

SUPPORTING INCLUSION IN TEACHING AND LEARNING STEM SUBJECTS WITHIN THE DISCO+ PROJECT

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ABSTRACT

Aim. The objectives of DISCO+ (Dropout and Inclusion at SchOol) project are twofold: to implement an inclusive approach and prevent early school leaving in STEM subjects. The participating partner institutions apply cooperative engineering to develop units in mathematics and science subjects that can be implemented in different European educational contexts to meet the project objectives. Within the project (WP2) 16 transnational groups of pre- and in-service teachers take part in an eTwinning digital training sessions on the notion of school inclusion in Europe, the implementation of the principle of equality between girls and boys, the development of the critical thinking in learning scientific disciplines. Small group discussions refine each participant's understanding of the issues involved, and the work carried out makes it possible to go beyond the local character of the definitions and to reach a common and shared understanding of the intercultural nuances present in each country. These exchanges will help build links between participants and create a network of European colleagues. The groups' experience books will serve as a basis for posters, which will be presented in June 2024. These presentations can be filmed and contribute to a 5-hour MOOC, which will be developed at a later phase in the project.

Methods. By adopting a methodology which includes collectively designing teaching-learning sequences in transnational context, the project applies transnational engineering. Each partner involved in the creation of one or more teaching-learning sequences must question the conditions of transferability of its point of view, its analyses and its testimonies in different educational contexts. In other words, the intercultural component of sequences designed jointly by partners from different countries should be ensured by addressing socially relevant issues and enriching their treatment with a variety of cultural viewpoints. The design of sequences on a transnational scale from this intercultural perspective will also make it possible to deal with the language issue in subjects such as mathematics and science. This methodology intends to develop a common culture on key issues such as sustainable development, inclusion and gender equality and to contribute to the creation of a European citizenship.

Results. The activities will result in several deliverables, which include a round table, dedicated to the notion of school inclusion on a European scale, a four-month long eTwinning digital training in 16 transnational groups (teacher trainees, practitioners) discussing and exchanging ideas on inclusion in European education systems, teaching Science subjects, equality of girls and boys and developing critical thinking. Group experience notebooks will be published as the result of exchanges between students, and will be disseminated through the realisation of a poster session allowing the mutualisation of the work of the different working (16 transnational) groups. During the implementation of „cooperative engineering“ around inclusion and STEM teaching approaches by deconstructing representations of these objects to identify European variables and invariants, an „online serious game“, and an accompanying guide is to be developed. The production of at least 4 teaching units (one per transnational team), two of which will be in mathematics and two in earth sciences (at least one unit is taught in the mother tongue and another in a CLIL approach) will be filmed and analysed by each “cooperative engineering” group on the eTwinning platform. Several activities will be used to produce resources, which in turn will be scripted into a 5-hour MOOC training module to be made available on the platform already developed as part of the DICO+ project.

Conclusions. In conclusion, the structure of the DISCO+ project will enable it to address the entire educational community in each country, including pupils, teachers, future teachers, trainers of trainers and inspectors.

Keywords: cooperative engineering, inclusion and diversity, early school leaving, STEM education, gender equality, the development of critical thinking

INTRODUCTION TO THE DISCO+ (DROPOUT AND INCLUSION AT SCHOOL) PROJECT

DISCO+ group has a shared history (Dico+, Elicit, Europrof) and feels ready to commit to DISCO+ with the motivation to continue learning and cooperating together. The previous DICO+ project, which won the ‘good practice’ label for quality resources and, in particular, the design of a platform for disseminating video sequences. This new project aims to build on this expertise and this platform to continue the collective development of educational resources.

DISCO+ consortium is made up of the following institutions: Regione Autonoma Valle D’aosta (Italy), Universite De Caen Normandie (France), Vytauto Didziojo Universitetas (Lithuania), Universidad De Cordoba (Spain), Colegiul National A T Laurian Botosani (Romania), Petőfi Sándor Katolikus Általános Iskola és Óvoda (Hungary, Kecskemet) Università Della Valle D’aosta (Italy).

Schools are on the front line when it comes to dealing with the upheavals in our societies and must constantly adapt. Securing training pathways by looking after the most vulnerable is a key concern of the project. Inclusive education, a major challenge for schools, is a complex concept. We see the potential of sharing our singular visions to shed light on this issue.

We have chosen to focus on the scientific disciplines of mathematics and earth sciences which have a universal dimension and are a major factor in early school leaving (Fortin et al, 2006). Our thinking led us to look at how to develop

critical thinking and equal access to these subjects on the basis of gender. This project is seen as an exploratory phase at the level of our institutions to develop the internationalisation of initial and continuing education.

The members of DISCO+ project consortium wish to develop expertise in the field of transnational engineering implementation in order to produce tools to better implement inclusive education as a means of securing educational pathways and preventing early school leaving. Therefore the collective has chosen to focus its action on the transition between primary and lower secondary school to consolidate links and and reduce the number of gaps in pupils' education. The players involved in this project represent these two stages in the schooling.

The cooperative engineering (CDpE, 2019) mobilised by the project is a mechanism derived from research in education and training to serve the professional development of those involved in education, both in initial training and lifelong learning. In particular, this system makes it possible to move away from the paradigm of 'the teacher alone faced with the complexity of the profession'.

The originality of the project lies in the introduction of a transnational dimension to the design of intercultural and plurilingual resources. This experiment will make it possible to gather tools and organise them by offering a training module in the form of a MOOC. The commitment of the various institutions to this project will open up new possibilities, allow us to discover and build new tools.

METHODS AND OBJECTIVES OF THE QUILL (QUALITY IN LANGUAGE LEARNING) PROJECT

The main aim of the project is to contribute to the professional development of future teachers, teachers and teacher trainers by involving them in the production of inclusive teaching-learning sequences in mathematics and science, within transnational groups. The consortium also intends to conduct analysis and produce knowledge on the effects of cooperative work from an intercultural and transnational perspective.

The DISCO+ project aims to explore the notion of inclusive education in greater depth by looking at it through the prism of the education systems and cultures of each country.

Several activities will be used to produce resources, which in turn will be scripted into

a training module

- (MOOC): the film of a round table dedicated to inclusive education in Europe, experience reports published on the
- eTwinning platform, a serious game, a poster session reporting on the work of the transnational groups, videos enriched with
- enriched videos of inclusive learning situations in mathematics or life and science, some using a CLIL approach.

The project is based on the notion of cooperative engineering, which means that the results must be grounded in reality, involving the design cycle, observing and analysing reality, then adjusting the design to better meet the needs of the pupils.

Transnational cooperative engineering will take an interest in scientific disciplines in order to design inclusive learning situations, while questioning the principle of gender equality and the development of critical thinking. Each group will produce commented and annotated videos of extracts from learning situations, which will be made available on the platform that has already been set up.

The aim of the DISCO+ project is to explore the notion of inclusive education in greater depth by looking at it through the prism of the education systems and cultures of each country. The group built up expertise during the DICO+ project on the conditions for implementing cooperative activities and sees the need to develop intercultural skills, particularly linguistic skills, for the DISCO+ project. The resources produced will have a multilingual dimension by combining several languages within a single resource.

Ultimately, the transnational nature of the project is part of a strategy for the internationalisation of training and aims to produce tools that can be used by trainers and teachers. It will enable project participants to set up or enhance a European cooperative network.

The creation of a MOOC linked to the available resources will ensure the project's long-term dissemination

In order to achieve the above-mentioned aims and objectives, the project has developed 3 workpackages to create the intellectual outputs.

ROUND TABLE FILMS ON INCLUSION AND PUBLICATION OF EXPERIENCE REPORTS AND POSTERS OF AN ETWINNING TRAINING (WP2)

One of the activities of DISCO+ project in this workpackage (WP") is the realisation of an international round table discussion dedicated to the notion of school inclusion on a European scale with its synchronous broadcasting. It was titled: Inclusive education: a central issue for the school of the 21st century. IN-SPE-UBO of Brittany organised a face-to-face round table (= December 2023) on the notion of inclusion for which each partner invited an expert (teacher, trainer, inspector, teacher-researcher) to participate. They developed aspects of inclusion representative of the most common situations in their territory. The round table was broadcast by video conference synchronously in each institution of the project and was recorded to allow its asynchronous broadcast.

The second activity is to create and moderate an online training of 4 virtual meetings for pre- and in-service teachers from each of the participating countries on the notion of school inclusion in Europe; the implementation of the principle of equality between girls and boys, the development of the critical thinking, in a situation of learning scientific disciplines. The training was held via eTwin-

ning between January and May, 2024. Altogether 16 multinational groups were formed; each group included 6 participants. Regarding the content session 0 was on getting to know each other. Session 1 included presentations and discussions of the education and training systems of the participants' home countries, which they were to compare and find commonalities and differences. Session 2 focused on the notion of inclusion. Session 3 was about the development of critical thinking of pupils in a situation of learning scientific disciplines; plus equality between girls and boys be in academic and scientific fields Session 4 was to finalise the shared experience notebook published on eTwinning digital space and used to take notes during the sessions. Finally, each group produced a multilingual poster. These publications are the result of exchanges between participants and trainers in continuing education from 3 partner countries for each group and also report on the management of cultural and linguistic obstacles encountered.

The third activity is a poster session allowing the mutualisation of the work of the different working groups (16 transnational groups) in Vilnius in June, 2024. This session will be broadcast live to the entire community involved in the project and will be made available on a platform for asynchronous consultation.

Group 15 and 16 were supervised by the author of this article. Group 15 (Judit B. Horváth, Barbara Kardos (Petőfi Sándor Katolikus Általános Iskola és



Figure 1

WP2 poster templates of DISCO+ project to be presented at the multilingual poster session in Vilnius, June 2024; Group 15 and 16

Source: DISCO+ project materials.

Óvoda, Hungary), Caterina Staffieri, Federica Borin (Assessorat Aoste, Italy), Christina Rios Villanueva (University of Cordoba, Spain)) had participants and Group 16 (Magdolna Supka, Julietta Bolyós-Vida, Enikő Kovács (Petőfi Sándor Katolikus Általános Iskola és Óvoda, Hungary), Clara Lago (Assessorat Aoste, Italy), Bronagh Sharpe, Cibele Suzuki Gomes Pedroso (University of Cordoba, Spain)) had participants from Italy, Spain and Hungary. Each group used Canva application to create their posters that can be seen in Figure 1. have worked according to common shared templates and methods in order to ensure the homogeneity and comparability of the contents.

Each group, drawing on their group experience book, has given ideas for STEM sessions that develop critical thinking skills, promote inclusive education and promote gender equality. Their poster should reflect the richness of the exchanges as a multicultural and multilingual group. The following questions could also be addressed in the poster: 1) What did they learn from their discussions?; 2) What difficulties were to be overcome during the discussions? What difficulties remain to be addressed?; 3) Inclusion, gender equality in STEM, development of critical thinking, multilingualism, interculturality

These results will be used in WP3 to design and produce a serious game and in WP5 as resources for the MOOC pedagogical scenario.

THE „ONLINE SERIOUS GAME” AND AN ACCOMPANYING GUIDE (WP3)

The main objective is the implementation of an innovative cooperative engineering by and for the trainers of the consortium, based on meta-analyses (representations and experiences of inclusion, cooperative learning and teaching approaches in mathematics and science in the partner countries) and aiming at the development of associated professional skills. The outcome is the development of an online serious game and an accompanying guide.

The activities in WP3 include creation of a corpus of filmed situations of teaching- learning sequences in mathematics and science, implemented by experienced teachers from each country. Analysis of these resources being done by national experts is to determine collectively the invariants and variants that exist between countries (teaching methods, objectives of skills, attitudes, implied values, etc.). This selection of extracts of situations will be used as a basis for the activities of the serious game, taking into account the various conceptions of inclusion and the various conceptions of science and mathematics teaching.

The activities of designing the serious game and grids for analysing professional practices bring together partners from different countries and aim to highlight common values and singular practices in order to overcome pedagogical borders, who will have to mobilise intercultural competences allowing for a meta-analysis in the form of an inventory of inclusive practices. The activity of producing the serious game is in itself an innovative practice in training and mobilises digital skills. The development of the serious game and the recommendation guide give a production objective which aims to federate

the working groups by giving a goal to be reached in the spirit of project-based teaching.

The development of two deliverables (the online serious game and the recommendations guide) will exceed the duration of the project: it is to be developed by the trainers, the game will be tested and revised, then included as a dissemination object in the 5-hour online MOOC created as the final outcome of the project. Conceived as free of rights, it can be freely used as a training tool for the implementation of transnational inclusive STEM systems, in initial and in-service teacher training. The aim of the recommendation guide will be to formalise the trainers' reflections following their experience and to define points of vigilance and recommendations for an optimal development and implementation of transnational inclusive sequences in STEM subjects. Further aims are the development of trainers' skills in different key areas (cooperative engineering, inclusion, pedagogical innovation and digital education) through different training devices and modalities (conferences, case studies, meta-analysis of professional representations and practices), and the development of trainers' intercultural competences through the cooperative development of the online game and the final recommendation guide.

THE CREATION AND PRACTICAL EXPERIMENTATION OF TEACHING SEQUENCES IN MATHEMATICS AND SCIENCE TO BE REPRODUCED IN DIFFERENT CONTEXTS (WP4)

The activities in WP4 result in the production of at least 4 teaching units (one per transnational team), two of which will be in mathematics and two in earth sciences. In each of these subjects, at least one teaching unit will be offered to pupils in the national language and the other in CLIL; the units are based on the principles of cooperative engineering and CLIL. Each unit will be documented so that the experience is observable and measurable in different contexts. Each learning situation will be implemented in the classroom at least three times and will be filmed for analysis by the engineering group and will constitute an available resource. These analysis times will take place remotely through the eTwinning platform. Each cooperative engineering team will analyse its experiments and select the video units that they consider interesting in relation to the cross-curricular themes of the project in order to produce enriched videos.

The first activity is bringing together the transnational teams who will elaborate together a teaching-learning situation in either mathematics or science, implemented in the national language or in English in the framework of a CLIL approach. The second activity involves drafting the documents for each unit such as lesson plans, including materials for the pupils and observation tools selected and publishing them on Twinspace. In the third activity, each national sub-group will experiment with the unit in a class in their country and produce a video, photos and shared documents. Each implementation will be analysed by the transnational team in an online meeting on the eTwinning platform and may

lead to a further development of the design for a new implementation. Finally, the fourth activity consists of organising a training seminar (France, Caen, April 2025) for the collective sharing and analysis of the experiments conducted by the different teams. During this seminar, video extracts will be chosen to be integrated into the scenario of enriched videos to be published on the DICO+ platform. Each video will shed specific light on the project's cross-cutting themes, i.e. inclusion, gender equality and the development of critical thinking). The enriched videos will be made up of extracts from classroom films, commented on by the trainee teachers and their trainers. Regarding the pupils, each group will analyse its experimentation process and produce an enriched video highlighting the positive effects observed in the classroom on the one hand, and those requiring further reflection on the other.

A 5-HOUR MOOC-COURSE DEVELOPED IN INTERNATIONAL COOPERATIVE ENGINEERING

The production of a MOOC constitutes in itself as an element of dissemination of the project within the partner institutions but also outside the walls by making it available on platforms dedicated to MOOCs. It will be articulated with the DiCO+ platform, enriched with the resources produced by WP2, 3 and 4 of the project.

The MOOC titled „Training through and in transnational cooperative engineering for the inclusion of vulnerable students in STEM subjects“, is a five-hour course for initial and in- service teacher training. Each institution will endeavour to integrate it into initial training programmes and make it available to teachers wishing to engage in this project approach.

This MOOC will offer a course on

1. Implementing transnational collaborative engineering via the eTwinning platform
 - i. preparatory phase - intercultural and technical dimensions (experience book)
 - ii. principles of transnational collaborative engineering (good practice guide)
2. a review of the work produced on inclusion, gender equality and critical thinking skills
 - i. resources produced by experts (round table, serious game)
 - ii. resources produced by students and teachers during the project (poster session)
3. an approach to the design, implementation and analysis of STEM learning situations, including a CLIL approach where appropriate, from an inclusive perspective and of the other concepts addressed:
 - i. Enriched videos (e.g. commented unit plans)
 - ii. Lesson plan and teaching materials produced It will propose a teaching scenario involving observation, analysis and reflection activities based

on a selection of extracts from the resources. The resources produced by the different work packages will be accessible via a link to a dedicated platform.

This MOOC will support the professional development of teachers in general a) by sharing the resources produced in a structured way on the complex themes of inclusion, gender equality and the development of critical thinking, b) by proposing an approach to building learning situations with other European partners in the framework of eTwinning partnerships at classroom and university level; c) explaining how transnational cooperative engineering works (intercultural dimension), d) by using resources from experimentation and real-life situations involving several languages. It will thus contribute to the development of the linguistic skills of the MOOC beneficiaries; moreover, it will contribute to STEM education in an integrated approach by adapting materials into its national language, taking care to include vulnerable groups and to develop students' critical thinking. It will support initial and continuing education stakeholders by producing a support tool to develop transnational training programmes and facilitate access to mobility for all through the use of the eTwinning platform. The resources mobilised will be extended (other examples of implementation, additional documents) on the DICO+ platform.

The multiplier effect of a production such as a MOOC makes it possible to envisage a significant impact. The main expected result is linked to the professional development of the actors involved and, consequently, on the care of the most vulnerable pupils. In the long term, the resources produced, whether edited within the MOOC or accessible via the DICO+ platform, will be included as initial and/or ongoing training content within the project's member institutions. They will thus participate in the implementation of new innovative training methods. In the same spirit, the objective of the MOOC to train teachers in cooperative engineering will contribute to developing the use of cooperative engineering, transnational or local, as a model for lifelong learning and professional development. Each partner will take up the results of the project to disseminate them within their own networks and significantly increase the project's influence. Finally, the fact of proposing concrete examples of good practice in terms of inclusion in different European educational contexts should make it possible to raise awareness among a wider public of the problems dealt with in the project and of the socially relevant issues that the project will have raised.

SUMMARY

Securing educational pathways by looking after the most vulnerable is a key concern of the project. To this end, the actions deployed concern the transition between primary and secondary school. The cooperative engineering mobilised by the project is a transnational mechanism for the professional development of teachers in initial and in-service training. In particular, this system makes it

possible to move away from the paradigm of the teacher alone facing the complexity of the profession. The production of resources will enable the design and sharing of a MOOC to support all educational actors wishing to engage in this process.

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