Teaching Informatics through CLIL: Taking Stock and Looking Ahead

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TEACHING INFORMATICS THROUGH CLIL: TAKING STOCK AND LOOKING AHEAD

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Abstract

This work focuses on exploring the implementation of CLIL in the teaching of informatics in Croatian schools. The aim is to determine the benefits and challenges of such an approach in addition to discussing the potential steps to improve the quality of this program for both students and teachers. The study presented in this work is twofold in terms of consisting of a questionnaire for students currently studying informatics through English with additional commentary from the teachers regarding their experience with the program in the form of written interviews. CLIL is not so widespread among Croatian schools which leads to a limited sample of participants. This is one of the biggest limitations of the study presented. Throughout the work, it is suggested that informatics is an excellent choice of subject to be taught through CLIL with reference to its origins and foundations which the findings supported. The results obtained were mostly in accordance with previous research on the effects of CLIL. The findings also suggest significant benefits for the students when implemented properly while at the same time discovering irrefutable difficulties for the teachers. Some results also show conflicting evidence based on the different language abilities of students before enrolling in the CLIL program. This work also covers measures that might prove to be effective in improving the overall quality of the program.

Key words: CLIL, English, student attitudes, teacher attitudes, informatics

Contents

1. Introduction

People today face many challenges regarding their education, professional abilities, and workforce demands. Society faces problems that are far more complex than they were in the past. Globalization has significantly increased the need for knowing more than one language in order to be able to participate and function in society. This undeniably leads to the need for a change in the educational system as we aim to better prepare students for the challenges they may face in the future.

Skills that seem to be indispensable in today's world are those regarding language abilities, communication skills, and an ability to navigate through this ever-growing digitalized society. In line with these demands, a new idea sparked within the European Union whose goal was to promote multilingualism, digital literacy, and other skills deemed necessary. Many different kinds of language teaching approaches stemmed from this need to work on specific skills, and one of those ideas was to implement CLIL into our educational practices. CLIL has been accepted by many institutions whose aim is to discover the most beneficial educational policies. The idea of this approach is to integrate foreign language and content teaching within a singular program (Coyle, Hood, & Marsh, 2010).

CLIL includes content being taught through the medium of a foreign language (Marsh D. , 2008) and there is no specific rule governing the choice of the language for teaching. However, throughout this work, we will focus mostly on CLIL programs in English and more specifically informatics courses taught in English.

Throughout this work, we will examine how informatics is taught through CLIL in Croatia considering the benefits and challenges students and teachers are faced in their everyday interactions with CLIL. The focus will predominately be on the students with additional input from teachers who agreed to participate in the study. The main aim is to determine how this program is implemented in addition to which steps can be taken to improve the quality of the experience for both teachers and students. With every change in our educational policies and approaches, certain institutions are obliged to participate and take responsibility to make sure that the process goes properly therefore this work will also examine the role of educational institutions in making this happen.

The motivation for this study arose when first being introduced to the CLIL methodology during my English language teaching methodology course as it provided new

insights into teaching informatics and a way to bridge the gap between my two majors innovatively. I have since then been able to complete my necessary pre-service training by teaching informatics through CLIL in the Private Grammar School Andrija Ljudevit Adamić in Rijeka. This short experience provided powerful insight into the fundamental issues that underline the implementation of this approach. Despite the immense efforts of the teacher and other staff members, it was extremely difficult to access the full potential of the approach. Throughout this work, we will attempt to determine the reasons these difficulties arise and hopefully provide insights into steps worth considering during the implementation of CLIL into the school curriculum.

2. The CLIL approach

Education in a foreign or second language is not a new concept and it dates back to the Roman Empire where children were educated in Greek to ensure they had access to opportunities that arose from the Roman Empire conquering Greek territories (Coyle, Hood, & Marsh, 2010). Even back then, language knowledge was the gateway to the world. A modern version of education in a foreign language is known today as Content and Language Integrated Learning (CLIL), which has rapidly attracted many interested followers over the recent years.

The increase in interest in CLIL stems from the demands on present-day education set by globalization. CLIL as such has its origins in the 1990s when it was first used by David Marsh at the University of Jyväskylä in Finland but has its roots in different immersion programs that took speed in the 1960s (Coyle, Hood, & Marsh, 2010). Since its beginnings, the European Commission and the Council of Europe have continued to promote and support CLIL as it complements the need for improving second-language education in Europe (Cenoz, Genesee, & Gorter, 2014). CLIL has since then been implemented all around the world and especially in Europe.

The term CLIL was coined by David Marsh in 1994 to describe an approach to education where content is taught through the means of a foreign or second language within the European context (Coyle, Hood, & Marsh, 2010). The authors describe CLIL as a dual-focused form of instruction where attention is given to both language and content through language-supportive methodologies (Coyle, Hood, & Marsh, 2010). It should be noted that the implementation of CLIL can include a wide range of educational practices since it is

conducted through the medium of a second language (L2) (Marsh D. , 2002). Moreover, CLIL can be used at different educational levels from preschool to higher education (Cenoz, 2015). One of the reasons for implementing this approach was the need for reorganizing the time allotted to language teaching in the curriculum to ensure appropriate language teaching and learning while keeping in mind the increasing need for diverse learning styles that became prominent as a result of the impact of globalization (Coyle, Hood, & Marsh, 2010). Aside from the need emanating from the recent changes in society, the importance of bilingualism was recognized by European Union as a skill necessary for lifelong learning. Some of the benefits of knowing more than one language include increased executive functions, successful conflict management, increased cognitive and sensory processing, and delayed cognitive decline as well as many others (Marian & Shook, 2012). It is therefore hardly surprising that since its initial stage, the European Commission and Council of Europe have funded different initiatives in support of CLIL intending to enhance L2 education and bilingualism throughout Europe (Cenoz, Genesee, & Gorter, 2014).

Globalization is altering the labor market which in turn leads to the requirement of a different set of skills. Meanwhile, educational policies remain unchanged thus not allowing for success in this new environment (Directorate-General for Education, Youth, Sport and Culture (European Commission), 2019). To fight this trend, the European Commission adopted the Key Competencies for lifelong learning document in May 2018. These include literacy competence, multilingual competence, mathematical competence and competence in science, technology, and engineering, digital competence, personal, social, and learning to learn competence, citizenship competence, entrepreneurship competence, and cultural awareness and expression competence. Literacy refers to the ability to understand and express concepts, feelings, and ideas in oral and written forms. Multilingual competence includes the ability to communicate by using different languages appropriately. Mathematical competence comprises the ability to use mathematical thinking to solve problems in real-life situations. Competence in science, technology, and engineering refers to the ability and willingness to explain the natural world utilizing observation as well as applying that knowledge in science accordingly. Personal, social, and learning to learn competence includes the ability to function alone and with others in society as well as grow and improve accordingly. Citizenship competence refers to the ability to fully participate in civic and social life as a responsible citizen. Entrepreneurship competence can be understood as the ability to recognize opportunities and ideas as well as transform them into values for others.

Cultural awareness and expression competence involve the ability to understand and express oneself in different cultures and societies (Directorate-General for Education, 2019) While all the domains are important, digital literacy, which entails knowledge, skills, and attitudes regarding the use of digital technologies for learning, work, and participating in society is considered to be the most relevant in today's world.

These competences could be integrated into the CLIL classroom and thus help students attain some of these skills needed in the globalized world. Firstly, CLIL is an answer to the increased need for multilingualism. Aside from promoting language knowledge, CLIL classes also often include content from the STEM area thus improving skills regarding math, science, technology, and engineering. Furthermore, CLIL often requires an increase in the use of ICT in the classroom, thus promoting digital literacy. Lastly, in line with the 5 C's of CLIL, all CLIL classes should include a cultural component that inherently develops cultural awareness.

At present, there is still a lack of consensus on the conceptualization of CLIL. Different scholars have differing opinions on the implementation of CLIL some see it as a specific form of instructional techniques, while others see it in curricular terms (Naves & Victori, 2010). Definitions of CLIL also vary and it can be described as a whole program, in some cases, or as additional lessons or activities conducted in a foreign language (Cenoz, Genesee, & Gorter, 2014). Marsh explains that the "[a]pplications of CLIL are multifarious depending on educational level, environment and the specific approach adopted." (Marsh D. , 2008, p. 233)., leaving us with an abundance of possibilities that are encompassed under the umbrella term CLIL.

One of the key divisions in CLIL worth considering is whether CLIL is or should be content-driven or language-driven. Many scholars argue that CLIL is content-driven, even though the motivation for CLIL arose from the need to implement more adequate language learning opportunities (Coyle, Hood, & Marsh, 2010). While some (Ting, 2010) might argue that CLIL classes ought to exhibit an equal division of attention between content and language, research conducted in real CLIL classrooms demonstrates the difficulties of achieving a strict balance between the two (Mehisto, 2008; Perez-Vidal & Juan-Garau, 2010).

Given the different realizations of CLIL, it can be described through many different models such as Soft CLIL, Hard CLIL, the 4 Cs of CLIL, the 5 Cs of CLIL, and the dimensions of CLIL. The Soft CLIL approach focuses primarily on the language aspect and

involves including more content-related materials in the foreign language classroom while Hard CLIL is content-driven and includes classes where academic subjects are taught in English by non-native content teachers (Nikula, 2017). The difference between hard and soft CLIL is the ratio between language and content which is in favor of language in soft CLIL, but in favor of content in hard CLIL (Savankova & Satylganova, 2018). Furthermore, CLIL was initially conceptualized through the 4 Cs (Content, Communication, Cognition, Culture) framework (Coyle, 1999). According to this framework, while preparing a CLIL lesson, teachers need to take into account the following: (1) the content meaning that they build lessons around what students already know and thus prepare students for what they are going to study next, (2) communication by promoting interaction among students rather than focusing on teacher talk, (3) cognition in terms of asking questions to promote analytical and creative thinking, that is, higher-order thinking skills, and (4) culture by helping students relate the content they are learning to the real world (Renau & Mart, 2018). In recent years, a fifth "C" referring to competences was added to optimize the effectiveness of the CLIL methodology. When preparing lessons, CLIL teachers should thus also consider competence by incorporating can-do statements about either content or language, which describe what the students will be able to do after the lesson (Renau & Mart, 2018). As for the five dimensions of CLIL, they include progression in knowledge and understanding of content, communicative interaction, development of communication skills, engagement in higher-order thinking skills, and deepening intercultural awareness (Coyle, Hood, & Marsh, 2010). For CLIL to be considered effective, it must take place through the abovementioned five dimensions.

In line with the above, we can conclude that CLIL is a very innovative approach to teaching. What differentiates CLIL from other language learning methods is that higher-order language skills are developed through content teaching in CLIL. (Marsh D. , 2008). Another difference is that CLIL is a holistic way of teaching which incorporates not just content and language, but many other skills and competences consistent with the needs of the community and future workplace (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2004-2006). Some of these competences include enabling students to be functional in more than one language, which is aligned with the European multilingual policy. The European Commission is collaborating with national governments in promoting bilingualism. This is a necessity considering the increased mobility within Europe (European Commission, 2018). CLIL also differs from language classes in regards to communication

skills as CLIL classes typically involve more opportunities for interaction (Nikula, 2005), thus allowing learning to take place in a more meaningful and efficient way (Lasagabaster, 2011). Language is not learned in isolation but rather incidentally through communication and in context (Genese, 2006). CLIL also allows for the improvement of specific terminology and lexicons in subject areas, which cannot be covered in language classes.

Successful implementation of CLIL also includes several key features, namely, authenticity, active learning, collaboration, complex orientation, gradual learning, and a stimulating learning environment (Mehisto, Marsh, & Frigols, 2008). Authenticity refers to using authentic materials in class. Active learning refers to students' active engagement with the materials, peer collaboration, and activity-based learning. The collaboration aspect entails close cooperation between language teachers and CLIL specialists in preparing lessons. Complex orientation, which is the basis of CLIL, refers to the ability to learn a language through non-linguistic disciplines and learn content through the means of a foreign language. Gradual learning is another very important aspect of CLIL which includes restructuring the skills into more practical formats to match different learning styles. Finally, a stimulating learning environment involves using an abundance of learning activities to keep the students interested and engaged with the material (Hrytsiuk, 2020).

2.1. Benefits of the CLIL approach

Certain benefits of the CLIL approach were mentioned while discussing what differentiates it from other approaches. These included the focus on communication which allows students to function in a foreign language thus enabling education to have a better response to the needs of the globalized society. Research has shown many benefits of implementing the CLIL approach such as building intercultural knowledge and understanding as well as introducing the wider cultural context (Klimova, 2012), allowing for more comprehensible L2 input (Krashen, 1982), looking at content from a broader perspective (Wolff, 2003), developing communicative skills (Lasagabaster, 2011; Klimova, 2012) and improving language knowledge (Chen & Kraklow, 2014) . Moreover, CLIL is also considered beneficial for improving the general effectiveness of learning skills which might be beneficial for further education (Goris, Denessen, & Verhoeven, 2019).

Furthermore, CLIL allows for accessing subject-specific target terminology and developing more accurate academic concepts which are highly unlikely to occur in other approaches to this extent (Lasagabaster & Sierra, 2009). CLIL has also been shown to increase learner motivation and confidence in the language as well as subject knowledge and foster greater participation than in L1 classes (Lasagabaster, 2011), create real communicative situations (Lasagabaster & Sierra, 2009) as well as reduce stress (Heras & Lasagabaster, 2015).

Something of particular importance in the world and Europe specifically is intercultural competence. We can define intercultural competence as the ability to act and communicate appropriately across cultures and with people from different cultural backgrounds (Leung, Ang, & Tan, 2014). The need for a better understanding of intercultural competence stems from the increased number of young people from all around the world, including third world countries, that decide to study here. Culture and language are undeniably interconnected, and one cannot truly learn a language without gaining knowledge about the culture behind it. Culture is present in language learning from day one (Bennett, 1993). Intercultural competence is especially necessary for us as members of the European Union as it is a multilingual and multicultural accord. Many educational institutions value this as a desired outcome of their teaching but fail to increase efforts to make this possible. Implementing CLIL is one of the ways the European Commission is aiming to improve the current situation.

Moreover, due to the demands of today's society, interdisciplinarity in terms of the combination of methods of two or more disciplines in pursuit of a common task (Moran, 2010) is highly necessary. In traditional education, content and language are considered separate entities, and language is not seen as content. CLIL bridges this gap and allows us to see them as one. CLIL complements learning according to new insights arising from interdisciplinarity research (Coyle, Hood, & Marsh, 2010).

2.2. Challenges of the CLIL approach

CLIL being such a complex approach, significant challenges arise from its implementation with a lot of them stemming from the language aspect, such as student's lower knowledge of the target language (TL) (Klimova, 2012), as well as the fact that learners often do not receive sufficient language development to achieve higher levels of proficiency (Nikula, 2017). Moreover, it is more difficult to design language objectives than content objectives (Beacher et al. 2013). One of the biggest challenges is the inadequate language level of the content teachers (Butler, 2005; Pena Díaz & Porto Requejo, 2008).

Regarding the application of CLIL programs, there seems to be a lack of knowledge in regards to setting clear aims, thus emphasizing the need for sufficient analysis of the programs (Mehisto, 2008). This lack of supervision of CLIL programs often leaves teachers unsure of what to do and what is expected of them. According to research, some issues seem to stem from the lack of integration in CLIL classes meaning that content and language are still separate as language teachers still see themselves as only language teachers and content teachers in turn see themselves as primarily content teachers in such a sense that the language aspect of CLIL classes comprises of translations. This suggests that team teaching can be a significant drawback of the CLIL approach (Mehisto, 2008; Mehisto, Marsh, & Frigols, 2008; Coyle, Hood, & Marsh, 2010). However, the majority of CLIL teachers were either trained to teach language or content, not both (Lo & Lin, 2015), which leads to the fact that not many content teachers have the necessary language skills nor are they experienced in teaching in a multilingual environment (Vilkancienė & Rozgienė, 2017).

Additionally, another challenge of the CLIL approach in regards to assessment and the lack of consistency between assessments in class and at the national level. CLIL classes aim to integrate both language and content; however, national exams focus only on content and are usually in the L1, which poses a significant issue for teachers and students (Serragiotto, 2007). Something also worth mentioning is the lack of suitable teaching materials. CLIL textbooks are few and far between meaning that teachers have to decide whether to use native speaker materials or to prepare their materials which is very time-consuming (Met, 1994). Materials developed for native speakers can be extremely difficult for L2 speakers because of the subject-specific terminology and the complex language and content. The final challenge worth mentioning is the general lack of teacher training for CLIL. It has been shown that CLIL teachers need to have a specific set of skills to teach both language and content, as well

as knowledge of different teaching methodologies. However, with little to no specialized CLIL courses and CLIL teacher education programs, adequately equipped teachers are few and far between (Eurydice, 2006) with the majority of teachers learning how to teach CLIL while on the job (Housen, 2002).

Research regarding content subjects being taught through the medium of a foreign language goes beyond the CLIL approach. This includes different immersion programs and is important to CLIL because we can learn about the effects of early versus late immersion which might correlate to the appropriate age to introduce CLIL classes. A longitudinal study conducted by Marsh, Hau, and Kong aimed to determine the effects of late immersion in English on content subjects in Hong Kong. Their study discovered the negative effects of the program on learning content subjects. They attribute these results to the (1) lack of competence among teachers and (2) the fact that late immersion is not as beneficial as early immersion (Marsh, Hau, & Kong, 2000). Several other studies have proven the negative effects of late immersion and by extension CLIL in Hong Kong (Yip, Tsang, & Cheung, 2003) and other Asian countries (Tan, 2005). These examples prove that CLIL can have negative effects on learning which is why it is important to implement this approach carefully.

2.3. English and CLIL

Due to the recent growth of informatization and globalization, the need for one common language increased significantly (Rao, 2019). This need escalated with the increase of bodies that contain representatives from all over the world such as different UN bodies, the World Bank, and the World Health Organization, among others. Initially, there were five languages (English, French, Spanish, Russian, and Chinese) designated for use by these bodies but with the cost of translators and clerical workers, it made sense to settle on one language in particular (Crystal, 2003). Today, English has become the *lingua franca* or global language of the world meaning that is it a widespread language that is learned and spoken internationally and that it enables people from diverse backgrounds to communicate (Crystal, 2003).

Given the diversity of CLIL contexts where content is taught through languages that are not the native language of the students (Marsh D. , 2008). the implementation of the CLIL

approach throughout Europe entails the use of foreign, regional, or minority languages, as well as other official state languages. However, a closer examination shows that the most widespread languages used are English, French and German, with English being at the very front (Eurydice, 2006). In fact, CLIL is frequently equated with CEIL or content and English integrated learning (Dalton-Puffer, 2011). This is not surprising since English is the language of education, science, and business, and being fluent in English opens the door to more opportunities regarding mobility, employment, and independent learning (Rao, 2019). The growing importance of English increases its presence in everyday facets of life making it a crucial skill for future opportunities. Therefore, teaching content subjects through the medium of English can be beneficial as it increases one's exposure to the target language and provides more opportunities for language acquisition.

Having established the key aspects, challenges, and benefits of CLIL concerning the English language, in the next section we will focus on informatics, a subject that lends itself well to CLIL in English since both are essential and prevalent in today's world.

3. Informatics

Informatics can be defined as the study of the structure, interactions, and behavior of computer systems. The term informatics stems from the word information as the discipline often refers to the representation, processing, and communication of information in both natural and computer systems (Hrvatska enciklopedija, mrežno izdanje, 2021). Informatics is a fast-growing field that is rapidly developing thanks to continuous discoveries and breakthroughs and includes many different areas and disciplines.

In the Croatian context, informatics as a school subject is taught throughout different levels of education from primary school and secondary school to higher education which is important as digital literacy is recognized as one of the key competences for lifelong learning. According to the national curriculum, informatics in both secondary and primary schools equips students with logical reasoning and analysis skills, problem-solving and decision making with the use of ICT skills, creativity, critical thinking as well as many others (Ministarstvo znanosti i obrazovanja, 2018). Informatics is a compulsory subject in the 5th and 6th grade while remaining an elective throughout the rest of primary school. Throughout primary school, Informatics is taught through 70 school periods or 35 weeks. The situation is a bit different in secondary schools because of the wide range of different vocational schools across the country. At present, informatics is a compulsory subject in the first grade of public

grammar schools while this varies significantly across different vocational and private schools. Even within grammar schools, there is a difference in the number of informatics classes as some schools offer more classes on science and mathematics thus including more informatics. Some vocational schools offer similar classes to informatics but under a different name, such as computing or computer science. In secondary school, informatics can be taught through a minimum of 70 and up to 105 school periods (Ministarstvo znanosti i obrazovanja, 2018).

The aims of studying informatics for students are the following: (1) attaining digital literacy skills so that they can independently and responsibly use ICT as well as prepare for lifelong learning and work in a digital society, (2) improving digital wisdom in terms of selecting and using appropriate tools depending on the task or issue at hand, (3) promoting critical thinking skills and creativity through the use of ICT, (4) developing computational thinking skills, problem-solving and programming skills, (5) attaining effective and responsible communication in a digital environment and (6) understanding and following digital safety recommendations (Ministarstvo znanosti i obrazovanja, 2018).

Computer science and information processing are the basis of a digital society as well as the focus of informatics. The curriculum sets out the program of study and attainment for the teaching of informatics into four domains: domain (A) Information and digital technology, domain (B) Computational thinking and programming, domain (C) Digital literacy and communication, and domain (D) E-society whose goal is to help achieve the aforementioned aims (Ministarstvo znanosti i obrazovanja, 2018). The first domain covers the basics of computer science as well as data manipulation. The second domain focuses on promoting logical and algorithmic thinking as well as problem-solving and programming, however, the focus is not on learning a programming language but on the process of creating the final product. The third domain is closely related to all the other domains as it provides the basis for the effective use of technology and communication. The fourth and final domain is based on the fact that we live in a digital society and thus focuses on online and data security, cyberbullying, and promoting competences for becoming responsible citizens in the digital society (Ministarstvo znanosti i obrazovanja, 2018).

The world we live in is undeniably consumed with technology. The reality is that newer generations learn how to use technology before they learn how to talk properly. Instead of looking at that as something negative, we ought to accept the unavoidable and focus our

attention on the importance of IT today and in the future. Informatics is not just important as a set of skills, but as a competence for lifelong learning. Furthermore, with the current situation in the world as of writing this, the Covid-19 pandemic has increased the need for these skills by shifting education and business into an online environment. Even before the pandemic, ICT was used in education. Teachers use technology every day in the form of laptops or PCs as well as other necessary equipment. A lot of educational processes are now online as well including e-Dnevnik, e-Matica, different online learning platforms, digital teaching content, interactive whiteboards, etc. Functioning in today's society without the use of ICT and computer skills is unimaginable. IT skills are crucial in different areas of life including work and study (Ministarstvo znanosti i obrazovanja, 2018).

3.1. ICT and education

ICT stands for information and communication technologies which can be defined as a set of technological tools that can be used to create, communicate, and store information (Tinio, 2003). These include television and radio as older examples and computers and the Internet as newer digital technologies which are potentially changing our approach to education. ICTs are rapidly developing, which results in changes in society as well. These changes are not only obvious in the way we use technology every day, but also in how we use it and how dependent we have become on it. Up until recently, ICT was something that could be used in education, but it wasn't seen as necessary and only some chose to include it (Tinio, 2003).

Throughout the recent years, the importance of ICT has grown significantly, in particular since 2020 after the onset of the Covid-19 pandemic when almost all communication moved online. People are now working online, attending universities, and graduating from them online. However, it should be borne in mind that all of this was extremely difficult due to the general lack of digital skills. When applied appropriately, ICTs can be extremely helpful in the educational process in terms of expanding access to education, improving quality, and creating an active learning process (Blurton, 1999; Tomičić , Cvrtila, & Pavetić, 2012). Although the use of ICT has improved significantly over the years, it remains an issue today. The European Commission underscores the importance of knowledge of ICT and foreign languages, while at the same time acknowledging the lack of ICT experts. This issue can only

be solved by innovative modern education which would implement ICT in teaching subjects other than informatics, which many are still reluctant to do so (Tomičić , Cvrtila, & Pavetić, 2012). However, educators must ensure students are well prepared for the digital age, and able to continually improve their skills.

3.2. Informatics and English

English is the *lingua franca* of the world, but English is also the *lingua franca* of computers and coding, thus meaning that informatics has its beginnings in English. Charles Babbage was an English scientist and is known today as the father of computing because of his many contributions towards creating a digital programmable computer and proposing the concept of a general-purpose computer known as the Analytical Engine, which subsequently led to the development of technology that we use today. (Babbage, 1989). Another reason why informatics and English are so connected is the fact that coding has its origins in English. Ada Lovelace, the daughter of the famous English poet Lord Byron, is considered the first programmer. She was Babbage's contemporary and is famous for writing the first algorithm for his Analytical Engine thus setting up the foundations for future programming (Studios, 2018). Since its beginnings, coding continues to be mostly in English, although there are non-English coding languages. An abundance of programming languages were developed in English speaking countries, while a smaller number of the most widespread programming languages were developed in non-English speaking countries, but the code remains in English (Studios, 2018), which speaks even more in favor of English being the original language of computers.

Furthermore, the concept known as the Internet was also created in English. The history of the Internet dates back to the 1960s when scientists were toying with the idea of a global network. This led to the creation of ARPANET, the first public computer network developed by the U.S. Defense Department, which later grew and developed into the Internet we know today (Leiner, et al., 2009). Given that the US and UK were at the forefront of the birth of the Internet, English had a leading role in its use.

The connection between computers and languages does not stop here. Computers have been used for teaching languages since the 1960s through computer-assisted language learning (CALL) approaches (Warschauer & Healey, 1998). CALL can be roughly divided

into three different approaches; behavioristic CALL, communicative CALL, and integrative CALL (Warschauer & Healey, 1998). Behavioristic CALL present throughout the 1960s and 1970s was based on the behavioral learning model and included repetitive language drills. The communicative approach, which emerged in the 1970s and 1980s, stressed the use of forms rather than the forms themselves and the focus was on promoting communication among the students. As most teachers moved from a strictly cognitive view of language learning toward a more socio-cognitive approach, greater emphasis was placed on using language in authentic contexts. Hence, a new approach to CALL was born. Integrative CALL, as the name suggests, aimed to integrate various language and technology skills into a single learning process by promoting the use of various tools to aid the process (Warschauer & Healey, 1998).

4. Teaching Informatics through CLIL

As already mentioned, CLIL is an umbrella term that includes different content-based programs taught through the medium of a foreign language (Genesee & Lindholm-Leary., 2013). CLIL is often implemented for teaching science subjects. Taking into consideration the current age of digitalization and the rise of technology, it is hardly surprising that informatics and computer science have been granted a crucial role in the world of science. Considering the position of informatics in science and the role of English in today's world, it seems fair to state that teaching informatics through English integrates the best of both worlds. Moreover, English and computers are irrevocably connected and go way back as we have mentioned in the previous chapter.

Regarding the role of the English language in informatics, when the content was initially created in English and many terms are still better known in their original form such as the case with informatics. CLIL students are often faced with specific academic registers that significantly differ from everyday language and this academic language is not restricted only to subject-specific vocabulary, but grammar features, sentence patterns, and different genres (Cammarata & Haley, 2018). The case is somewhat different with informatics, as English is the original language of informatics and many English terms are used in place of their L1 counterparts. English is a widespread communication tool and an international language that compliments the computer (Kypshakbaeva & Davletova, 2020).

There are numerous benefits of learning informatics through English, Aside from the students' familiarity with the language, research has shown certain additional benefits of learning IT in its original language (Rintaningrum, 2019). Using English helps create an interactive learning environment that allows students to expand the range of methods to gain knowledge independently as well as develop information competence and adapt to life in an information society (Hrytsiuk, 2020) This also leads to an increase in motivation and involvement of students and developing language skills in a professional sphere (Piotrowska & Alekseeva, 2020). Furthermore, research has also shown that developing digital literacy through CLIL is more effective than through monolingual instruction (Danilov, Salekhova, & Yakaeva, 2018).

While the teaching of informatics through CLIL does seem to have numerous benefits; however, it is necessary to take certain steps to ensure it is conducted properly. For effective application of the CLIL methodology, it is necessary to include interesting authentic educational materials. Furthermore, a joint effort in supporting the learning process is needed by both content and language teacher. CLIL teachers should also promote interaction between participants and introduce the cultural component in the subject content as well as integrate an interdisciplinary approach to the learning process (Hrytsiuk, 2020). The many benefits of CLIL speak in favor of its implementation, however, the means of how to do so are still up for debate.

As for the challenges of teaching IT through CLIL, there is little research on whether and how English specifically affects this field. Therefore, this study aims to fill the gap in the field and identify the challenges of teaching informatics through English. Regarding the general challenges of CLIL discussed in the section on CLIL, it seems fair to say that they are also reflected in the informatics classroom.

What could ensure more effective implementation of CLIL in the informatics classroom and ensure that teachers are adequately prepared to teach content through English is the provision of education and training for double majors in teaching programs. Specifically, double majors in English and other subjects, such as informatics are ideal candidates for teaching content subjects through the means of a foreign language as they have the necessary knowledge in both areas. Employing teachers with this combination of subjects would also be beneficial for the schools as the cost of additional training would be significantly lower than training content teachers in language skills and CLIL methodology. One such example is a

university in Russia that started a program in “Pedagogics with two majors: Foreign language (English) and Computer Science” to implement CLIL in a dual major bachelor's program. The main reason for starting this program was to meet the labor market needs which showed a lack of teachers in English and Computer Science. Furthermore, it was realized that there was a close connection between English and IT as better English skills correlated positively with good skills in the IT-sphere and vice versa (Ivanova & Zarovniaeva, 2020). As for the potential challenges and financial risks of implementing this program, they included language difficulties of the faculty, additional costs of equipment, and lack of experience in this type of endeavor. After determining the project's viability, it was finally launched in 2020 with fifteen state-funded vacant spots for students. If the program yields the expected results, it will be further developed and the capacities will be increased (Ivanova & Zarovniaeva, 2020). Taking into consideration that language and digital skills are needed in other contexts as well, this university can serve as an example of best practice in preparing informatics teachers to teach content through English.

5. The present study

5.1.Context

Few schools in Croatia offer CLIL classes in their program and even fewer offer informatics classes in English. From the information available online, the following schools offer CLIL classes in Croatia: the private grammar school Andrija Ljudevit Adamić in Rijeka, the IV. Grammar School in Zagreb, the X. Grammar School Ivan Supek, the XVI. Grammar School in Zagreb, the XVIII. Grammar School in Zagreb and private Secondary School of Economics Inova from Zagreb. As CLIL can be implemented differently throughout the school system, some schools participated in certain CLIL projects by offering temporary classes or projects in foreign languages. Such schools are the Grammar and vocational school Berdinand Frankopan from Ogulin and the Zabok School of Art, Design, Graphics, and Clothing. Out of the aforementioned schools, only a few offer informatics-related classes in English, the private grammar school Andrija Ljudevit Adamić in Rijeka and, the X. Grammar School Ivan Supek which did not have informatics CLIL classes this year but expect to in the future. The school from Ogulin participated in a CLIL robotics

competition in German, and the Zabok school offered web design classes in English for a project in 2017.

The school that is most in focus in this study is the private grammar school Andrija Ljudevit Adamić in Rijeka. This is the only school in the Primorje-Gorski Kotar County that offers CLIL classes. The school was first introduced to CLIL as part of an EU project "Multilingual education – improving language learning and intercultural skills. Afterward, they introduced a pilot CLIL project into their curriculum in 2015 and have been implementing it ever since. They offer classes in Croatian, English, Italian, and German. The table below shows CLIL classes currently held in the school (Table 1).

Table 1 Subjects taught through CLIL

	CLIL classes	
	English	**Italian / German**
1st grade	Art, Ethics, Informatics	
2nd grad	Art, Ethics, Informatics, Psychology	
3rd grade	Art, Ethics, Informatics, Psychology, Geography	
4th grade	History, Politics and economy	Music

5.2.Aims and Research Questions

The motivation for this study stems from the opportunity I had to teach through CLIL during my pre-service training. My experience teaching through CLIL made me realize that preparing CLIL classes was quite a challenging task due to the amount of planning and preparation that needs to go into every single lesson. What made these classes even more challenging were the students' different language levels, which required the use of varying degrees of scaffolding to ensure comprehension and adequate participation of all students. Taking into consideration my double major studies and specific background in teaching English and informatics, preparing and teaching CLIL lessons seemed completely natural. However, not all informatics CLIL teachers have a background in both language and informatics and do not have a solid foundation to teach informatics through English.

Therefore, this study aimed to examine students' and teachers' attitudes and experiences towards informatics through CLIL. The main focus was on determining students' attitudes and perceived difficulties. These findings were then compared to the experience of two CLIL teachers. The focus was on gaining insights into what students perceive as the benefits and challenges of their CLIL classes, which language aspects they find most difficult, and whether they notice an improvement in their content and language skills. The study also examined the teachers' perspectives on the challenges and benefits of teaching informatics through English, as well as the type of support that they would need to improve their teaching with respect to the type of support they receive. Furthermore, based on the results, the study aimed to identify the measures that could be taken to improve the quality of this program.

The study was guided by the following research questions.

RQ1: What are the benefits and challenges of teaching informatics through CLIL?

RQ2: What are the benefits and challenges of this approach for students?

RQ3: What measures could be taken to improve the quality of teaching informatics through CLIL?

RQ4: What types of support are teachers receiving?

RQ5: What are the prerequisites for becoming a CLIL teacher in informatics?

5.3. Participants

Considering this was a dual-focused study, the participants will be described separately. The participants in the first part of this study comprised high school students from the private Grammar School Andrija Ljudevit Adamić who are currently taking informatics classes through CLIL. In total, 64 students completed the survey. All participants are between the ages of 14 and 18 with the majority of participants being aged 14 (43.8 %) followed by 17 (26.6 %). Sixteen participants are aged 16 (25 %) followed by two participants aged 14 (3.1 %) and one participant aged 18 (1.6 %). Before enrolling, the students were interviewed to determine their eligibility to participate in the program as the school does not offer the possibility to attend only Croatian classes.

The majority of participants were male (N=34, 53,1 %) followed by 24 female (37.5 %) and six who did not report their sex (9.4 %). Concerning the grades they were in, 32 participants were in the first grade of grammar school (50 %), followed by 18 in the second grade (28,1 %) and 14 in the third grade (21.9 %). Visual representation of sex and grade can be seen in Figures 1 and 2.

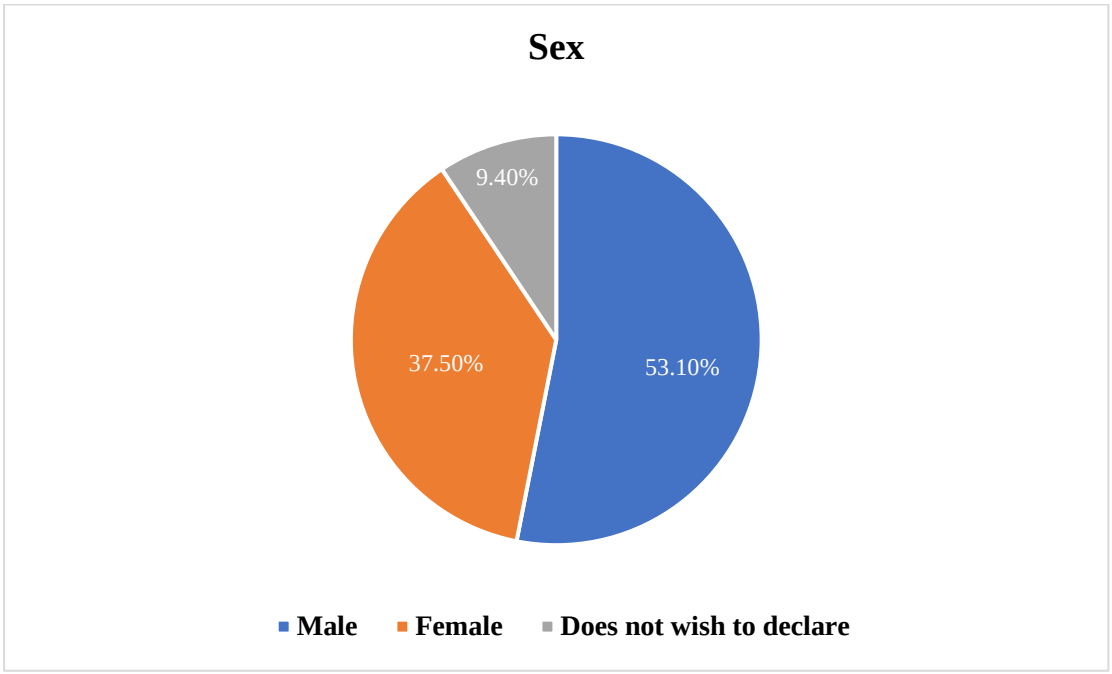

Figure 1 Participants' sex

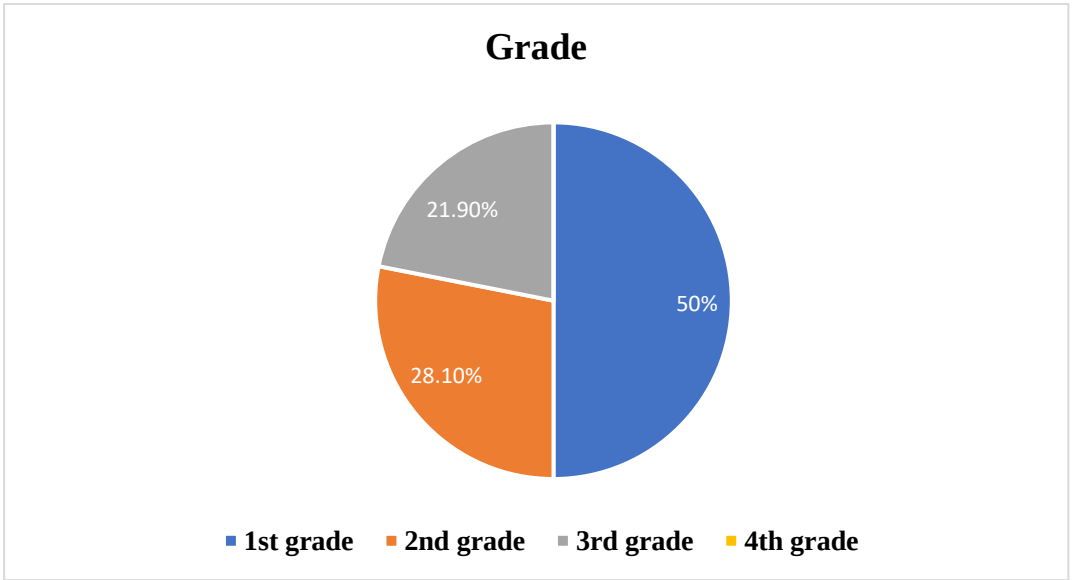

Figure 2 Participants' grade

Regarding the second part of the study, CLIL teachers in Croatia are few and far between with even fewer CLIL informatics teachers. This study only included two CLIL teachers, one from the Tenth Grammar School Ivan Supek in Zagreb and one from the Private Grammar School Andrija Ljudevit Adamić in Rijeka. Both participants are female and in the 35-44 age group. Both are maths and informatics teachers. Between the two of them, they teach classes from the first to the fourth grade. Their language levels are B2 and C1. Both stated that they wanted to teach informatics through CLIL.

The Tenth Grammar School Ivan Supek in Zagreb doesn't currently offer informatics CLIL classes therefore there were no students eligible to participate in the first part of the study but the teacher agreed to be interviewed. Overall, seven schools that offer CLIL programs were asked to participate in the study but declined to do so. The previously mentioned grammar schools in Zagreb do not offer informatics classes in their CLIL program therefore they could not participate and the school in Zabok and their CLIL teachers never replied.

5.4.Methodology

This study was conducted in two phases. The first phase focused on students studying informatics through English. For this part of the study, an online questionnaire was created in Croatian using Google Forms and distributed to students electronically. The questionnaire was distributed and supervised by an informatics CLIL teacher. All students currently studying informatics through CLIL were eligible to participate.

The questionnaire comprised three parts. The first part focused on general information described in the section about participants. The second part focused on questions about their language abilities. Specifically, the participants were asked to rate their language abilities on a scale from one to five with one being very poor to five being excellent, their ability to participate in class in a foreign language on a scale from never to always, and how often they use L1 and L2 in the classroom on a scale from never to always as well as the situations where they feel the use of L1 is necessary.

The third part investigated students' attitudes and experiences with learning informatics through English. A Likert-type scale was used to examine how students perceive their knowledge of the content subject as well as how they perceive the difficulty of the CLIL program. This section also included questions regarding the benefits and challenges of the

program and questions to elicit information on class materials they use in class, assessment, language correction, and their general attitude.

The second part of the study with CLIL teachers was first planned as a semi-structured interview; however, at the request of the participants, it was conducted in the form of written interview questions which were sent via email, and follow-up questions were asked as needed. The interview was written and conducted in Croatian to ensure clarity and allow the teachers to best express their opinions. All of the answers used in the study are translations of their written responses. The purpose of the interviews was to gain insight into teaching informatics through CLIL. The interview was organized into eight sections. The first section covered general information elaborated in the part about participants. The second part of the interview focused on being a CLIL teacher including their motivation for becoming CLIL teachers and the obligations they have aside from teaching. The next section aimed to gain insight into the language used in their teachings such as the use of L1 in the classroom, decisions about which aspects of the language to teach, and correction of language mistakes in oral or written form. Section four deals specifically with teaching informatics through English in terms of the potential benefits and challenges and elicits their opinion about what makes informatics a good subject for CLIL and the potential connection between computers and English. Section five of the interviews focused on the support CLIL teachers need to ensure the best outcomes of their teaching in contrast to the support they receive. The remaining two sections focused on the use and preparation of learning materials and assessment with respect to the national curriculum and guidelines.

6. Results

Due to the organization of the study, the results will be discussed separately for the parts about students and teachers. The results will also be organized in sections as the data was collected. This study was a combination of quantitative and qualitative research methods and the results will be presented accordingly. Both the questionnaire and interviews were conducted in Croatian therefore the presented results are translations from the original input.

6.1. Language

Participants rated their language skills on a scale from 1 to 5 with 1 being very poor and 5 being excellent. As can be seen in Figure 3, the majority of participants declared that their knowledge of English was excellent (N=24, 37.5%) followed by 22 participants who

consider their knowledge of English very good (34.4 %). Thirteen participants consider their English abilities as good (20.3 %) while only five participants declared their knowledge of English as poor (7.8 %) and no one decided on very poor (Figure 3).

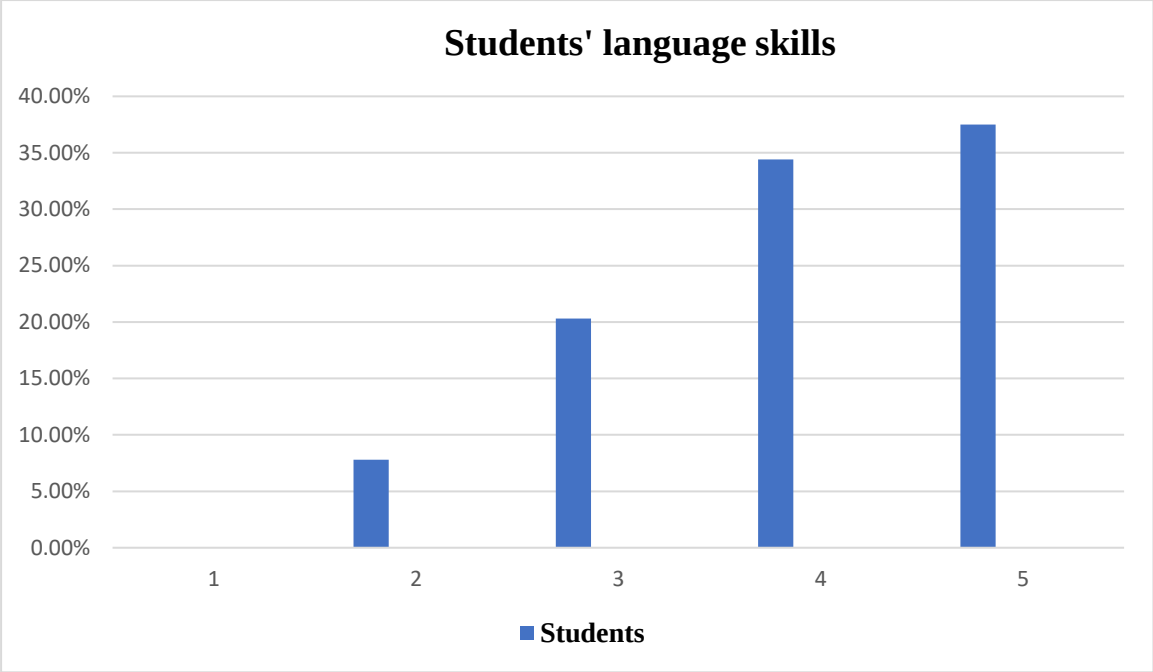

Figure 3 Students' language skills

According to the teachers interviewed, a preselection process was necessary for the students to determine their abilities to participate in a CLIL program. Teacher 1 stated that the students were required to complete an interview upon registration, while Teacher 2 noted that the students needed to score an adequate number of points on an entrance exam to be enrolled in the CLIL program. Regardless of the efforts, the language abilities of students are still quite varied and pose a problem.

The following questions were aimed to determine the students' ability to pay attention to lessons in English using a rating scale. We examined how difficult they perceive classes in English to be (Figure 4) and their ability to participate in such classes (Figure 5). The majority of participants stated that it is very easy for them to participate in lectures in English (N= 25, 39.1 %) and over half of the participants stated that they are able always to pay attention in class (N=33, 51.6 %). This number is followed by many who stated that they perceive classes in English as easy (N=16, 25 %) and can almost always pay attention (N=24, 37.5 %). A significant number of participants remained neutral in their perception of the difficulty of classes (N=15, 23.4 %) while a few stated that they find it difficult (N=6,

9.4%) or rather very difficult (N=2, 3.1%). The students' perception of difficulty doesn't necessarily correlate to their ability to pay attention in class as few stated that they can only sometimes pay attention in class (N=6, 9.4%) while only one student stated that they can do so rarely. No one stated that they are never able to pay attention in class.

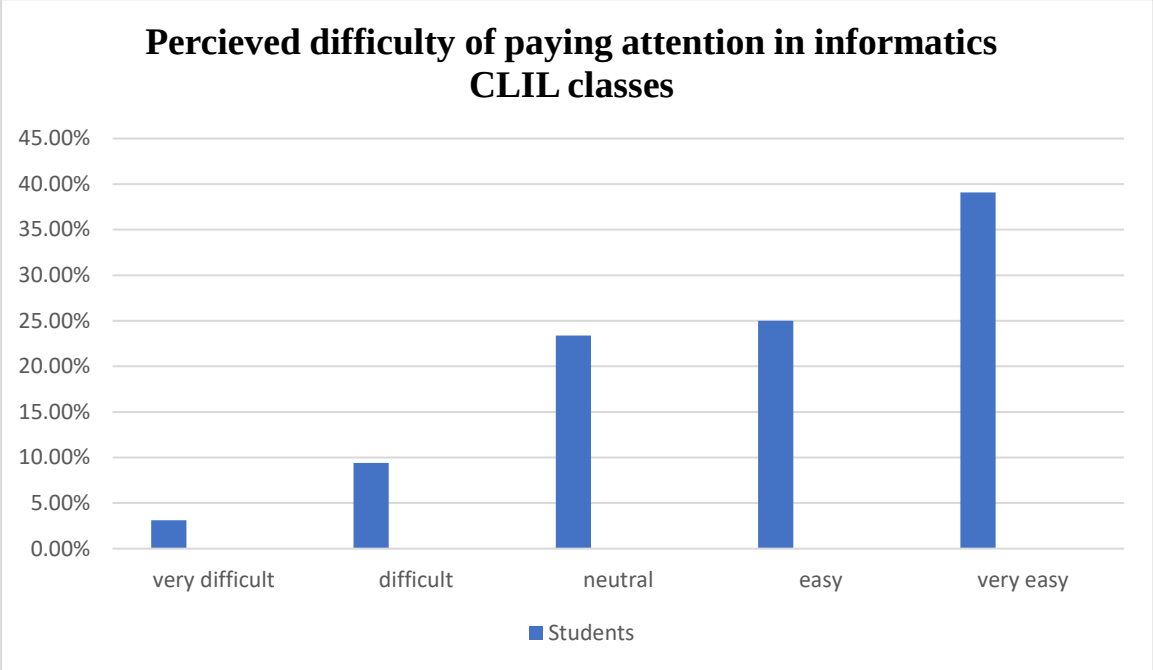

Figure 4 Students'percieved difficulty in paying attention in class

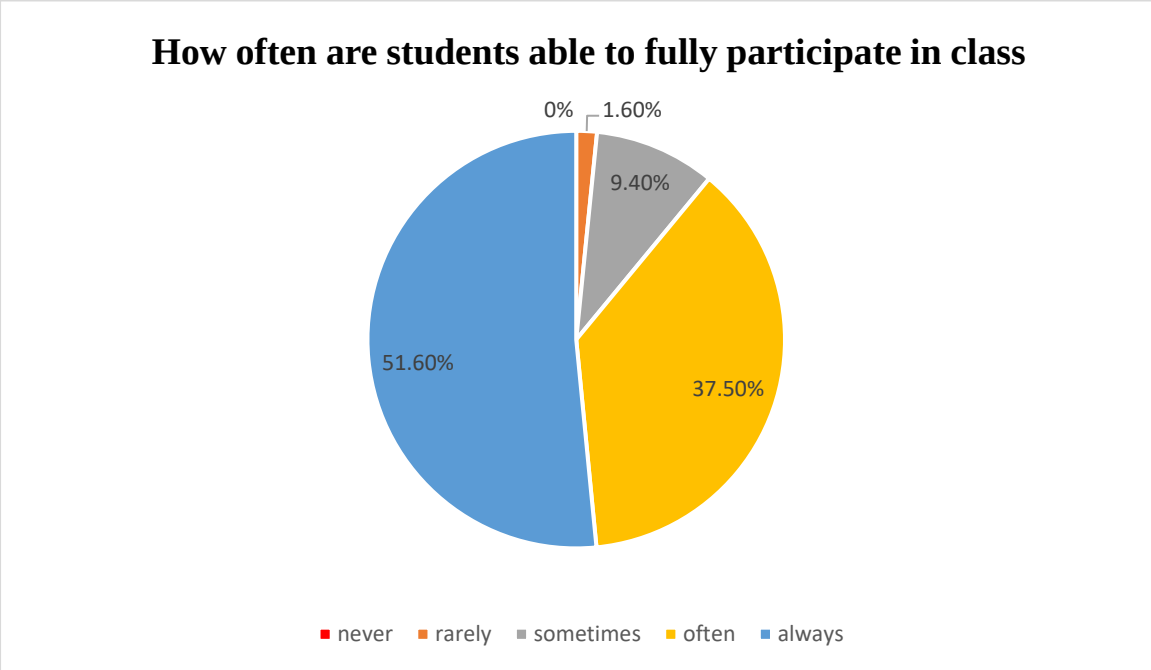

Figure 5 How often students are able to participate in class

Concerning the use of L1 and L2 in the classroom, this study aimed to determine to which extent the students use L1 in the classroom examining which language they prefer to use for speaking and writing. When it comes to the use of L1 and L2 in the classroom, the results are surprising. Only one student stated that they always use English for speaking in class (1.6 %) followed by several (N=19, 29.7 %) who use it often with a majority of students (N=24, 37.5 %) who stated that they use English for speaking sometimes and a significant number (N=17, 26.6%) of students only rarely speak English in class, and even some (N=3, 4.7 %) stated that they never speak English in class.

The results are somewhat similar when it comes to the use of L2 for writing in class. Only four students (6.3 %) stated that they always write in English in class. Incidentally, four is also the number of students (6.3 %) who never write in the L2. The majority of students (N=22, 34.4 %) claimed they use L2 for writing often followed by many (N=20, 31.3 %) who use it occasionally and a significant number of students (N=14, 21.9 %) who use it only rarely.

Regarding the use of Croatian for speaking in class, no one stated that they never use Croatian for speaking in class The largest number of participants (N=28, 43.8%) declared that they often speak Croatian in class followed by many (N=24, 37.5 %) who use it always. Only six (9.4%) students stated that they use the L1 occasionally and six (9.4 %) use it rarely.

The situation doesn't change drastically when it comes to the use of L1 for writing. Same as above, the majority of participants (N=25, 39.1 %) stated that they often use L1 for writing in class followed by many (N=23, 35.9 %) who use it always. Some (N=9, 14.1 %) stated that they use L1 for writing occasionally, and a few (N=5, 7.8 %) that they use it rarely. Two students (3.1 %) stated that they never write in Croatian in class. These results are presented in Table 2.

Table 2 Distribution of L1 and L2 use

Use of language	Always	Often	Sometimes	Rarely	Never
Use of L2 for speaking	1.6 %	29.7 %	**37.5 %**	26.6 %	4.7 %
Use of L2 for writing	6.3 %	**34.4 %**	31.3 %	21.9 %	6.3 %
Use of L1 for speaking	37.5 %	**43.8 %**	9.4 %	9.4 %	0 %
Use of L1 for writing	35.9 %	**39.1 %**	14.1 %	7.8 %	3.1 %

Furthermore, the teachers were also asked how often the students use L1 in the classroom and their answers range from sometimes to always. The teachers also use Croatian in the classroom with their answers ranging from sometimes to often. When asked when they usually resort to using the L1, they agree that it is necessary when the content subject is too complex.

When the material is too complex for the students to understand in English. Also, everything we learn in English we repeat in Croatian. The students need to be familiar with Croatian terminology because of the Matura exam. (Teacher 1)

When the material is complex and requires further explanation. (Teacher 2)

The students were also asked when they prefer to use L1 instead of L2 in the classroom. The majority (N=20, 31.3 %) stated that they prefer the use of Croatian for group work followed by many who prefer it for oral presentations (N=16, 25 %) and asking questions (N=16, 25 %). Some (N=7, 10.9 %) prefer to complete assignments in Croatian and a few students (N=4, 6.25 %) prefer to use Croatian for all of the above. Only one student (1.55 %) stated that they use Croatian only when they do not know how to say something in English (Table 3). The questionnaire also aimed to examine in which situations the teacher used L1. Students noted that the teacher tends to use Croatian when explaining new concepts (N=39, 60.9 %) when explaining activities and assignments (N=18, 28.1%), in teaching materials (N=2, 3.1 %), oral exams (N=2, 3.1 %), written exams (N=1, 1.6%) and all of the above (N=2, 3.1 %) (Table 4).

Table 3 Situations in which students prefer to use Croatian

Students prefer to use Croatian for	**Number of students (percentage)**
Group work	20 (31.3 %)
Oral presentation	16 (25.0 %)
Asking questions	16 (25.0 %)
Completing assignments	7 (10.9 %)
All of the above	4 (6.25%)
Only when I don't know how to ask in English	1 (1.55%)

Table 4 Situations in which teachers use Croatian (according to students)

Teachers prefer to use Croatian for	Number of students (percentage)
Explaining new concepts	39 (60.9 %)
Explaining activities and assignments	18 (28.1 %)
Teaching materials	2 (3.1 %)
Oral exams	2 (3.1 %)
Written exams	1 (1.6 %)
All of the above	2 (3.1 %)

Finally, the students were asked to rate their teacher's language abilities on a scale from 1 to 5 with one being very poor and five being excellent. The results were very promising. The majority (N=30, 47.6) rated the teacher's knowledge of English as excellent, followed by many (N=26, 41.3 %) who consider it very good, and a few (N=7, 11.1%) stated it is good. No one ranked the language abilities of the teacher below good (Figure 6).

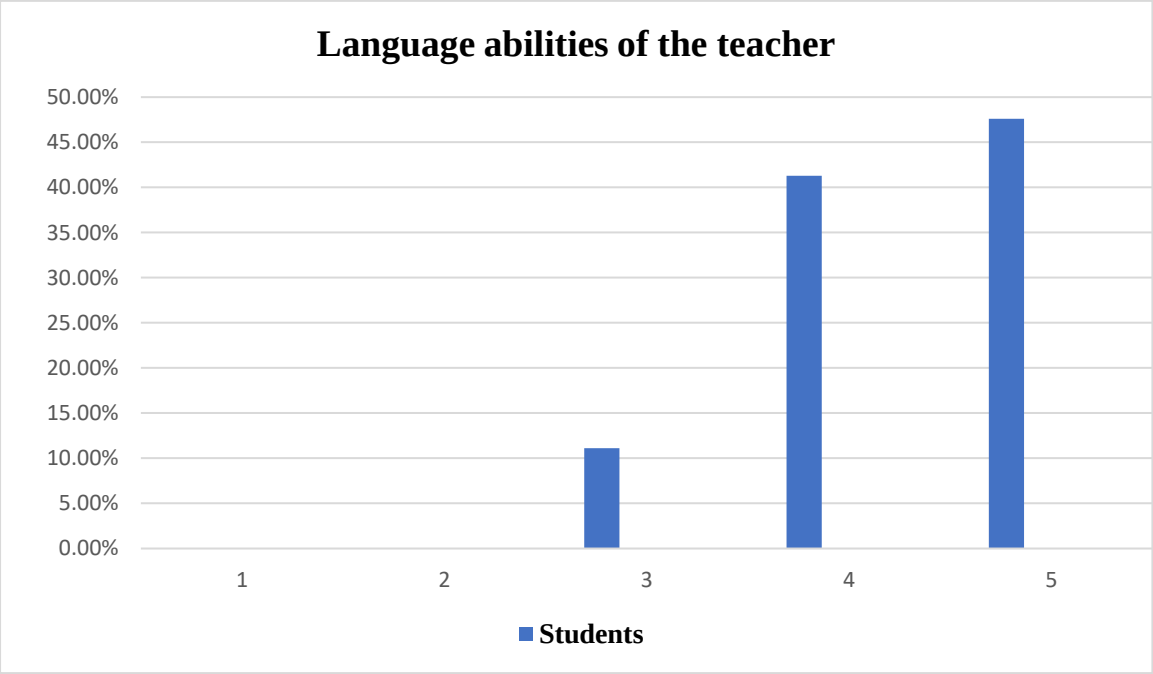

Figure 6 Students' view of the language abilities of the teacher

6.2. Informatics and English

The participants of this study have studied informatics for between one and eleven years. Of the 64 participants, four gave inconclusive answers so they were taken out of the final figures. In contrast, the participants have studied informatics through CLIL for between a few months and five years. The exact numbers are represented in Table 5.

Table 5 Years the participants have been studying informatics in Croatian in comparison to English

Years studying informatics	**Number of students**	**Years of studying informatics in English**	
1 year	1	<1 year	5
2 years	11		
3 years	12	1	31
4 years	9		
5 years	7	2	14
6 years	3		
7 years	2	3	13
8 years	5		
9 years	5	5	1
10 years	5		
11 years	1		

We can see that the majority of students have studied informatics for only two to three years. In comparison, the majority of the students have studied informatics through CLIL for only one year.

Aside from the number of years they have studied the subject, we also aimed to examine how the participants perceive their knowledge of informatics before and after learning it through CLIL. In the questionnaire, the students were asked to rate their knowledge of informatics on a scale from 1 being very poor to 5 being excellent. Before CLIL, the majority (N=23, 35.9 %) of participants rated their knowledge as a 3 on the scale which would correspond to a grade of good, while the majority (N=32, 50.0 %) of the

students rated their current knowledge as a 4 or very good on the scale. We see a decrease in the number of students who rated their previous knowledge as very poor or poor as well as a slight increase in those who rated their knowledge as excellent. According to these results, the average grade can be determined before and after CLIL. The mean score before CLIL was 3.17 while the grade after CLIl show an increase to 3.70. The exact numbers can be seen in Table 6.

Table 6 Participants' perception of their knowledge of the content before and after CLIL

Grades	**Before CLIL (number of students)**	**After CLIL (number of students)**
1 (very poor)	4 (6.3 %)	1 (1.6 %)
2 (poor)	12 (18.8 %)	3 (4.7 %)
3 (good)	23 (35.9 %)	19 (29.7 %)
4 (very good)	19 (29.7 %)	32 (50 %)
5 (excellent)	6 (9.4 %)	9 (14.1 %)
Mean score	**3.17**	**3.70**

Furthermore, a Likert scale was used to determine students' attitudes towards informatics and English and learning informatics this way. The results of this section are summed up in Table 7 below in mean scores. When asked whether studying informatics in English is more difficult than in Croatian, the results are quite literally split. The majority of participants (N=18, 28.1 %) chose ‘neutral’ with the same number of participants (N=10, 15.6 %) stating that they ‘somewhat agree’ that is ‘somewhat disagree’. Interestingly, the exact number of students (N=13, 20.3 %) also chose ‘strongly agree’ and ‘strongly disagree’. However, when asked whether they think English and informatics are connected, the vast majority strongly agree (N=35, 54.7 %). Only one student strongly disagrees (1.6 %) and a few somewhat disagree (N=2, 3.1%). The results are more diverse regarding their impression of the possible improvement of their language skills by studying informatics through English. The majority (N=20, 31.3 %) stated that they somewhat agree, but quite a few participants remained neutral (N=16, 25 %) and even stated that they somewhat disagree (N=15, 23.5 %).

The participants mostly strongly agree (N=26, 40.6 %) that informatics is important with some who are neutral n=14, 21.9 %) and a few that somewhat disagree (N=2, 3.1 %). However, all participants either somewhat (N=9, 14.1 %) or strongly agree (N=55, 85.9 %) that English is important. Furthermore, the majority of participants strongly agree (N=32, 50 %) or agree (N=23, 35.9 %) that learning informatics through English is useful with very few (N=6, 9.4 %) who remained neutral or somewhat disagree (N=3, 4.7 %).

Table 7 Students' attitudes towards informatics being taught through CLIL

STATEMENT	Mean Score
Learning informatics in the L2 is more difficult than in the L1.	3.00
Informatics and English are connected.	4.34
My language abilities have improved after studying informatics in English.	3.23
Informatics is important.	4.13
English is important.	4.86
Learning informatics through English is useful.	4.31

Furthermore, we aimed to determine the teachers' attitudes towards informatics specifically being taught through English. Both teachers agree that informatics and English are connected.

A lot of IT terminology is based in English, more sources are available in English than in Croatian. Programming languages are in English. (Teacher 1)

Informatics is filled with commands which originate in English, programming languages are usually in English as well as the commands it is more natural to learn informatics this way. (Teacher 2)

Through the questionnaire, we also aimed to ascertain which specific skills improved as a result of studying informatics through CLIL. The students were able to select multiple answers or add their own. Only one student added to the selection stating that nothing improved as a result of studying this way. The most significant improvement was noticed regarding subject-specific vocabulary (N=31, 48.4 %) and general vocabulary (N=30, 46.9

%). This is followed by improvements concerning listening comprehension (N=29, 45.3 %), speaking (N=19, 29.7%), writing (N=14, 21.9 %), and reading comprehension (N=12, 18.8 %) (Table 8).

Table 8 Language skills improved after studying through CLIL (according to students)

Skills improved after studying through CLIL	**Number of students (percentage)**
Subject-specific vocabulary	31 (48.4 %)
General vocabulary	30 (46.9 %)
Writing skills	14 (21.9 %)
Reading comprehension	12 (18.8 %)
Listening comprehension	29 (45.3 %)
Speaking skills	19 (29.7 %)
No improvement	1 (1.6 %)

Lastly, the participants were asked about the benefits and challenges of CLIL. The participants were asked to state the biggest challenge they encounter while studying informatics through CLIL. They could choose from the multiple choices or add their own. The majority of students consider learning subject-specific English terminology (N=19, 30.2%) to be their biggest challenge. This number is followed by many who stated that they do not experience challenges (N=11, 17.5 %). Other challenges mentioned were simultaneous learning of content and language (N=9, 14.29 %), communicating in a foreign language (N=8, 12.7 %), lack of appropriate language skills (N=7, 11.1 %), language abilities of the teacher (N=3, 4.8 %), unsuitable learning materials (N=3, 4.8 %), poor knowledge of informatics (N=2, 3.2 %) and writing (N=1, 1.6 %) (Table 9). One participant added that not enough English is used in class. Since this is not a challenge but a statement describing their situation, it will be taken out from the scores.

Table 9 Challenges of studying informatics through CLIL

Challenges of studying informatics through CLIL	Number of students (percentage)
Learning subject-specific terminology	19 (30.2 %)
Simultaneous learning of content and language	9 (14.29 %)
Communicating in a foreign language	8 (12.7 %)
Lack of appropriate language skills	7 (11.1 %)
Language abilities of the teacher	3 (4.8 %)
Poor knowledge of informatics	2 (3.2 %)
Unsuitable learning materials	3 (4.8 %)
Writing in English	1 (1.6 %)
No challenges	11 (17.5 %)

Aside from the challenges, we also wanted to examine the benefits of implementing this program for the students. Out of all of the participants, one person (1.6 %) stated that there are no benefits of this program. However, the majority (N=63, 98.4 %) of participants did find some positive aspects of studying this way so we have the following results. The majority (N=20, 31.3 %) stated that English terminology is better known than Croatian. A quarter of participants (N=16, 25 %) recognized improvements in their English skills as a major benefit while some also consider this program as beneficial for further education (N=15, 23.4 %) and think of it as a better way of learning a language (N=12, 18.8 %). No students stated that they notice an increase in motivation to study. The results are presented in Table 10 below.

Table 10 Benefits of studying informatics through CLIL

Benefits of studying informatics through CLIL	Number of students (percentage)
English terminology is better known than Croatian	20 (31.3 %)
Improvement in English language skills	16 (25.0 %)
Beneficial for further education	15 (23.4 %)
A better way of learning a language	12 (18.8 %)
Greater motivation for learning	0 (0.0 %)
None of the above	1 (1.6 %)

When the teachers were asked about the benefits and challenges of this program for the students they noted the improvement of language skills, less stress regarding language learning, and better opportunities for further education.

Students improve their language skills significantly and are not limited to sources only in Croatian which is necessary for further education. Moreover, they have the opportunity to learn things that would not be available in regular classes because of the differences between the two programs… Less stress while speaking in the L2 and its use in general as well as preparing them to continue their studies in English. (Teacher 1)

Improvement in language skills. Better opportunities for further education, prosperity, and widening one's horizons. (Teacher 2)

Regarding the perceived challenges for the students, they mention two; lack of familiarity with the Croatian equivalents and weak language skills. One of the teachers stated that they adapt their teaching to students*'* needs which results in minimal challenges.

We tend to adjust to their needs to the challenges are minimal in comparison to the benefits…Less familiar with the Croatian terminology in comparison to their peers. (Teacher 1)

Lack of appropriate language skills leads to further issues. (Teacher 2)

This study also aimed to examine the teachers' perceptions of the benefits and challenges of teaching informatics through CLIL. When asked about the benefits of teaching informatics, both teachers focused more on the benefits for students and had little to say about benefits for them, aside from considering it as "*an opportunity to improve my language skills*" (Teacher 2) and "*gain new experiences"* (Teacher 1).

As for the challenges the teachers do encounter certain difficulties in their teaching with the majority of them boiling down to CLIL being time-consuming, and them having to devote more attention to preparing classes.

It is extremely difficult to find enough time to prepare everything (I work in two schools and have a lot of different programs – currently nine) taking into consideration everyday obligations. (Teacher 1)

A lot of time is required for lesson planning and studying the terminology…A lot of time is required for creating a database of CLIL materials. Available materials are mostly for

elementary school. It is difficult to cover all of the material laid down by the curriculum. It is necessary to reduce and adapt materials to suit each student. (Teacher 2)

6.3.Assessment and Error Correction and Materials

This study also aimed to examine how students are assessed, which language is predominately used, and to which extent language is corrected in these situations. The participants were asked to answer the following questions in regards to how often they occur in the classroom on a scale from never to always. According to the results, written exams are mostly conducted in English with the largest number of participants (N=19, 29.7 %) stating that they are always conducted in English and only a few (N=12, 18.8 %) stating that this occurs rarely. No one stated that written exams are never in English. However, when asked how often they have written exams in Croatian, 14 participants (21.9 %) stated always and 13 (20.3 %) often. The results are not much different regarding oral examinations. Only one participant (1.6 %) stated that they never have oral exams in English with the majority stating that this occurs often followed by always. Concerning oral examinations in Croatian, the majority (N=21, 32.8 %) stated that they never occur. This is followed by many (N=15, 23.4 %) who stated that this only rarely occurs. However, quite a significant number of students stated that this occurs often (N=11, 17.2%) and always (N=13, 20.3 %). Looking at the results participant by participant, the majority of those who stated that their examinations are often in Croatian are in the first grade and this is their first year of learning informatics through English which could explain the enhanced need for L1 use. Furthermore, some students stated that they either rarely (N=10, 15.6 %) or never (N=1, 1.6 %) have oral exams in English. All of the results are presented in Table 11 below.

Table 11 Assessment in L1 compared to assessment in L2

	Never	**Rarely**	**Sometimes**	**Often**	**Always**
Written exams in English	0 (0.0 %)	12 (18.8%)	18 (28.1%)	15 (23.4 %)	**19 (29.7 %)**
Written exams in Croatian	**16 (25.0%)**	13 (20.3 %)	8 (12.5 %)	13 (20.3 %)	14 (21.9 %)
Oral exams in English	1 (1.6 %)	10 (15.6 %)	14 (21.9 %)	**20 (31.3 %)**	19 (29.7 %)
Oral exams in Croatian	**21 (32.8 %)**	15 (23.4 %)	4 (6.3 %)	11 (17.2 %)	13 (20.3 %)

Furthermore, we aimed to examine whether language errors are corrected in class as well as what is assessed, only content, or both language and content assessed as well. According to the results, language mistakes are rarely (N=20, 31.3 %) or never (N=15, 23.4 %) corrected. These numbers are followed by many (N=14, 21.9) stating that language is only sometimes corrected with few stating that this happens often (N=9, 14.1 %) and always (N=6, 9.4 %). However, when it comes to grading, the vast majority of participants (N=39, 60.9 %) stated that only content knowledge is graded. This number is followed by some (N=22, 34.4 %) stating that both are graded and even two participants (3.2 %) stating that only their language knowledge is graded. One participant (1.6 %) added that both are graded with greater importance placed on content knowledge.

The teachers were very divided when asked whether they correct language mistakes with one stating strictly yes and one stating strictly no. However, they both try to include language aspects in their teaching. Both teachers stated that they conduct assessments mostly in English. The assessment is conducted without the help of a language teacher.

I sometimes consult with a language teacher on which aspects of language to teach... I try to correct language mistakes… Assessment is conducted only by subject teachers. (Teacher 1)

I try to include language aspects but I do not correct language mistakes. (Teacher 2)

Moving on, the students were also asked about the types of materials they most often use in class. According to the results, both English and Croatian materials are used in the classroom. Regarding English learning materials, the majority of participants (N=25, 37.5 %)

stated that they often use them, followed by many (N=20, 31.3 %) stating that they sometimes use them and some (N=17, 26.6 %) who always use them. On the other hand, the majority of participants (N=22, 34.4 %) also stated that they often use Croatian learning materials. This is followed by many (N=14, 21.9 %) stating that they rarely use them and sometimes (N=13, 20.3 %) use them. Some participants (N=11, 17.2 %) also stated that they always use learning materials in Croatian and a few (N=4, 6.3 %) even stated that they never use them.

According to the teachers, learning outcomes are set in Croatian according to the National Curriculum. Their teaching follows the topics prescribed by the curriculum and they use a Croatian textbook as a base for their teaching.

I use Croatian textbooks set as a guide by the National Curriculum which realizes learning outcomes. (Teacher 1)

I use Croatian textbooks. (Teacher 2)

They prepare their own materials with the help of the Internet and thorough research. They noted that there are limited resources online but mentioned Cambridge's School Support Hub (Teacher 2) and Khan Academy (Teacher 1). They use an abundance of online tools such as Trinket, Quizziz, Socrative, Mentimeter, and Kahoot.

There aren't a lot of materials available, but you can find something. I really like Khan Academy… I use Trinket, Kahoot, Socrative, Quizziz, Mentimeter, and Photoshop… (Teacher 1)

Yes, I find teaching material on the Cambridge School Support Hub… I use a lot of different sites like Kahoot, Mentimeter… (Teacher 2)

6.4.Students' views of the program

Lastly, the students were asked their opinion of this program. Out of 64 students, only three didn't consider learning Informatics through English as somewhat positive. These were their comments translated from Croatian.

It would be better if it was half in Croatian, and half in English. (S44)

Sometimes unnecessary, but alright. (S43)

Not necessary. (S42)

Some participants remained more neutral such as:

Useful, but not that necessary. (S3)

Good and bad. (S11)

It's all the same to me. (S22)

Out of all the participants who consider this program positive and beneficial, several mentioned the obvious connection between informatics and English.

I think it's good to learn informatics in English because of the way the subject is connected to the language and to make further encounters with informatics easier. (S28)

Furthermore, some also noticed that English is the base language of informatics and that many terms are better known in their original form rather than the translated versions.

Considering the fact that a lot of the subject matter is in English, I think this way of learning is very good and effective.. (S53)

I like it because informatics mostly uses English terms so it makes sense that classes are in English. (S27)

I think it is useful because we usually use computers set up in English. (S54)

It's better than learning it in Croatian. (S23)

Some participants also consider this program beneficial as they believe it better prepares them for further education.

I think it is very beneficial and it will help us in our further education. (S45)

I like it and it provides better opportunities for further education. (S21)

I think it is great because we will need it for university. (S29)

Many participants noticed an improvement in their language skills thanks to studying informatics this way.

I think it is very good because it helps us learn English better. (S17)

It helps us improve our English verbal skills and vocabulary. (S2)

I like it because it allows me to improve my English. (S38)

Beneficial for improving language skills. (S20)

Improving verbal skills. (S5)

However, some do argue that there is not enough focus placed on promoting communication skills as well as not enough English used in class.

I think this approach is very beneficial. It is much easier to navigate through the subject and understand it because all of the terms are in fact English. I can see an improvement in my reading comprehension but communication and verbal skills suffer because they are not used enough and often overlooked. It is often assumed that our language abilities are greater than they are and that is why I cont see an improvement but a regression regarding those skills. (S63)

Informatics and English are connected, there is no one without the other. However, I do think that not enough English is used in class. (S10)

6.5. Introducing CLIL and becoming a CLIL teacher

The teachers were also asked their opinion about the process of becoming a CLIL teacher. To become a CLIL teacher, certain steps are necessary. In this section, we will recount the experience of the two CLIL teachers on their process and discuss why their schools introduced CLIL into their programs. Firstly, a minimum of the B2 language level according to the Common European Framework of Reference for Languages (CERF) is needed to teach through CLIL. To ensure they have the proper qualifications to teach informatics through CLIL, the teachers were required to complete the Cambridge B2 level examination. According to Teacher 1, aside from the language examination, CLIL teachers in their school are "*required to complete the Cambridge Teaching Knowledge Test (TKT)"*. According to the Cambridge website, this exam is used to test knowledge in specific areas of English language teaching and upon completion provides a globally recognized certificate in teaching (TKT Teaching Knowledge Test, 2022). Aside from attaining the necessary language certification, CLIL teachers are often required to attend further seminars and courses to better prepare them for this new environment. Regarding further certifications, the situation is a bit different between the two as Teacher 1 was required to complete the TKT and CLIL exam held by Cambridge, while the proficiency test was enough for Teacher 2. Both teachers attend semi-

regular English language courses to "*stay in touch with the language*" (Teacher 1). These occur biweekly that is once a year and are both organized by their respective schools.

Certain skills are also required for being a teacher and this is especially true for becoming a CLIL teacher. When asked which skills are necessary, the teachers stated the following.

Creativity, flexibility, communication skills as well as being prepared for continuous learning and improving acquired knowledge and skills. (Teacher 1)

Knowledge of subject-specific terminology, rich vocabulary, grammar skills, and good pronunciation. (Teacher 2)

As far as their motivation for becoming a CLIL teacher, they have stated new experiences, such as, improving skills, travel, and meeting new people as their biggest motivations.

Regarding the reasons why CLIL was introduced into their school programs, they mentioned CLIL as an easier way of learning a language, which was important for the students who planned on continuing their studies abroad in a foreign language.

We were introduced to CLIL as part of a project we the school collaborated on. We think CLIL allows for a less stressful way of learning a language within a content subject which turned out to be true. We have a lot of students who plan on continuing their education abroad and CLIL helps with that. (Teacher 1)

To make it easier for students who want to go study abroad. (Teacher 2)

6.6. Teacher support for CLIL

For CLIL to be most beneficial, it must be implemented appropriately. For many teachers, this is quite a novelty and they thus require additional support. Usually, teachers have a support network consisting of their school and colleagues and state institutions designed to improve the educational system. CLIL in these stages might still raise a lot of questions about the optimal way to implement this program. In the interviews, both teachers stated that they receive some sort of support for their work. However, all of this support is local meaning that it stems mostly from their schools and colleagues. None mentioned any form of support provided from the Ministry, Teacher Training Agency. When asked about the support they receive, the teachers stated the following.

I receive support from the headmistress and colleagues. (Teacher 1)

I receive support from the headmaster, different advisors, and colleagues who have been teaching my subject in English longer than I have. (Teacher 2)

The interviews also aimed to elicit which types of support the teachers still need and the answers were quite different.

I would benefit from further (paid) training and collaboration with other CLIL teachers. (Teacher 1)

I think my school has provided all the necessary support. (Teacher 2)

Furthermore, the interviewed teachers do not see an immense need for support from language teachers as they stated that they only reach out to them in specific situations.

Only when I have language outcomes in a lesson. (Teacher 1)

Only when I need to write letters of recommendation in English. (Teacher 2)

The teachers were also asked specifically about the role of the Teacher Training Agency. Teacher 2 refused to answer this question, while Teacher 1 stated the following.

Our school is currently in the process of becoming a training school for CLIL. We had a visit with the English adviser from Teacher Training Agency (AZOO).

7. Discussion

This section will feature a discussion of the results with respect to the research questions and available literature. The first research question inquired into the benefits of teaching informatics through CLIL with a particular focus on how students perceived the program. Additional insights on the topic were also provided by the teachers. As already mentioned, CLIL was introduced as a means of improving language skills in Europe, and this is singled out as one of the most significant benefits of introducing the CLIL program (Chen & Kraklow, 2014). The results of this study support the claim that CLIL indeed helps develop the students' language skills with a quarter of participants stating that this is the most significant benefit of their studies. The students noticed improvements in different areas of their language abilities including writing skills, reading comprehension, listening skills, and vocabulary. Improvement of language skills by the students is corroborated by teachers who stated that they notice an improvement in the language skills of their students. Furthermore,

many students also noted that this approach provides a better way of learning a language. Many participants also recognized the role of CLIL as beneficial for their further education which speaks in favor of the importance of English and informatics. The teachers also corroborated these statements.

However, the majority of participants stated that the biggest benefit of studying informatics through CLIL is that computer terminology is already in English, which speaks in favor of informatics being a good choice of subject to be taught in English. This is in accordance with the statement that the English language complements the needs of the subject in question (Kypshakbaeva & Davletova, 2020). However, in spite of the interconnection between English and informatics, few schools offer this. Of all the schools in Croatia which offer CLIL classes, only two offer full-time informatics courses in English with a few schools, as it was mentioned previously, that participated in short-term CLIL projects. This lack of availability of informatics courses in English might require greater attention in the near future.

Furthermore, related to the content, learning a subject through CLIL includes the learning of subject-specific terminology in the L2. Accessing this subject-specific terminology is one of the many benefits of this approach (Lasagabaster & Sierra, 2009) listed previously. This subject-specific language can be described as comprising of two parts; the ability to participate in the subject's communicative practices and the practices linked to acquiring this ability (Hüttner, 2020). The findings of this study suggest that some students face challenges in acquiring these skills as they possess varying language abilities, are not presented with sufficient opportunities for meaningful communication, and are occasionally unfamiliar with the necessary terminology.

Furthermore, many researchers argue that CLIL improves students' communication skills through constant exposure to the language and different activities designed to improve this aspect of language knowledge. In other words, through increased input and output students better develop their language skills. This is since CLIL creates real communicative situations and allows for an improvement in these skills (Lasagabaster & Sierra, 2009). Additionally, the CLIL framework itself emphasizes the importance of communication by promoting interactions among students (Renau & Mart, 2018). However, what was noted in this study is the exact opposite as the results show that students would like to improve their communication skills but are unable to do so because of the lack of L2 used in the classroom.

The frequent use of L1 can be attributed to many different factors ranging from lack of appropriate teacher training or even teachers' weak language skills as they do not seem to be confident in their language teaching abilities or scaffolding practices other than translating. The interviewed teachers mentioned semi-regular seminars but these include learning the language and not learning how to teach the language therefore we might argue that the current practices of CLIL teacher training might need to be revised. Furthermore, communicative activities tend to require more time than if the teacher is doing most of the talking. With limited time available for all teachers, it is excepted that time-consuming activities take a back seat.

Something that was also noted by both students and teachers is the fact that CLIL classes better prepare students for further education. The findings showed that both students and teachers were quite adamant about their confidence that the program will allow students to better navigate their university education as the majority wish to continue their studies abroad which is in agreement with previous research (Goris, Denessen, & Verhoeven, 2019).

Some studies also noted that CLIL students tend to show an increased motivation to study and participate in class as well as a reduction of stress (Heras & Lasagabaster, 2015). However, the findings in this study did not show that students in CLIL classes are more motivated to study and participate in lessons, but the teachers noted a lessening of stress in the CLIL classroom. In addition, CLIL is usually associated with an increase in intercultural competence; however, whether this is true was difficult to ascertain from the results as there seems to be little else in focus aside from the content. This brings us to the topic of the difficulty of achieving a balance within the program. The CLIL framework suggests that CLIL lessons ought to include different aspects aside from language and content. Although the teachers claim to be well versed in the methodology, there seems to be a lack of integration between language and content, which is in agreement with previous research on the possible difficulties of the approach (Mehisto, 2008; Perez-Vidal & Juan-Garau, 2010).

Regarding the challenges of the CLIL program, the results vary substantially. This could be the result of the different language abilities of the students as well as their different educational backgrounds. When discussing certain benefits, it was made clear that a significant number of students consider the fact that English terminology is better known than Croatian concerning informatics. However, the majority of students listed learning subject-specific vocabulary as the biggest challenge followed by many stating that they consider the

simultaneous learning of content and language as the biggest obstacle while some consider this as pretty straightforward and reasonable. These results show that there are significant differences between students and that they react to the same program differently. Based on this we might argue that the program is not well suited for everyone. As was mentioned previously, the teachers noted that there are preliminary measures taken before enrolling students into the program in form of interviews and entrance exams, however, these might need to be revised as there are still vast differences regarding the language abilities of students. We could argue that these differences in prior knowledge and abilities serve as the biggest challenge as they do not allow for an optimal learning environment because many participants stated that they do not find anything as a challenge in the program. Furthermore, it was noted by the teachers that the necessary level of English for teaching CLIL is B2 which is accidentally the same level as the exit exam from secondary school. Arising from this is the possibility that at some point in their education, teachers and students are on the same level of English. Even though the students rated the language abilities of their teacher rather high, it is evident that some issues still exist. This study shows agreement with others arguing that prior language abilities of students and language abilities of teachers are challenges of the CLIL program (Nikula, 2017).

Nevertheless, when asked about the differences in their knowledge of the content subject, the data collected showed an overall increase in the perceived level of knowledge after being introduced to CLIL. Even though a large number of students consider learning through CLIL more challenging than learning in the L1, they seem to overcome those challenges and improve their overall knowledge of content and language skills.

However, according to the results from both teachers and students, this study also seems to confirm issues regarding combining the content and language aspects of CLIL (Perez-Vidal & Juan-Garau, 2010). The results show significant reliance on translation and the use of the L1 in the classroom with little mention of other scaffolding options. Teachers are also reluctant to include the language aspect in their classroom, and rarely correct language errors or consider language learning outcomes. They seem to be teaching informatics in English rather than through English which suggests that there is no true integration of the content and language, most likely due to the fact that they do not have a language background. Furthermore, regarding language learning outcomes, it was mentioned previously that designing them can be more difficult than designing content outcomes (Beacher et al. 2013).

This is evident in the reluctance of the interviewed teachers to include language outcomes in their teaching.

Furthermore, this study is in agreement with the results presented in previous research showing that some of the biggest challenges of CLIL include the time required for preparing lessons, lack of suitable teaching materials (Met, 1994), and lack of supervision (Mehisto, 2008). Regarding the lack of suitable teaching materials, it was shown in the results that teachers are required to prepare their materials which is difficult and time-consuming. Even if there are suitable teaching materials, they are not readily available to the teachers so they have to design their own or use online materials that happen to be in English. Designing and adapting teaching materials is a discipline of its own and relying on teachers to take over this workload is an immense obstacle to the CLIL approach, which needs urgent attention.

Furthermore, the CLIL approach is not contained within the curriculum the teachers are obligated to adhere to which poses additional issues. CLIL lesson plans should include both language and content outcomes which we have seen is not the case here. Content teachers do not feel comfortable including language outcomes in their lessons and thus focus only on what they know. However, this does not seem to be in line with the CLIL approach. This study speaks in favor of previous research describing the issues regarding lack of consistency (Mehisto, 2008). The results from this study showed a significant lack of consistency in the answers regarding the use of L2 in assessment. This might stem from the fact that the teachers are required to use Croatian textbooks and address Croatian learning outcomes while teaching and assessing in English and preparing the students for the Matura exam in Croatian. These findings also support the previously mentioned issues regarding the arrangement of such exams (Serragiotto, 2007).

This study is also in agreement with research stating the lack of teacher training is an issue appertaining to the CLIL approach (Eurydice, 2006). As was stated in the results, the teachers did receive certain training specifically related to the language and continue to do so on a semi-regular basis. Despite the training, they show reluctance to include language in their teaching. Furthermore, the majority of the support and training comes from the schools and language teachers with little mention of CLIL-specific training. Moreover, the teachers have stated that they have received guidelines on how to implement the method from their school and other colleagues with no mention of supervising institutions and CLIL specialists. This also confirms the statements made in research referring to CLIL teachers learning while

on the job (Housen, 2002). The role of the Teacher Training Agency remains unknown as well as the extent to which CLIL training is available to the teachers?

According to the Teacher Training Agency's website, its mission is to create a new culture of education through continuous support and improvement of the quality of the educational process by applying the best Croatian, European, and world educational practices (Agencija za odgoj i obrazovanje, n.d.). However, this does not seem to include supporting the implementation of CLIL programs as they do not offer continuous support for schools providing programs in CLIL. According to sources available online, the last seminar concerning CLIL was organized in 2010 by the Agency and the University of Cambridge in which they referenced the work of Mehisto, Marsh and Frigols from 2008.

This brings us to the discussion of a different research question that guided this study and is regarding the measure that could be taken to improve the quality of teaching informatics through CLIL. Based on the gathered results, it might be beneficial to include or revise preliminary entrance exams to better determine the students' language abilities and thus organize the classes accordingly. Despite the many benefits of the approach, a student whose language abilities hinder them from participating in lessons will less likely reap these benefits. Moreover, both teachers and students might benefit from clear guidelines which would provide a less stressful and hectic work environment. Following that, teachers' workload might lessen if they were to receive help in designing teaching materials in addition to receiving some already prepared materials. Finally, a restructuring of priorities in the lessons might benefit students. Something that was noted throughout the results was the lack of communication and insignificant use of the L2 in the classroom. An abundance of research (Klimova, 2012; Lasagabaster, 2011) speaks in favor of promoting L2 communication skills either in regular language classes or through CLIL but this aspect seems to be lacking in the case of our participants. Although both teachers and students agree that there is an improvement in their language skills; however, the limitations of this approach were noted specifically by students dissatisfied with the amount of L2 used.

8. Limitations and implications

The most significant limitations of this study stem from the number and sample of participants. Due to the specific topic, the number of participants was very limited. Firstly, there are only a few schools in Croatia that offer CLIL classes out of which even fewer offer informatics classes in English. Consequently, the number of teachers available for the study is also very limited. In the end, only two schools agreed to participate, however, one does not currently offer informatics classes in English, therefore all of the student participants are from one school. To get more reliable data, it would be beneficial to include a wider range of teachers and students to examine certain aspects across the spectrum. It might also be useful to conduct similar research using different methods, such as classroom observation, in addition to the ones used in this study.

Furthermore, there is not a lot of research available on informatics and CLIL specifically which results in few reference points for the study at hand. A significant portion of the literature available at this point is regarding teaching technological subjects through languages other than English, such as Russian (Danilov, Salekhova, & Yakaeva, 2018; Danilov A. , Salekhova, Zaripova, & Grigorieva, 2022), which is not directly relevant for this specific study.

This study aims to fill the gap in the field and its significance lies in the first-hand recollections of the experience of learning and teaching through CLIL. However, as was mentioned already, the sample size of participants is quite limited and it might be beneficial to revisit this research with a wider scope and perhaps at a later time when more schools have had the opportunity to include informatics into their CLIL programs. Additionally, it might prove useful to conduct a comparative study to determine the efficacy of the program in comparison to perhaps language classes or content subjects in the L1.

This study also contains pedagogical implications for schools implementing or considering the implementation of CLIL and proposes measures for a more successful implementation of CLIL in the teaching of informatics based on the findings and propositions by both students and teachers. These findings might also prove useful in the implementation of CLIL in other subjects.

9. Conclusion

Taking into account all that was gathered throughout this work, there seems to be an overall positive attitude towards teaching and learning informatics through English. Both teachers and students recognize that informatics is based on English and agree on the benefits of learning content in its original form. Both parties in the majority also continue to list their perceived benefits of the program which are for the most part in line with previous research conducted on the benefits of CLIL.

However, despite everyone's best efforts, significant obstacles arise with the implementation of the program. These obstacles most considerably affect those immediately involved in the process. This work offers some suggestions on how to possibly improve the quality of teaching informatics through CLIL. These suggestions can be summarized in terms of providing more support for teachers, providing clear guidelines on the implementation of CLIL on a national level, and improving the quality of teacher training in regards to the CLIL methodology. Once teachers have received the necessary assistance, they will be much better prepared to guide the students through the program while providing the necessary scaffolding and adhering to their specific needs.

Nevertheless, there is no one prescription for the successful implementation of the program. Mostly it will come down to research, hard work, and trial and error. However, as long as everyone involved possesses the motivation and willingness to put in the effort, the benefits of implementing CLIL in general but more specifically in the teaching of informatics will by far outshine any challenges.

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Appendix

Stavovi učenika o pohađanju informatike na engleskom jeziku

Dragi učenici,

zahvaljujem što ste pristali sudjelovati u istraživanju kojeg provodim u sklopu izrade diplomskog rada na temu podučavanja informatike na engleskom jeziku.

Cilj je ispitivanja je utvrditi stavove učenika o slušanju nastave informatike na engleskom jeziku.

Sve su informacije dobivene ovim upitnikom povjerljive i koristit će se isključivo u ovom istraživanju i neće se analizirati odgovori svakoga pojedinačnog učenika.

Ovdje nema točnih i pogrešnih odgovora. Zanima me Tvoje mišljenje.

Opće informacije

1. Dob
2. Spol
    a. muški
    b. ženski
    c. ne želim se izjasniti
3. Razred
    a. 1. razred
    b. 2. razred
    c. 3. razred
    d. 4. razred
4. Škola

Jezik

5. Ocjeni svoje znanje engleskog jezika od 1 do 5 gdje je 1 vrlo slabo, a 5 izvrsno.

1 2 3 4 5

6. Koliko ti je zahjtevno pratiti nastavu informatike na engleskom jeziku od 1 vrlo zahtjevno do 5 vrlo jednostavno.

1 2 3 4 5

7. Možeš li u potpunosti pratiti nastavu na engleskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
8. Koliko često koristiš engleski jezik u govoru na nastavi?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
9. Koliko često koristiš hrvatski jezik u govoru na nastavi?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
10. Koliko često koristiš engleski jezik u pisanju na nastavi?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
11. Koliko često koristiš hrvatski jezik u pisanju na nastavi?
    a. nikad
    b. ponekad
    c. rijetko
    d. često

e. uvijek

12. Nastavnik najčešće koristi krvatski jezik na nastavi za
    a. objašnjavanje novih pojmova
    b. usmeno ispitivanje
    c. pisana provjer znanja
    d. objašnjavanje zadataka
    e. korištenje materijala za učenje
    f. ostalo:_____
13. Radije koristiš hrvatski za
    a. postavljanje pitanja
    b. grupni rad
    c. usmena izlaganje
    d. rješavanje zadataka
    e. ostalo:_____

Informatika i engleski jezik

14. Koliko godina već učiš informatiku?
15. Koliko godina već učiš informatiku na engleskom jeziku?
16. Ocjeni svoje znanje informatike prije početka učenja na engleskom jeziku na skali od 1 do 5 gdje je 1 vrlo slabo, a 5 izvrsno.

    1 2 3 4 5

17. Ocjeni svoje znanje informatike sada na skali od 1 do 5 gdje je 1 vrlo slabo, a 5 izvrsno.

    1 2 3 4 5

18. Učenje informatike na engleskom jeziku je zahtjevnije od učenja na hrvatskom jeziku.

    Uopće se ne slažem 1 2 3 4 5 U potpunosti se slažem

19. Informatika i engleski jezik su povezani.

    Uopće se ne slažem 1 2 3 4 5 U potpunosti se slažem

20. Poznavanje informatike je bitno.

    Uopće se ne slažem 1 2 3 4 5 U potpunosti se slažem

21. Poznavanje engleskog jezika je bitno.

    Uopće se ne slažem 1 2 3 4 5 U potpunosti se slažem

22. Korisno je imati nastavu informatike na engleskom jeziku.

Uopće se ne slažem 1 2 3 4 5 U potpunosti se slažem

23. Moje poznavanje engleskog jezika se poboljšalo nakon slušanja nastave informatike na engleskom jeziku.

    Uopće se ne slažem 1 2 3 4 5 U potpunosti se slažem

24. Nastava na engleskom mi je pomogla da razvijem (možeš označiti više odgovora)
    a. vještinu pisanja
    b. stručni informatički vokabular
    c. opći vokabular
    d. čitanje s razumijevanjem
    e. slušanje s razumijevanjem
    f. govorenje
    g. ostalo: _____

25. Ocjeni razinu poznavanje engleskog jezika svog nastavnika na skali od 1 do 5 gdje je 1 vrlo slabo, a 5 izvrsno.

    1 2 3 4 5

26. Što ti je najveći izazov u pohađanju nastave iz informatike na engleskom jeziku?
    a. nedovoljno poznavanje jezika
    b. istovremeno učenje jezika i nastavnih sadržaja
    c. jezična razina nastavnika
    d. neodgovarajući materijali za učenje
    e. komunikacija na engleskom jeziku
    f. učenje engleskih naziva pojmova iz informatike
    g. ostalo: _____

27. Koje su najveće prednosti pohađanja nastave informatike na engleskom jeziku?
    a. engleski nazivi pojmova su bolje poznati od hrvatski
    b. dodatno poboljšanje mojeg znanja engleskog jezika
    c. bolje mogućnosti za kasnije oprazovanje (npr. upis na željeni studij u inozemstvu)
    d. bolji način učenja jezika
    e. veća motivacija za učenjem
    f. ostalo:_____

Provjere znanja

28. Koliko često imate pisane provjere na engleskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
29. Koliko često imate pisane provjere na hrvatskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
30. Koliko često imate usmene provjere na engleskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
31. Koliko često imate usmene provjere na hrvatskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
32. Koliko često koristite nastavne materijale na engleskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek
33. Koliko često koristite nastavne materijale na hrvatskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko

d. često
e. uvijek

34. Koliko često ti nastavnik ispravlja pogreške koje napraviš na engleskom jeziku?
    a. nikad
    b. ponekad
    c. rijetko
    d. često
    e. uvijek

35. Ocjenjuje li se tvoje znanje engleskog jezika ili samo gradiva informatike?
    a. ocjenjuje se samo gradivo informatike
    b. ocjenjuje se samo znanje engleskog jezika
    c. ocjenjuje se oboje
    d. ostalo:_____

36. Koje je tvoje mišljenje o učenju informatike na engleskom jeziku?

_____

_____

Pisani intervju

Svrha ovog pismenog intervjua je utvrđivanje stavova nastavnika o provođenju nastave iz informatike na engleskom jeziku. Podaci se prikupljaju isključivo u svrhu pisanja diplomsog rada na temu podučavanja informatike na engleskom jeziku po metodologiji CLIL. Pri obradi podataka bit će osigurana anonimnost ispitanika.

Hvala Vam što ste pristali sudjelovati.

Opće informacije

1. U kojoj školi predajete?
2. U kojim razredima predajete?
3. Koje predmete predajete?
4. Koje predmete predajete na englesom jeziku?
5. Koja je Vaša razina poznavanja engleskog jezika?
6. Zašto je Vaša škola uvela dvojezičnu nastavu?
7. Kako je informatika odabrana kao predmet koji će se podučavati na engleskom jeziku?
8. Koje su po Vašem mišljenju prednosti i nedostaci uvođenja dvojezične nastave?

Nastavnici

9. Jeste li htjeli podučavati informatiku na engleskom jeziku? Zašto?
10. Koje su vještine potrebne za podučavanje informatike na engleskom jeziku?
11. Koju vrstu obuke prolaze nastavnici da bi mogli predavati informatiku na engleskom jeziku?
12. Traži li se od Vas da redovito pohađate edukacije kako biste unaprijedili svoje znanje o ovoj metodi?
13. Koliko često?
14. Tko organizira takve događaje?
15. Koje su prednosti pohađanja ovih edukacija?
16. Koja je potrebna razina poznavanja engleskog jezika za provođenje dvojezične nastave?
17. Koja je testiranja potrebno položiti za podučavanje informatike na engleskom jeziku?

Jezik

18. Koliko često koristite hrvatski jezik u nastavi?
19. Kada najčešće koristite hrvatski jezik u nastavi?
20. Koliko često učenici koriste hrvatski jezik?
21. Podučavate li učenike i jezičnim pravilima ili samo sadržajem?
22. Kako odabirete koje aspekte jezika podučavati?
23. Ispravljate li jezične pogreške u govoru?
24. Ispravljate li jezične pogreške u pismu?

Podučavanje informatike na engleskom jeziku

25. Koji su izazovi kod poučavanja informatike na engleskom jeziku?
26. Koje su prednosti podučavanja informatike na engleskom jeziku?
27. Što čini informatiku dobrim predmetom za dvojezičnu nastavu?
28. Kako su informatika i engleski jezik povezani?

Potpora

29. Dobivate li potrebnu potporu od svoje škole za provođenje nastave na engleskom jeziku?
30. Koja vrsta potpore Vam je potrebna?
31. Je li Vam potrebna potpora nastavnika engleskog jezika? Kada?
32. Jeste li dobili smjernice o tome kako implementirati ovu metodu. Ako da, od koga?
33. Kakvu ulogu imaju Ministarstvo znanosti i obrazovanja te AZOO u provođenju dvojezične nastave?
34. Imate li podršku roditelja za provođenje dvojezične nastave?

Materijali, priprema i kurikulum

35. Koje udžbenike koristite u nastavi?
36. Tko priprema materijale koje koristite na nastavi?
37. Postoje li gotovi materijali koje možete koristiti? Gdje ih nalazite?
38. Koliko je zahtjevna priprema vlstitih nastavnih materijala za nastavu na engleskom jeziku?
39. Pomaže li Vam tko u pripremi materijala za nastavu? Tko?
40. Koristite li online alate u nastavi?
41. Koje online alate najviše koristite?
42. Kako pripremate učenike za državnu maturu?

Provjere znanja

43. Ispravljate li jezične pogreške?
44. Provodite li provjere znanja samostalno ili uz pomoć nastavnika engleskog jezika?
45. Na kojem jeziku su pisane provjere znanja?
46. Kako postavljate ishode učenja?
47. Kako se ishodi učenja ostvaruju?
48. Kako postupate u situacijama kada učenik zna informatiku, ali ne zna dovoljno dobro engleski?

Učenici

49. Koji je kriterij za učenike za pohađanje dvojezične nastave?
50. Koje su prednosti nastave informatike na engleskom jeziku za učenike?
51. Koje su otežavajuće oklnosti za učenike kod učenja informatike na engleskom jeziku?
52. Primjećujete li poboljšanje jezičnih vještina učenika?
53. Primjećujete li napredak u poznavanju sadržja kod učenika?