location, which can be compared to acquiring new learning material. The task becomes much more complex if the directions are given in a foreign language. To the same extent, the acquisition of new material becomes much more challenging if the lessons are held in a foreign language.

## Cross-Curricular Integration of English and Chemistry

### *Spontaneous Start and Close Cooperation*

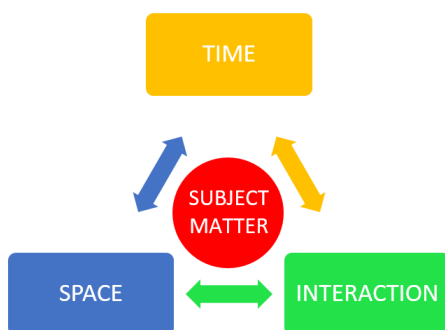
Education is the process of promoting learning, acquiring knowledge, and developing skills, values, beliefs, and habits. Education has a formative effect, as it represents the process of developing habits, knowledge, and abilities that the student did not have before (Lamichhane, 2018). Lessons are a vital component of education and are a deliberate, planned, systematic, and organized activity of teachers and students to achieve concrete educational goals. It is a process teachers and students create through their individual and joint activity, in which different relationships are intertwined in didactic communication and interaction (Kramar and Cugmas, 2019).

The learning process is, therefore, a process of acquiring knowledge and developing new skills. The interaction between teacher and student takes place in the same space at the same time. During distance learning, these structured ties suddenly broke. The teacher and student were no longer present in the same place at the same time, and the interaction between them was destroyed. In a short period, it was necessary to redefine the concept of lessons, re-establish interaction between all participants of the learning process, and re-evaluate the work methodology.

Distance learning brought significant challenges and new possibilities along with the search for different approaches to create an authentic, meaningful, and active learning environment, even though the teacher and student are not in constant interaction anymore.

### Figure 2

*Placement of the Learning Process in Time, Space, and Interaction between Participants of the Learning Process (own work).*



In search of new teaching opportunities, the chemistry and biology teacher wanted to use a video explaining the learning material in English and asked for an opinion on the language appropriateness for 8th-grade students. I explained that the students acquire

knowledge on three levels simultaneously and therefore need guidance in professional and linguistic areas. Together we outlined the course and method of work and timed the tasks. It was a completely spontaneous beginning of several months-long process of cross-curricular integration.

The work in the chemistry and English classes was carefully planned and coordinated. In the chemistry lesson, the students focused on the subject matter from the field of chemistry. In the English lesson, students gained the vocabulary needed to understand the explanation in English. Together with the chemistry teacher, we determined which online tools the students needed to acquire and consolidate the learning material.

### Learning Chemistry in English

**Figure 3**

*Online Worksheet Basic Atomic Structure (Sukič Kuzma, 2020).*

**BASIC ATOMIC STRUCTURE**

1. Drag the following words next to the pictures.

Word bank: attract, electron, inside, liquid, neutron, nucleus, outside, gas, proton, solid, thick, thin, building blocks, magnified view

2. Connect English and Slovenian expressions.

building blocks	električni nalogj
electric charge	gradniki
empty space	muščen
magnified view	masa
mass	meriti
mile away	miljo svetlin (16 km)
size	povečan pogled
spinning	prazen proktor
to add up	seštetiti
to measure	širik
to weigh	tehtati
wide	velikost
	vretiti se

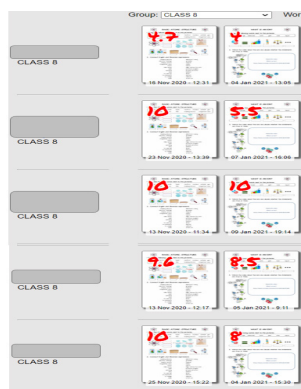
3. Watch the video about the basic atomic structure and complete the sentences.

Word bank: add up, attract, tiny, building blocks, electrons, empty space, mass, middle, mile, million, moving, negative, neutrons, nucleus, outside, positive, pull, protons, size, spin

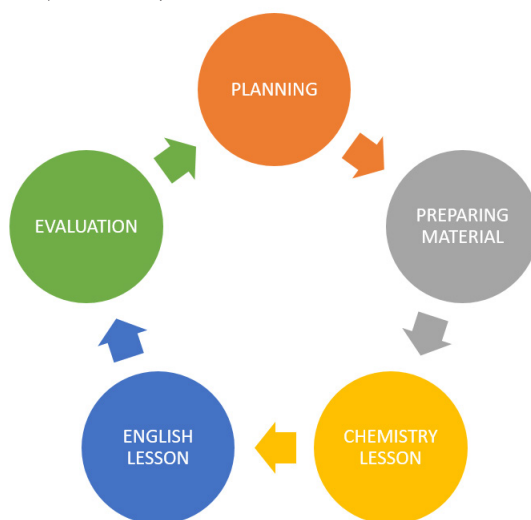
Atoms are the \_\_\_\_\_ that make up everything. Atoms are so \_\_\_\_\_ that we could place one \_\_\_\_\_ atoms lined up in a row on the width of a paper sheet. In the center of the atom it is the \_\_\_\_\_ which is made up of two different particles \_\_\_\_\_ and \_\_\_\_\_. On the \_\_\_\_\_ of the atoms, there are even smaller particles called \_\_\_\_\_. They are constantly \_\_\_\_\_ around the center but nucleus stays solid right in the \_\_\_\_\_ of the atom. Electric charge is very important. Protons have a \_\_\_\_\_ electric charge and electrons have a \_\_\_\_\_ electric charge. Opposite charges \_\_\_\_\_ so negatively charged electrons are attracted to positively charged protons that \_\_\_\_\_ them in. With atoms, beside their electric charge, it is also important how much they weigh - their \_\_\_\_\_. Protons and neutrons are very similar in \_\_\_\_\_ and mass. They weigh 1 AMU. When we are talking about the mass of atoms, we usually \_\_\_\_\_ the protons and neutrons because the electrons are too tiny. The electrons don't \_\_\_\_\_ in nice circles, they buzz around all over the place. If nucleus would be the size of a grape, the electrons would be a \_\_\_\_\_ away. So most of an atom is actually \_\_\_\_\_.

Before the start of cross-curricular integration, the chemistry teacher and I determined the content, methods, and learning outcomes. We reviewed all the material from chemistry and a linguistic point of view. I prepared listening comprehension based on the video explanation of Tyler DeWitt (2012a) about the structure of the atom for the English class. The students watched a video explanation on YouTube and then did the tasks using the online tool Liveworksheets, which I prepared as an online workbook for the students.

The first two tasks were based on keywords and relevant vocabulary in their mother tongue and English. The third task checked comprehension of the text. The students had to complete the text summary with the given words. Students had the opportunity to check the answers and get immediate feedback on their tasks as the online learning tool self-corrects the worksheet. The online platform Liveworksheets lets the teacher see the students' achievements and thus monitor their work in real time.

**Figure 4***Insight into Students' Achievements (own work)*

After the chemistry and English lessons, there was a joint evaluation of the work, planning the next step, and preparing relevant material.

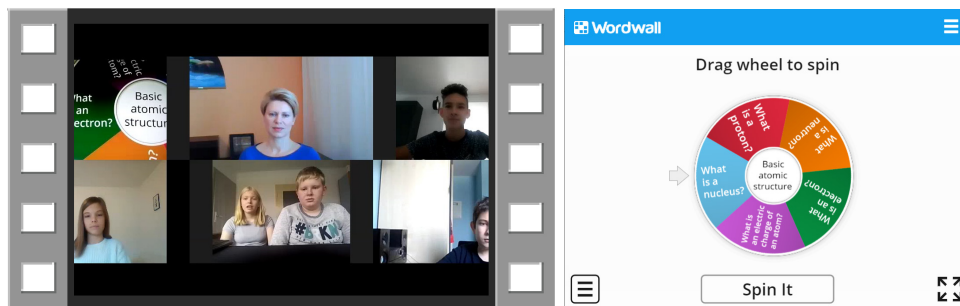
**Figure 5***Schematic Representation of the Planning, Preparation, Implementation, and Evaluation of the Learning Process (own work)*

In the next step, during the chemistry lesson, the students checked and consolidated their knowledge with the help of a video in the online application Edpuzzle. In the English lesson, the students synthesized their knowledge and reproduced the acquired knowledge in English. The work took place in small heterogeneous groups of five students. The task of each group was to explain the learning material to their classmates. For this purpose, the students had the questions prepared in the Wordwall web application. The students first worked independently in a group. They helped each other regarding the appropriateness of the explanation, as they had to use different sources in English and in their mother

tongue. In conclusion, we checked their knowledge and gathered evidence of learning. We recorded a video explanation using the Zoom online platform.

**Figure 6**

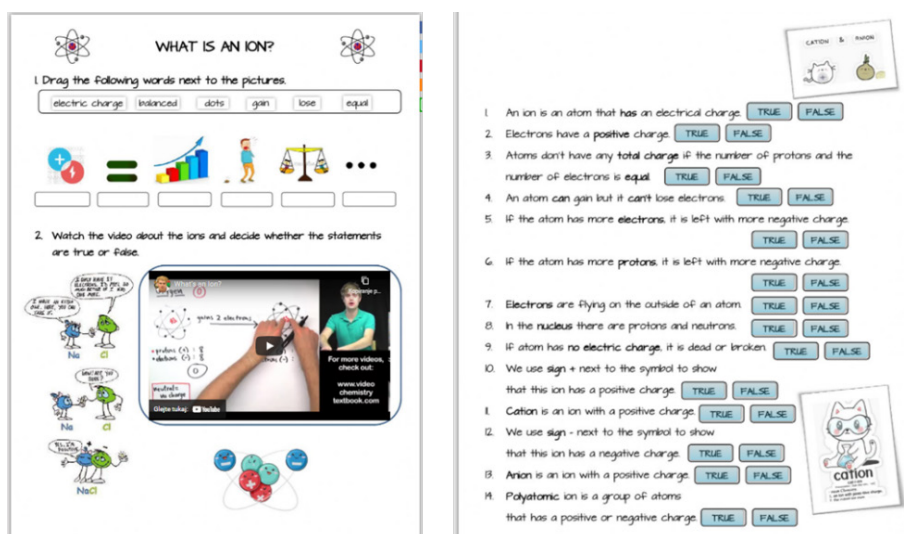
*Group Work in the Online Zoom Platform and Questions in the Wordwall Application (own work)*



In the chemistry lesson, students were given instructions for constructing a model of an atom. For its construction, they had to use the knowledge they had acquired from distance learning chemistry and English lessons. After evaluating the students' work and getting positive feedback, the chemistry teacher and I decided to continue with the cross-curricular integration of chemistry and English. Similarly, we worked on the topic of ions. We used the video explanation of the same author on the topic of ionic compounds (DeWitt, 2012b). In the English class, I prepared an online worksheet based on a video explanation but chose different types of tasks.

**Figure 7**

*Online Worksheet what is an Ion? (Sukič Kuzma, 2021)*



The students applied the knowledge they had acquired during the video explanation in the chemistry lesson to name ionic compounds. They used the WordItOut application for work.

### *Cross-Curricular Integration and Flipped Learning*

Based on the learning process planning, implementation, and evaluation scheme, which leads to new planning (see figure 3), the chemistry teacher and I decided on a topic, but this time with a different approach. We decided to use flipped learning.

Flipped learning (also called flipped classroom) is a pedagogical approach in which material delivery is moved from the classroom to an individual learning space. As a result, the classroom is transformed into a dynamic, interactive, joint learning environment where the teacher guides the students to use concepts and learning material creatively (Sams et al., 2014). This pedagogical approach swaps the typical elements of material delivery and homework. Students watch short video lectures at home, while class time is devoted to practical exercises, projects, or discussions (Falciani, 2022). Flipped learning establishes a framework that provides students with individualized education tailored to their needs (Bergmann & Sams, 2012). Students can access the learning material according to their needs as they adjust the time, learning speed, and the number of repetitions of the explanation to their needs. The video explanation replaces the teacher's explanation and, at the same time, puts the responsibility of learning on the students.

Students watched an explanation of Tyler Dewitt's (2013) Writing Formulas with Polyatomic Ions on their own. Further work took place in heterogeneous groups, which were carefully planned according to their knowledge of chemistry and English. The students gave each other explanations and findings and shared the work within the group. The task of each group was to use the Wordwall online learning tool to prepare English activities for the other groups' students.

### **Figure 8**

*Examples of Activities Prepared by Student Groups (own work)*

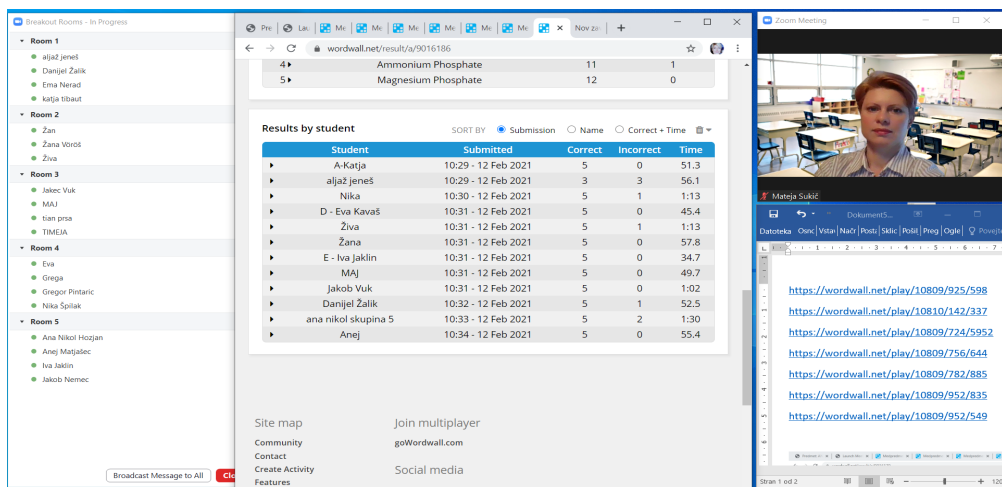


The work in the lessons was carefully planned and coordinated. The students sent their activities to the teachers for language and professional review. During the English class, the students were divided into breakout rooms on the Zoom online platform, where they solved activities prepared by the students of the other groups, thus checking, and consolidating their knowledge. The Wordwall online learning tool allows teachers to see students' achievements and monitor their work.



**Figure 9**

*Work in Groups (Breakout Rooms) in the Zoom Online Platform (own source)*



During the chemistry lesson, students divided into the same heterogeneous groups recorded a video explanation of the learning material in Slovenian. They had to apply the knowledge at higher taxonomic levels, select a part of the learning material and prepare a video explanation. After the lessons, the chemistry teacher and I analysed and assessed the students' work.

### *Return to the Classrooms and Synthesis of Knowledge*

After several months of remote work, the students returned to school. They synthesized and upgraded the knowledge they had acquired, used the built models of atoms, and prepared a presentation based on predetermined criteria.

## **Cross-Curricular Integration of English and Biology**

### *The Transition from Remote Learning to Classroom Lessons*

The new school year brought new challenges and new ventures. The chemistry and biology teacher and I decided to continue with the cross-curricular integration and upgrade it to a new level. We decided to work with the same students (who, in the new school year, became ninth graders) and connect biology and English in the field of Genetics. In order to work on the up-to-date topic and use resources in a foreign language, we decided on an article from the Encyclopaedia Britannica website, the Kids version ("genetics," 2022).

I edited the article, abridged and adapted the text, and sent it to the biology teacher for peer review. In the English class, we first listened to the abridged and adapted text using the Microsoft Edge reader, then read it and briefly summarized individual paragraphs. The first part of the worksheet aimed at reading comprehension of the text; the students had to find the appropriate headings for the individual paragraphs. The second part of the worksheet aimed at acquiring and understanding the vocabulary. I established the level of understanding of the text with additional questions and provided an extra explanation if necessary.

**Figure 10**  
*An Abridged and Adapted Text on Genetics and Consolidation Exercises (own source)*

The first part of the cross-curricular integration occurred in the classroom, and the second was conducted remotely. The students solved two worksheets in Liveworksheets, where they checked and consolidated the knowledge they acquired in biology and English lessons. On the first worksheet, the students labelled the double helix and its components in English, and on the second worksheet, they completed the summary of the article with the given words. The third part of the cross-curricular integration in English took place in the classroom again. The students were given two listening and reading comprehension texts on genetics.

The next phase followed in the biology lesson. The students received instructions to prepare a video explaining different genetics topics. They checked their understanding with the help of videos in the Edpuzzle online tool.

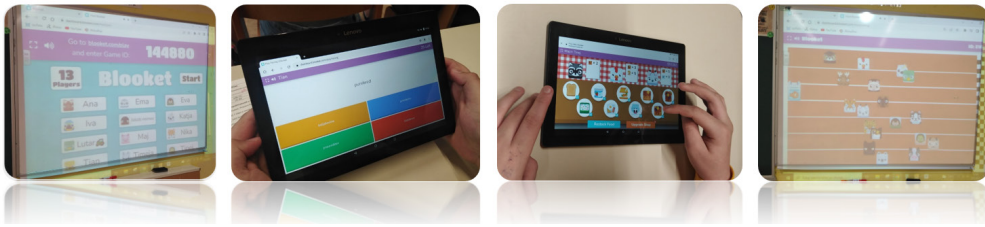
*Gamification and Consolidation of Vocabulary*

The gamification of learning is an educational approach to motivate students to learn by using video game design and game elements in learning environments. The goal is to maximize enjoyment and engagement by capturing the interest of learners and inspiring them to continue learning (Kapp, 2012; "HRD Institute - Gamification of Learning," 2022). Games (especially online games) introduce the characteristics that make them so attractive to young people in the learning process: novelty, freshness, relaxation, fun, involvement, randomness, competition, and cooperation with other players.

To consolidate the vocabulary, I chose a new online game called Blooket. Blooket is a learning platform that uses quiz-like online games and animal avatars for learning. Many pre-set questions and answers are available; however, teachers can also create their own quizzes (Edwards, 2022). Unlike other learning platforms, Blooket is much more similar to classic computer games, where players score points and achieve goals. However, it differs from classic games in the way students score points here and progress in the game by answering learning questions. Blooket offers several game modes (e.g., classic, racing, café, gold quest, and others). I prepared a vocabulary quiz on genetics using the Blooket learning platform. The game was new for the students, which certainly added to their motivation. After the lessons, the biology teacher and I assessed the students' work and evaluated their progress. The students gave us positive and encouraging feedback, as they found this way of learning enjoyable, different, varied, and inclusive.

**Figure 11**

*Using the Blooket Learning Platform to Consolidate Vocabulary (Own Source)*



**Applications**

*Assessment of Learning Applications according to the SAMR Model*


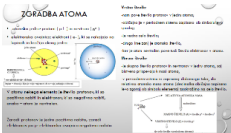
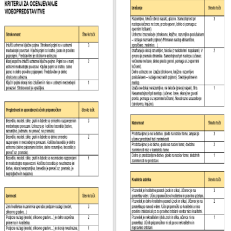

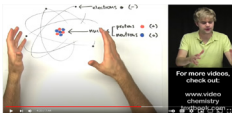


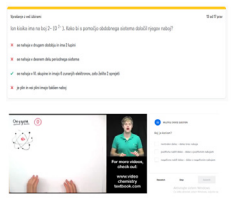
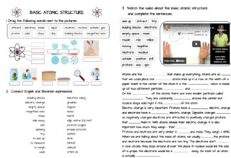



**Figure 12**

*SAMR Model of Introducing ICT into Lessons (Jedrinović et al., 2018)*



**Table 1**

*Presentation of Applications according to the SAMR Model (own work of Suzana Kotnjek and Mateja Sukič Kuzma)*

SUBSTITUTION	AUGMENTATION	MODIFICATION	REDEFINITION
<p><b>WordItOut</b></p>  <p>writing out chemistry formulas</p> <p><b>PowerPoint</b></p>  <p>writing down reference points and explanation of the learning material</p> <p><b>Word</b></p>  <p>writing down evaluation criteria</p>	<p><b>WordWall</b></p>  <p>understanding and interpretation of acquired knowledge</p> <p><b>YouTube</b></p>  <p>understanding and interpretation of acquired knowledge</p> <p><b>Blooket</b></p>  <p>understanding and interpretation of acquired knowledge</p> <p><b>Microsoft Edge</b></p>  <p>synthesizing speech</p>	<p><b>Edpuzzle</b></p>  <p>analysing and evaluating acquired knowledge</p> <p><b>Liveworksheets</b></p>  <p>analysing and evaluating acquired knowledge</p>	<p><b>Wordwall</b></p>  <p>creating digital tasks with collaborative learning</p> <p><b>PPT / Zoom</b></p>  <p>making video explanations</p> <p><b>Edpuzzle</b></p>  <p>making interactive tasks based on video explanation</p>

**Table 2**  
*Identified Advantages and Disadvantages of the Applications Based on the Used Activities*





<b>Application</b>	<b>Advantages</b>	<b>Disadvantages</b>
<b>YouTube</b>	<ul style="list-style-type: none"> <li>- listening comprehension,</li> <li>- another expert's explanation,</li> <li>- authentic use of the English language,</li> <li>- is always available to students,</li> <li>- the possibility of repeatedly listening and stopping the recording,</li> </ul>	<ul style="list-style-type: none"> <li>- there is no authentic teacher-student contact,</li> <li>- complex understanding due to a foreign language,</li> <li>- the teacher does not get feedback on whether the student watched the video,</li> </ul>
<b>Edpuzzle</b>	<ul style="list-style-type: none"> <li>- listening comprehension and visual support,</li> <li>- solving tasks without skipping clips,</li> <li>- feedback for the teacher/student,</li> <li>- the possibility of creating tasks,</li> <li>- use of own or online recordings,</li> <li>- creating closed classes (data protection),</li> <li>- partially free use,</li> </ul>	<ul style="list-style-type: none"> <li>- applications that are too demanding for some students,</li> <li>- technical problems,</li> <li>- the possibility of doing the task only once,</li> </ul>
<b>Wordwall</b>	<ul style="list-style-type: none"> <li>- varied and diverse templates,</li> <li>- suitable for all levels of teaching,</li> <li>- feedback for the teacher/student,</li> <li>- the possibility of creating tasks,</li> <li>- free basic version,</li> </ul>	<ul style="list-style-type: none"> <li>- limited free basic version,</li> <li>- feedback not available by students, only by tasks,</li> </ul>
<b>WordItOut</b>	<ul style="list-style-type: none"> <li>- a variety of shapes, fonts, and colours,</li> <li>- the possibility of writing chemistry formulas,</li> <li>- the possibility of using Slavic letters,</li> <li>- free of charge,</li> </ul>	<ul style="list-style-type: none"> <li>- instructions and use of the application are not available in Slovenian,</li> </ul>
<b>Liveworksheets</b>	<ul style="list-style-type: none"> <li>- digitized worksheets,</li> <li>- a variety of tasks,</li> <li>- the possibility of inserting audio/video clips,</li> <li>- feedback for the teacher/student,</li> <li>- creating workbooks,</li> <li>- use of already created worksheets,</li> <li>- the possibility of creating tasks,</li> <li>- the possibility of solving tasks once or multiple times,</li> </ul>	<ul style="list-style-type: none"> <li>- more demanding task creation,</li> <li>- the teacher must anticipate all possible correct answers,</li> </ul>
<b>Blooket</b>	<ul style="list-style-type: none"> <li>- fun, social and educational,</li> <li>- a quiz in the form of a classic computer game,</li> <li>- contains elements of the unexpected,</li> <li>- free basic version,</li> </ul>	<ul style="list-style-type: none"> <li>- limited basic version,</li> <li>- problems importing a ready-made list of tasks,</li> </ul>
<b>Microsoft Edge</b>	<ul style="list-style-type: none"> <li>- opening pdf documents,</li> <li>- the possibility of creating audio recordings (text to speech) in different languages,</li> <li>- native-speaker-like pronunciation.</li> </ul>	<ul style="list-style-type: none"> <li>- the monotony of speech.</li> </ul>

*Note:* own work of Suzana Kotnjek, Mateja Sukič Kuzma.

*The Development of Digital Competences (DigComp 2.1)*

**Table 3**

*The development of digital competences according to DigComp 2.1 (Carretero, Vuorikari, and Punie, 2017)*

Competence areas	Competences	Activities
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	<ul style="list-style-type: none"> <li>- watching an educational video on YouTube,</li> <li>- solving tasks in Liveworksheets, Edpuzzle, and WordItOut applications,</li> <li>- searching for data to create an atom model using the Google browser,</li> <li>- preparing a PowerPoint presentation,</li> </ul>
	1.2 Evaluating data, information, and digital content	
2. Communication and collaboration	2.1 Interacting through digital technologies	<ul style="list-style-type: none"> <li>- collaborative learning in small groups using the Zoom platform and the Wordwall application,</li> <li>- preparation and sharing of digital content in small groups in the Wordwall application,</li> </ul>
	2.2 Sharing through digital technologies	<ul style="list-style-type: none"> <li>- communication using Snapchat and Messenger groups,</li> </ul>
	2.4 Collaborating through digital technologies	
3. Digital content creation	3.1 Developing digital content	<ul style="list-style-type: none"> <li>- creating digital content in the Wordwall application,</li> <li>- creating a video explanation using various tools (Zoom, PowerPoint, electronic devices),</li> </ul>
	3.2 Integrating and re-elaborating digital content	<ul style="list-style-type: none"> <li>- creating digital content in the online tool Edpuzzle,</li> </ul> 
5. Problem solving	5.1 Solving technical problems	<ul style="list-style-type: none"> <li>- choosing an appropriate tool for making videos and creating digital content,</li> <li>- choosing an appropriate online environment for sharing digital content.</li> </ul> 

*Note:* own work of Suzana Kotnjek and Mateja Sukič Kuzma.

## Conclusions

In the last two school years, teaching and learning became much more demanding and uncertain, but at the same time, it also offered unique challenges and opportunities. Cross-curricular integration enabled students and teachers to use new modern online tools

and innovative work methods and allowed them to grow professionally and personally. The students acquired knowledge in natural sciences differently, reached their own conclusions, and learned with and from each other. At the same time, they also significantly improved their comprehension of English. Students listened to and read authentic texts, expanded their vocabulary, and gained professional terminology in a foreign language. Students improved their skills at working with various electronic devices and online learning tools (YouTube, online classrooms, Edpuzzle, Liveworksheets, Wordwall, WordItOut, Zoom - breakrooms, creating videos).

As an English teacher, I believe that the goal of English language learning is not only mastering grammar and enriching vocabulary but using English as a tool for acquiring new knowledge. Mastering a foreign language is not knowledge but a skill that must be used in authentic situations. I want to teach students to use English to learn and acquire new knowledge, use foreign resources, and read articles in a foreign language.

Connecting different subject areas, learning the content in different languages, and using various online tools is the right way to gain knowledge in the future. In the future, students will not only be passive recipients of information but will have to be able to find relevant information themselves, compare, analyse, and evaluate it. It does change not only the student's role but also the teacher's role. The teacher in the future is no longer a lecturer, he is not someone who delivers the lesson to the students, but guides, directs, and encourages students in their own search for knowledge.

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## References

- Barnes, J. (2015). An introduction to cross-curricular learning. In Driscoll, P., Lambirth, A., & Roden, J. (Eds.), *The creative primary curriculum*. Sage. [https://www.researchgate.net/publication/274313611\\_An\\_Introduction\\_to\\_Cross-Curricular\\_Learning](https://www.researchgate.net/publication/274313611_An_Introduction_to_Cross-Curricular_Learning)
- Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. International Society for Technology in Education / ISTE.
- Coyle, D. (2002). Against all odds: Lessons from content & language integrated learning in English secondary schools. In D. W. C. So, & G. M. Jones (Eds.), *Education & society in plurilingual contexts*. VUB Brussels University Press.
- Carretero, S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1 Okvir digitalnih kompetenc za državljane. Osem ravni doseganja kompetenc in primeri rabe* [DigComp 2.1 digital competence framework for citizens. Eight levels of competency achievement and examples of use]. Zavod RS za šolstvo. <http://www.zrss.si/pdf/digcomp-2-1-okvir-digitalnih-kompetenc.pdf>
- Coyle, D., Hood, P., & Marsh, D. (2013). *CLIL*. Cambridge University Press.
- DeWitt, T. (2012a). *Basic atomic structure: A look inside the atom* [Video]. <https://www.youtube.com/watch?v=h6LPAwAmnCQ>
- DeWitt, T. (2012b). *What's an Ion?* [Video]. <https://www.youtube.com/watch?v=WWc3k2723IM>
- DeWitt, T. (2013). *Writing Formulas with Polyatomic Ions* [Video]. <https://www.youtube.com/watch?v=p9iQ5Qn42DM>

- Edwards, L. (2022). What is blooket and how does it work? Tips & tricks. <https://www.techlearning.com/how-to/what-is-blooket-and-how-does-it-work-tips-and-tricks>
- Falciani, I. (2022). *Flipped Classroom > Training Course for Teachers*. <https://www.teacheracademy.eu/course/flipped-classroom/>
- Genetics. (2022). <https://kids.britannica.com/students/article/genetics/274516#>
- HRD Institute - Gamification of Learning. (2022). [https://sites.google.com/hrdinstitute.org/hrdi/online-teaching-hub/online-teaching-tools/gamification-of-learning#h.p\\_WAlenOvdFDTm](https://sites.google.com/hrdinstitute.org/hrdi/online-teaching-hub/online-teaching-tools/gamification-of-learning#h.p_WAlenOvdFDTm)
- Jazbec, S., & Lovrin, M. (2015). Koncept CLIL - novost ali stalnica pri učiteljih na OŠ v Sloveniji: študija primera. *Revija Za Elementarno Izobraževanje = Journal of Elementary Education*, 8(1/2), 65–79. [http://www.pef.um.si/content/Zalozba/clanki\\_2015\\_letnik8%20stev1-2/REI%208%201-2%2004.pdf](http://www.pef.um.si/content/Zalozba/clanki_2015_letnik8%20stev1-2/REI%208%201-2%2004.pdf)
- Jedrinović, S., Cerar, Š., Zapušek, M., Kristl, N., Papić, M., & Žurbi, R. idr. (2018). *Strokovna izhodišča za didaktično uporabo IKT na 9 študijskih področjih* [Professional starting points for the didactic use of ICT in 9 study areas]. <http://naslokar.fmf.uni-lj.si/FMF/sidu.pdf>
- Kapp, K. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. Wiley.
- Kramar, M., & Cugmas, A. (2019). *Vojaška didaktika*. URN:NBN:SI:DOC-FW1VU7YF. <http://www.dlib.si>
- Lamichhane, C. (2018). Understanding the education philosophy and its implications. *NCC Journal*, 3(1), 24–29. <https://doi.org/10.3126/nccj.v3i1.20245>
- Marsh, D. (2000). Using languages to learn and learning to use languages. <http://archive.ecml.at/mtp2/climatrix/pdf/1uk.pdf>
- Mehisto, P., Marsh, D., & Frigols, M. (2012). *Uncovering CLIL*. Macmillan Education.
- Sams, A., Bergmann, J., Daniels, K., Bennett, B., Marshall, H., & Arfstrom, K. (2014). What is flipped learning? [https://flippedlearning.org/wp-content/uploads/2016/07/FLIP\\_handout\\_FNL\\_Web.pdf](https://flippedlearning.org/wp-content/uploads/2016/07/FLIP_handout_FNL_Web.pdf)
- Sicherl-Kafol, B. (2008). Medpredmetno povezovanje v osnovni šoli [Cross-curricular integration in elementary school]. *Didakta*, 18/19, 7–9. [http://www.didakta.si/doc/revija\\_didakta\\_2008\\_november.pdf](http://www.didakta.si/doc/revija_didakta_2008_november.pdf)
- Sukič Kuzma, M. (2020). Basic atomic structure. In Liveworksheets. <https://www.liveworksheets.com/iv1340559xl>
- Sukič Kuzma, M. (2021). What is an Ion? In Liveworksheets. <https://www.liveworksheets.com/om1452139ay>
- Sukič Kuzma, M. (2022). Genetics. In Liveworksheets. <https://www.liveworksheets.com/kc2865537sc>

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**Mateja Sukič Kuzma**

English and German Teacher, Primary School Miško Kranjec Velika Polana, Velika Polana  
215/b, 9225 Velika Polana, Slovenia.  
E-mail: [mateja.s.kuzma@gmail.com](mailto:mateja.s.kuzma@gmail.com)