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eTWINNING: ALLIANCES IN DIVERSITY TOWARD A COMMON GOAL - SUSTAINABLE DEVELOPMENT

eTWINNING: ALIANZAS EN LA DIVERSIDAD HACIA UN OBJETIVO COMÚN EL DESARROLLO SOSTENIBLE

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Abstract:

The eTwinning platform has enabled collaboration between two European university institutions, one located in Italy and the other in Spain. Both have teamed up to work towards a main objective: the development of educational materials related to renewable energy, specifically solar and hydro energy, aimed at primary school pupils. The secondary objective is to evaluate the previous knowledge of eTwinning, the learning styles of the students and their perception of the experience of creating materials using the method called Corners of Learning Styles for Primary, Secondary and Higher Education (REAPSES). This article presents a detailed description of the mixed study carried out by one of the institutions, with the participation of 61 students. The study uses questionnaires and addresses the analysis of results through both quantitative and qualitative approaches. Despite the technological and linguistic challenges faced, this collaboration successfully culminated in the creation of 56 educational materials. This experience gave university students the opportunity to develop practical skills and technological competencies, while improving their social skills, contributed to their integral development and enriched the teaching and learning process in a diverse European context.

Key words: ICT; teaching resources; corners of learning styles; education; sustainable development; renewable energy.

Resumen:

La plataforma eTwinning ha permitido la colaboración entre dos instituciones universitarias europeas, una ubicada en Italia y la otra en España. Ambas se han unido para trabajar hacia un objetivo principal como es el desarrollo de materiales educativos relacionados con las energías renovables, específicamente la energía solar e hidráulica, dirigidos a estudiantes de primaria. Se plantea como objetivo secundario evaluar el conocimiento previo de eTwinning, los estilos de aprendizaje de los estudiantes y su percepción de la experiencia de creación de materiales utilizando el método denominado Rincones de Estilos de Aprendizaje para Primaria, Secundaria y Estudios Superiores (REAPSES). En este artículo, se presenta una descripción detallada del estudio mixto llevado a cabo por una de las instituciones, con la participación de 61 estudiantes. Dicho estudio hace uso de cuestionarios y aborda el análisis de resultados mediante enfoques tanto cuantitativos como cualitativos. A pesar de los desafíos tecnológicos y lingüísticos afrontados, esta colaboración culminó con éxito en la creación de 56 materiales educativos. Esta experiencia brindó a los estudiantes universitarios la oportunidad de desarrollar habilidades prácticas y competencias tecnológicas, al mismo tiempo que mejoró sus habilidades sociales, contribuyó al desarrollo integral y enriqueció el proceso de enseñanza y aprendizaje en un contexto europeo diverso.

Palabras clave: TIC; recursos didácticos; rincones de estilos de aprendizaje; educación; desarrollo sostenible; energías renovables.

1. Introduction

Since eTwinning inception (Servicio Nacional de Apoyo eTwinning, 2019), the European Union has advocated for collaboration and partnership among its member states through various strategies, including educational and training programs that have promoted the integration of technologies in the field of education. A clear example of this approach is the eTwinning platform. This platform serves as a meeting point for various collaborative initiatives between educational institutions within the European Union, all with the purpose of addressing shared issues through joint projects.

This article focuses on the process developed by two European institutions that have come together to address the lack of educational materials focused on renewable energies, specifically solar and hydraulic energy, for primary school pupils. During this process, a common objective was established, and derived secondary objectives were defined, allowing for the analysis of material creation from various perspectives. This article documents the overall results and the process of generating these results from the perspective of one of the participating institutions.

All these actions are in line with the objectives of promoting sustainability and preparing the new generations for a more equitable future, objectives that are shared by the European Commission (2023). In this context, this article provides a general background, details the methodology employed, presents the obtained results, discusses them, and finally, presents the study's conclusions, as outlined below.

1.1 Rationale

The European Community has facilitated stronger collaboration and partnership processes among its member states through various initiatives. Specifically in education, programs like Socrates (Decision 253/2000/EC), Leonardo da Vinci (Decision 1999/382/EC), and the eLearning program have played a role in the effective integration of information and communication technologies into European education and training systems (Decision 2318/2003/EC).

This eLearning program serves as a framework for the eTwinning initiative, which has played an important role in supporting the development of inter-institutional partnerships to address common issues and concerns through its platform. It is worth noting that eTwinning, initially designed by the European Commission to promote collaboration between early childhood and primary education schools using ICT, has been in operation since 2005 (Servicio Nacional de Apoyo eTwinning, 2019).

In this regard, over time, the European Union has allowed to improve their collaboration processes through multiple channels, with eTwinning being one of them (European Commission, 2023). The European School Education Platform is "the meeting point for all stakeholders in the school education sector (school staff, researchers, policymakers) to find news, interviews, publications, examples of best practices, courses, and partners for their Erasmus+ projects" (European Commission, 2023, p. 1). Pateraki (2018) monitors the impact of eTwinning activities on teaching practice and competence development. Currently, educators from different educational levels come together to achieve this goal, participating in various contributions facilitated by the platform (Table 1).

Table 1
eTwinning contributions to teaching life. Own development from Pateraki (2018)

Category	Advantage
Transversal and life skills	Enhances life and school skills through innovative cross-curricular activities.
Engagement	Helps students improve their motivation through projects and new tools to become active and passionate learners.
Peer-to-peer collaboration	Allows students to work in small groups, promoting collaboration and the sharing of perspectives.
Fun	Enables students to have fun with eTwinning activities through direct and indirect experiences and games.
Innovative tools	Teachers learn and enhance new online tools and resources.
Best practices	Teachers can experiment with new teaching methods and approaches to different subjects, thereby improving their teaching experiences.
Continuous professional development	Through innovation, professional updating, improved communication in different languages, and the adoption of ICT.
New opportunities	eTwinning opens up new opportunities for schools through the exchange of information, knowledge, and educational practices, allowing for the integration of different regions and countries in a short period.

The dynamics within the eTwinning Platform involve project creators' agreeing on the topic, its duration, how students will participate in the project, the number of partners, the expected outcome, language preferences, tools, and other related aspects. In some countries, such as Spain, promotional calls are made during training events related to eTwinning (Ministry of Education and Vocational Training of Spain, 2023).

1.2 Sustainability and the 2030 Agenda

In terms of legislation, efforts have been made at different levels to promote integration through various strategies such as agreements, policies, and treaties. For example, the Lisbon Treaty sets a common objective in its article 3: “To create a space of freedom without internal borders, characterized by solidarity, respect, and protection of cultural and linguistic diversity, gender equality, and the protection and improvement of environmental quality” (Lafuente, 2013, p. 29). Additionally, the European Council approves the *Framework for Climate and Energy Policies by 2030* (European Council, 2014, p. 1).

Subsequently, the European Green Deal was signed, emphasizing a key principle: the transition to clean energy, reducing greenhouse gas emissions, and enhancing the quality of life for our citizens. Within these principles, one of the objectives is to empower consumers (European Commission, 2023).

On September 25, 2015, at the World Summit for Sustainable Development, the 193 member states of the United Nations adopted the 2030 Agenda to promote Sustainable Development worldwide. It is an urgent call to action for all countries, both developed and developing, in a global alliance. It recognizes that ending poverty and other deprivations must go hand in hand with strategies to improve health and education, reduce inequality, and stimulate economic growth – all while addressing climate change and working to preserve our oceans and forests. Students are agents of change in this endeavor (United Nations, 2015).

The current Organic Law 3/2020, of December 29, known as the Celaá Law, recognizes the importance of education in relation to sustainable development, in accordance with the provisions of the 2030 Agenda. This is specifically reflected in Sustainable Development Goal (SDG) 4, which promotes quality, inclusive, and equitable education as a foundation for improving our lives and sustainable development.

On a broader scale, development goals are reflected in SDGs 7 (affordable and clean energy) and 13 (climate action). Specifically, regarding education, target 13.3 proposes: "improving education, awareness, and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning" (United Nations, 2015, p. 1). In Europe, measures and objectives have been adopted over time to contribute to the achievement of these SDGs (García Lupiola, 2023).

In this context, this project was carried out within the framework of eTwinning and had the main objective of developing educational materials aimed at primary school pupils on renewable energies, with a particular focus on solar and hydraulic energy.

Both solar and hydraulic energy are considered renewable energies and are defined as "those that are produced continuously and are inexhaustible on a human scale. They also have the additional advantage of complementing each other, promoting integration" (Fundación Confemetal, 2020, p. 20) while maintaining balance with nature. Renewable energies include Wind, Hydraulic, Biomass, Geothermal, and Solar, which can be transformed into forms of energy used by human activity such as heat and electricity, with a lower impact than those based on fossil fuels.

1.3 Sustainable energy and education experiences

With respect to sustainable energies in relation to educational processes, different approaches have been made. Garzón Baquero and Bellon Monsalve (2022) review the perspectives and practices in the promotion of education on sustainable energies. In Esparza et al. (2022) we find the diagnosis of previous knowledge, while Gallego (2019) also explores the dimension of the problem of sustainability as a field of knowledge.

On the other hand, at a didactic level, Cisterna et al.'s (2018) paper deals with the methodology of an experience in training and transfer of didactic tools on the rational use of energy and renewable energies. Some other references are worth mentioning at this level: the methodology of problem-based learning in the education of renewable energies proposed by Pérez Montero and Salcedo Benavides (2022), the LIDERA Project by Martínez-Guerrero et al. (2022), and the proposal that combines augmented reality for the study of renewable energies as a training tool for teachers (Becerra Rodríguez, 2022), among others.

In this sense, the proposal allowed establishing a convergent contribution based on common objectives, starting from different formative processes, where the eTwinning platform generated a space for conciliation in the midst of differences and technologies allowed overcoming language barriers. All this contributed from the experience to add individual and collective spaces to: "Mobilize students at a collective level to configure sustainable futures as far as possible and invite them to make changes in favor of a more sustainable planet" (Bianchi et al., 2022, p. 25).

This article allows students with worked topics to visualize future perspectives and identify actions to achieve a sustainable future, encouraging creativity and imagination.

2. Objective

The main objective of this work is focused on the development of educational materials related to renewable energies, specifically solar and hydraulic energy, aimed at primary school pupils. In addition to this common objective, this project presents the following secondary objectives:

- To determine the prior knowledge of the eTwinning platform.
- To identify students' self-perception in relation to their learning styles.
- To discover students' learning styles.
- To evaluate the level of acceptance of the experience after its execution.

3. Methodology

This study emerged due to the shortage of educational materials for solar and hydraulic energy training at the primary level, a deficiency identified by the Italian team. This led to the search for collaborators through the European School Education Platform (ESEP). Consequently, the Spanish team established contact and agreed on a common objective: to develop educational materials for primary school pupils, with the focus on renewable energies, emphasizing solar and hydraulic energy. However, secondary objectives related to specific teaching contexts and the objectives of each subject were also pursued, linked to the contents of the subjects and the interests of the researchers who made up the teams in both countries.

The Italian team opted for a Content and Language Integrated Learning (CLIL) approach, complemented by the EAS method (Situated Learning Episode) developed by Rivoltella (2016). The EAS method establishes three phases for each teaching unit: the preparatory phase (introduction to the topic), the operative phase (carrying out an activity), and the reflective phase (analysis of what was done and why) (Leone & Luzzini, 2016).

On the other hand, in Spain, the REAPSES method (Corners of Learning Styles for Primary, Secondary, and Higher Education) developed by Castellanos Vega (2020) was used. This method incorporates the learning styles defined by Alonso et al. (1994) into the training process. In essence, the teacher adapts their teaching according to the learning styles present in the classroom.

In this document, we will focus on the process carried out by the University of Zaragoza.

To achieve the objectives, a mixed-method study was conducted, combining descriptive elements with advanced statistical analyses such as correlations and analysis of variance. Data were collected through two questionnaires: the CHAEA (Learning Styles Questionnaire) and the Teacher Evaluation Questionnaire (Alonso et al. 1994). To develop materials that aligned with the overall objective, activity guides were created, and support was provided to the students during in-class work sessions, which took place for two hours weekly in April 2023. Participants' anonymity was maintained, and their participation was voluntary.

The work process with the students began with the presentation of the educational experience proposal to two natural groups of the *Developmental Psychology* course taught by the research teachers, framing the process within an inter-university collaboration project through the eTwinning platform. The students who decided to participate filled out both the Teaching Evaluation Questionnaire, which included an informed consent section, and the CHAEA Questionnaire by Alonso et al. (1994).

The process started with the presentation of essential information on the topic by each group teacher. Then, students were divided into subgroups of three or four people, covering the four learning styles and the two themes: Solar Energy and Hydraulic Energy. These subgroups were physically distributed into four corners: Active, Reflective, Theoretical, and Pragmatic. An activity guide was provided for each corner, and students were allowed to develop their materials during class hours with teacher guidance.

3.1 Population and sample

The overall experience involved 81 undergraduate education students from the University of Milan (Italy) and the University of Zaragoza (Spain), who participated voluntarily and gave their informed consent. Specifically, according to each institution, 20 participants belonged to the University of Milan (Italy), and were undergoing teacher training following the CLIL approach. 61 students belonged to the University of Zaragoza (Spain) and were studying the course on *Developmental Psychology* in the first year of the Degree in Primary Education. This study focused on the 61 students who were at the University of Zaragoza (Spain), since they shared the same learning method and area. Their age range was 18 to 21 years. No sociodemographic or personal information was collected. The data were anonymized for processing.

3.2 Instruments

The study was undertaken in accordance with the Learning Style Corners method for Primary, Secondary and Higher Studies (Castellanos Vega, 2020) followed in the course of *Educational Psychology*, which includes the application of the questionnaire CHAEA (Alonso et al., 1994) and a questionnaire to evaluate the educational experience. Both are detailed below.

3.2.1 The CHAEA (Honey-Alonso Learning Styles Questionnaire) digital version

The Honey-Alonso Learning Styles Questionnaire (CHAEA) is a tool used to assess individuals' learning styles. It consists of 80 items in its original version, designed to evaluate learning preferences in four main dimensions (active, reflective, theoretical, pragmatic), with 20 items in each dimension. It is a self-administered test with dichotomous scoring, either agreement (sign +) or disagreement (sign –). The absolute score that the student obtains in each section indicates the degree of preference (Alonso et al., 1994).

The instrument's reliability has been reaffirmed by various research studies in different populations, both in its English and Spanish versions (Camarero Suárez et al., 2000). This version is available in various digital repositories, and the online version developed by the Autonomous University of the State of Hidalgo (Muñoz, 2018) was used, allowing profile download and anonymous application without prior registration.

3.2.2 Teacher feedback questionnaires

This questionnaire was originally created to evaluate the student experience and consisted of 11 questions. These questions inquired about prior knowledge of the eTwinning platform, students' preferences and experiences during the activity, as well as a rating on a scale of 1-10 regarding their perception of the effectiveness and impact of the activity on their learning. It was constructed through inter-subjective agreement among the Spanish researchers. It was administered both at the beginning and at the end of the study.

3.2.3 Activity development guide

This guide was developed in agreement among the research teachers as a supporting material for the study. It aimed to provide guidance to students on applying the REAPSES method during the development of materials for primary education pupils related to sustainable energy generation, specifically solar and hydraulic energy, taking into account learning styles (Table 2).

Table 2
Activity guide according to learning styles developed for the study

Type of corner	Description
Pragmatic	In this corner, the creation of an experiment related to solar and hydraulic energy is proposed. Applications that can be used to record this experiment are provided, the methodology to be followed is detailed, the target audience is indicated, the necessary materials are listed, and a detailed explanation of the experiment is given. Finally, it shows how to properly conclude the experiment.
Theoretical	In this corner, terminology and concepts related to solar and hydraulic energy are worked on. Materials that can be used, such as Educaplay, Kahoot, Quizizz, Live Worksheets, which will be published through an infographic, are presented.
Reflexive	In this corner, generated activities that invite thinking and reflection on the subject related to solar and hydraulic energy are worked on. Materials that can be used, such as Edpuzzle, StoryJumper, Live Worksheets, which will be published through an infographic, are presented.
Active	In this corner, the development of a game related to renewable energy is proposed, using digital resources to explain the rules and dynamics of the game. Photos of the game and a link to the game itself are also included.

3.3 Procedure: data gathering and data analysis

Maintaining the distribution of the two natural groups, they were subdivided into self-formed subgroups of between four and five people, who chose one of the work topics (Solar Energy or Hydraulic Energy). The objective set for the subgroups generally consisted of developing training activities that were proposed, taking into account the four learning styles.

To collect the data, two moments were established: At the initial moment, once the subgroups were formed, the participants were asked to fill out the CHAEA questionnaire, digital version, and the evaluation questionnaire as a pre-test. The second moment, which coincided with the completion of the educational experience, allowed the participating population to complete the evaluation questionnaire as a post-test.

For the analysis of the data, due to the complexity of the common project, two levels of results were taken into account, one that accounted for the common objective set and another level for the results of the sample taken into account for the report. In the same way, according to the moments of the study, the results were analyzed using color coding techniques, descriptive statistics, graphic analysis, trend measures such as variance and correlation (correlation coefficient). Qualitative variables were also categorized through content analysis of the responses to the open questions contained in the pre- and post-questionnaires.

Specifically, to carry out the analysis of trend and correlation measures, a sample was formed from the paired results between pre- and post-test (not all students completed the voluntary final evaluation questionnaire). Therefore, unpaired data were removed to allow analysis of variance and correlation coefficient.

4. Results

Due to the complexity of this collaborative project, an analysis of the results was conducted at two different levels. The first level focused on results related to the overall project objective, reflecting the general experience. The second level analyzed specific results related to the secondary objectives set by the research team at the University of Zaragoza. Below is a summary of these two levels of analysis.

4.1 Level 1: overall results (common objective)

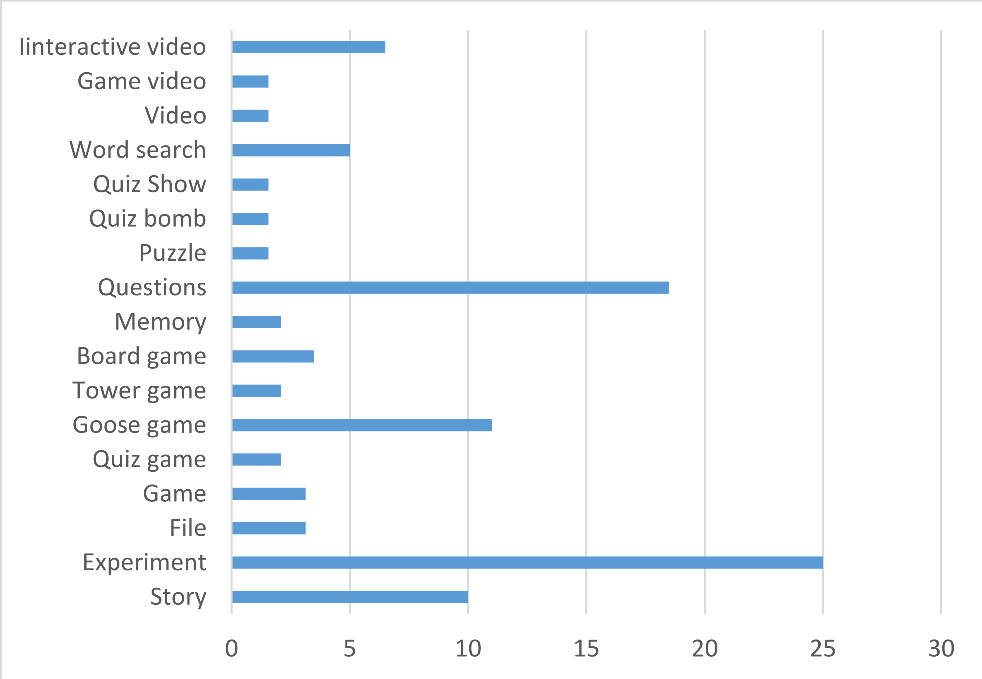
At this level, the results that emerged from the joint experience in creating educational materials on solar and hydraulic energy are presented and analyzed, including the categorization of the materials developed.

In total, 56 educational resources were created, of which 24 are related to the topic of hydraulic energy and 32 to solar energy. These materials were developed by a total of 14 subgroups that were formed during the experience. The resources were aimed at children aged 6 to 12 years old and addressed different learning styles, with one material designed for each style. Each subgroup developed one material for each learning style following the REAPSES method, in accordance with the provided guidelines and established procedures.

When analyzing the percentage distribution of these materials, it is noteworthy that 65% of the resources are concentrated in four main categories: Experiments (25%), Questions (19%), Goose Game (11%), and Stories (10%). The remaining 35% is distributed across 13 other categories, as shown in Figure 1.

Figure 1

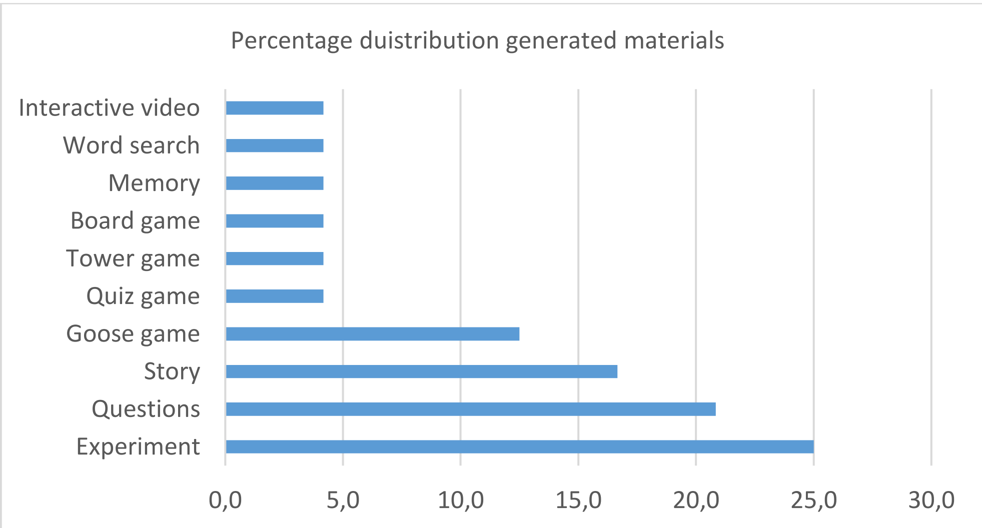
Percentage distribution of educational materials



In relation to the materials designed for teaching about hydraulic energy, a total of 24 educational resources have been created. These materials were developed by six working subgroups and are intended for children aged 7 to 12 years old. In total, ten different categories of resources have been developed. Figure 2 represents the percentage distribution of these materials, showing that 75% is distributed across four main categories: experiments (25% of the total), questions (21%), stories (17%), and Goose Game (13%). The remaining 25% is divided similarly among the six remaining categories.

Figure 2

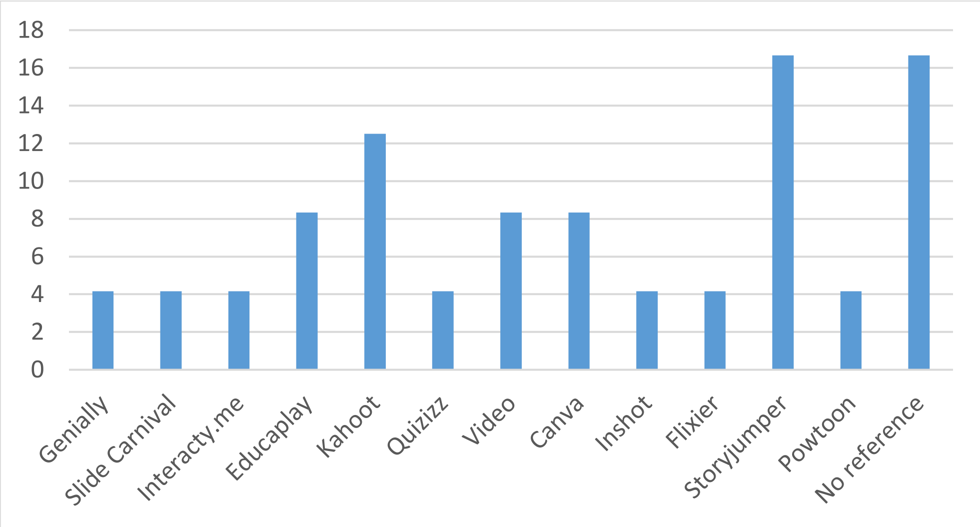
Percentage distribution of generated materials: hydraulic energy



Regarding the Information and Communication Technologies (ICT) used for creating the materials (Figure 3), a total of 13 different applications were employed. Of these, 30% is attributed to three main applications (StoryJumper with 17% and Kahoot with 13%), while the remaining 70% is distributed among ten other applications. An additional 17% did not provide information about the ICT used during the material's development, as it was created manually.

Figure 3

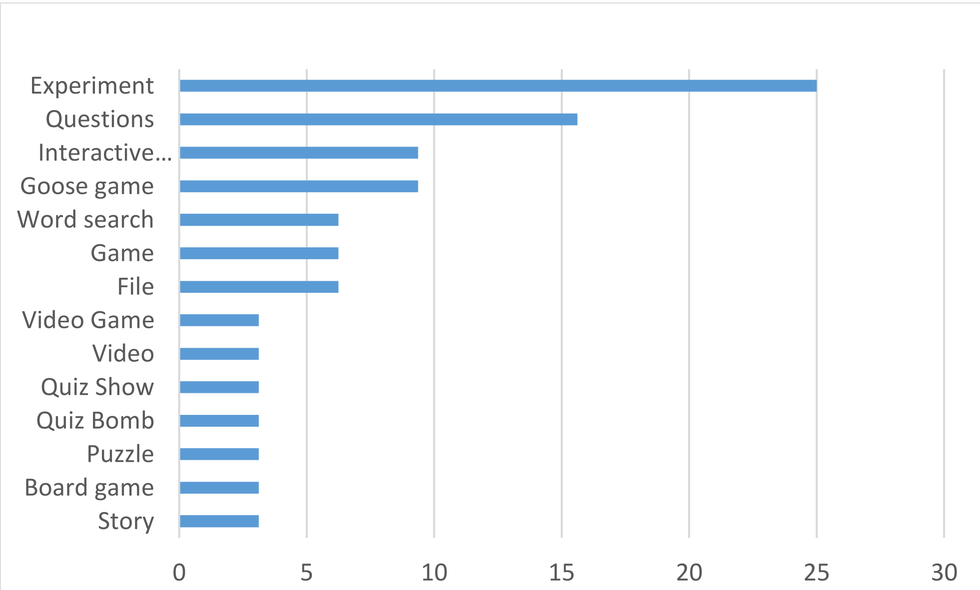
Percentage distribution according to ICT used



In relation to the materials on Solar Energy, a total of 32 educational resources were created. These materials were developed by eight subgroups and are aimed at children aged between 6 and 12. Of these materials, 59% were concentrated in four main categories: Experiments (25%), questions (16%), interactive videos (9%), and board games (9%). The remaining 41% was distributed among the other ten available categories (Figure 4).

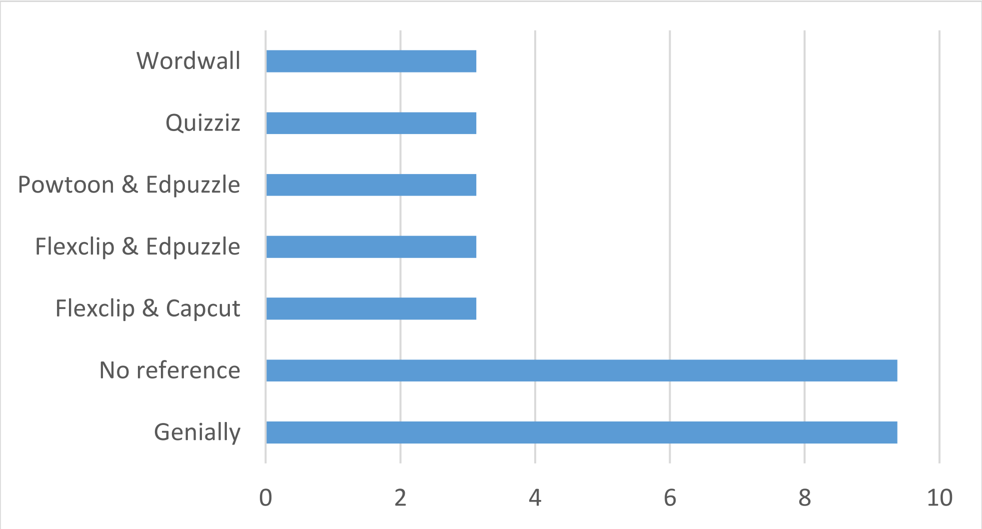
Figure 4

Percentage distribution of generated materials: solar energy



When considering Information and Communication Technologies (ICT), we can observe, according to Figure 5, that a total of 21 categories of applications were identified. Of these categories, 3 correspond to combinations of applications, 17 are individual applications, and one did not mention a specific application. Regarding distribution, it is noteworthy that 27% of the materials used three main applications: Educaplay (9%), Genially (9%), and video (9%). The remaining 81% of the materials were distributed among the other 14 categories, with a predominant trend of one material per application.

Figure 5
Percentage distribution of ICT used: solar energy



After the self-classification carried out by the students, we observed that, within the active learning style, there was a preference for creating games, representing 18% of the materials built, surpassing other options like memory, puzzle, quiz show, or video game.

On the other hand, the pragmatic style primarily focused on creating experiments, which constituted 25% of the total materials, demonstrating a practical experience-oriented approach.

Regarding the reflective style, there was a notable production of materials like Stories (9%), Interactive Video (7%), and Word Search (4%), compared to other alternatives.

In the case of the theoretical style, the preference leaned towards creating questions (16%) and worksheets (4%) (Table 3).

Table 3
Percentage distribution of materials by learning style

Learning style	type of material	amount	%
Active	goose game	5	9%
	board game	3	5%
	game	1	2%
	tower game	1	2%
	Memory	1	2%
	Puzzle	1	2%
	Quiz Show	1	2%
	Game video	1	2%
Pragmatic	Experiment	14	25%
Reflexive	story	5	9%
	Interactive video	4	7%
	word search	2	4%
	game show	1	2%
	questions	1	2%
	Video	1	2%
Teoric	questions	9	16%
	file	2	4%
	game	1	2%
	Quiz Bomb	1	2%
	word search	1	2%
	Total	**56**	**100%**

Regarding learning styles and the use of ICT, in general terms, students relied on Information and Communication Technologies (ICT) in 97.5% of cases for the development of materials, while 2.5% chose to create materials without using digital tools.

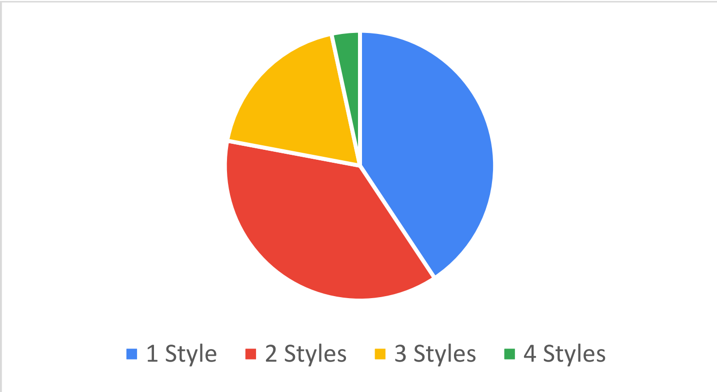
Specifically, for the active learning style, of the 14 materials generated, 5 were created manually, without the use of ICT. In the pragmatic style, of the 14 materials, only 1 was created by hand, as was the case with the reflective style. On the other hand, for the theoretical style, all materials were created using ICT, and, in addition, are shared on the eTwinning platform so that students from Italy and Spain know how the topics of hydraulic and solar energy can be generated and worked from different methodologies contributing towards a common theme.

4.2 Level 2: specific results

In general, although there were 61 students, in terms of the initial completion of instruments, we had 60 responses, and in the final process, we had 39 complete responses to all instruments. This reduction is explained because they were working in teams towards the end, and some participants completed the final questionnaire as a team, while others forgot to do it or chose not to. Therefore, we present the results obtained throughout the process, divided into two blocks: Initial and Comparative.

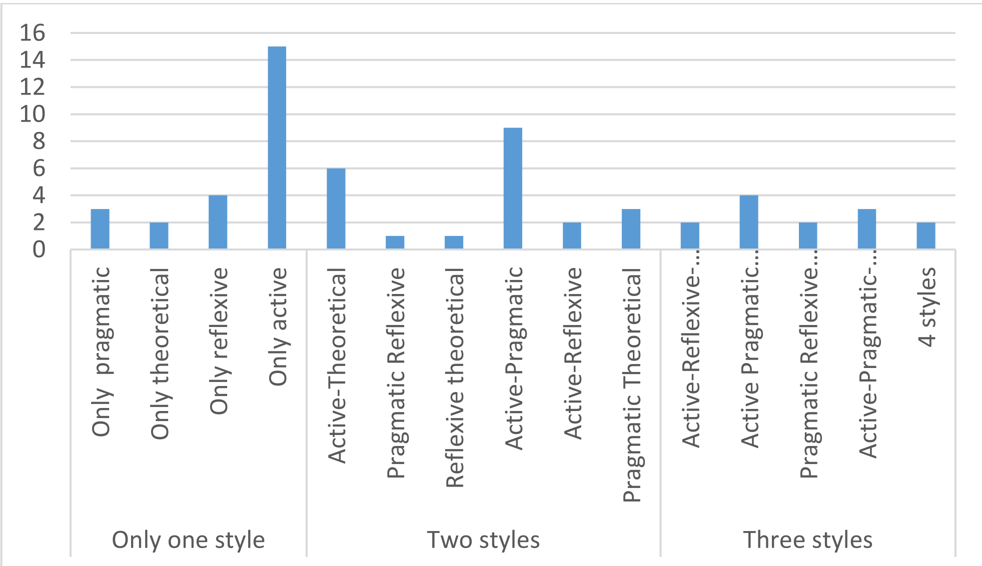
The eTwinning platform is known by 1.7% of the sample, and 100% of the sample states that they know little about learning styles. Specifically, regarding their self-identification with the four learning styles, some students identify with only one style, while others choose to include other styles (Figure 6). The majority tend to identify with one learning style, followed by two styles.

Figure 6
Self-perception of learning style, number of styles



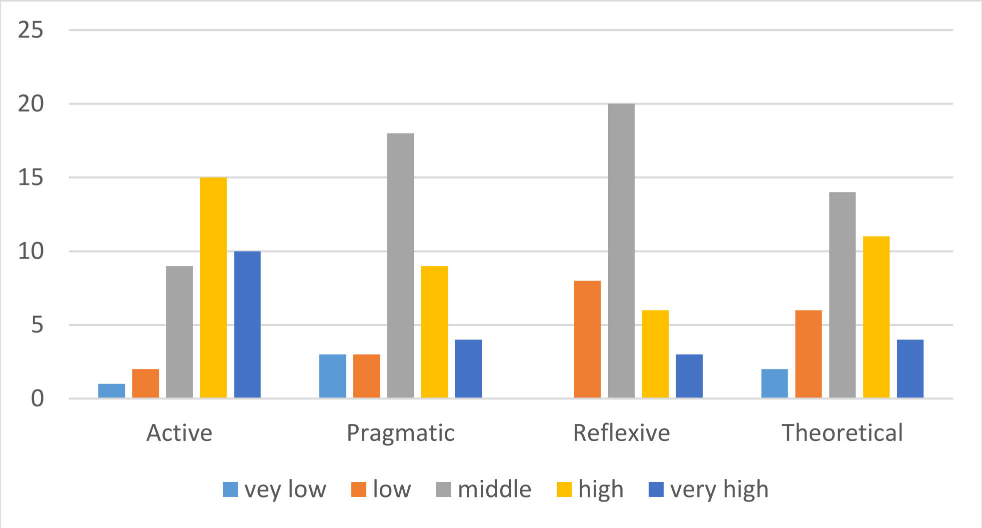
On the other hand, if we focus on those who identified with one learning style, we find that 63% identify with the active style. For those who identify with two styles, the active-pragmatic combination prevails (41%) followed by active-theoretical (27%). Among those who identify with three learning styles, the active-pragmatic-theoretical combination prevails (21%), followed by active-pragmatic-reflective (16%). Finally, those who identify with all four learning styles make up 3% of the sample. It is worth noting that out of the 60 participants, 59 responded to this initial questionnaire (Figure 7).

Figure 7
Self-perception of learning style, types of style



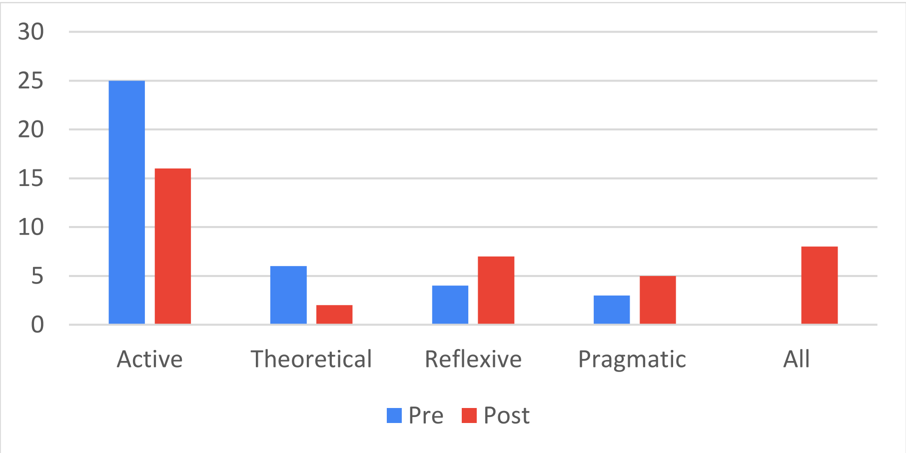
When referring to the learning styles that students possess, through the application of the CHAEA learning style questionnaire (Alonso et al., 1994) digital version (Muñoz, 2018), the learning styles present in the sample were identified (Figure 8). There is a very high and high tendency for the active learning style, followed by the theoretical and pragmatic styles, while the reflective style has a lower presence.

Figure 8
Learning styles present in the sample according to CHAEA



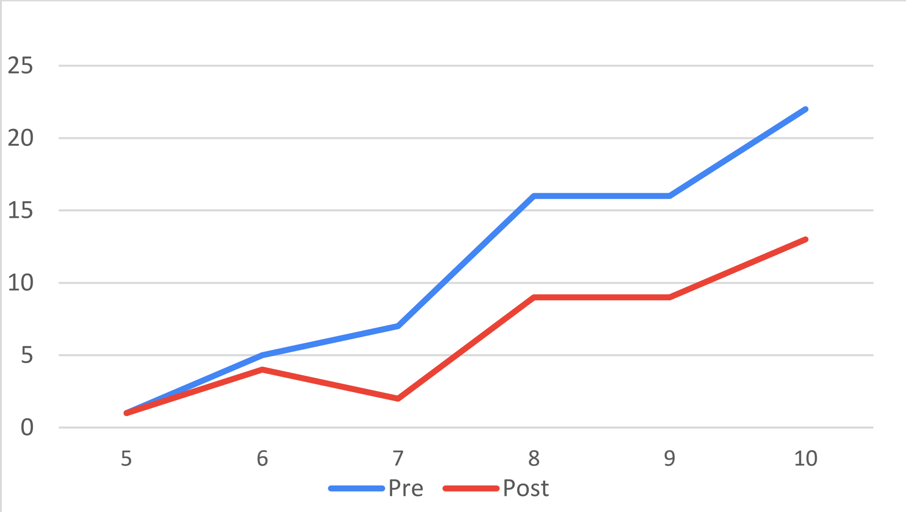
Likewise, when comparing the results of the initial and final questionnaires, it is found that in terms of the preferred learning style for creating materials, a preference for active learning style activities prevails. After the training process, there is a greater acceptance of other styles, as evidenced by the appearance of the "all" category, as well as the increase in other categories (Figure 9). There is a negative variance (-0.03), indicating that the participants' responses are highly clustered around a central value related to the predominant learning style (active), and they have a high consistency in how they identify their preferences when creating materials. On the other hand, the very weak negative correlation (-0.02) indicates a slight tendency for an increase in knowledge about learning styles to lead to a decrease in concentration in a particular learning style, although statistically, this relationship is very weak.

Figure 9
Preferred activity by learning style



However, when compared to the final assessment, we find that the rating tends to decrease while maintaining its overall positive trend (Figure 10).

Figure 10
Initial and final satisfaction levels



Regarding the question about what they would change about the activity, initially only 3% expressed a desire to make changes, without specifying what those changes would be. However, by the end of the process, this percentage increased to 9%, with two positions: one mentioned that they had requested more feedback from the teachers, and the other, in terms of the dynamics, suggested removing the presentation step that was part of the guide.

As for the difficulties mentioned in the initial evaluation, in general, 18% expressed having faced challenges. Specifically, 9% reported difficulties related to their inexperience with the suggested ICT (6%), which they resolved through their own research, and issues with their device that shut down during the practice (3%). In the final evaluation, 30% encountered some inconvenience, distributed as follows: 6% reported difficulties regarding the weight of the videos versus the platform's capacity, which they resolved by sending the material via email. There were also problems with the requested English translation (12%), which were resolved through an online translator. Additionally, 3% had problems with creating infographics, which they resolved by working on it, and another 3% faced challenges with specific applications, which they resolved through research. There was also 3% who struggled with time management, which they addressed by searching online. Another 3% had concerns about the clarity of the instructions, which they resolved by changing their attitude (being more patient), and finally, 3% felt they had worked more than others, which they resolved by changing their attitude (they accepted they had worked more, and that was that).

5. Discussion and conclusions

Taking into account the objectives of this research, we can say that students gained knowledge through this experience about what the eTwinning platform is and what it means to work on a common theme, which is of great importance for future primary school educators.

Apropos the distribution of materials, there is a concentration in four main categories: experiments, questions, games, and stories. This suggests that students perceive these categories to be especially effective for learning about hydraulic and solar energy. However, there is also a need to strengthen the other categories to enrich the variety of available resources.

On the other hand, the predominance of the use of Information and Communication Technologies (ICT) in the creation of materials reflects their significance in contemporary education and their ability to enrich the learning process (Carneiro et al., 2021; García de Diego & Salinas, 2023).

At a specific level, the internal dynamics such as pedagogical objectives, methodology, subjects, and other common variables (cultural systems, customs, institutional policies, internal regulations, prior knowledge, among others) reflect and nourish the diversity of each country and situation addressed within the European context. However, far from being an obstacle, this diversity is a representation of how heterogeneous solutions can be created to contribute to common problems. By defining a common objective, it becomes evident that there are different ways to independently solve problems while maintaining a common direction.

Furthermore, since this experience directly involved university students in the creation of materials, it facilitated their familiarity with solar and hydraulic energy while developing practical skills within a specific context. This practical approach was highly valued by the students, despite the effort and development of competencies required, especially in terms of managing Information and Communication Technologies (ICT).

This experience adds to the multidisciplinary efforts that academia is undertaking in the field of sustainable energy generation, including the construction of wind generators from the electronics department (Gallego Torres et al., 2018), or the Mendocino motor (a motor powered by solar energy) (Estupiñan et al., 2017), the construction of a wind turbine module (Calderón Cerquera, 2019), or the computerized didactic proposal (Bonza Camargo et al., 2018).

In this regard, we find that the proposed experience allowed students to "learn by doing," facing a common challenge based on their own disciplinary knowledge, which became a motivating factor for the course. This is demonstrated by other authors who have undertaken participatory proposals (Restrepo Gómez, 2020) with a high content of ICT, such as Navas (2011) and Ulazia and Ibarra-Berastegi (2020), where thematic content was addressed alongside the creation of materials. This not only facilitated the transfer to the development of activities but also improved metacognitive skills related to self-planning, self-assessment, self-regulation, self-awareness, and refinement, as indicated by other authors (Kaya & Keçik, 2021; Ruiz Martín, 2020). Additionally, it expanded the appropriation of tools like eTwinning and various applications that can be used within their practices.

About the second, to discover student's learning styles and third objectives, to evaluate the level of acceptance of the experience after its execution of this research. Concerning the styles of learning present, it is concluded that there is a general trend, both in self-perception and in the applied questionnaire, towards a predominance of the active style. However, these trends only reveal a trait, as different styles can coexist within each participant. Nevertheless, the learning style tendency of the creator of the educational experience will likely influence the experience they provide to their learners. For example, a creator with a predominant active style will tend to prefer active-type activities. Therefore, their knowledge of other learning styles in the classroom, as well as the development of skills in creating materials for different learning styles, will allow them to enhance learning processes and possible inclusion experiences within their field of action (Fustero Ballabriga, 2021; González-Pons et al., 2022).

Regarding the fourth objective, concerning material development, it is found that the experience enables the development of core and transversal skills in competencies such as creativity, cooperative work, empathy, and time management. These skills contribute to the holistic development of students, while also allowing them to appropriate technological tools and connect with peers, thereby improving their social skills (Carneiro et al., 2021; García de Diego & Salinas, 2023).

About the cooperative group work of the students, it is worth noting that this type of active methodology in the classroom promotes the development of skills related to socio-affective aspects and the abilities related to the construction of learning.

Focusing on the socio-affective sphere, cooperative dynamics contribute to the development of a comprehensive set of skills that are considered essential for functioning effectively in various social contexts and scenarios. We are talking about skills such as collaborating effectively with others, establishing and maintaining positive relationships, resolving conflicts constructively, participating in dialogue and negotiation, advocating for opinions and perspectives, and empathizing with others (Díaz Pato et al., 2021; García de Diego & Salinas, 2023).

Furthermore, if we narrow our focus to the students' competence for learning, cooperative interaction promotes the development of both cognitive skills related to searching, organizing, elaborating, and retrieving information, and metacognitive skills related to identifying their strengths and weaknesses, task planning, self-regulation, evaluating the work performed, and managing improvement processes (Zariquiey Biondi, 2016).

Concerning the process, it is important to acknowledge that the variation in the number of records throughout the process makes it challenging to observe trends that are being attempted to determine in a generalized manner. However, it is essential to remember that human groups have freedom, and this prevails over research processes, respecting their decision to participate or not in the process or in some of its parts.

In general, it is important to highlight the continuity and success achieved in accomplishing the objective set in this voluntary project. This is particularly relevant when compared to other volunteer processes that often experience high dropout rates or low achievements (Dávila de León, 2008; Medina Ruiz, 2019).

As for limitations, initially, few were perceived. However, as the process progressed, increasing difficulties related to the use of the English language as a means of communication emerged. These difficulties were resolved through the use of technology and rapid learning about technology. Therefore, we could conclude that technology reduces creation times, especially when it has low learning curves in relation to the time required for its appropriation. However, it also raises issues related to technological units for communication in languages other than the native one, which could extend to the creation of educational materials without the use of technology.

Regarding the teaching experience, this type of project allows for the extension of the impact that academic spaces can generate within the contexts in which they are carried out, reinforcing the contribution to fulfilling the social function of the university. Similarly, it enables greater knowledge in non-disciplinary areas and an increase in academic networks through collaborative work (Castellanos Vega & Durak, 2022; Gilleran et al., 2017; Pedró & Galán-Muros, 2022; Punto Europa, 2023).

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