Charting Cultural Fluency: Leveraging Digital Story Maps for Language Proficiency in ESP Education

Mapeando la Fluidez Cultural: Mapas Digitales en la adquisición de competencias en inglés para Fines Específicos

Cartografiant la Fluïdesa Cultural: Aprofitament dels Mapes Digitals per a l'adquisició de Competències en Anglès per a Fins Específics

Mercedes Rico García[1] Laura V. Fielden Burns[2]

1 | University of Extremadura. mricogar@unex.es
2 | University of Extremadura. lvfielden@unex.es

ABSTRACT: Cultural cartography as a way to understand the relationship between cultural manifestations and maps involves visual, symbolic and cognitive mechanisms of inquiry referring to the interpretation of territorial landscapes. The introduction of geo-computation techniques has enabled users to approach map-like visualizations of the world under different parameters. The design and interpretation of map symbology is crucial which according to Peirce (1994) is activated by forming a relationship between three distinct elements: signs, interpretants and objects. In this light, the study aims to explore the usage of digital story maps to enhance students' cultural and linguistic acquisition in a course of English for engineers in higher education.

To cover the objective, the methodology comprises a two-phased didactic approach developed as a final course project within the English for Specific Purposes (ESP) classroom. Divided into two groups, the instruction starts for the experimental and the control groups with a set of learning sessions analysing the theoretical framework underlying the semiotic process of map making and symbol interpretation. The second step for the experimental group involves the analysis and production of digital cartographic storytelling created by learners through collaborative team work, while the control group continues to analyse and then presents their conclusions about pre-existing maps to the rest of the class. The study demonstrates that the introduction of map-creation using a web-based mapping platform provided students with the ability to create geocoded narratives through visual representations, enhanced critical and spatial thinking and fostered the development of cultural and communication skills in a foreign language.

KEYWORDS: mapping; storytelling; semiotics; English for specific purposes

RESUMEN: La cartografía cultural como forma de entender la relación entre manifestaciones culturales y los mapas conlleva mecanismos de análisis de elementos visuales, simbólicos y cognitivos que ha permitido a los usuarios acercarse a representaciones del mundo similares a mapas bajo diferentes parámetros. El diseño y la interpretación de la simbología cartográfica es crucial, ya que según Peirce (1994) se activa a partir de la relación entre tres elementos distintos: signos, interpretantes y objetos. Este estudio tiene como objetivo explorar el uso de mapas de historias digitales para mejorar la adquisición cultural y lingüística de los estudiantes de un curso de inglés para ingenieros en educación superior.

Para dar respuesta al objetivo, la metodología comprende un enfoque didáctico desarrollado en dos fases como proyecto final de curso dentro del aula de inglés para Fines Específicos (ESP). Divididos

en dos grupos, la instrucción comienza para los grupos experimental y de control con una serie de sesiones de aprendizaje que analizan el marco teórico subyacente al proceso semiótico de elaboración de mapas e interpretación de símbolos. El segundo paso para el grupo experimental implica el análisis y la producción de narraciones cartográficas digitales creadas por los alumnos a través de un trabajo colaborativo en equipo, mientras que el grupo de control analiza y presenta sus conclusiones sobre mapas preexistentes al resto de la clase. El estudio demuestra que la introducción de una fase de creación de mapas utilizando una plataforma cartográfica basada en la web (grupo experimental) brindó a los estudiantes la capacidad de crear narrativas geocodificadas a través de representaciones visuales, mejoró el pensamiento crítico y espacial y fomentó el desarrollo de habilidades culturales y de comunicación en un idioma extranjero.

PALABRAS CLAVE: mapeo; narración; semiótica; inglés para fines específicos

RESUM: la cartografia cultural com a manera de comprendre la relació entre manifestacions culturals i mapes involucra mecanismes d'indagació visuals, simbòlics i cognitius referits a la interpretació dels paisatges territorials. La introducció de tècniques de *geocomputación ha permés als usuaris acostar-se a visualitzacions del món similars a mapes sota diferents paràmetres. El disseny i la interpretació de la simbologia cartogràfica és crucial, ja que segons *Peirce (1994) s'activa formant una relació entre tres elements diferents: signes, *interpretantes i objectes. En este sentit, l'estudi té com a objectiu explorar l'ús de mapes d'històries digitals per a millorar l'adquisició cultural i lingüística dels estudiants en un curs d'anglés per a enginyers en educació superior.
Per a cobrir l'objectiu, la metodologia comprén un enfocament didàctic de dos fases desenvolupat com a projecte final de curs dins de l'aula d'Inglés per a Fins Específics (*ESP). Dividits en dos grups, la instrucció comença per als grups experimental i de control amb una sèrie de sessions d'aprenentatge que analitzen el marc teòric subjacent al procés semiòtic d'elaboració de mapes i interpretació de símbols. El segon pas per al grup experimental implica l'anàlisi i la producció de narracions cartogràfiques digitals creades pels alumnes a través del treball col·laboratiu en equip, mentres que el grup de control continua analitzant i després presenta les seues conclusions sobre mapes preexistents a la resta de la classe. L'estudi demostra que la introducció de la creació de mapes utilitzant una plataforma cartogràfica basada en la web va brindar als estudiants la capacitat de crear narratives *geocodificadas a través de representacions visuals, va millorar el pensament crític i espacial i va fomentar el desenvolupament d'habilitats culturals i de comunicació en un idioma estranger.

PARAULES CLAU: mapatge; Narració; Semiòtica; anglés per a fins específics

---

Practitioner notes

What is already known about this topic:

- Digital storytelling is an effective didactic strategy for oral production already in use in EFL classrooms.
- Experiential learning (Kolb, 1984) allows for greater student engagement with new content, which facilitates language acquisition.

What this paper adds:

- A methodological framework for teaching English language learners; in particular English for Specific Purposes students, through learning semiotics and digital map-making in an experiential cycle of learning.
- Results regarding the implementation of the methodological framework in a higher education environment

Implications for practice and/or policy

- Researchers should consider adapting innovative methodological framework to develop language skills and subject content in the ESP classroom.
- Specialized digital tools should be incorporated on a regular basis for the teaching and learning of a foreign language, in particular when these involve the possibility of students creating a product of their own.
- Learning acquisition is higher when student engagement occurs through direct creative processes.

1. INTRODUCTION

The use of digital technology has paved the way for enhancing learners' skills and has enabled teachers to employ new resources, strategies, and creative activities. As a digital mapping tool, geographic information systems (GIS) can be used across disciplines with students of different technical expertise creating varied teaching possibilities through interactive student projects. Like the technology widely available today, GIS projects have become an integral part of project-based learning (PBL) (ChanLin, 2008) to produce, display and analyse data for different purposes (Hlatywayo & Manik, 2022). Geographic information systems can empower users to become active decoders of spatial information, allowing students and teachers to work on real life issues collaboratively and analyse local, national or international events in a broader cultural context. Language and sign interpretation are also central to any cultural analysis of a given map (Mohr et al., 2020; Spillman, 2020), as the meaning encoded in geo-referenced information. Since maps are produced and used by people embedded in particular cultures, cultural cartography can be understood as (1) the cartography of cultural representations of specific territories and (2) as the relationship between culture and interpretation, analysis and description through geographically mediated themes and places.

According to Cosgrove (2008), cultural cartography consists of a figure (map) or textual (metaphorical map) mechanism of sociological inquiry and interpretation, referring to a given territory. Maps are treated not as neutral representations, but rather as extensions of culture themselves, with an influence on other aspects of life (Perkins, 2008). Therefore, maps tell a story informed by the unique cultural perspective of their creator, or, to use a more linguistic framework, its narrator. Stories, creating them and interpreting them, represent a basic communicative exercise that is a staple in education and, in particular, in foreign language teaching and learning. Among the new formats available to create stories through map making, and thanks to the explosion of multimedia and the spread of online techniques, one of the most innovative options is the digital story map. Unlike reference maps, which tell us where something is, these thematic maps show the spatial distribution of specific data themes for selected geographic areas (e.g., overpopulation, migration flows, deforestation, etc.) enabling a greater understanding of the relationships between particular locations and data themes being explored.

Thus, and by acknowledging the link between language, culture, and place, this paper investigates the potential of digital maps as stories, as a communicative exercise for analysing cartographic signs through specific terminology, as well as for practicing different linguistic skills in an ESP class for students enrolled in undergraduate degrees in Industrial Design and Geomatics and Land-Surveying at a public university in Spain. When comparing a control and an experimental group, which used printed and digital story maps respectively, results showed that the creation and interpretation of geocoded stories could benefit the acquisition of map making concepts, language, and culture related competences.

2. CONCEPTUAL FRAMEWORK

2.1. Visual communication through sign interpretation in mapping

The uniqueness of maps lies in the wide array of expressive tools that they utilize to convey their fundamental cartographic information. Maps can be described as a fusion of visual and linguistic elements, often referred to as "picture-language hybrids" (Kulvicki, 2015, 149) that include visual elements, symbols and language through a multi-modal discourse. The design of effective map symbology is crucial for cartographers since they use signs to represent direction, location, distance and land features, among others, with a constant tension between adhering to international

standards - such as symbols, legends, scales, and colour conventions to ensure that maps are easily understood by a global audience- and incorporating culture-specific elements to reflect the unique cultural aspects of the region the maps represent. Choosing the best strategies for symbolism comes from knowing the variety of visual resources that exist and how to use them.

According to Peirce (1994), symbols enable communication by forming a relationship between three distinct elements:

- Sign: The physical data and sign types being transferred; for example, a red line on a map

- Object: what the sign refers to, the feature in the real world, i.e., red lines = a sign of traffic conditions

- Interpretant: The readiness of an interpreter to provide meaning for a sign, such as the way we identify a highway or a lake on a map. There is no meaning without interpretation.

(Authors, 2023), based on Peirce (1994).

Returning to cartography, if map symbology is working properly, map readers observe the signs on a map and easily link them to both the proper interpretant and the object itself, which can also be said about purely linguistic signs (Noth, 2014). However, shared experience is crucial for effective interpretation of signs because the meanings are partly determined by culture; thus, for example, the interpretation of colour, traditions and even concepts such as nature, heat, snow or a fast-flowing river may be subjected to different interpretations according to the reader's cultural experience.

In this sense, sign interpretation contains three branches that need to be taken into consideration by cartographers and which are also relevant to language teaching and learning:

- Syntactics: the study of how signs relate to each other to create a cohesive and clear entity. From a geometry dimension some of the basic relations are collinearity, parallelism, concentricity, incidence, and intersection (Zhao et al., 2011).

- Semantics: a branch which studies the relationships between the elements working on how "meaning" is established. The key representational elements of cartography are space, markers (including lines, colours, and textures), and tags (including labels and graphical symbols). According to Bellone et al. (2020) texts should contain thematic and semantic information, in addition to colour and geometric information, because an image is richer than mere colour and geometry alone.

- Pragmatics: the study of the effects of signs on their users, in this case how map readers use the information from maps to make decisions.

2.2. Elements and signs which constitute maps

Mapping is the process by which a collection of data is compiled and formatted into a virtual representation, giving an accurate image of a particular area. We can look at this in terms of its composite parts.

- Main map body: This is the map itself. All the other elements provide supplementary information meant to clarify and/or support the main map body.

- Legend: The legend explains any symbol used on the map, including a short description of what each symbol indicates. Key element for the study of context and culture.

- Title: The title reflects the subject and includes the geographic name, the layer name, and the indicator name.

- Inset map: It shows a specific area of the main map on a larger scale giving details over an area of interest. Relevant component for the generation of the story and the language acquisition.

- Scale indicator: The scale relates a single map distance unit to a corresponding distance in the real world.

- Orientation indicator: It is the relationship between the directions shown on the map vs compass directions in the real world.

- Source note: It shows where the information displayed on the map comes from. Key element for the generation of the story and the acquisition of language and culture.

- Creator graphic: This element is intended to tell the viewer who created the map. Leading component for the generation of the story and the acquisition of language and culture.

2.3. Digital maps

Unlike paper maps where users cannot obtain any more information than has been explicitly drawn, digital maps contain layers which show different features and variables. This allows users to visualize different relationships including grids, labels, geographical entities, etc. (Jones et al., 2004). One clear advantage of digital maps is that users can edit and change the appearance of the information they contain, gaining control over the information and what to display. At the same time, the map can be linked to databases so that objects can be selected, and further information can be shown. The data linked to the map may include photographs, tables or spreadsheets, and hypermedia elements, hypertexts, etc. In other words, apart from the visible design of the map, digital maps offer a complex, multimedia information structure which can help users to explore the relationship between a great deal of variables (pollution, over-population, deforestation and flooding, etc.) They combine a set of resources to decodify map language (sign process, context, marginal notes), background information about the territory, and other peripheral information that extends the map reader's information base as well as deepens its complexity.

2.3.1. Cartographic storytelling and the acquisition of language and culture skills

Maps and their design tell a visual story. This story that a map tells includes both language and culture, dimensions which are naturally intertwined. Like stories, maps reveal perspectives and biases that originate in the viewpoint of the narrative, such as those clearly visible in early world maps where the edge of a flat world butted up against a monstrous (literally) unknown and where the, now laughable, intentions and worldview of the map creator/narrator was paramount to its reading (Roth, 2020). What is enticing in maps as a story is the reveal: discovering the story is part of its promise and allure, where the viewer is intimately involved in the process of storytelling as a listener/interpreter. In this sense, map reading is an interactive exercise, involving both the creative intentions of the cartographer/narrator and the parallel process of discovery/interpretation by the viewer/reader. This has become even more apparent, for example, in the rise of citizen" maps through "volunteered geography" (Goodchild, 2007) where everyday people contribute to digital mapmaking through readily available information on the internet combined with their own experiences and travel.

This tension, created by the hand-in-hand act of interpreting and narrating, is key to storytelling in general. Narratives of all kinds have also been used in foreign language learning for skill development. Barrett (2006) notes that stories combine a

variety of important pedagogical aspects that are beneficial for foreign language learners, such as student engagement and reflection for deep learning, as well as social interaction, which is key to a more productive language use.

Storytelling in foreign language learning has been shown to help students retain vocabulary and grammatical structures, as well as more accurate pronunciation recall (Wajnryb, 2003). Speaking fluency has been shown to increase after exposure to certain storytelling methodologies, such as the Contextualized Storytelling Approach (CSA) (Cary, 1998) and positive results have been seen for both younger students and adult learners (Atta-Alla, 2012; Kim, 2010), as long as the participants show interest in stories to some degree, and these are told at their proficiency level (Kim, 2010).

A new take on narration in language teaching is digital storytelling (DST), which adds to the traditional form aspects of digital technologies and multimodal learning, since a key aspect of digital storytelling is to request students to collect material from multiple sources (Reinders, 2011).

Yuksel et al. (2011) found multiple benefits to digital storytelling in language classrooms, including for content and social skills. Leschenko et al. (2017), who used DST for English as a Foreign Language university students in the Ukraine, found that after a DST project students demonstrated higher levels of digital competence, conforming the effectiveness of the approach in general. Reyes et al.(2012) note that in working on DST, education majors at a Spanish university were able to work on different language skills, which improved after the project was completed. Students also improved linguistic routines and used more complex structures and varied expressions to open and close a conversation after the DST project.

Digital storytelling is quite similar to map-making as a narrative, in that both offer a determined perspective as they guide the listener/interpreter through a series of visual cues and signs curated by the creator, so that map-making provides the opportunity to similarly develop certain linguistic skills for ESP students, which was the focus of this project. This may span a variety of skills which engage in a number of different task types for creating a map, including production like writing (legends, labels, descriptions); speaking (explaining map in a presentation, working to create the map collaboratively); listening (listening and interacting with others in collaboration for map creation), and reading (reading sources for map creation, reading others' maps, etc.). It also engages intercultural competence, often called the "fifth skill" (Pulverness, 1999) in language learning, since the map is related to people in a given place and time. Finally, mediation, which is the use of a foreign language to mediate a text (written or spoken) for a third party and which has gained importance in language teaching since it was added to the *Common European Framework of Reference for languages* in 2018, can be practiced in DST and in map-making, since a map can be explained to a third party in a number of contexts.

In the same line Oskoz and Elola (2016) show how the integration of text, images, and sound in second language (L2) contexts may enhance the gains learners may experience (speaking, listening, and writing), including their use of grammar, vocabulary, and writing conventions.

According to Moradi and Chen (2019) the combination of societal constructivism and technology-integrated learning is crucial for obtaining academic goals and digital storytelling involves phases and steps supported by technologies to foster academic performance. In terms of digital mapping, Kikiclaya (2020) points out that utilizing both text and visuals supply learners with an entertaining and creative medium for revising concepts and that collaborative digital graphic writing provides a useful way to support retention of content.

In short, DST and digital mapping may come together for ESP skill work in interesting ways. What makes this *story mapping* work is its reliance on visuals as part of an interactive, multimodal and collaborative process. This is possible through digital

tools and software available to create GIS stories through maps for professional and nonprofessional users, marketed by different vendors or for free. In the present study, we used archGIS Story maps by ESRI (Environmental Systems Research Institute - https://www.esri.com/en-us/home, a well-known supplier of geographic information system software and geodatabase applications. For non-commercial use, users can create, store, and manage maps, scenes, apps and stories, for free.

3. THE STUDY

3.1. Objective

The study aims to explore the usage of digital story maps to enhance the acquisition of cultural and linguistic content in a course of English for engineers in higher education. We look at the following specific objectives:

> Ob. 1: To measure the effectiveness of using a web-based mapping platform to create geocoded narratives

> Obj. 2: To foster the development of cultural and communication skills in a foreign language

Hypothesis for these objectives will be discussed at the end of the Study section.

3.2. Population

The study participants were second year students at a public university in Spain taking classes in two main degree programs: Industrial Design and Geomatics and Land-Surveying. There were a total of 72 (n=72) participants, 45 men and 27 women. The course that they were taking was called Technical English, an ESP course focused on the acquisition of competences in English for engineering fields. Students participated as part of their class assignments, so that their participation was obligatory to some degree. Their work remains anonymous when used to exemplify points in this paper.

3.3. Course content and timing

The three-month course, running from February to May 2019, was divided into 4 units, covering B2 specific language and culture in ESP, and designed to prepare students for their professional endeavours in the field of eco-design and land-surveying studies. Unit 1 deals with current and emerging global challenges and Unit 2 delves into one of the main problems of the world today: global warming and consumerism. Units 3 and 4 try to look for answers and solutions to global concerns: while Unit 3 focuses on eco-friendly behaviours and actions; Unit 4 analyses the potential effects of circular economy.

Each unit of the course was composed of 12 class sessions which lasted 50 minutes: 8 sessions for steps 1-1 of phase 1 (Figure 2) (experimental group and control groups); 4 sessions for practice experimentation, what is called Students' production phase in Figure 2, which represents the 4th phase of Kolb's experiential cycles (op. cit.), explained below.

3.3.1. Course competences

The units detailed above covered a series of syllabus objectives which can be examined as desired competencies for students to acquire. The competences covered in Technical English include soft skills related with language acquisition (SK), such as:

– Being fluent in English as a foreign language (B2 *Common European Framework of Reference* CEFR).

– Diversity and multiculturality.

– Working in international contexts.

The syllabus also includes specific Competences (SC), which include in this case:

– Capacity and skills in sustainable design.

– Eco-design: Design and redesign existing concepts of a product.

– Methodology for the selection of materials and their manufacturing processes.

– Design and develop geomatics and topographic projects.

– Planning, execution and management of processes and products applicable to environmental, agronomic, forestry and mining engineering, etc. in the geomatic field.

3.4. Methodology

To reach the objective, the methodology comprises a two-phased methodological approach following Kolb's (1984) experiential learning phases, which comes from humanistic and constructivist approaches to education. This approach arises from the belief that learning occurs naturally as a result of active engagement with a task or problem to be solved. Direct experience according to Kolb is critical in the development of knowledge construction, since learning takes place through discovery as a result of active participation, where learning is "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984). Kolb's design was chosen because it focuses on this experiential component which allows for personal implication and responsibility in the skills training being undertaken in a way mere theoretical learning does not. Through Kolb's different cycles students take knowledge, apply it, reflect on that application, and learn from their mistakes in application, directly. This level of student engagement is desirable not only for content learning, in this case for learning the essential components of cartography, but also for linguistic acquisition, where students learn key map vocabulary by applying in a productive, experiential exercise.

To cover the competences above, materials and input were taken from the Internet and/or designed by the course teachers, with the objective of covering those included in both course plans. Students undertook the following steps to engage in this language and cultural training in class, where Steps 1-3 were the same for both groups, including working with the input (maps) in different formats and learning to analyse these using semiotic theory. Cultural analysis was applied in Step 2 and students were asked to work on tasks, such as analysing maps for cultural interpretations, in Step 3. Finally, in Step 4, the productive stage, students performed different productive tasks.

Students undertook the following steps to engage in this language and cultural training in class, where Steps 1-3 were the same for both groups, including working with the input (maps) in different formats and learning to analyse these using semiotic theory. Cultural analysis was applied in Step 2 and students were asked to work on tasks, such as analysing maps for cultural interpretations, in Step 3. Finally, in Step 4, the productive stage, students performed different productive tasks. This process is visible in Figure 1:

It is the active experimentation that is most essential to Kolb's model, so that students must actively create something or do something that puts what they have learned into hands-on, practical application and into an appropriate context where they control the outcome. This model has been used successfully in other ESP environments to work on relevant issues for the field under study in ESP (Rico & Fielden, 2020). The reflection and observation phases are particularly interesting for specific skill work when this methodology is used in language learning in collaboration, since
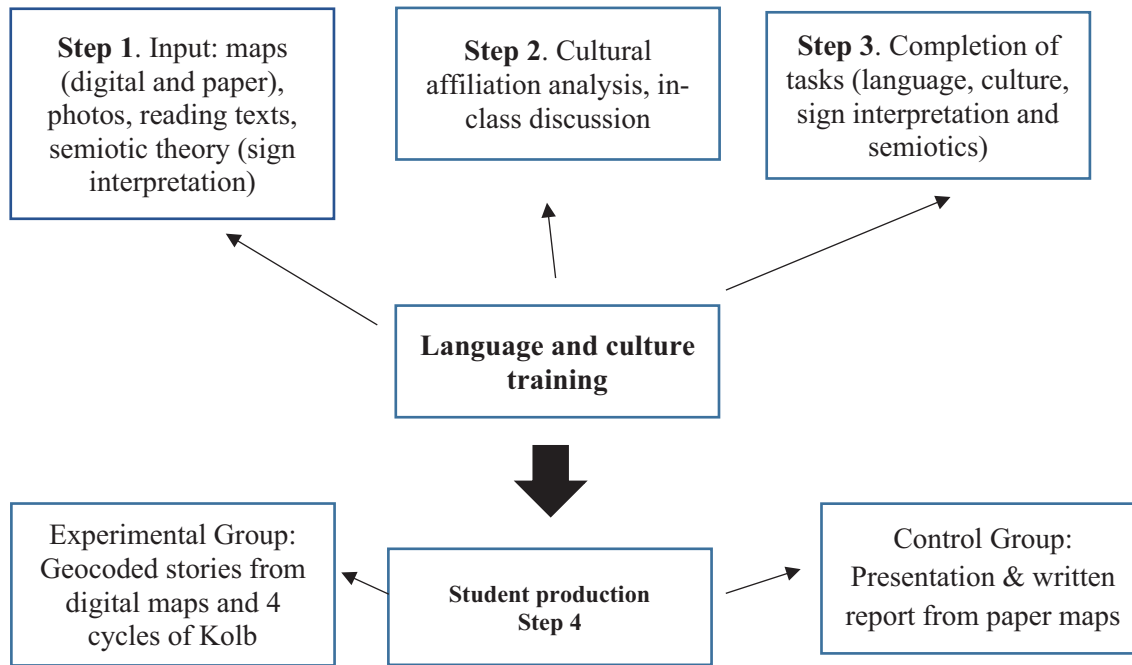
| **Step 1**. Input: maps (digital and paper), photos, reading texts, semiotic theory (sign interpretation) | **Step 2**. Cultural affiliation analysis, in-class discussion | **Step 3**. Completion of tasks (language, culture, sign interpretation and semiotics) |

Language and culture training

| Experimental Group: Geocoded stories from digital maps and 4 cycles of Kolb | **Student production Step 4** | Control Group: Presentation & written report from paper maps |

Figure 1. *Tasks design (Authors own creation, 2023)*

1. Concrete experience

- Ss receive training in map creation, including learning about appropriate terminology and types of thematic maps. In parrallel, they receive training in symbol interpretation through semiotics.

2. Reflective observation

- Using the training from Phase 1, Ss analyze a series of thematic maps through semiotics, appplying terminology to locate different map sections, etc.

3. Abstract conceptualization

- Ss in teams discuss the thematic maps of Phase 2 in terms of how sucessful the symbols and narration used to tell the geo-story was. They discuss the different possible interpretations of the map by feasible viewers.

4. Active experimentation

- Ss create their own thematic maps using the training and semiotic analysis done in Phases 1-3 as a base. This process includes a metaphase of thinking about how well their maps might be interpreted by another future audience, i.e., how well their sysmbles have been understood to narrate their visual geo-story.
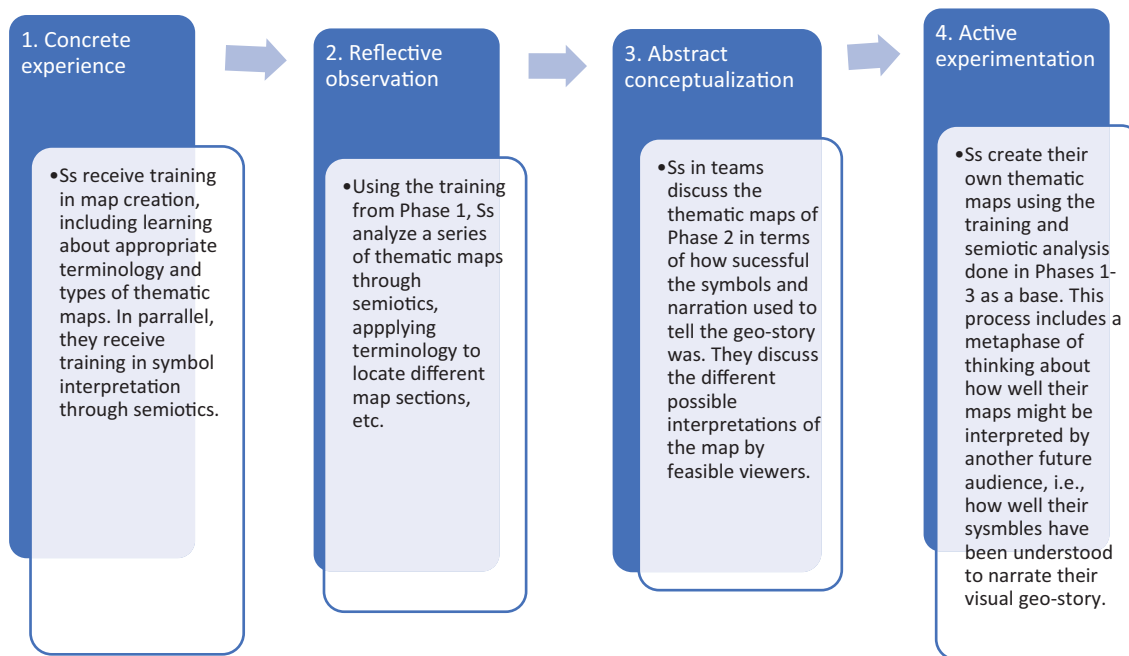
Figure 2. *Experiential learning sessions. (Authors own creation, 2023)*

they can be undertaken in the L2 and represent excellent opportunities for listening and speaking practice, including negotiating for meaning. The active experimentation phase, which in our case represents a final project which will be detailed below, was also useful for an ESP class where doing real-world, concrete tasks using relevant terminology and structures is vital for students' future professional lives.

In the study, the student participants were divided and randomly distributed into a control and an experimental group of 36 students each (n=72 total), the experimental learners being those who worked with digital maps and the Kolb cycles, as illustrated in Figure 2, below.

In Phase 4, the experimentation phase according to Kolb (1984), students complete a final project which is the creation of a geo-story told through a thematic digital, in the case of the experimental group, or paper map for the control group, after having completed the first three phases (see Annex 1: Table of content for task completion).

In both cases, the geo stories were assessed following the table in Annex 2. Table for Data assessment (Phase 2). More details on this process for the experimental and control groups are given below.

Table 1. Class sessions timeline 1-8. (Authors own creation, 2023)

Class Sessions-50 min	Experimental group & Control group	
Sessions 1-2 (Phase 1, Kolb, 1984)	Presentation of thematic maps and training in language and terminology for map creation. Semiotic training in map symbols (signs, interpretants and objects, Peirce (1994). This step aimed at understanding the role of semiotics in meaning making and appreciating differences from different cultural affiliations relevant to map creation. In class explanation was supported by materials ranging from class notes, videos, photographs from different countries and cultures. Emphasis is placed on differential interpretations according to culture.	
Sessions 3-4 (Phase 2, Kolb, 1984)	Review and practice work post training in terminology: vocabulary exercises, matching, etc., as well as a review of semiotic terms.	
Sessions 5-6 (Phase 2-3, Kolb, 1984)	Learning through observation and comparison, analysing content according to the semiotic framework provided and looking for differences, and unfamiliar situations among the content presented in step 1. This step aimed at understanding the role of semiotics in meaning making and appreciating differences from different cultural affiliations. Analysis of existing maps using semiotics. Discussion of thematic maps and their various interpretations through semiotics and culture. Discussion of how well they are narrated, and other possibilities for narrating a similar map.	
Sessions 7-8 (Phase 2-3, Kolb, 1984)	Semiotic analysis and discussion of existing maps continues. Learning through reflection by means of in-class discussion through visuals and printing material on thematic maps giving rise to new ideas, or modification of existing concepts. Introduction of final project and software to be used.	
Class Sessions-50 min	Experimental group	Control group
Sessions 9-10 (Phase 4, Kolb, 1984)	Final project work begins. Students work in teams to create digital thematic maps they will present in Session 12 in oral and written formats (geo story from digital maps)	Final project work begins. Students work in teams to investigate other paper thematic maps online. They choose one to write a report on and to present orally to their class in session 12 (geo story from paper maps)
Sessions 11-12 (Phase 4, Kolb, 1984)	Final project work finishes and is presented to rest of class. The final output includes a digital map created by students and a written geo story describing the map. Students turn in a final written report on their map.	Final project work finishes and is presented to the rest of class in the last session. The final output includes a paper thematic map from the internet and a written geo story describing the map. The final report is turned in.

Therefore, the main difference between the control and experimental group was the map creation process in the fourth phase, together with a focus on semiotics for meta-analysis of existing and their own maps post-creation (in the case of the experimental group), in the latter. Since this active experimentation (phase 4) is key to the difference between the groups, it is explained in more detail below.

Experimental group: the final phase of active experimentation (representing step four in Kolb's scheme) involved the production of digital cartographic storytelling, combining interactive maps, signs and multimedia content created by learners working collaboratively in small teams of 4-5 students to map, and telling stories about current world concerns – global problems, environment friendly actions, consumption, overpopulation, pollution, the circular economy, to name a few options

presented to them-. In this step, students are trained to work with a digital map creator, ArcGIS (https://www.esri.com/en-us/arcgis/products/arcgis-online/overview) a mapping tool that helps professional and non-professional users create maps easily. This tool was chosen because it is easy for students to learn to work with and free to use. Once the maps had been created, each team had to present them to the rest of the class explaining the selection of signs targeted to specific audiences. This presentation included a meta-creation phase where students explain the semiotic components of their map in terms of its sign, object and interpretant. This offered a more complete cycle onto the creative process from the narrators' points of view as well as from the interpretants´, so that students received key feedback on how their maps were "read" by viewers and viewers received key feedback on the creators' intentions for the map being read.

Control group: Based on the content presented by teachers in the previous phases, students firstly undertook a research stage where they looked for the same types of thematic maps in the above-mentioned areas for the experiential group (consumption, overpopulation, etc.). They found and analysed a series of printed maps to put their theoretical knowledge into practice. Then they had to choose a map to complete a written report on and present to the rest of the class as a final project in an oral presentation. In contrast to the experiential group, they did not create their own map, or do a meta-analysis of its creation in the presentation phase.

3.5. Administration and research instruments

The research study was based on quantitative and qualitative research methods for better triangulation of data. Data were collected and analysed through pre-established rubrics (Annex 2) to analyse how well students acquired content and language in 3 key areas:

- Sign interpretation in map making.
- Linguistic acquisition on current and emerging global issues in engineering, including specific vocabulary, GIS related terminology and language skills development.
- Cultural awareness about global issues regarding world regions, including students' understanding of differences and production of cultural characteristics of signs (conceptual and perceptual features of signs).

These areas were analysed in terms of the written geo stories produced in the final projects completed by both groups- The oral presentations were recorded and transcribed, and the language in them was then coded for the above 3 areas (sign interpretation, mapmaking terminology and language used and cultural considerations), enumerated and analysed with the statistical package SPSS.

An evaluation sheet (Authors) was created to analyse the output produced in the second phase (see Annex 2), included four main dimensions (map sections, signs interpretation, language and culture), subdivided into a set of 16 indicators, whose completion were measured on a Likert scale, ranging from 1 to 5 points, with 1 being the lowest score and 5 the highest. Validity was obtained by requesting commentary and suggestions from three experts in the field of geomatics, design and cultural studies. It was tested for reliability using Cronbach's alpha to test internal consistency of items. The calculation performed concluded with a 0.70 alpha, that is 0.10 points above the 0.6 standard. The reliability of the opinions and beliefs questionnaire can be consequently considered appropriate.

Students' final presentations were compared and scored using their final grades on the oral and written outputs. The final projects were evaluated using a 1 to 10 grading

scale, in which 1 is the lowest, 10 the maximum grade and 5 is the minimum pass mark. The use of this scale is motivated by the familiarization that students have with grades ranging between these values, since they are used to this measurement in exams and academic activities in all subjects at the university. Raw data is provided by researchers in the tables of content used for task completion (see Annex 1).

3.6. Hypotheses and statistical analysis

To reach our objective aimed at measuring the effectiveness of using a web-based mapping platform to create geocoded narratives and foster the development of cultural and communication skills in a foreign language, we proposed the following hypotheses:

> Hypothesis 1: In the dimension "linguistic acquisition on global issues in engineering", there is a significant difference between the mean score obtained by the experimental group and the mean score obtained by the control group through a data assessment table (XE ≠ XC).

> Hypothesis 2: In the dimension "cultural awareness about global issues regarding world regions" there is a significant difference between the mean score obtained by experimental group (XE) and the mean score obtained by the control group (XC) (XE ≠ XC).

> Hypothesis 3: In the dimension "creation of map and geographic stories (language, culture and map symbolism) through digital geocoded narratives versus written report and oral presentation on a pre-existing map in an ESP course", there is a significant difference between the mean score obtained by experimental group and the mean score obtained by control group (XE ≠ XC) (XE ≠ XC).

To contrast the hypotheses, we carried out an analysis of difference between means, which are the means of control group (students who did not make their own maps) versus experimental group (students who did make their own maps using the experiential cycles of Kolb) for the variables under study, by performing the t-Student test for independent samples. Before performing this test, we checked the normality of distributions in both groups. Normality of the scores was tested using the Kolmogorov–Smirnov test. The level was set at 0.05 for all analyses.

4. RESULTS AND DISCUSSION

To cover the research hypotheses and examine the results of both groups, we analysed the differences between the three hypotheses by conducting a Student's t test for two independent samples. According to the Levene test for equality of variances, the P-value associated with an F contrast statistic should be higher than 0.05 for the dimensions analysed at a 0.05 level of significance, three in this case, and, therefore, we cannot reject the hypotheses of equal variances for such dimensions. Considering this, tables 2 and 3 show the results obtained in the student's t-tests.

4.1. Hypothesis 1

According to the t-test (table 2), in the dimension, "linguistic acquisition on current and emerging global issues in engineering" there is a significant difference between the mean score obtained by the experimental group and the results obtained by the control group (p≤0.05). That is, the results support hypothesis 1, meaning that students who were exposed to the experiential methodology instruction for the acquisition of linguistic and semiotic conceptualization in map making and completed the geocoded narrative with a digital GIS software showed a higher degree of specific

vocabulary, GIS related terminology and concepts, noun phrases (global warming, greenhouse effect, layer, annotation, codes, marginal notes, icons, indexes, spatial query, etc.) than those simply describing a pre-existing map after the previous sessions of class instructions. Students' linguistic skills, including specific vocabulary, improved after creating digital stories (Yuksel et al., 2011).

Table 2. Independent samples test hypothesis 1. (Authors, 2023)

		Levene's Test for Equality of Variances		t-test for equality of means				
		F	Sig.	t	gl	Sig. (bil)	Mean Difference	Std. Error Difference
HP1_Unit1_ Phase2_Step4	Equal variances assumed	.034	.854	-1.997	65	.050	-1.033	.517
	Equal variances not assumed			-1.996	63.47	.050	-1.033	.518

In table 3, we show the overall contrast of means between control and experimental groups.

Table 3. Descriptive statistics hypothesis 1. (Authors own creation, 2023)

Descriptive statistics			
Control group			
	Means	Standard deviation	N
HP1_Unit1_Phase2_Step4	6.16	2.115	36
Experimental group			
	Media	Standard deviation	N
HP1_Unit1_Phase2_Step4	7.68	1.833	36

As we can see, there exist significant differences in mean values between the two groups of students (6.16 versus 7.68, control and experimental group respectively). The results could imply that map-making enhances the development of linguistic skills for EFL students (specific vocabulary and terminology), and also the acquisition of productive skills such as writing (sources notes, titles, labels, descriptions, etc.), speaking (discussion, collaborative work group to create the map, map presentation, etc.) and mediation (interpretation and description of map symbology when reading or listening or when interacting with others for map creation collaboratively). Receptive skills (reading and listening), in phase 1 from in class instructions are also practiced through multimedia inputs. These results echo other studies undertaken with DST in EFL classrooms (Leschenko et al., 2017; Reyes et al., 2012).

4.2. Hypothesis 2

In the dimension "Cultural awareness about global issues regarding world regions", there is a significant difference between the mean score obtained by experimental group and the mean score obtained by control group (XE ≠ XC)", table 4 shows that at a 0.05 level of significance the t test doesn't support hypothesis 2 (p>0.05), that is, there is no significant difference in the cultural awareness both groups show about world region disparities.

Table 4. Independent samples test hypothesis 2. (Authors own creation, 2023)

		Levene's Test for Equality of Variances		t-test for equality of means					
		F	Sig.	t	gl	Sig. (bil)	Mean Difference	Std. Error Difference	
HP2_Unit1_Phase2_Step4	Equal variances assumed	.521	.473	-.860	60	.393	-.452	.525	
	Equal variances not assumed			-.860	58.50	.393	-.452	.525	

We focused this line of research on gaining insights into how students perceived and applied cultural differences in terms of colours, shape, lines, etc. when analysing and creating thematic maps on the same topic: current and emerging global issues (e.g., Climate change, ecological collapse, overpopulation, migration flows, etc.). Students' understanding of differences in terms of the production of cultural characteristics of signs (conceptual and perceptual features of signs); sign process productions, reception and contextual factors, etc., is indicative of their cultural awareness at a basic level. Culture is a crucial issue and our results could be partly explained by the standardised geographical data and geo-media we are exposed to. Cultural factors are often under-appreciated by students who, in an ever-closer and digitalized world, often wrongly assume that societies are more universal than they are (Fielden & Rico, 2021). Global understanding is key to engineering since the prosperity of each region depends on the evolution of others and their interdependence for shared resources, etc., so that this should be further investigated.

However, there are some differences in the mean values between both groups (6.10 versus 6.55 in the case of the experimental group). In this sense, and though the number of culture conceptualizations generated by each group suggested no significant differences, there is a slightly better percentage for the experimental group, which may indicate that creating maps was more helpful to internalizing the role of culture in map-making, though clearly more research must be done since this was a non-significant difference.

In Table 5, we show the overall contrast of means between control and experimental groups (6.10 versus 6.55 respectively).

Table 5. Descriptive statistics hypothesis 2. (Authors own creation, 2023)

Descriptive statistics			
Control group			
	Means	Standard deviation	N
HP2_Unit1_Phase2_Step4	6.10	2.226	36
Experimental group			
	Media	Standard deviation	N
HP2_Unit1_Phase2_Step4	6.55	1.895	36

The results could be partly derived from a lack in the semiotic decodification of sign types (degrees of iconicity, indexicality and symbology) according to culture differences. Moreover, as thematic map creators are mainly concerned with making the map look as real as possible, accuracy in the communication of data, its patterns and relations is crucial.

4.3. Hypothesis 3

In the dimension "Creation of map and geographic stories (language, culture and map symbolism) through self-made geocoded narratives versus written report and oral presentation with genially on a pre-existing map in an ESP courses", there is a noticeable difference between the mean score obtained by the experimental group and the results obtained by the control group.

Table 6. Independent samples test hypothesis 3. (Authors own creation, 2023)

		Levene's Test for Equality of Variances		t-test for equality of means				
		F	Sig.	t	gl	Sig. (bil)	Mean Difference	Std. Error Difference
HP3_Unit1_Phase2_Step4	Equal variances assumed	.444	.508	-1.999	64	.050	-1.021	.511
	Equal variances not assumed			-2.007	63.78	.049	-1.021	,509

From Table 6, the p value associated with a t-Student test is lower than 0.05 for this hypothesis, which means that results support the third hypothesis, that is, students who undertake the creation of a digital GIS story in their learning are evaluated more positively, getting higher scores than those who describe a pre-existing map of their choice (oral presentation and written report).

There also exist significant differences in mean values between both groups of students (6. 06 versus 7.55 in the case of the experimental group, scores in a grading scale ranging from 0 to 10 points, with a minimum pass mark of 5 to achieve the minimum acceptance level of competence). Mean results are shown in Table 7 below.

Table 7. Descriptive statistics hypothesis 3. (Authors own creation, 2023)

Descriptive statistics			
Control group			
	Means	Standard deviation	N
HP3_Unit4_Phase2_Final Project	6.06	1.999	36
Experimental group			
	Media	Standard deviation	N
HP3_Unit4_Phase2_Final Project	7.55	1.786	36

This higher evaluation may have firstly to do with the understanding of concepts, the interpretation of map symbology (signs and objects) and the more frequent and accurate use of key terminology and concepts, as seen in the results for this hypothesis. The final process of learning by doing could develop a better understanding of spatial thinking, the exploration and interpretation of the world issues under study, which was also seen in other FL contexts using digital storytelling projects where students' linguistic skills improved (Leschenko et al.,2017; Reyes et al.,2012). Moreover, the semiotic decodification of map symbology and the multimedia artifacts of the mapping platform throughout its layers have influenced the results.

5. CONCLUSION

The results of this study point toward the importance that the semiotic instruction and the creation or production phase, the culmination of Kolb's experiential cycle for learning, may have for developing linguistic and intercultural skills for EFL, and concretely ESP, students. Students who created a map here used more specific vocabulary and terminology. They also showed an acquisition of more conceptual knowledge in terms of map interpretation from the semiotic approach, than students who simply presented a pre-existing map. This echoes students' vocabulary gains in Yuksel et al. (2011) and could be in part due to the greater use of productive skills in the creation phase, such as writing (sources notes, titles, labels, descriptions, etc.), speaking (discussion, collaborative work group to create the map, map presentation, etc.) and mediation (interpretation and description of map symbology when reading or listening or when interacting with others for map creation collaboratively, or it could be due to the simple fact that creation implies greater investment on the part of the learner, engaging him or her in deeper levels of critical thinking that are necessary for fabricating a product as was done in students maps here. To sum up, the act of creation, an active process, results in more profound learning than mere observation and analysis. Experiential learning provides opportunities for immersive and hands-on sessions through work experience, discussion and problem solving.

Likewise, as the world is shrinking thanks to online communities, thematic symbolism could be more culturally globalized, making it more difficult to perceive and learn about cultural differences in class sessions. Aspects such as colour, shapes, contour lines, building types, etc., that may have a variety of associations within a particular culture, have, to some extent, blurred their distinctions in the globalised geo open systems of well-known online maps at our disposal. This could partly explain the results obtained in the second hypothesis. However, given the important role of cultural symbolism, in language and cartography, the slightly better percentage for the experimental group, though not significant may be a reason for optimism, since it may point to the production map-creation phase as one that aids internalization of some of these cultural points.

The global dimension of hypothesis 3 in terms of the incidence of digital map making in the creation of successful geographical storytelling for language, culture and semiotic acquisition in ESP course can have been greatly determined by the second phase of our class methodology (learning by doing). The development of spatial thinking carried out by the experimental group could have enhanced the understanding of concepts, the interpretation of map symbology (signs and objects) and the linguistic acquisition on this topic, which was also seen in other FL contexts using digital storytelling projects where students' linguistic skills improved (Leschenko et al., 2017; Reyes et al., 2012). Making sense of their previous knowledge and in class experiences seems to have engaged students in hands-on, creative modes of learning.

The study also shows that the semiotic approach and the introduction of the multimedia artifacts of web-based mapping platforms have provided students with the ability to create geocoded narratives through visual representations and foster the development of cultural, mediation and communication skills in a foreign language.

In short, geo maps offer a comprehensive and engaging platform for language and culture learning that goes beyond the limitations of printed maps. They facilitate interactive, real-time, and personalized learning experiences, aligning more closely with the dynamic and multifaceted nature of language and culture education. As a result, we conclude with the following pedagogical considerations for future ESP classes:

- Productive, experimentation work phases push students to try out language and its meaning in more profound ways.

- One key part of this work is its orientation to an authentic context/problem
- Cultural components in EFL work may not be as clear to students as we think and may need juxtaposition to be appropriately worked.

REFERENCES

Atta-Alla, M. (2012). Integrating language skills through storytelling. *English Language Teaching 5*(12), 1-13.

Barrett, H. (2006). Researching and evaluating digital storytelling as a deep learning tool. *Technology and Teacher Education Annual, 1*, 647-672.

Bellone, T., Dante, V., Mandelli, A. & Mussio, L. (2020). An example of syntactic and semantic ties among images, texts and maps. *Applied Geomat 12*(Suppl 1), 85–96. https://doi.org/10.1007/s12518-019-00294-3

Caquard, S. & Cartwright, W. (2014). Narrative cartography: From mapping stories to the narrative of maps and mapping. *The Cartographic Journal, 51*(2), 101-106. https://doi.org/10.1179/0008704114Z.000000000130

Cary, S. (1998). *The effectiveness of a contextualized storytelling approach for second language acquisition.* (Unpublished doctoral dissertation). University of San Francisco, California.

Cosgrove, D. (2008). Cultural Cartography: Maps and Mapping in Cultural Geography. *Annales de géographie, 660-661*, 159-178. https://doi.org/10.3917/ag.660.0159

Chien, C. W. (2012). Use of Graphic Organizers in a Language Teachers' Professional Development. *English Language Teaching, 5*(10), 49-57.

ChanLin, L. J. (2008). Technology integration applied to project-based learning in science. *Innovations in Education and Teaching International, 45*(1), 55 – 65.

Dodge, M., Kitchin, R., & Perkins, C. (2011). *The Map Reader: Theories of Mapping Practice and Cartographic Representation.* Wiley-Blackwell. http://dx.doi.org/10.1002/9780470979587.

Fielden Burns, L. & Rico García, M. (2021). Intercultural and linguistic competences for engineering ESP classes: A didactic framework proposal through problem-based learning. *International Journal of Applied Linguistics, 32*(1). https://doi.org/10.1111/ijal.12370

Giannakou, O. & Klonari, A. I. (2019). Digital Storytelling In Education Using WebGIS. *European Journal of Geography, 10*(3), 154-172.

Goodchild, M. F. (2007). Citizens as sensors: the world of volunteered geography. *GeoJournal, 69*(4), 211-221.

Hlatywayo, J. & Manik, S. (2022). Teaching Geographic Information Systems (GIS) in South African High Schools in the Frances Baard District. *Universal Journal of Educational Research, 10*(5), 334 - 348. https://doi.org/10.13189/ujer.2022.100503

Jones, A., Blake, C., Davies, C., & Scanlon, E. (2004). Digital maps for learning: a review and prospects. *Computers and Education, 43*(1-2), 91–107.

Kılıçkaya, F. (2020) Learners' perceptions of collaborative digital graphic writing based on semantic mapping. *Computer Assisted Language Learning, 33*(1-2), 58-84. https://doi.org/10.1080/09588221.2018.1544912

Kim, M. (2010). The effects of storytelling on adult English language learners. *Linguistic Research, 27*(3), 447-473.

Kulvicki, J. (2015). *Maps, pictures, and predication.* Ergo, 2.

Kolb, D.A. (1984). *Experiential Learning: Experience as the Source of Learning and Development.* Prentice-Hall

Leshchenko, M., Ruban, L., & Tymchuk, L. (2017). Digital storytelling in a foreign language classroom of higher educational establishments. In 13th International Conference on ICT in Education, Research and Industrial Applications. *Integration, Harmonization and Knowledge Transfer* (pp. 428–439). Retrieved from http://ceur-ws.org/Vol-1844/10000428.pdf

Moradi, H. & Chen, H. (2019). Digital Storytelling in Language Education. *Behavioral Sciences, 9*(12), 147. MDPI AG. Retrieved from http://dx.doi.org/10.3390/bs9120147

Mohr, J., Bail, C., Frye, M., Lena, J., Lizardo, O., McDonnell, T., Mische, A., Tavory, I., & Wherry, F. (2020). *Measuring Culture.* Columbia University Press.

Nöth, W. (2014). The semiotics of learning new words. *Journal of Philosophy of Education, 48*(3).

Oskoz, A., & Elola, I. (2016). Digital stories: Bringing multimodal texts to the Spanish writing classroom. *ReCALL, 28*(3), 326–342. Oskoz, A., & Elola, I. (2016). Digital stories in L2 education: Overview. *CALICO Journal, 33*(2), 157–173.

Peirce, C. S. (1994). *Peirce on Signs: Writings on Semiotics, James Hoopes, ed., paper, 294 pp.* University of North Carolina (Chapel Hill) Press.

Perkins, C. (2008) Cultures of map use. *The Cartographic Journal, 45*(2), 150–158.

Pulverness, A. (1999). The fifth skill-intercultural awareness and language learning. *British Studies Now: Anthology Issues, 2*, 6-10.

Reinders, H. (2011). Digital storytelling in the language classroom. *ELTWO Journal, 3.*

Reyes Torres, A., Pich Ponce, E. & García Pastor, M.D. (2012). Digital storytelling as a pedagogical tool within a didactic sequence in Foreign Language Teaching. *Digital Education Review, 22.*

Rico-García, M., & Fielden Burns, L. V. (2020). Intercultural communication in engineering studies: a key competence in global labour markets. *European Journal of Engineering Education, 45*(6), 833–853. https://doi.org/10.1080/03043797.2019.1654980

Roth, R. (2021). Cartographic design as visual storytelling: Synthesis and review of map-based narratives, genres, and tropes. *The Cartographic Journal, 58*(1), 83-114. https://doi.org/10.1080/00087041.2019.1633103

Spillman, L. (2020). *What is Cultural Sociology?* John Wiley & Sons.

Wajnryb, R. (2003). *Stories: Narrative Activities in the Language Classroom. Cambridge Handbooks for Language Teachers.* Cambridge University Press.

Yuksel, P., Robin, B., & McNeil, S. (2011). Educational Uses of Digital Storytelling all around the World. In M. Koehler and P. Mishra (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011: (pp.1264-1271).* Chesapeake, VA: AACE. Retrieved from http://digitalstorytelling.coe.uh.edu/survey/SITE_DigitalStorytelling.pdf

Zhao, F., Du, Q., & Zeng, X. (2011). Syntax-based construction theory for symbols in web thematic maps. *2011 19th International Conference on Geoinformatics, 1-5.*

ANNEXES

Annex 1. Table of Content for task completion.

Creating or describing geo stories about global issues			
Main Map body	Semiotic Analysis	Language	Cultural Issues
Title	Signs	Terminology	Colour
Legends	Object	Phrases / Sentences	shapes
Inset	Interpretant	Skills	Contour lines
Scale	Meaning construction (relations & process)	Mediation	Buildings
Orientation	Context		Open spaces
Source note			
Creator			

Annex 2. Table for Data assessment (Phase 2). (Authors own creation, 2023)

| Experimental/ Control Groups	Student			
	Phase two: Assessment			
Aspects	Items		Experimental Group	Control Group
Punctuation			0 1 2 3 4 5	0 1 2 3 4 5
General	0 Map main parts			
Semiotics in map interpretation and construction	1	Sign features & Types (Icon, Index, Symbol)		
	2	Interpretant		
	3	Object		
	4	Paradigms & Syntagmatic (relations and process)		
		LAYERS		
	5	Pragmatic (context)		
Language	6	Map terminology		
	7	Phrases and sentences		
	8	Production Skills		
	9	Reception Skills (Reading)		
	10	Mediation (meaning making)		
Culture Issues	11	Colour		
	12	Shapes		
	13	Contour lines		
	14	Type of buildings & materials		
	15	Open & Leisure spaces		
			Punctuation (0-10 points)	
Overall assessment	Final outputs			

Annex 3. Figures: Example of input resources for control group
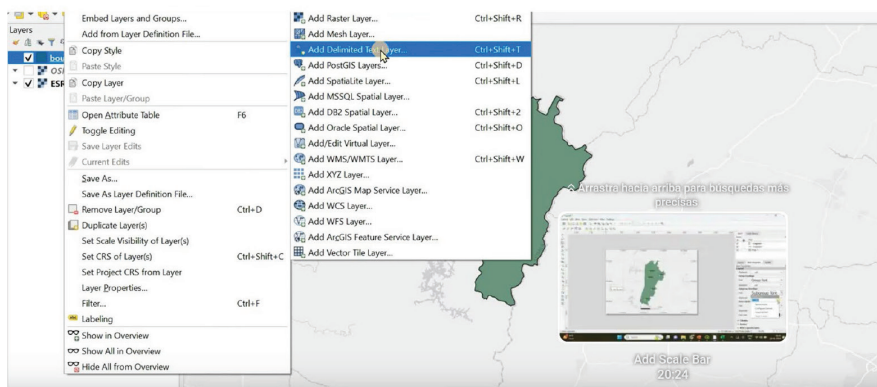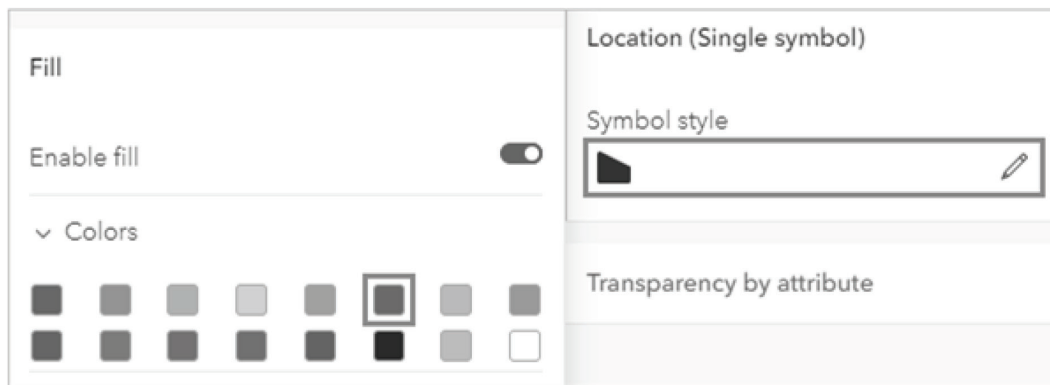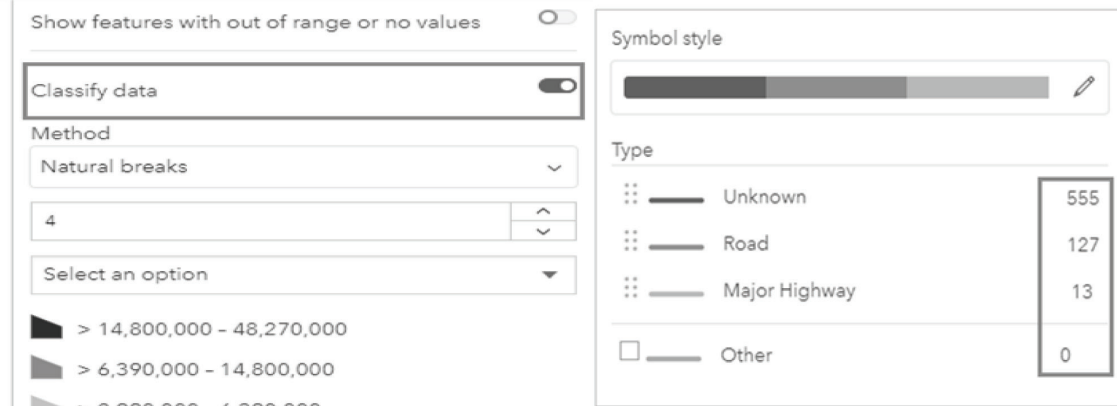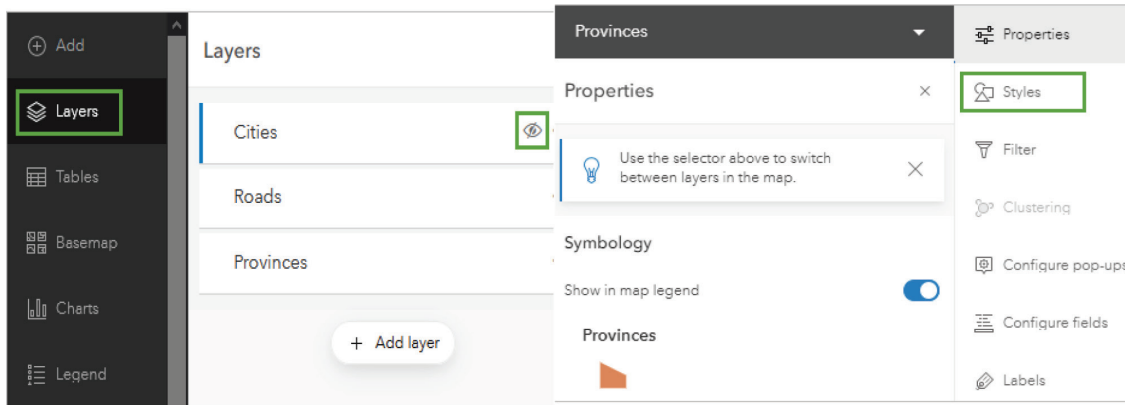(Language and culture training)

Images and maps provided to control group students
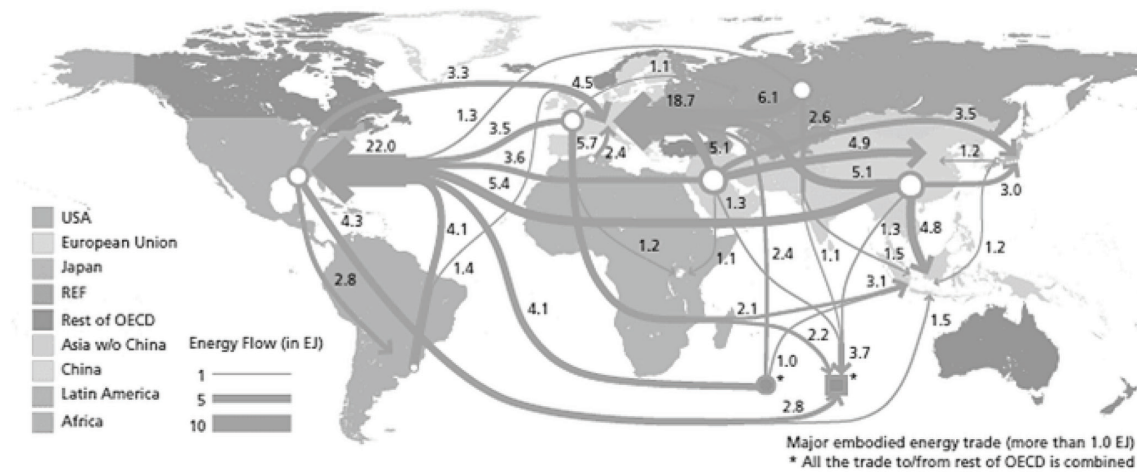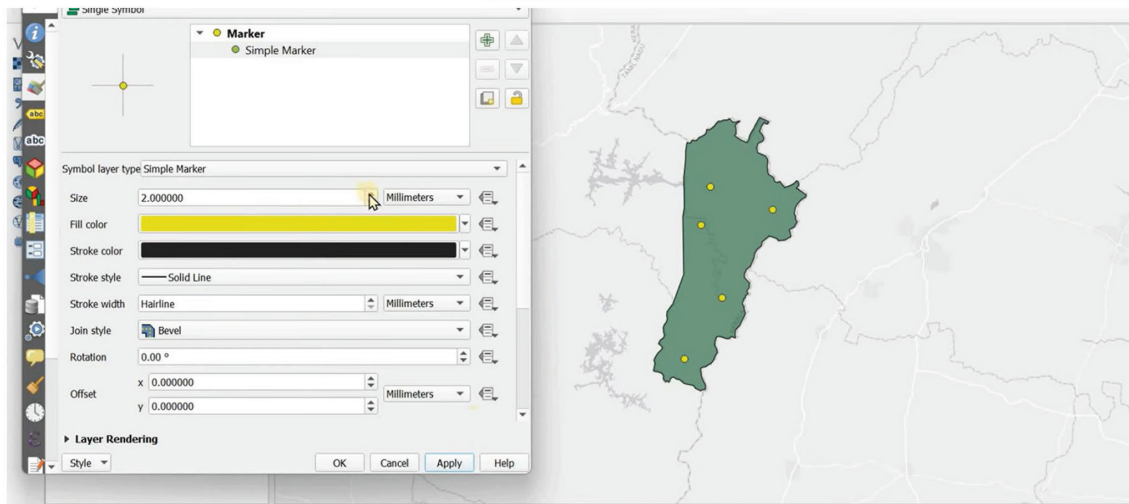

Map 1. Global issues and goals.
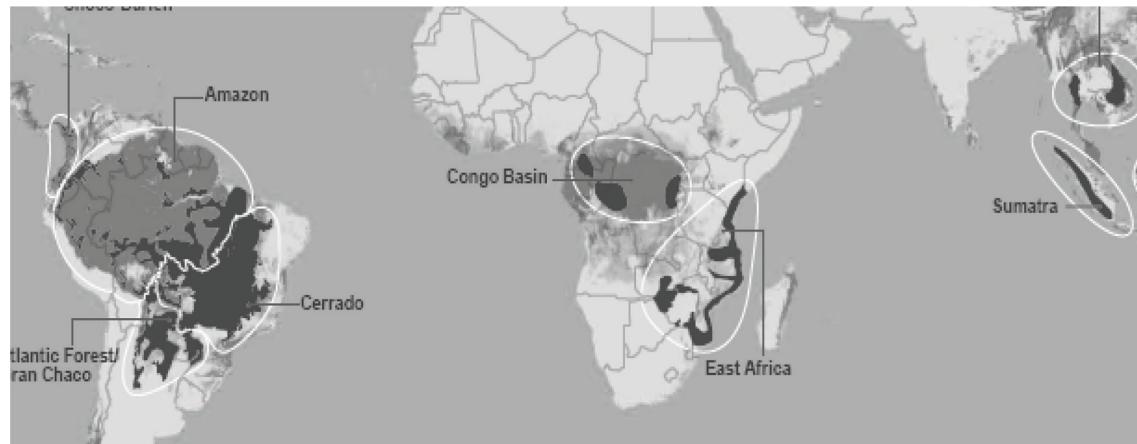
Map 2. Energy Trade.

Map 3. *Deforestation.*

Map Making (ArcGIS software). Maps produced by Experimental group students

Map 4. Environment friendly Countries.