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FOSTERING CROSS-CURRICULAR DIGITAL COMPETENCE WITH ARCGIS STORYMAPS: A SECONDARY EDUCATION CASE STUDY

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Abstract: Due to the recent enhancement of the educational legislation in Spain, and, consequently, in Catalonia, a pivotal role of the transversal digital competence in compulsory secondary education has been elevated. While the importance of digital literacy has been widely recognised, some researchers claim that its practical extension to the school context should be explored more in detail. The current paper presents a case of implementation of a cross-curricular learning situation — centered on Geography and supported by Catalan and English — for third-year compulsory education students in Catalonia and examines the acquisition of digital competence through StoryMaps, a digital story mapping (DSM) tool on the ArcGIS Online platform. Employing an action research approach, the integration of ArcGIS StoryMaps into instructional scenarios was quantified through three instruments: a student survey, a teacher questionnaire, and student grades derived from a customized assessment rubric. Results indicate strong endorsement from both students and teachers regarding StoryMaps' capacity to foster engagement, content understanding, and skill extension— confirming its high applicability in interdisciplinary contexts. These findings affirm the tool's effectiveness in enhancing transversal digital competence in secondary education while highlighting the value of digital storytelling tools in curriculum design. However, the limited sample size and the focus on a single competence domain constrain the generalizability of results. Future research should include larger, more diverse cohorts and explore the application of StoryMaps across additional competences and subject areas.

Key words: secondary education, digital competence, interdisciplinary assessment, Geography, StoryMaps, technology integration.

Fomento de la competencia digital transversal a través de ArcGIS Online StoryMaps: un estudio de caso de educación secundaria

Resumen: La reciente actualización de la legislación educativa en España, y consecuentemente, en Cataluña, ha reforzado el papel de la competencia digital transversal en la educación secundaria obligatoria. Aunque se reconoce la importancia de la alfabetización digital, su implementación efectiva en las escuelas aún está poco explorada. Este trabajo presenta un caso de implementación de una situación de aprendizaje interdisciplinar basada en el contenido de Geografía para estudiantes de 3º de ESO en Cataluña — con apoyo de las asignaturas de lenguas catalana e inglesa — para evaluar el desarrollo de la competencia digital utilizando ArcGIS StoryMaps, una herramienta de narración digital. Mediante el enfoque de investigación-acción se cuantificó la integración de StoryMaps a través de tres instrumentos: encuesta a estudiantes, cuestionario docente y calificaciones basadas en una rúbrica personalizada. El estudio revela que tanto el alumnado como el profesorado valoran positivamente la contribución de los *digital storytelling maps* a la adquisición de la competencia digital: ArcGIS StoryMaps facilita la participación, mejora la comprensión del contenido y extiende las capacidades de aprendizaje —demostrando una gran aplicabilidad en contextos interdisciplinarios. Estos resultados subrayan la eficacia del recurso digital para fortalecer la competencia digital transversal e ilustran su valor en el diseño curricular. No obstante, el tamaño reducido de la muestra y el enfoque exclusivo en la competencia digital limitan la generalización de los hallazgos. Investigaciones futuras deberían incorporar muestras más amplias y diversas, así como examinar el impacto de StoryMaps en otros dominios competenciales y áreas temáticas.

Palabras Clave: educación secundaria, competencia digital, evaluación interdisciplinar, Geografía, StoryMaps, integración tecnológica.

1. INTRODUCTION

1.1. Digital Competence in Secondary Schools in Catalonia (Spain)

The rapid development of information and knowledge society is profoundly transforming all the facets of our contemporary life. Education is its essential component. Thus, it is logical that digital literacy enters more and more into national curricula of countries all over the world. Information and communication technologies (ICT) have become part of the modern lifestyle and, consequently, schools are urged to incorporate the digital competence aspect of learner's educational practice.

As a State Member of the European Union, Spain does not stand aside from these processes and steadily introduces pertinent modifications into the national educational legislation, according to the guidelines of international organisations, such as United Nations Educational, Scientific and Cultural Organisation (UNESCO), The Organisation for Economic Co-Operation and Development (OECD) and the European Parliament and the Council. In this regard, the recent educational Organic Law 3/2020, known by its acronym in Spanish as LOMLOE, aims (LOMLOE, 3/2020, Preamble) to equip learners with skills needed to ensure their full integration into the digital society. All throughout the text it is pointed out that digital competence is intrinsically cross-curricular and cannot be limited to the mastering of use of different digital devices and applications. This idea is further developed in the LOMLOE' arrangement for secondary education: "The digital competence implies safety, sustainable, critical and responsible employment of digital technologies for learning, employment and social interaction..." (Royal Decree 217/2022, Annex 1).

Similar definition can be found in the Catalanian regional curriculum for compulsory stages, there are only added personal wellness and leisure activities to the implications of the digital competence (Decree 175/2022, Annex 1). Although the legislative documentation in force seems to be relatively new, it follows up, at least at a general level, the same competence-based guidelines that had been first introduced by the previous Organic Educational Law (LOE, 2/2006), what basically means that educational system has been going through the transformative changes for more than fifteen years by now, and yet, the process is far from being over. It is remarkable though that among eight transversal competences of the national curriculum, the digital one has always held a key position.

Since the very beginning and until now, ICT integration in secondary education in Spain has been seen by many (De Cid et al., 2010; Llorens & Alarcón, 2022) as an opportunity for innovation and an overall change driver. Almost simultaneously, it has been noticed, as Ferrari's (2012) analysis of digital competence frameworks worldwide revealed that "while there are numerous 'digital literacy' initiatives, [...] few of these are organised on what we understand here as a framework, i.e., an organised conceptualisation of intertwined competences" (p. 29). Similar situation has been also reported in Spain, where, according to some scholars (López et al., 2021, p. 6), it was rather difficult to find the proper instruments of data collection for its evaluation, and although conceptualised, digital competence seemed not to be developed well enough, being too general for the school assessment (Pérez-Escoda et al., 2016, p. 172). In the Catalanian context, it has been also observed (Guàrdia et al., 2017, p. 77) that there were not enough indications in school curricula on how to apply digital competence. The latter, in the words of Sancho & Padilla (2016, p. 58), "is less evident in practical terms and difficult to be transferred to the context of schools."

It can be noted that despite undeniable advancements in developing digital competence in Catalonia, the educational community is still concerned with several issues of its implementation in the classrooms, such as teachers' instrumental readiness (Estebanell & Ferrés, 2009-2010, p. 109) or lack of initiatives of the interdisciplinary evaluation (Guàrdia, 2017; Guitert et al, 2021). In response to these shortcomings, the Department of Education of the Generalitat de Catalunya has been launching various initiatives. One foundational framework was Decree 269/2007 (enacted on December 11, 2007), which restructured the Department and embedded ICT across teaching, learning, administration, and strategic planning. More recently, the Digital Education Plan of Catalonia (2020–2023) was introduced to further strengthen digital competence among teachers and students, promote pedagogical innovation through technology, and provide methodological guidance and support in collaboration with leading research centres. The process of adapting schools to digital advances may vary depending on the particular context and educational project of each centre and its technological and pedagogical readiness, always according to the indications of the newly developed curriculum for primary and secondary education of Catalonia region (Decree 175/2022).

The current study aims to examine a single case of the implementational process in a public centre of secondary education located in Catalonia. Based on the teachers' driving group teamwork on evaluating transversal digital competence, there has been developed and implemented a learning scenario that integrates Geography, English and Catalan languages. This cross-disciplinary approach supports comprehensive assessment of both disciplinary skills and transversal (namely, digital one) competences, in the framework of the school educational project.

The driving group agreed on the web-based application StoryMaps (ESRI ©), as the shared digital tool for all the three subjects, whose usability and contribution to the learning objectives are under the loop in the current research. No previous reports on the effectiveness of StoryMaps for the assessment of digital competence were found so far, but both national and international researchers back up the general benefits of this aid for the classroom context. To mention some, the powerful combination of storytelling capabilities coupled with dynamic cloud-based mapping services (Kerski, 2015, p. 22) allows students to develop content knowledge and digital literacy (Giannakou & Klonari, 2019, p. 169).

In Spanish context, Buzo-Sánchez et al. (2022, p. 1214) highlighted an overall user- friendliness of web-based GIS tools, an important advantage for secondary schools. Puertas et al. (2023) examined applications of ArcGIS Online in Spanish secondary education and underlined that ESRI "provides schools with free access to the platform" (p. 19), including StoryMaps application, among others. As the school driving group was looking for digital aid that would be easily accessible and simultaneously suitable for both geographic and linguistic content, all the above-mentioned advantages were taken into account. As a result, ArcGIS StoryMaps application has been chosen as the digital tool to enrich the interdisciplinary learning situation with. The process of its application to the assessment of digital competence at the intersection of Geography, English and Catalan matters, aligned onto a common sequence, is described and examined in this paper.

1.2 Research on the Digital Competence

While designing learning situations, teachers are given relative freedom to adapt them to the school context and students' needs and requirements. On the practical level, it might create certain doubts, especially when it comes to the assessment of the transversal competences, such as the digital one, as they do not belong to any specific matter, but should be developed through the educational process as a whole. From the very beginning, it has been highlighted (de Cid et al., 2010, p. 4) that ICT should be put at the service of improving the teaching-learning process, working as a driver of methodological innovations.

Although the regional curriculum for primary and secondary stages has recently (Decree 175/2022) been modified, the spirit of the digital competence remains the same, so that some findings of the researchers based on the previous one, might be useful to be outlined and borne in mind. In the words of Estebanell & Ferrés (2009-2010, p. 108), the importance of digital competence consists not only of the use of the tools per se, but rather of the benefits that they can bring to the learning process. One of the possible benefits is, according to Sancho & Padilla (2016, p. 57), the students' ability to transform information into knowledge, as well as to contrast and critically evaluate the data available.

Nevertheless, to accomplish this task, digital competence must be addressed from an interdisciplinary perspective. The need for a cross-curricular approach to the assessment of digital competence has been stated by almost all authors (Baeza et al., 2022; Guitert et al., 2021; Estebanell & Ferrés, 2009-2010; Sancho & Padilla, 2016). Such a line of action allows teachers "to assess students' digital competences as embedded in disciplinary and interdisciplinary problem situations" (Guàrdia et al., 2017, p. 79). This implementation has not been straightforward, as researchers have identified several barriers hindering its effectiveness, including the need for more innovative meaningful practices (de Sid et al., 2010, p. 3; Estebanell & Ferrés, 2009-2010, p. 107; Bosco et al., 2016, p. 215). Additionally, the persistence of teacher-centered instruction and a predominantly instrumental approach to tool training—focusing on how to use technology rather than how to teach with it—have also been cited as significant challenges (Sancho & Padilla, 2016, p. 59-60).

In this regard, Guitert et al. (2021, p. 134) presented an attempt to "support schools and teachers in the teaching and learning process by providing them with a way to integrate the complexity of digital competence and make the necessary adaptations". Such adjustments relate to the framework for evaluating digital

competence in secondary schools, developed by the Edul@b research group at the Open University of Catalonia. This group has focused—then and now—on leveraging meaningful ICT use to help students develop essential 21st-century skills, including critical thinking and information evaluation. As they put it, the goal is empowering students “to discern credible information from misinformation in the age of digital abundance” (Edul@b, 2023).

According to the findings of the group (Guitert et al., 2021, p. 141), one of the critical areas of the students’ digital performance is information seeking (namely, planning, searching and selecting data, information and digital content). Such a point has strongly resonated with the concerns of the teachers involved in the centre’s interdisciplinary action plan and became a starting point for designing a learning situation with ArcGIS StoryMaps, a promising tool for enhancing broad digital skills with geo-spatial data. It is defined as “*an app-builder product that creates interactive narratives by combining maps, multimedia content, and text to communicate stories in a visually engaging way*” (“ArcGIS StoryMaps,” n.d., para. 1).

This platform enables users to combine geospatial data with narrative structures, fostering engagement, motivation, and interdisciplinary learning in geography and related disciplines. Many authors have demonstrated its important role for promoting digital competence in specific ways (Berendsen et al., 2018, p. 4; Groshans et al., 2019, p. 3) above all related to geography. education (De Lázaro et al., 2016; Buzo-Sánchez et al., 2022, p. 1210).

The current study examines this learning design through the lens of transversal digital competence—according to its definition by Decree 175/2022 (Annex 1 of the decree)—including information literacy skills. The guiding research question consists of determining the extent to which StoryMaps could be integrated into a cross-curricular learning scenario of the compulsory secondary stage from the perspective of the assessment of the digital competence, given its importance within the frame of the 21st century skills and life-long learning. Providing its intrinsically transversal essence, the digital competence was also the scarlet thread that assembled and stuck together all the three subject matters of the learning situation, settled on the methodological principles of the integrated use of languages, according to the principles of the educational project of the school.

2. SOURCES AND METHODOLOGY

2.1. Settings

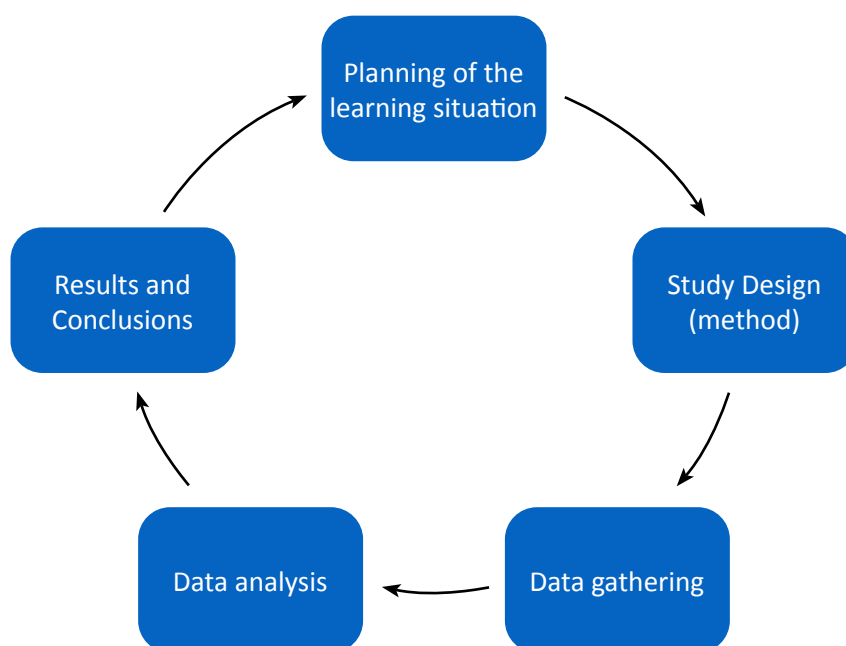
Drawing on an action research methodology, this study operationalises the guiding research question through a cyclical and iterative process of planning, action, observation, and reflection. Within this framework, the participating teachers—acting as co-researchers throughout the project—collaboratively designed, implemented, and evaluated an interdisciplinary learning scenario aimed at fostering and assessing students’ transversal digital competence.

Throughout implementation, multiple data sources were to be collected and analyzed, enabling iterative refinement of both pedagogical design and research focus. This approach aligns with action research’s core principles of participatory inquiry and context-specific improvement, offering both practical and scholarly contributions to educational practice. It is also based on the school’s endeavour to improve the teaching practice and to enhance a better competence performance for the students. This “a practice-changing practice” (Kemmis, 2009, p. 9) approach is particularly indicated for educational settings willing to reflect on and analyse data collectively in order to address the challenges being faced.

As to ensure the circular process of the data gathering and examination according to the objectives of the study, the five main stages (Lee-Post, 2009, p. 64) of the action research were set to be followed, as shown in the Figure 1.

The current investigation deals with the materials generated through the implementation process of the learning scenario, which first has been planned by the teachers’ driving group. At the second step, the teachers’ team agreed on the study design, establishing a unified framework for assessing transversal digital competence at the intersection of the three subjects: namely, Catalan language (as the instructional one), English (as a first foreign), being both applied to the subject matter of Geography. The subsequent steps of the action research are detailed in subsections 2.3 and 2.4, with the results presented in Section 3.

FIGURE 1.
STEPS OF THE ACTION RESEARCH.



Source: own elaboration, based on Lee-Post, 2009

As part of the school's linguistic project, aimed at integrating content and language learning through the Content and Language Integrated Learning (CLIL) methodology, students were first introduced to the topic in both Catalan and English. They engaged with and analyzed relevant media publications, with English materials adapted to their proficiency level.

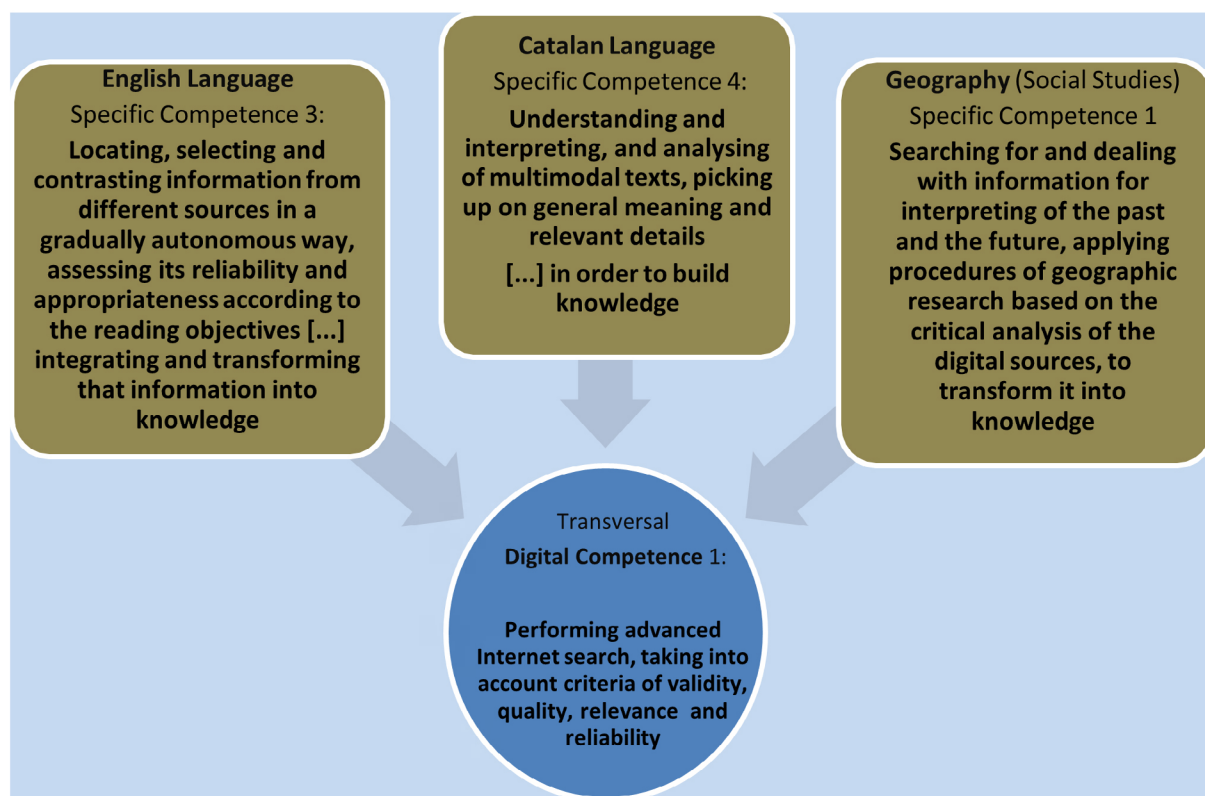
This preparatory phase was followed by instruction in the geographical aspects of Social Science, focusing on global societal challenges. In this segment, students explored contemporary issues such as sustainable development, climate change, inequalities, and urbanisation.

The teachers put in common specific competences of each subject, trying to detect possible synergies between all the three of them and, at the same time, to find the common ground for the transversal digital competence. The findings of this teamwork led to understanding of the critical processing of information and turning it into knowledge as the sticking point of learning objectives, as it is schematically shown in Figure 2. The definition and enumeration of the competences chosen for the assessment correspond to the local curriculum for basic education (Annex 1 of Decree 175/2022): one specific competence for each subject matter and one transversal, namely, the digital competence, that matches the three of them.

The title of the learning scenario under the loop goes as "Future Challenges" ("Reptes del futur") and matches, at its core, geographical knowledge of the regional curriculum for the 3rd year of compulsory education (Year 10th of KS-4 according to the British schooling system) within the curricular subject of Social Science. At the beginning of the sequence, each student individually completed a questionnaire on Knowledge and Prior Study Inventory, in order to determine to which extent they were familiar with the key concepts of the learning scenario, as well as with the digital aid StoryMaps.

No student has reported any previous knowledge on StoryMaps, thus the first acquaintance with the tool has been set as the learning objective. Instead of an instrumental mastering, students were appointed to explore StoryMaps as an informative resource to be critically processed by learners, in accordance to operative indicator 1 of the digital competence (CD1) as formulated in the regional curriculum (Decree 175/2022, Annex 1): doing

FIGURE 2.
SYNERGIES BETWEEN SPECIFIC AND TRANSVERSAL COMPETENCES OF THE INTERDISCIPLINARY LEARNING SCENARIO.



an advanced Internet search, taking into account criteria of validity, quality, relevance and reliability and thus selecting information critically.

Exploring the examples available on the website of the ArcGIS StoryMaps Community (Appendix B), students were scaffolded to gather real-life information for their oral expositions on the future challenges, after having received coordinated input from Geography, Catalan and English languages on the topic, with the materials curated by the teachers.

Once they have got familiar with the main concept, learners were led to enrich and expand their knowledge with digital story maps, to enlarge informational intake, on the one hand, and, on the other, to critically select and examine the content of an external digital source. They were given opportunities to compare and contrast, analyse information, and reflect on important issues that affect society and thus their own lives. With teachers' support, they determined the top five global topics actually present in their local area (metropolitan area of Barcelona), namely: social inequalities, tourism impact, housing, urban sustainability, energy transition).

The final outcome of the learning sequence—a collaborative exposition on one of the above-mentioned topics—was designed to provide students with an opportunity to produce and co-produce coherent oral texts that showcased both individual and collective understanding. Through this culminating task, learners were expected to demonstrate their grasp of the selected contemporary issues, articulate the connections between these issues at global and local scales, and reflect critically on their wider implications. Moreover, the exposition invited students to express the changes they would like to see in relation to these challenges and to consider how, as a student community, they could meaningfully contribute to fostering such transformations. In doing so, the activity sought not only to assess oral communication skills but also to promote civic engagement, critical thinking, and collaborative sense-making.

Students worked cooperatively under the teachers' scaffolding in order to select from the ArcGIS StoryMaps community the most suitable material that would help them endow their ideas and address the chosen topic in

an appropriate way. This task was held in common for the three subjects and is assessed through the rubric with indicators of both specific and transversal competences.

The digital competence was the only one graded by all the teachers participating in this implementation. They all worked cooperatively and contributed together to each step of the process leading to the answering of the research question.

2.2. Participants

The study was conducted in four group-classes of the 3rd Year of Basic Education (A, B, C, D), with a total number of 93 students aged 14 to 15. Although the number of students slightly varied among the groups, it is considered irrelevant for the aim of the study, as all of them were participating in the same learning situation, with the same learning objectives and materials, and were assessed through the same instruments. All the students completed the self-assessment questionnaire in the same period of time.

As per teachers' schedule and school's distribution of the teaching hours, there were 12 teachers involved in the implementation of the learning situation: six teachers for the groups B, C, D and six teachers for the group A; in terms of subjects, there were four teachers for each of them (Geography, English language, Catalan language).

The number of teachers involved was doubled due to the two split hours for each subject on a weekly basis, set by the school management in order to reduce the students' ratio and personalise the learning-teaching process. These 12 teachers have also completed a survey as participants of the investigation process.

2.3. Instruments and Data Gathering

In order to measure the contribution of digital story maps to the acquisition of the transversal digital competence, three different instruments of data collecting were considered: 1) a questionnaire answered by the students (Table 1 in the Appendix section), 2) a survey individually completed by each of the teachers involved (Table 5A in the Appendix section), and 3) the grades of the final product related to the digital competence, as per collective teachers' evaluation according to the rubric provided for the case (Table 6A in the Appendix section). For the objectives of the study, only the grades of the transversal digital competence were taken into account and analysed, based on the level of attainment of the operative indicators according to the regional curriculum.

So as to gauge digital story maps effectiveness in classrooms, the Triple E Framework has been employed, under the CC Licence. According to what has been stated by scholars like Estebanell & Ferrés (2009-2010, p. 107), digital competence extends beyond tool usage to include pedagogical benefits—such as planning, critical information use, and reflective learning. Sancho and Padilla (2016, p. 57) further highlight the importance of enabling students to transform information into knowledge through critical evaluation.

The need for an interdisciplinary, situated approach is emphasised by Baeza et al. (2022), Guitert et al. (2021), and others, who advocate embedding digital competences within disciplinary and cross-curricular contexts. The Triple E Framework has been adopted as it coherently bridges theory and practice in digital competence development. It has been designed and put at the disposal of the education community by Kolb (2020), with the aim of supporting teachers in their endeavour to improve classroom practices while using digital tools.

The method was validated later by external research (Schatzke, 2019), which backed up the Triple E rubric as a reliable instrument to gauge technology integrating into the lessons. This aligns with the emphasis on critical information use, interdisciplinary embedding of digital competence, and higher-order learning. The framework offers a structured, pedagogical instrument through which the use of ArcGIS StoryMaps can be designed, observed, and evaluated, ensuring both theoretical fidelity and methodological clarity.

In order to examine a digital tool, it is put under scrutiny through a series of questions grouped into three areas (namely, engagement, enhancing and extending) developed to measure the extent to which a digital aid matches the learning goals. These three areas were kept as data categories for the further steps of the study, as they add depth and clarity to the data gathered from both students and teachers.

According to the purpose of the research, teachers' survey is also based on the Triple E Framework. As can be seen in the Table 5A (Appendix section), there are nine questions with three Likert scale items, so as to rate the

integration of digital story maps into the learning scenario. The interpretation of the results is provided by the author (Kolb, 2020) at the bottom of the rubric, being 18 the maximum mark that could be scored by a tech tool.

Students' self-evaluation survey (Table 1, Appendix section) consists of six statements with three Likert scale items for ranking. The questions were formulated in order to measure learners' self-perceptions on the contribution of the tool StoryMaps to their progress while searching for information and transforming it into proper knowledge for the final task of the learning scenario.

Learners ranked their agreement with each statement, being a numeral three an option for agreement, two – nor agreement neither disagreement (neutral), one- an option for disagreement. It can be noticed that the statements, although formulated in an appropriate for learners' understanding manner, are aligned with the three areas of the teachers' questionnaire: sentences 1- 2 are related to the area of engagement, sentences 3-4 – enhancement, whereas 5-6 – extension, respectively).

Finally, the third instrument of data gathering consists of the rubric for the digital competence evaluation after having completed the task with help of digital story maps (Table 6A, Appendix section) completed by the teachers, through the three assessment criteria for the processing of the information from digital source (namely, searching, identification of key concepts, and transformation into knowledge matching respectively the categories of engagement, enhancement and extension) with the correspondent operational descriptors of attainment grouped into three levels and their respective numerical values for grading: expert level for marks 9.0 to 10.0; novice level for marks from 7.0 to 8.9; apprentice level for marks from 5.0 to 6.9 . For the results under the numerical value of 5.0, no level is assigned, as it is considered a non-satisfactory level of attainment. It could be seen that the maximum scoring of the rubric is 10 out 10, as it often happens in school context.

Once gathered, data from all the three instruments meant to be triangulated in order to ensure the reliability of the results obtained (Creswell, 2008, p. 259). In other words, the results of the corresponding students' and teachers' surveys could be compared and contrasted with the students' grades as per criterion-referenced rubric (Table 6A, Appendix section).

2.4. Quantitative Data Analysis

Data from all the three instruments were examined using quantitative analysis techniques, in order to answer the research question. The results of the questionnaires were originated by two groups of participants (namely, teachers and students) and supported by the third data source, the grades collectively provided by the teachers as a result of acquiring digital competence by the students.

For the purpose of the triangulation, data deriving from each instrument was grouped into the three categories (engagement, enhancement, extension), conceived to gauge digital story maps usability all throughout the learning sequence. These categories stem from the Triple E Rubric design (Kolb, 2020) and thus are intrinsic to the data obtained from students' and teachers' sources. They are not considered as instruments of information gathering, but rather supporting layers helpful for the more thorough and comprehensive analysis of the results. The three category tiers come to the aid of coherence and accuracy while triangulating the data sources.

The reliability of the data has been verified through analysis of variance across the three datasets. Specifically, we calculated group means per category and, in the case of the teachers' survey, by subject area. This statistical approach ensures consistent measurement and minimizes variance-related biases, offering a valid alternative to triangulation in quantitative context.

3. RESULTS

Table 2 displays the results of the questionnaire completed by the teachers:

In the Table 2 can be observed the aggregated scores and the breakdown by subject area – Geography, English, and Catalan. It has been considered to display the scoring distribution for each subject, as they are slightly different in total scoring (Geography mark is higher than that of English, and English one is higher than that of Catalan). These values are based on the teachers' responses to the Triple E framework questionnaire. There were twelve participants, four by each of the three subjects involved. While overall scores varied slightly by subject

TABLE 2.
MARKS OBTAINED AS PER TEACHERS' QUESTIONNAIRE BASED ON THE TRIPLE E FRAMEWORK.

Categories	Engagement	Enhancement	Extension	Total Score
Geography Teachers	4.0	5.0	6.0	15.0
	4.0	5.0	6.0	15.0
	5.0	5.0	6.0	16.0
	5.0	6.0	5.0	16.0
Mean (Geography)				15.5
English Teachers	4.0	5.0	5.0	14
	4.0	6.0	5.0	15
	4.0	5.0	5.0	14
	4.0	5.0	5.0	14
Mean (English)				14.25
Catalan Teachers	5.0	4.0	5.0	14
	4.0	5.0	5.0	14
	3.0	5.0	5.0	13
	4.0	3.0	5.0	13
Mean (Catalan)				13.50
Total Mean	4.17	4.92	5.25	14.42
Variance	0.33	0.63	0.15	0.51

(Geography > English > Catalan), a consistent pattern emerged: all teachers rated the Extension dimension—how StoryMaps help students transform information into knowledge—the highest.

Enhancement and Engagement received somewhat lower but still favourable ratings. Notably, according to Kolb's (2020) interpretation of the Triple E Framework, all three subjects demonstrated an “excellent” alignment between StoryMaps and their learning goals.

Teachers across all three subject areas—Geography, English, and Catalan—consistently rated the Extension dimension of digital StoryMaps highest, recognising its power to enable students to transform information into meaningful knowledge. Enhancement and Engagement received slightly lower, though still commendable, scores. Despite the lower ratings in the other areas, the overall alignment of StoryMaps with learning objectives was deemed excellent across all three subjects, according to the interpretation of the Triple E Framework (Kolb, 2020).

Table 3 shows the results of the students' self-evaluation questionnaire.

TABLE 3.
MARKS OBTAINED AS PER STUDENTS' SELF-EVALUATION QUESTIONNAIRE.

Categories	Engagement	Enhancement	Extension	Total Score
Average score	5.50	5.50	5.25	16.25
Variance	0.33	0.31	0.45	0.47

For the 93 participating students, mean scores were calculated and presented collectively, as the low variance across responses confirmed a high level of homogeneity. Scores were categorized under the same dimensions used in teacher evaluations—Engagement, Enhancement, and Extension—which reinforces the methodological coherence through triangulation. The overall mean rating reached 16.25 out of 18, an outcome that falls within the “excellent” range, as defined by the Triple E Framework rubric (13–18 points indicate strong alignment between technology and learning goals (Kolb, 2020).

Finally, Table 4 shows the results of the collective teachers' grading as per assessment rubric.

TABLE 4.
GRADES OBTAINED AS PER ASSESSMENT RUBRIC ON THE DIGITAL COMPETENCE.

Categories	Engagement	Enhancement	Extension	Total Score
Average grade	2.45	2.57	2.73	7.8
Variance	1.45	0.95	1.73	2.1

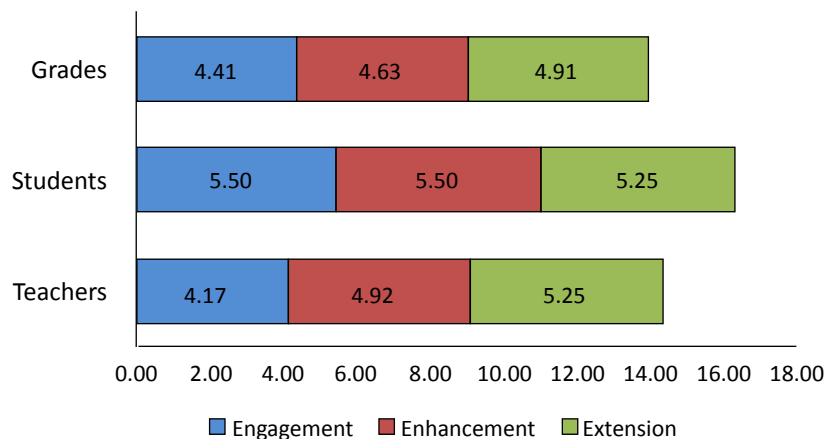
The operational indicators were deliberately aligned with the digital storytelling features already identified through earlier assessment instruments (Triple E questionnaire and student evaluations). These indicators were mapped categorially to the dimensions of StoryMaps—namely, Engagement, Enhancement, and Extension—to ensure consistency and comparability across analysis tools.

Teachers' grades, as represented in Table 4, achieved an average of 7.80 out of 10,

highlighting a strong demonstration of students' digital competence. Importantly, these scores reflect attainment of digital competence, rather than overall task performance, and thus serve as a focused gauge of StoryMaps' effectiveness.

Figure 3 graphically shows the outcome stemmed from the three instruments. As the grades were originated by the teachers, certain alignment between the categorial scoring can be observed. Due to the limited space, the instruments were renamed in a shortened way as "teachers" for the questionnaire completed by this group of participants, "students" -for the questionnaire completed by them, and "grades"- the data from the grading rubric on attainment of digital competence.

FIGURE 3.
TRIANGULATION OF THE DATA OBTAINED.



It is important to note that the evaluation scale used in the third instrument (the rubric- based grades) differs from the first two instruments, with maximum scores of 10 instead of 18. To allow meaningful comparison across all three data sources, the rubric grades were recalculated and scaled proportionally to align with the 18-point system used in the questionnaires. Once normalised, the three instruments—teachers' questionnaires, students' self-assessments, and rubric-based grades—exhibited a notable degree of consistency in how StoryMaps contributed to the development of students' digital competence, as illustrated in Figure3. This convergence across sources provides additional confidence in the findings and supports the suitability of the instrumental design.

Both groups of participants, teachers and students, confirmed StoryMaps' effective support. However, the graph displays some differences in the average ratings, for instance, students evaluate the aspect of engagement higher than teachers, and their overall ranking of the tool outreached that of the teachers. According to the data obtained, students rank the tool generally higher than the teachers, putting the engagement aspect first. It can be observed though that both teachers and students assessed the extension aspect of digital story mapping (DSM) very positively, which means that its contribution to learners' capacity to foster the building process of new knowledge is recognised by all the participants of the learning-teaching process.

It can be also said that, despite previous lack of familiarity with the tool, students were rapidly able to turn it into a valuable learning instrument. Their perceptions, as well as their grades on the digital competence development, are also in concordance, as shown in Figure 3. The graphical comparison casts more equally distributed categorial rankings as per students' perception, whereas teachers clearly put the aspect of extension first.

4. DISCUSSION

According to the study, this first attempt of digital story maps integration into the classroom for interdisciplinary assessment of the transversal digital competence was successful, the overall positive contribution of the tool to the learning process was highly rated by both teachers and students. This main result confirms the outstanding milestone from scientific literature around the education use of ArcGIS StoryMaps and other geotechnologies: the digital competence is enhanced (De Lázaro et al., 2016; Berendsen et al., 2018; Groshans et al., 2019), thanks to improvement of motivation (Giannakou & Klonari, 2019; Buzo-Sánchez et al., 2022), a facilitation of interdisciplinary issues (Groshans et al., 2019; Puertas et al., 2025), the easiness of use (Berendsen et al., 2018; Giannakou & Klonari, 2019; Puertas et al., 2023) and the enrichment of educative narratives through combined discursive formats (Berendsen et al., 2018; Groshans et al., 2019). The three instruments of data gathering from two different sources, while triangulated, deliver beneficial results in terms of engagement, enhancement and extension; this pattern was consistent across all three subject areas and categories of digital skill assessment in order to measure digital story maps assistance on the interdisciplinary stage. All the three participating subjects reported, as per teachers' questionnaire, a positive impact, especially noticeable in case of Geography matter.

Actually, Geography Education is the more researched field for the use of ArcGIS StoryMaps, as digital maps firstly enhance geographical information (Berendsen et al., 2018). Although the use of storymaps as a means of developing digital competence in cross-curricular settings is well documented (Berendsen et al., 2018; Giannakou & Klonari, 2019), its implementation in a bilingual geography context appears to be less frequent (Martín Álvarez, 2022; Piechocki-Serra, 2024). These findings were corroborated by quantitative outcomes aligned with the Triple E Framework, which validates StoryMaps as an effective tool for facilitating transversal skills in secondary education. Research suggests that geotechnologies may be particularly effective in secondary education (Álvarez & de Lázaro, 2019), perhaps due to the versatility of these tools and their capacity to support a wide range of spatial analysis and problem-solving activities appropriate for this educational stage (Berendsen et al., 2018; Buzo et al., 2022; Puertas et al., 2023). The triangulated data further enhances the credibility and robustness of these conclusions. Research supports this approach; triangulation—combining multiple methods or data sources—strengthens both the validity and reliability of research findings by reducing bias and providing deeper insight into complex phenomena. Furthermore, although the use of storymaps from a cross-curricular digital competence is not a pioneering idea [citations from Introduction], the implementation in a bilingual way alongside Geography might be quite original.

Despite these promising outcomes, several limitations must be acknowledged:

1. **Subject-Level Variance:** Although StoryMaps passed the Triple E test across subjects, the reason for the differences in the ranking among the subjects remains unexplored. Understanding this differential impact could inform subject-specific adaptations.
2. **Sample Constraints:** The study involved four student groups, each with unique characteristics. However, due to the small sample size, these distinctions were not factored into the analysis, potentially masking group-specific dynamics.

3. **Instrument Design:** The students' survey was simplified for clarity, and its categories were not clearly outlined to participants. Unlike the teachers' questionnaire, this lack of structure may have influenced student responses and reduced measurement precision.
4. **Scope of Competence Analysis:** The study focused exclusively on digital competence, despite the interdisciplinary learning scenario addressing other specific and transversal competences. Thus, potential broader benefits of StoryMaps remain unexplored.

Further investigation is needed to explore more in detail the possibilities of enriching the teaching-learning process, and on a bigger scale. More extended sample size could help to explore the issue more in detail, and from a different viewpoint, for instance, from a gender perspective. It would be important to explore possible contribution of digital story maps to a variety of learning situations, and not only at the scope of the digital competence, although there is room for investigation with the latter, but also for other specific and transversal competence.

5. CONCLUSIONS

This study provides initial evidence that digital StoryMaps can support the development of transversal digital competence in cross-curricular secondary education, particularly in bilingual Geography contexts. Both teachers and students reported that the integration of StoryMaps enhanced engagement, motivation, and interdisciplinary learning, with Geography emerging as the subject area showing the most noticeable benefits. These results align with previous research highlighting the potential of geotechnologies to support digital competence, interdisciplinary analysis, and higher-order thinking (Berendsen et al., 2018; Giannakou & Klonari, 2019; Buzo-Sánchez et al., 2022).

While the findings suggest positive trends, the limited sample size, variation across subjects, and the focus on digital competence highlight the need for further research to explore broader pedagogical applications.

Future studies could examine larger and more diverse student groups, investigate additional competences, and assess potential differences across gender or socio-cultural backgrounds. Alternative methodological approaches may also help identify subject-specific adaptations and uncover further opportunities for StoryMaps to foster critical thinking, collaboration, and interdisciplinary learning. Overall, this study serves as a first step in integrating StoryMaps into secondary education, highlighting the tool's potential for enhancing digital competence and offering a foundation for continued exploration of its pedagogical possibilities.

6. SUPPLEMENTARY MATERIAL

Appendix A

Table 1A. *Students' self-evaluation questionnaire on StoryMaps*

Please, choose the number that better reflects your personal experience of the learning situation while working with digital story maps, using the following scale:

1- if you disagree with the statement 2- if you nor agree neither disagree (neutral) 3 –if you agree

Statements to reflect upon:

1. *StoryMaps* by ArcGIS Online help me gather and select information for the final task
2. *StoryMaps* by ArcGIS Online help me stay focused on task
3. *StoryMaps* by ArcGIS Online provide me with authentic and concrete examples
4. *StoryMaps* by ArcGIS Online help me link theoretical concepts to the real life
5. *StoryMaps* by ArcGIS Online assist my understanding of the key concepts and vocabulary
6. *StoryMaps* by ArcGIS Online help me recognise global issues in my local area

TABLE 5A.
TEACHERS' QUESTIONNAIRE BASED ON TRIPLE E EVALUATION RUBRIC (KOLB, 2020)

Engagement in the learning	0=No	1=Somewhat	2=Yes
The technology allows students to focus on the assignment/activity/goals with less distraction (Time on Task)			
The technology motivates students to start the learning process			
The technology causes a shift in the behaviour of the students, where they move from passive to active social learners (through co-use or co-engagement)			
Enhancement of the learning goals	0=No	1=Somewhat	2=Yes
The technology tool allows students to develop or demonstrate a more sophisticated understanding of the learning goals or content (using higher-order thinking skills)			
The technology creates supports (scaffolds) to make it easier to understand concepts or ideas (e.g. differentiate, personalise or scaffold learning)			
The technology creates paths for students to demonstrate their understanding of the learning goals in a way that they could not do with traditional tools			
Extending the learning goals	0=No	1=Somewhat	2=Yes
The technology creates opportunities for students to learn outside of their typical school day (24/7 connection)			
The technology creates a bridge between students school learning and their everyday life experiences (connects learning goals with real life experiences)			
The technology allows students to build authentic life soft skills, which they can use in their everyday lives			
READING THE RESULTS 13-16 Points: Exceptional connection between learning goals and tool 1-12 Points: Some connection between learning goals and tool 6 Points or below: Low connection between learning goals and tool		TOTALS _____/18	

TABLE 6A.
RUBRIC FOR THE EVALUATION OF THE DIGITAL COMPETENCE FOR TEACHER GRADING

Assessment criteria	Attainment indicators by level		
	Expert 10.0-9.0	Novice 8.9-7.0	Apprentice 6.9-5.0
1. Information search online (3,3)	Defines the information need required by the task based on individual reflection.	Defines the information required by the task based on shared reflection.	Defines the information required by the task based on collective reflection.
2. Identification of the key concepts (3,3)	Identifies key concepts of words based on individual reflection and connects them to examples after individual reflection	Identifies key concepts of words based on individual reflection and connects them to examples after shared reflection	Identifies key concepts of words based on individual reflection and connects them to examples after collective reflection
3. Transformation into knowledge (3,3)	Recognises the objectivity and authenticity of information and knows how to individually get relevant information from the source for the final product	Recognises the objectivity and authenticity of information and knows how to get relevant information from the source for the final product with occasional guidance	Recognises the objectivity and authenticity of information and knows how to get relevant information from the source for the final product with guidance and support

DECLARATION OF CONFLICT OF INTEREST

The author of this article declares that they have no financial, professional, or personal conflicts of interest that could have inappropriately influenced this work.

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