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Friulian CLIL methodology
A case study

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Abstract. The use of an additional language in teaching and learning school subjects at "Arturo Malignani" ITI (a Technical Upper Secondary School in Udine), begun in the 1990s, was a pioneering experience in Italy. The vehicular language used was English, which paved the way for the first CLIL (Content and Language Integrated Learning) methodology lessons.
The use of Friulian as a vehicular language in CLIL lessons began at "Malignani" ITI at the start of the current century, in a cultural environment that accepted the learning of school subjects through the medium of a language other than the one normally used in the classroom. The use of Friulian, a regional minority language, in CLIL was possible thanks to the recognition of Friulian as a language of instruction within a context of plurilingual education and communication as outlined by 482/99 national law. The first Friulian CLIL experiment, conducted during the 2005/06 school year, was promoted by the IRRSAE of FVG and involved "Malignani" ITI teachers of different school subjects. In these experiences, the main innovations were, on the one hand, the tutorial use of English, on the other hand, the production of bilingual modules on subjects not strictly part of the school curriculum but with certain areas of convergence. The second phase was more methodologically structured: a team of teachers was initially involved in training sessions organised by a Ca' Foscari University Research Group; subsequently, as the experiment unfolded step by step, it was monitored thanks to the predisposition of a web platform. In order to attribute authenticity to the classroom experiences, subjects were introduced from buildings in which people lived or worked, such as houses, laboratories and farms. The main topics were: a) the production of electric energy from renewable sources, b) electric safety apparatus, and c) speed control in electric motors.

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Key words. Friulian CLIL, linguistic micro code switching; mother tongue, real life environment, history and language variety of Friuli, symbolic value, cognitive development.

1. Introduction. The use of an additional language in teaching and learning school subjects at "Arturo Malignani" ITI[1], begun in the 1990s, was a pioneering experience in Italy. The vehicular language used was English, which paved the way for the first CLIL (Content and Language Integrated Learning) methodology lessons.

The use of Friulian as a vehicular language in CLIL lessons began at "Malignani" ITI at the start of the current century, in a cultural environment that accepted the learning of school subjects through the medium of a language other than the one normally used in the classroom. The use of Friulian, a regional minority language, in CLIL was possible thanks to the recognition of Friulian as a language of instruction within a context of plurilingual education and communication as outlined by 482/99 national law.

The first Friulian CLIL "shocking" experiment, conducted during the 2005/06 school year, was promoted by the IRRSAE[2] of Friuli Venezia Giulia and involved "Malignani" ITI teachers of different school subjects. In these experiences, the main innovations were, on the one hand, the tutorial use of English, on the other hand, the production of bilingual modules on subjects not strictly part of the school curriculum but with certain areas of convergence.

The second phase was more methodologically structured: a team of teachers was initially involved in training sessions organised by a Ca' Foscari University Research Group; subsequently, as the experiment unfolded step by step, it was monitored thanks to the predisposition of a web platform. During the second CLIL phase, I followed the guidelines of the previous IRRSAE experience in my classes, but with a more formal approach based on an increasing awareness of some notable operational factors that deserve to be highlighted. At the beginning, I adopted a gentle approach in the first term lessons, using a "micro switching linguistic code" method (Italian to Friulian accompanied by English). The students were immersed, in a sense, in an environment aimed at building their confidence in hearing multiple languages and this, progressively, increased their acceptance of learning the discipline's content through more than one language. Following their familiarisation with this sort of "linguistic entertainment", the students

[1] "Arturo Malignani" ITI (now, ISIS) is a Technical Upper Secondary School based in Udine.

[2] IRRSAE stands for Istituto Regionale di Ricerca, Sperimentazione e Aggiornamento Educativi (Regional Institute for Educational Research, Experimentation and Professional Development), later called IRRE

were informed that both the Teachers Board and the Parent-Teacher-Student School Council had approved a Friulian CLIL experimental project.

In order to attribute authenticity to the classroom experiences, subjects were introduced from buildings in which people lived or worked, such as houses, laboratories and farms. The main topics were: a) the production of electric energy from renewable sources, b) electric safety apparatus, and c) speed control in electric motors.

The fact that most of the students in my classes were bilingual helped a lot: in fact, the majority of my students were Friulian speakers. This is a very important cultural environmental condition for accepting the use as a medium of instruction of a language without any apparent practical use. Friulian just provides a better knowledge of the history and linguistic variety of Friuli (Friulian is the most spoken language in the FVG Region); moreover, CLIL promotes the symbolic value of languages and boosts flexibility and cognitive development. The latter two are important factors that have been studied in-depth by scholars.

Two milestones have characterised the Friulian CLIL project: at the beginning of the experiment, an input questionnaire – prepared by a Ca' Foscari research team – was distributed to students to glean some statistically useful data regarding students' linguistic backgrounds. At the end of the experiment, an output questionnaire – focussed on subject content – was distributed for an assessment of learner outcomes.

The best outcomes (focused on both the content and language) were achieved in the classes I followed constantly, from the third to the fifth year of school. As a matter of fact, in the last year of my disciplinary course, I was able to hold complete lessons in Friulian and, with much satisfaction, some of the students voluntarily asked to give their final speech in Friulian.

2. A brief history of the introduction of CLIL in a Technical Upper Secondary School in Udine Province. The CLIL methodology was introduced in Italy in 2003 by way of a reform law. It upheld the European directives that recommend a national language education policy within the larger European plurilingual education discourse. According to the 1995 European Council Resolution, students of European Union Member States should have, as a general rule, the opportunity to learn two EU (European Union) languages other than their mother tongue(s) or regional language. A way to put the EU directives into practice was through the CLIL method, which is a modern approach to intertwining language with content.

Before CLIL became synonymous with vehicular use of a language in teaching and learning, in which both content and language are interwoven, "Arturo Malignani" ITI[3] promoted

[3] ITI (Istituto Tecnico Industriale, literally Industrial Technical Institute) "Arturo Malignani" later became ISIS (Istituto Statale di Istruzione Superiore, literally State Upper Education Institute "Arturo Malignani".

the vehicular use of a foreign language in a disciplinary context in the frame of the European Petra project. It started in the 1992/93 school year, with an experimental Electrotechnics and Automation Electric Systems teaching syllabus in English[4]. Subsequently, in the 1999/2000 school year, the CLIC/CLIL (Content and Language Integrated Classrooms/ Learning) network was promoted by "Malignani" ITI, in collaboration with five local schools. The additional language was English, a foreign language adopted in all Upper Secondary School curricula.

The first experiments in applying the CLIL methodology to Friulian began in 2005, and this method was promoted by the IRSSAE of Friuli Venezia Giulia with the support of Ca' Foscari University. In the first experimentation phase, Liceo scientifico "Niccolò Copernico"[5], "Arturo Malignani" ITI were involved. Subsequently, this methodology was extended to other schools teaching a variety of subjects like Mechanics, Electrotechnics, History, Italian literature and even German!

In 2009, the President of Udine Province financed a more extensive experimental project that remained active until 2012. This project involved teachers at ITI "Arturo Malignani" (Udine), Liceo scientifico "Giovanni Marinelli" (Udine), Liceo classico "Jacopo Stellini" (Udine), ITI "Fermo Solari" (Tolmezzo), IPSIA "Antonio Mattioni" (Cividale), Liceo scientifico "Luigi Magrini" (Gemona). In the final year of the experimentation, teachers at Liceo pedagogico e linguistico "Caterina Percoto" (Udine) and ITC "Giuseppe Marchetti" (Gemona) joined the project[6].

In 2014 a CLIL project called "*La Lavagne Plurilengâl* / Plurilingual Blackboard", involving a team of teachers with previous Friulian CLIL teaching experience, was financed by ARLEF[7].

The aim of this last phase was to demonstrate the communicational strength of the Friulian language even outside the school environment.

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[4] The European PETRA project aimed to put in communication students of European Upper School classes participating in the project (for further information, see http://www2.malignani.ud.it/clil/clil.html).

[5] Liceo scientifico "Niccolò Copernico" is a Scientific Studies Upper Secondary School based in Udine.

[6] As said before, ITI (now, ISIS) "Arturo Malignani" is a Technical Upper Secondary School based in Udine. Liceo scientifico "Giovanni Marinelli" is a Scientific Studies Upper Secondary School; Liceo classico "Jacopo Stellini" is a Classical Studies Upper Secondary School; ITI (now ISIS) "Fermo Solari" is a Technical Upper Secondary School; IPSIA "Antonio Mattioni" is an Industry and Handcraft Vocational Upper Secondary School; Liceo scientifico "Luigi Magrini" is a Scientific Studies Upper Secondary School; Liceo pedagogico e linguistico "Caterina Perconto" is a Pedagogical and Linguistic Studies Upper Secondary School; ITC "Giuseppe Marchetti" is a Technical-Commercial Upper Secondary School.

[7] ARLeF stands for *Agenzie Regjonâl pe Lenghe Furlane* (Regjonal Agency for the Friulian Language). ARLeF "is a public body of the Autonomous Region of Friuli Venezia Giulia that coordinates activities involving the safeguarding and promotion of the Friulian language in accordance with Regional policy" (for further information, see: https://arlef.it/en/agency/about-us/).

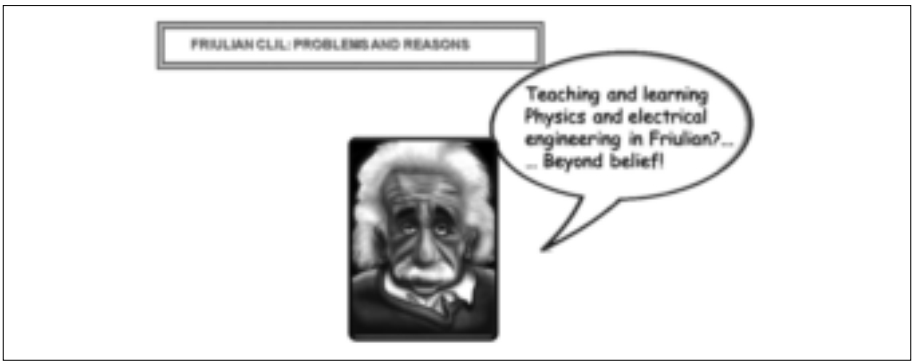

Figure 1. In CLIL methodology experiences any language can be used as a medium of instruction.

3. Policies to support the conservation of minority languages in Europe and in Italy. Around the 1990s, the European Council voted in favour of linguistic diversity[8]. This principle is also enshrined in the EU Charter and in the Treaty on European Union. At the same time, following the fall of the Berlin Wall, a driving force of globalisation boosted new challenges for language learning education as a whole. As a matter of fact, until the educational linguistic approach of the '90s, English was the sole language promoted as "lingua franca".

The CLIL methodology contributes to overcoming the common use of a single language for disciplinary contents: that is, German in precedence to English or French in Europe; and, in the future, Arabic or Chinese – or any other language elected by a Political Board as "lingua franca" – in precedence to English on a global level. CLIL, in contrast, promotes the intertwined use of any additional languages embedded in the socio-economic, political and cultural traditions of different nations and regions, with any disciplinary contents (Fig. 1).

This is a challenge for teachers of various disciplines, requiring them to change their current mindsets grounded in Physics, Chemistry, Literature, and so on, in order to build integrated language and contents modules. By the way, the contemporary use of more than one language to teach contents is an effort that will be rewarded – as I personally observed – as it stimulates cognitive flexibility and is consistent

[8] A Framework Convention for the Protection of National Minorities was subscribed in 1995 (Council of Europe Treaty Series, 157). The EU has 24 official languages: Bulgarian, Croatia, Czech, Danish, Dutch, English, Estonian, Finnish, French, German, Greek, Hungarian, Irish, Italian, Latvian, Lithuanian, Maltese, Polish, Portuguese, Romanian, Slovak, Slovenian, Spanish, and Swedish. The working/procedural languages of the European Commission are English, French, and German; the European Parliament accepts all official languages as working languages.

with the generation C and the millennial generation born between 1990 and 2015, in the digital technology era. The digital apprenticeship of this latest historical period produces permanent maps of abilities in the brains of young people, which prepare the new generations to practice the "learning by doing" method, similar to the CLIL methodology.

4. Some considerations regarding factors that negatively and positively influence minority CLIL languages and Friulian CLIL. In general terms, Friulian CLIL comes from the acronym MLAC (Modern /Minority Language Across Curriculum – which accords full dignity to all languages and is suitable for introducing minority languages (regional or cultural heritage) into a school curriculum. The inclusion of a regional language in CLIL is very well suited to Italy and to Friuli, that, due to its linguistic richness, that is still not adequately recognised in Italy, can be considered a mini Europe from a linguistic point of view.

Generally speaking, a minority language moves from being the colloquial language of affection spoken in the family, to workplaces where manual labour prevails (agriculture, industry, crafts), or into small businesses and areas of intermediation. Only occasionally is it used as a high-level means of communication, such as in a Public Administrative Councils, a legal studio or a business consultancy. In order to promote the high-level, formal use of a minority language, it needs to become a language of instruction with a rich literary production.

In other words, Friulian may only acquire prestige and a place in high-level communication if it becomes an effective means of communication in different subjects, particularly in the technological and scientific fields. In these latter fields, especially, we find a significant lack of Friulian terms. Friulian is a Romantic language, which developed predominantly during the centuries of Longobard domination over a vast area that, in addition to the current Friuli region, included the Cadore (currently in the Province of Belluno), the territory of Portogruaro up to the Livenza river (currently incorporated in the metropolitan area of Venice), and a large part of Istria that today includes Trieste and Muggia in Italy as well as a number of cities and villages in Slovenia and in Croatia. The language's lexicon and phonetics developed within an agricultural and artisanal economic context. The main Friulian dictionaries date back to the pre-technological era and, therefore, lack lemmas referring to science and technology.

In the large FVG Region, particularly Udine Province, people speak the so-called *marilenghe* (mother tongue), one of the minority languages recognised by the Italian state[9].

[9] The national law 482/99 recognized as minority languages spoken in Italy the following languages: Albanian, Catalan, German, Greek, Slovenian, Croatian, French, Provençal, Friulian, Ladin, Occitan and Sardinian.

Before any other consideration, a judgment on the status of the Friulian language cannot fail to recognise that Friulian is a grammatically and phonetically well-characterised language, with a rich literary and artistic heritage; moreover, a significant quota of Friulians consider it the strongest marker of Friulian identity.

Nevertheless, Friulian is currently at risk of extinction due to pressure from the more dominant Italian and English languages, the latter being the 'lingua franca' of globalisation.

What follows is an analysis of the main factors responsible for the year-on-year reduction in the number of Friulian speakers.

Friulian speakers do not know how to write in Friulian and, therefore, those wishing to make professional use of the language lack any written references; this is further aggravated by the lack of scientific and technological terms that exist in Italian and foreign dictionaries.

Children learn their first language inside the parental home; strictly speaking, one's mother tongue could be considered one's first language at school if it were taught from 2 to 4 years of age. Outside this age range, the brain processes it as a second or third language. In any case, one's mother tongue is learned orally and, if not taught at school, remains within the circuit of emotional relationships and for everyday low-level communication.

Upper Secondary School students (15-18 years old) have a well-shaped brain for expressing their skills in Italian and in foreign languages and consider the teaching of Italian and foreign languages a safeguard against entering a globalised world with a linguistic deficit. Within this age range, the introduction of a minority language could be perceived by learners as an obstacle, rather than a cultural enrichment and strengthening of cognitive abilities that has no impact on the learning of other languages used in the school curriculum. Consequently, any attempt to introduce a minority language project into a school becomes a major challenge.

In fact, the main difficulty encountered was having to overcome resistance from language colleagues (English teachers, naturally) and parental prejudices. These stemmed from the lack of basic knowledge in their children due to the total absence of any education in the Friulian history, culture and language, which they should have gradually acquired during the course of their primary schooling. Moreover, parents needed to be better informed on how the plurilingual brain works.

A further problematic aspect, was that not all students were Friulian speakers; the presence of students from different cultural environments required the development of metalinguistic teaching strategies. New technologies offer the possibility to achieve this aim. For example, one can accompany a predicate with a symbol, one can try to translate a text automatically to check the logical connections that retain the meaning, and so on.

It was based on this knowledge, that the Educational Institutions of the FVG Region started to plan the Friulan CLIL Upper Secondary School experiment; however, it should be noted that the Friulian CLIL has different characteristics from a foreign language CLIL.

The elements that characterise the CLIL experience in Friulian and differentiate it from CLIL in a foreign language can be found in various categories of analysis. Here I have only considered those that pertain to my experience in teaching a technical and scientific discipline at a polytechnic school.

5. What skills should a Friulian CLIL teacher have? Before attempting to answer this crucial question, let us consider some of the factors to keep in mind before starting a Friulian CLIL experience:

a) a minority language CLIL in an Italian Lower or Upper Secondary School does not enjoy the support given the specific teaching of the Friulian Language;
b) a minority language like Friulian is a language without a state, limited to a small territory and consequently holding little interest for work opportunities; however, it should be stressed that proven knowledge of a local language opens the door to cognitive flexibility and a high level of civic awareness, factors that could prove very valuable when applying for a job;
c) the vehicular use of a minority language cannot be accorded the same status as a more widely used language if policy doesn't provide any economic support, particularly in the training of teachers;
d) a minority language could be a favourable vector for transmitting the country's history, connecting older and younger generations;
e) the Friulian language has, like its beautiful and unique natural scenery, an economic value often not acknowledged by the market.

Going back to the question we previously asked: "what skills should a Friulian CLIL teacher have?". A Friulian CLIL teacher will be both a content teacher and a Friulian speaker; in other words, a teacher with a specific degree in a disciplinary subject and an ability to think in different languages and adapt subjects and specific methods in Friulian for which he/she won't have any certification of competence. This lack of certification does not mean that a Friulian CLIL teacher lacks linguistic competence, but rather that he/she would never adopt the role of a language teacher[10].

In the following paragraph, I will consider some of the operational aspects of my work as a former teacher of technical subjects at the "Malignani" ITI in Udine.

[10] Even though a certificate of language proficiency level in Friulian language is not required, a Friulian CLIL teacher level of language competence should reach the CEFR C1 level required for foreign language CLIL.

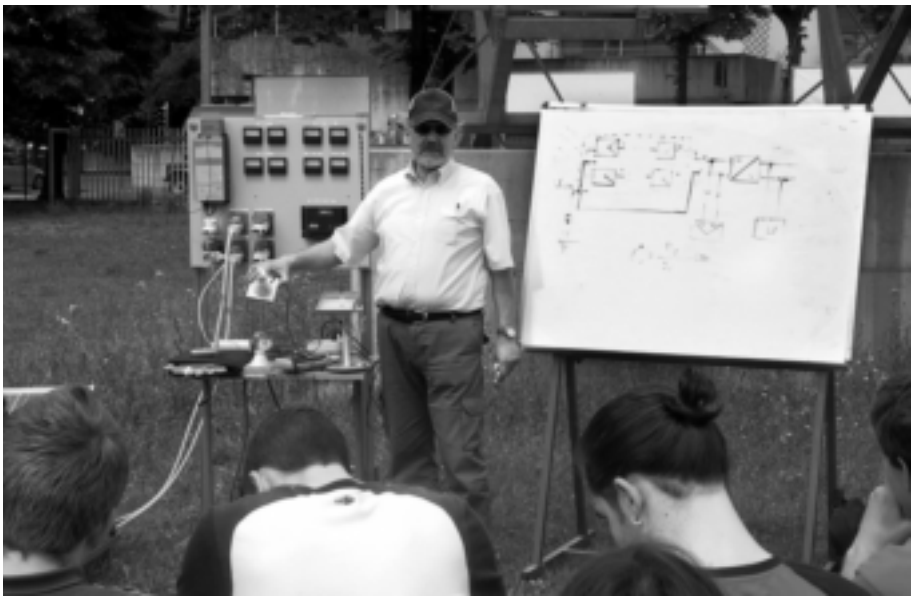

Figure 2. Friulian CLIL open-air lesson.

6. A Friulian CLIL experience operational factors practised in a Technical School environment. The success of a minority language CLIL experience depends heavily on external and internal factors. A relevant factor will be the linguistic and cultural cohesion of the class, a condition verified in my classes with the majority of students coming from the Friulian-speaking territory of the province.

The amount of time spent working in class – including time spent for explanations and tests – can be quantified in about ten hours during the second term of the school year. In addition, other ten or so hours were employed in preparing materials (slides, lecture notes in Friulian and English… and measures with lab apparatus, of course!) and, finally, in the preparation of exercises to assess the students.

During the official presentation of the results reported on my CLIL course to a team composed of the IRRE representative, Ca' Foscari researchers, the President of the Province of Udine, the school headmaster and other guests, I also presented a special electric board discussed with students in classroom (see photograph of an outside lesson in Fig. 2)[11].

[11] The electric board exchanges photovoltaic panels from parallel to series using electromagnetic trips, i.e. from high voltage and low current to low voltage and high current.

The choice to accompany Friulian with English has matured within the SSTeF[12] Management Committe, on which I have been present since the year after its founding. Of additional importance has been the long-standing experience of English CLIL, rooted in "Malignani" ITI with a subject part of the Electrotechnics Specialisation curriculum[13].

It should be stressed that a CLIL methodology with a technical subject may be handled by some teachers with a certain degree of superficiality and an underestimation of the language's didactic value. A technical teacher, usually with a degree in engineering, may consider a local language CLIL with the view of "anything goes". Actually, the habitual approach of a "standard teacher" is to focus attention almost exclusively on the subject content and little or nothing on the language, which thus remains at a poor lexical and cognitive level. In contrast, the CLIL methodology stresses the concept of an interwoven language and content, even though emphasis may be greater on one or other at any given time. There are two reasons for this unbalance: on one hand, the teacher training of an expert in technical subjects requires good competence in maths and laboratory skills, not in communication; on the other hand, the industry needs specialised figures updated on the latest technological outcomes but, at the same time, overlooks the rapid obsolescence of new technologies.

This imbalance between content and language was not present in the training curricula of the Technical Schools of the 60s and 70s. Scientific and literary subjects carried the same weight at least up to the third year. I was a student at "Malignani" in those years, and so had an opportunity to experience first-hand a Friulian CLIL as a means of restoring the traditional balance between language and content.

7. An input enquiry on linguistic background environment. The classes involved in the Friulian CLIL, supported by English as the tutorial language, were 3rd ELT A, 3rd ELT B and 4th ELT A in 2009/10. Before starting the CLIL module, a questionnaire was distributed with tables to be filled in. The table titles are shown below.

Proficiency

- Listening comprehension
- Oral listening production
- Written and reading comprehension
- Written and reading production

[12] SSTeF stands for *Societât Sientifiche e Tecnologjiche Furlane* (Scientific and Technological Friulian Society). SSTeF was founded in 2001 by the former Rector of Udine University Marzio Strassoldo (Marzi Strassolt) and the neuroscientist Franco Fabbro, together with many other Friulian scientists and researchers.

[13] English CLIL was initially introduced at "Arturo Malignani" Technical School by Rodolfo Malacrea, supported by an English language teacher, CLIL lesson topics were extracted from the subject "Electrotechnics and Electric Systems Automation".

Use
– Do you hear the Friulian language? Where?
– Do you speak the Friulian language? Where?

Statistical processing of the data provided useful indications on the linguistic environment for future linguistic educational policies. Below are summarised the overall results:
– a majority of students claimed to live in a Friulian-speaking linguistic environment;
– a minority heard and spoke Friulian in the family;
– Friulian-speaking students used Friulian with each other in school and in public (sport, bar);
– very few read books, papers etc. in Friulian;
– almost nobody wrote in Friulian.

Before starting the CLIL experiment, a 'teacher community' was established, as previously mentioned, according to stages managed by the Ca' Foscari research group. Meetings in Udine organised by the IRRE of FVG[14] proved very useful in the sharing of a common CLIL vision within the Teacher Team.

8. Considerations regarding the epistemology of Friulian CLIL and the experiment's results. The Friulian CLIL experience, involving subjects that required the development of programmes implemented on a computer, calls to mind analogous elements of computer science and neuroscience. The points for reflection that stem from these, include support for not only maintaining a mother tongue but also developing it, so that – in the case of Friulian – everyone may recognise its specific phonological, syntactic and lexical differences with respect to the official school language.

The computer works by activating a sequence of different shells at great speed, each coded by specific (artificial) languages (the software). The language closest to the computer's operating mechanism and almost fused (embedded) with the electronic circuits (the hardware) is written in binary language. Every instruction becomes an instantaneous command, which activates a BiT (Binary digiT) that takes only two on/off values. A program written in binary language is the native language of the machine and is unique to each computer brand.

Users who interact with a computer or a smartphone use an interface that is easy, efficient, as well as enjoyable and work-oriented. The "user friendly" languages used to programme computers understand the problem and then work on a level completely detached from the internal data processing mechanisms. This means that every instruction executed by the user-friendly interface must be translated into a series of machine language instructions. Their execution requires time, despite everything seemingly happening in real time for the end user i.e. apparently without interruptions while instructions are processed.

[14] IRRE stands for Istituto Regionale di Ricerca Educativa (Regional Institute for Educational Research).

By shifting attention now to the human brain – with obvious caution, given the acknowledged immense complexity of the human brain relative to the deterministic and dichotomous artificial one – neuroscientists have discovered that, while the first learned language occupies a narrow part of the brain, second or any subsequent languages are randomly spread over larger areas of brain tissue. This scientific evidence justifies translating the computer's data processing efficiency to the human brain: learning one's first language in one's early years is a rapid process, and the syntactic and lexical core is maintained throughout one's life. This "increased efficiency" in first language learning happens because the brain is in a plastic learning mode and able to learn languages spontaneously. One should also consider that one's first language is related to the affective dimension cultivated in the domestic environment, which later predisposes the child to listen to adults and cultivate satisfying interpersonal relationships.

Following this thread of analogy and given the considerations set out above, the CLIL experiment in a minority language should facilitate the learning of school subjects.

Another socio-linguistic aspect that deserves mention is the imaginative reduction so critical to the scientific field. Presenting topics in a second language can create the belief that only by learning that language will one be able to understand the scientific concepts while other languages lack the necessary words and syntactic constructs. Using the language of affection to explain Newton's laws, for example, disproves the legend that an understanding of the higher concepts of science can only occur within certain native socio-cultural and linguistic contexts. These concepts are by nature language-neutral, in that they can be explained in the universal language of mathematical symbols, which are understandable in any language without adding to or detracting from the basic concept they are expressing.

These notes on the analogous functioning of the human brain with that of the computer deserve, in my opinion, further investigation. This may already have been done; if so, however, it is likely it was done without the knowledge and experience in local language or native language CLIL that we, the "Malignani" CLIL team, possess[15].

What follows are some considerations on the results of the experiment.

The most striking shortfall in my Friulian CLIL experience was in the assessment of learning outcomes, largely because of the short time allocated. This lack of an assessment has been highlighted before and centres on the question "Do we assess language or content?".

In fact, given the decision to base the CLIL experience on a mere mod-

[15] The experimentation was coordinated by Rosalba Perini as part of the Li.Ve project on behalf of the

ule lasting a few hours, it would be impossible to assign the same weight to both language and disciplinary contents.

The need to focus mainly on content, neglecting an evaluation of the linguistic production on both a lexical and syntactic level, adds yet another reason to the one already highlighted in the text to rely on English – a foreign language taught in the curriculum of the Electrotechnical Specialisation – as the language for tutorials.

The most notable, often amusing, focus on language was in the translation of words and technical terms from English to Friulian.

9. Subjects taken from real life work and daily life environments to teach and learn both content and language. The presentation of the main topics in my hybrid Friulian CLIL was delivered at different stages, across three school years. A variety of materials, including slides, papers, apparatus and instruments, were produced and digitally archived. A copy was sent to *Societât Filologjiche Furlane* repository, as suggested by the Course Director[16].

As said before, CLIL involves the interweaving of content and language, even though the teacher may, at any given time, emphasise one or other term recalled in the CLIL acronym. My Friulian CLIL lessons focussed on content and emphasis was on vocabulary rather than on syntax. Consequently, the tests distributed to students were prepared to evaluate their understanding of the contents and students were free to give answers in Friulian or the other two languages. In practice, the students were given the option of answering in their preferred language. Nobody chose to answer in English, while a good share used a mix of Italian and Friulian.

In the next paragraphs, I have included some examples from three of the subjects presented[17].

9.1. Energy production. Nuclear fission. This didactic unit shows how the daily Friulian language has a term closer to the actual meaning of measurement than either Italian or English does.

We start from the consideration that the search for new energy sources and new technologies has periodically taken the stage in recent years.

One technology for the production of electricity, banned in Italy following the 1987 referendum, is nuclear power. In summary, a nuclear reaction is a transformation of mass in which the sum of the masses following fission is less than the original

IRRE of the FVG. The teachers involved in the first phase of the experiment were – in addition to the author of this paper – Roberto D'Agostini (Mechanics), Rodolfo Malacrea (Electric Systems Automation), Ernesto Ribano (Italian Literature and History), Elvio Sgrazzutti (Electrotechnics).

[16] At the time, the idea was to publish a special volume on Friulian CLIL experiences in Secondary Schools of the Province of Udine; unfortunately, at present the volume has not been published yet.

[17] The examples illustrated in the following paragraphs were partially discussed following my communication at the 16th SSTeF Meeting, held in Capriva (GO), in 2017.

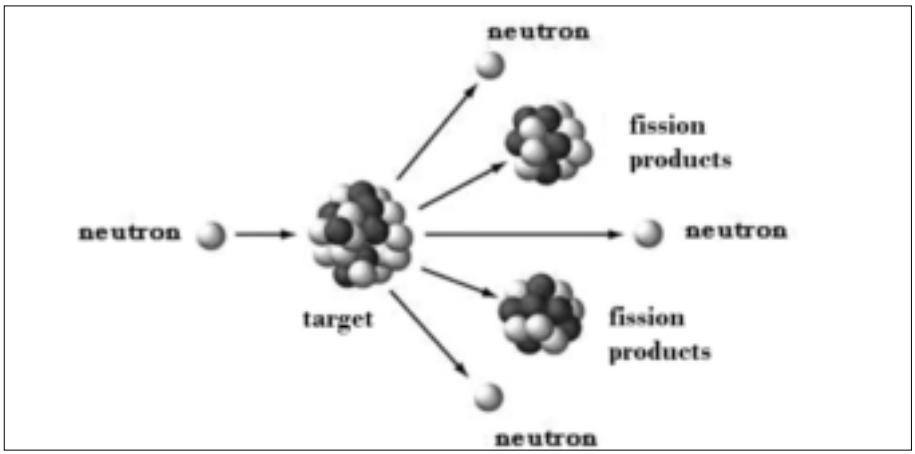

Figure 3. Nuclear Fission.

mass of the origin material (neutron + target nucleus) (figure 3).

The reaction made available to students in their third school year was written as follows

$$M_J\ (n + 235U) \rightarrow M_{JES}$$
$$[(\text{radioactive elements}) + 2{,}4\ n] + \text{<heath>} \qquad (9.1)$$

MJ is the input reaction mass of a nucleus split by a neutron and *MJES* is the output mass.

Based on the Einstein equation

$$E = (M_J - M_{JES})\ c^2 = \Delta M\ c^2 = \text{<heath>} \qquad (9.2)$$

the difference in mass ΔM has fully transformed into thermal energy.

In Physics, the numerical result is always accompanied by another number indicating uncertainty interval. In the transformation of mass to thermal energy, the fissile uranium mass defect is about 1%, which means that a more precise measurement does not exceed this range. In Friulian, this interval is indicated with a precise mathematical term (*plui o mancul*), that is more or less the measured value of something. With the conventional mathematical symbol, we write that the difference in mass transformed into energy is

$$<\Delta M> \pm 0{,}1\% \qquad (9.3)$$

where <*ΔM*> indicates the approximate number measured.

In English and Italian, the colloquial term used, including by experts, is *about* and *circa*, which hides the meaning of measurement that always has to be accompanied by the interval of uncertainty or absolute value. In Friulian, we found a statement that invites further investigation.

This small but significant lexical element shows how a local language

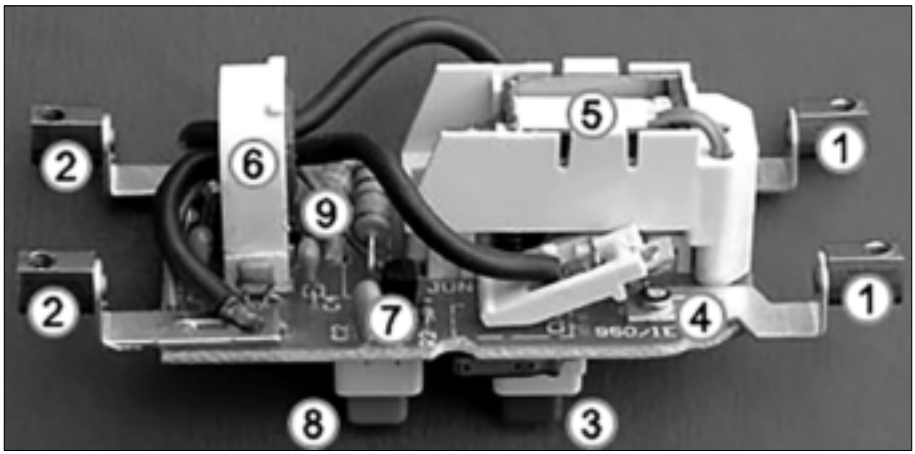

Figure 4. Cross section of a protection unit.

Table 1. Key to Figure 4 in Friulian and English.

Key to figure 4	*Clâf di leture de figure 4*
The incoming supply live conductor and the neutral conductor are connected to the poles in (1) and the electric load in (2). The green and yellow earth conductor is not labelled because it can't be broken. If the button is pushed (3) the electric contact is established (4) and the coil hidden at the back (5) and supplied by the electric current keeps the contacts closed; this effect is maintained even if the button is released. The sense coil (6) develops the differential transformer's function.	*Il condutôr di fase in jentrade e il neutri a son colegâts ai smuarsets in (1) e la fase in jessude sul caric in (2).* *Il condutôr di tiere vert e zâl nol è dissegnât, parcè che nol pues sei çoncjât.* *Se il boton al ven cjalcjât (3), al ven stabilît il contat eletric (4) e la bobine, platade inte part daûr (5) e che e je alimentade de corint e ten sierâts i contats; chest efiet si manten ancje se il pulsant al ven molât.* *La bobine di sensibilitât (6) e davuelç la funzion di trasformadôr diferenziâl.*

can take a step ahead of more widely spoken languages. This aspect is manifested even more clearly in the field of natural and biological sciences considering that the Friulian, formed in an agrarian economy, retains a memory of names and techniques. This offers a good reason to promote policies for the preservation and strengthening of a minority language.

9.2. Automatic protections in low voltage electrical circuits against electrical equipment damage and user injury. The topic chosen bears con-

Table 2. Friulian-English glossary and phraseology.

English	*Furlan*
the incoming supply live conductor	*il condutôr di fase in jentrade*
the neutral conductor	*il neutri*
are connected	*a son colegâts*
to the poles	*ai smuarsets*
electric load	*caric eletric*
earth conductor	*condutôr di tiere*
button	*boton*
the electric contact	*il contat eletric*
is established	*al ven stabilît*
the coil	*la bobine*
hidden at the back	*platade te part daûr*
supplied	*alimentade*
by the electric current	*de corint eletriche*
keeps	*e manten*
the contacts closed	*sierâts i contats*
the sesnse coil	*la bobine di sensibilitât*
develops the differential transformer's function	*e davuelç la funzion di trasformadôr diferenziâl*

siderable technical depth, and is one where content predominates over language. In the following example, it is possible, to evaluate how Friulian communication remains at the same level as that of English. Moreover, it can be added that the meaning of certain terms is more effectively captured in Friulian than in English.

In the modern workplace, fatalities are becoming a real emergency, with healthcare cost consequences. For this reason, one of the main goals of our society is to decrease risk, i.e., build a safer work environment.

With this issue in mind, our aim was to turn the focus onto the main actions taken to avoid electrical component damage and user injury resulting from a loss of insulation of hazardous live-parts in domestic and industrial electric plants.

Before starting, we faced the more general main topic: safety in both domestic and industrial electrical circuits. The distribution of low voltage electricity (LV) is not a sufficient measure for the protection of equipment and the prevention from user injury. Legislation obliges the designer to indicate the points in the circuit where electrical

Table 3. Questions and answers designed to assess the student's level of knowledge on the subject.

The questions and answers are written in English and Friulian and concern the definitions of the reference currents reported in the data sheet.		*Lis domandis e lis rispuestis a son scritis par furlan e inglês e a considerin lis definizions des corints che a vegnin letis a pît dal grafic.*
Q	State the definition of rated current I_n	*D* *Dami la definizion di corint nominâl I_n*
A	The electric current that the circuit breaker shall carry during its operating life without interruptions.	*R* *La corint eletriche che il dispositîf di interuzion al lasse cori cence interuzions di sorte par dut il timp di vite.*
Q	State the definition of no tripping current I_{nf}	*D* *Dami la definizion di corint di no interuzion I_{nf}:*
A	Maximum overcurrent value that does not trip the circuit breaker within the conventional time (1h, 2h).	*R* *Valôr limit superiôr di sorecorint che il dispositîf di interuzion al lasse cori par il timp stabilît par convenzion (1h, 2h).*
Q	State the meaning of the first lower current limit I_{m1}	*D* *Dami il significât dal prin limit di sore corint I_{m1}*
A	Minimum overcurrent value which may activate the circuit breaker	*R* *Valôr di limit inferiôr di sorecorint che e podarès fâ intervignì il dispositîf di interuzion.*
Q	State the meaning of the second minimum over current value I_{m2}	*D* *Dami il significât dal secont valôr limit di sore corint I_{m2}*
A	Minimum overcurrent value which definitely activates the circuit breaker.	*R* *Valôr di limit inferiôr di sorecorint che par sigûr al fasarà intervignî il dispositîf di interuzion.*

protection must be installed and, moreover, to verify the existence of an earth conductor. The legal consequences for not doing so, are borne by both the company and the owner of the circuit.

The technical rules for protection and safety are regulated by different bodies, such as CEI, CENELEC and IEC, and mainly concern over short circuit currents and current faults. The most popular protection choice is the so-called "lifesaver" or "differential switch" that interrupts the power supply. The current flow is restored by raising the lever after eliminating the cause of the fault.

In Figure 4 we see the cross section of a protection unit. The description of its function does not require students to have specific technical knowledge, just a general background in Electrotechnics. The

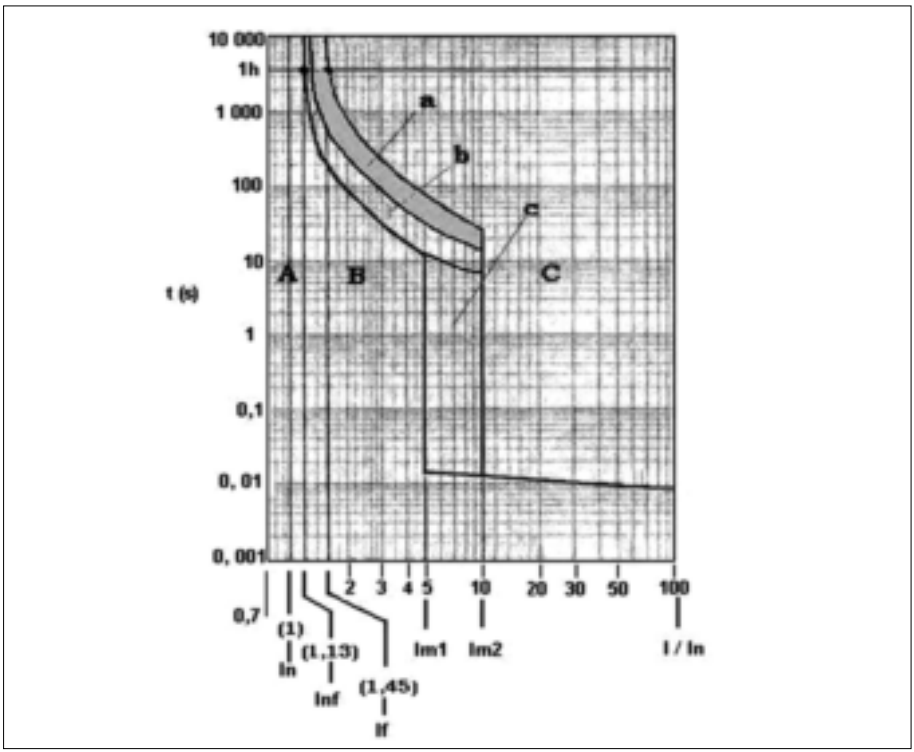

Figure 5. Operational features of an automatic circuit breaker.

key to reading the text is as follows (see also Tab. 1): *Il condutôr di fase in jentrade* / The incoming supply live conductor – *e il neutri*/ and the neutral conductor – *a son colegâts ai smuarsets in (1)* / are connected to the poles in (1) – *e la fase in jessude sul caric in (2)* / and the electric load in (2). *Il condutôr di tiere vert e zal nol è dissegnât* / The green and yellow earth conductor is not labelled – *parcè che nol pues sei* çoncjât. / because it can't be broken.

Se il boton al ven cjalcjât (3) / If the button is pushed (3) *al ven stabilît il contat electric (4)* / an electric contact is estabilished (4) *e la bobine, platade inte part daûr (5)* / and the coil hidden at the back (5) *e che e je alimentade de corint e ten sierâts i contats;*/ and supplied by the electric current keeps the contacts closed; *chest efiet si manten ancje se il pulsant al ven molât.*/ this effect is maintained even if the button is released. *La bobine di sensibilitât (6) e davuelç la funzion di trasformadôr diferenziâl*/ The sense coil (6) develops the differential transformer's function.

Let's consider the consequences of lexical enrichment (see Tab. 1 and Tab. 2) on the operational features

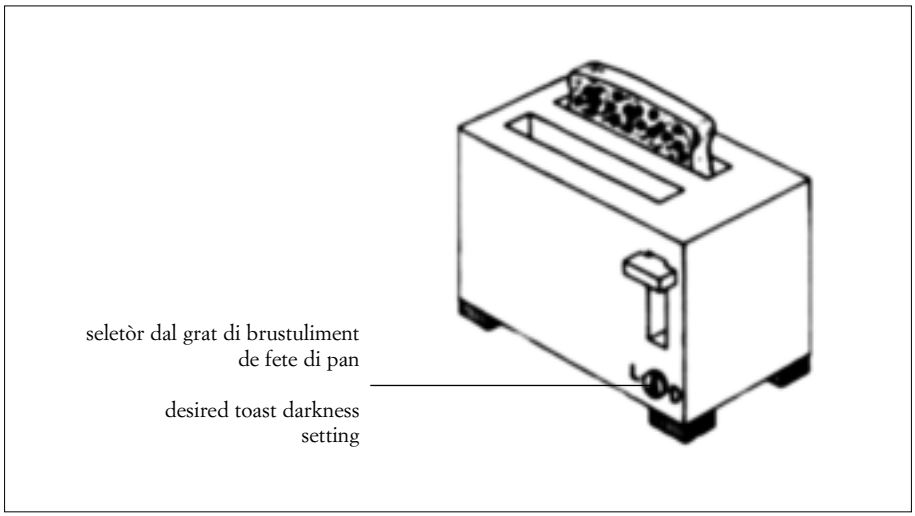

Figure 6. A toaster.

of an automatic circuit breaker tripping characteristically. Let's imagine a teacher with a student in front of him: the teacher wishes to assess the student's level of knowledge on the subject. The questions and answers are written in English and Friulian (Tab. 3) and concern the definitions of the reference currents reported in the data sheet (Fig. 5).

9.3. Open-closed loop control. The case of a direct current motor speed control. This educational unit was prepared to prove the Friulian language's effectiveness in communicating this important engineering concept, but also in other fields of science. I wondered if this concept had been in tested in practical activities and if the Friulian language had words and syntactic forms suitable for expressing it. In the following section – after considering the function of two objects found in every home that, in their operation, perfectly demonstrate the control process – we study the model and mathematical formalism that explain the speed control of a direct current motor.

In Figure 6 we can see a toaster. The setting of the "darkness" knob or timer is the input quantity, or the degree of darkness.

If the degree of darkness is unsatisfactory, because of the type of bread or for some other reason, this condition can in no way automatically alter the length of time that heat is applied, since the output quantity has no effect on the input quantity. There isn't a reaction or feedback (*reazion a cessecûl*) that rules the interval time. The concept is simplified in the block diagram (i*ntal diagram a blocs al ven semplificât il concet)* in Figure 7.

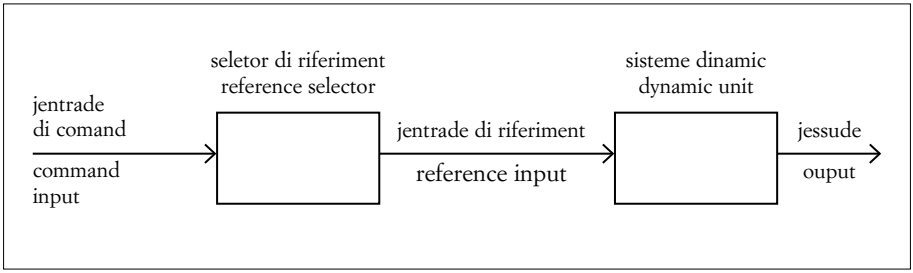

Figure 7. Open loop block diagram.

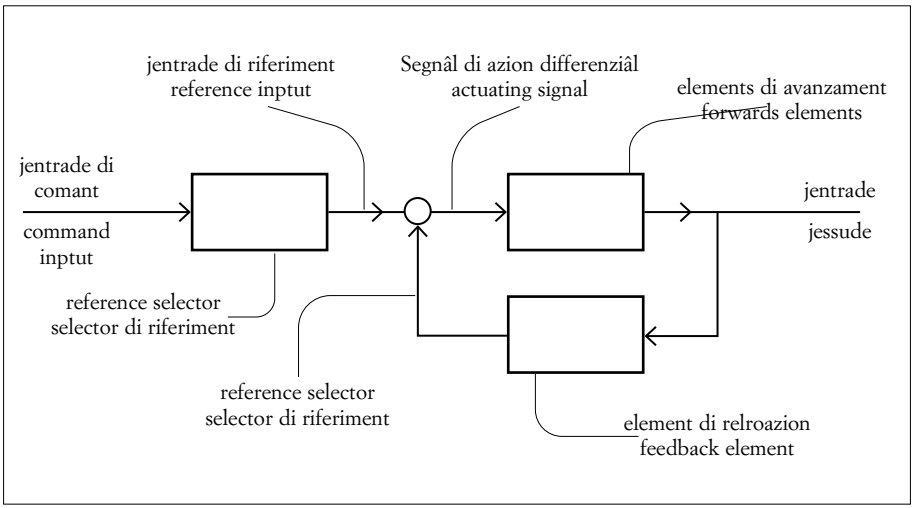

Figure 8. Closed loop control.

The other case chosen is the maintenance of a racing bike's balance. Equilibrium is maintained through the principle of angular momentum conservation; however, were a sudden random event change this, such as a hole in the road or a wrong manoeuvre with the handlebars, the bicycle would risk falling over. If the bike does not fall, this would be due to the cyclist having manually produced a reaction contrary to the overturning, i.e. a feedback that returns the angular momentum value to that which will keep him going.

Closed-loop controls are widespread and are at the base of drone technology. In the technical school, we test the performances of electric motors. Adjusting speed is necessary and the theory has been developed around mathematical models that describe the conditions for regulating the speed of a motor under load to keep it stable.

The direct current shunt is an example of a feedback application (see figure 8).

Given an armature voltage, the field current can regulate the motor speed. In this case the applied armature is the input quantity. A change in the mechanical value, due to a change in mechanical load, alters the speed. Until this point our motor works in an open loop mode. A person could be assigned the task of sensing the actual output value and comparing it to the command input. To improve the performance of the closed loop system so that the output is as close as possible to the desired value, i.e. reduce to zero the time difference as quickly as possible, the person can be replaced by an electronic system. The transfer functions from the system referring to the diagram in figure 8 and results

$$W(s) = ((F(s)\,km) / ((1+ s\,Te)\,(1 + s\,Tm)) /(1 + H(s)\,(F(s)\,km) / ((1+ s\,Te)\,(1 + s\,Tm)) \quad (9.4)$$

expression defined in complex variable s. This second order transfer function is easy to study (being an algebraic expression) and can be read in any of the world's languages.

10. Conclusions. In the first part of this work, I have sought to expound on the CLIL experiences in the "A. Malignani" ITI technical school that I attended for two decades, as well as the distinctive features of the Friulian CLIL compared to the standard one. In the second part, I have used three examples to briefly illustrate an authentic project conducted at a technical and physical level. In these examples, it was possible to evaluate the different weight attributed to the language and the disciplinary contents, starting from a level of linguistic knowledge among students. The tools used to interweave language and content, and partially described in this contribution, were oral and written questions as well as laboratory and workshop activities.

In this CLIL experience, Friulian has certainly acquired much from English, especially in terms of the lexical enrichment of the Friulian vocabulary. This publication is the first contribution to introduce the use of Friulian in the teaching at a technical school (though the term, Polytechnic, may be more appropriate, considering that the "Arturo Malignani" ISIS in Udine offers various specialisations). It is necessary, however, to strongly emphasise that without a linguistic policy, aimed above all at the new generations just starting school, this effort will be for nought. The hope, however, is that it can serve as a feedback for discussion in cultural and language policies, as well as shift the attention of the region's politicians towards passing appropriate laws that support the introduction of the Friulian language at all levels, from kindergarten and primary schools to secondary schools and university.

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