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A Web-Scaffolding GIS Method of Spatial Planning with Rural Buildings for Teaching/Learning in Higher Education Research

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Abstract: In higher education research, computer and information technologies are getting increased consideration and attention. These technologies can be integrated into the design education through taking into account a scaffolding mechanism, which will support activities of teaching/learning in a distributed environment. This research presents a digital-based scaffolding geographic information systems (GIS) teaching/learning strategy to support architecture, urban and landscape design undergraduate students' spatial planning in a distributed design environment, especially for suitable site selection of rural buildings as an approach in higher education research. The aim of this work is to investigate the measurement and verification of the strategy proposed, which would support architecture, urban and landscape design undergraduate students to have more understanding of spatial planning in a collaborative learning context while having communication with teachers and/or experts. In a collaborative teaching/learning context, it supports learning outcomes and interaction effects of architecture, urban and landscape design undergraduate students. Here, the web model proposed adapted a spatial planning methodology and its examination for integrating a rural building in a case study area (Hervas, Spain). Using the web-based GIS model, architecture, urban and landscape design undergraduate students can correctly plan and design a rural building as using various categorized factors and taking favors from them. Moreover, the web model can support architecture, urban and landscape design undergraduate students who request communication from teachers and/or experts in a dispersed location. Hence, the web-based scaffolding GIS information model can be an approaching method to assess the competence and efficiency of using scaffoldings in encouraging teaching/learning activities for architecture, urban and landscape design undergraduate students. It is to improve meta-cognitive consciousness and in addition to knowledge achievement with regard to spatial GIS planning processes in a disseminated design environment. Thus, it is to satisfy a mix of architecture, urban and landscape design undergraduate students with different requirements in a collaborative learning project context.

Keywords: Web-Based GIS, Scaffolding Teaching/Learning, Rural Buildings, Design Undergraduate Education, Spatial Planning, Collaborative Learning, Higher Education Research

1. Introduction

Computer and internet technologies are becoming the major method within the last decade, more precisely the world wide web (WWW) is getting increased consideration and attention in the area of higher education research due to their potential to support novel forms of collaborative teaching/learning activities [1, 2, 3]. Particularly, in architecture, landscape architecture and urban planning education and practice, their rapid growth also has had a major influence [4]. Thus, these technologies proposed can be combined with paper-based teaching/learning materials due to their potential to support teaching/learning activities of collaborative and cooperative environments. However, the core pedagogy of design studio's teaching/learning has not radically changed and in the digital age is still much more challenging although such dynamic learning environments is much more engaging [5, 6, 7]. The challenge of integrating these technologies into the design studio has been made to pay attention in a scaffolding mechanism [2, 4].

Table 1. *Comparison of collaboration technologies [26].*

Technology features	Blogs	Internet board	Information portal	Instant messaging	Wiki
Share ideas in real time				√	
Ability to social interaction and discussion		√		√	√
Post rich content	√	√			√
Search within solutions	√	√	√		√
Anytime anywhere availability	√	√	√	√	√
Archival of information	√	√	√		√
Ease of use		√		√	

Previous researches specify that learners who have been short of adequate knowledge can adequately perform problem solving with various scaffolding model inquiries in higher education research [8, 9, 10]. First, scaffolding learning with these technologies applied has been assessed to support teaching/learning [11, 12]. Then, its software tools in recent project-based approaches have been investigated to offer ways to use various supporting forms [13, 14]. Hence, in the current situations, it is important to be known of such differences, since offering appropriate support to each learner can result in the improvement of his or her performance [11, 13]. Many research attempts have been completed to advance a combined tool in a unique web framework [14, 15, 16]. Still, only few researches have performed interactions among multiple modes of scaffolding and for design studio education settings [8, 18]. Because of the current situation aforementioned, in the design studio, careful site assessment is a starting point to process in design studio and needs to obey certain criteria [19].

Due to enough reasons related, collaborative and cooperative processes can be met as an integration process designed at solving complicated decision making problems [20, 21, 22]. Various participants with different levels of individual knowledge and experience is able to share their experience and knowledge on a compromise solution to make answers to conflicting opinions about desirable planning results [23, 24, 25]. There are many collaboration and cooperative technologies existing to create and share participants' experience and knowledge as shown in Table 1 [15, 26]. During the last decade, efforts have been completed to improve an integrative instrument capable of treating with both the communicative and analytical side of spatial planning and design process within a unique web framework [27, 28, 29].

Several researchers have mentioned general design and planning criteria for improving the visual impact of the rural buildings on the landscape [25, 29]. The characteristics measured contain the correct sitting in connection with the natural contours of the landscape, materials, shape and form, textures, colors, subdivision of volumes, relationship to existing buildings and their groupings, and the space organization surrounding to the building, which connects the building to the landscape [30, 31]. The mixing of the building with environment and landscape generally depends more on the right selection of location than on any other weighted aspects. The GIS suggests practical tools to work the location in depth when studying spatial planning opportunities, limitations, visual characteristics and the overall landscape part [23, 25]. Subsequently selected a proposed location, the setting in which the rural building will be set is necessary to be examined and analyzed so as to reflect the visual components of the setting that characterize the landscape in terms of number of stakeholder interests presented [23, 28].

This article presents a web-based scaffolding GIS interface to support spatial planning with rural buildings as a collaborative learning method for undergraduate architecture, urban and landscape design students and investigates new opportunities as scaffolding mechanism that this tool might bring to contemporary design education. The emphasis is to design and implement a GIS-enabled web-based scaffolding model established with the different methodologies, with the primary aim of highlighting the planning of a rural building. Using the web-based scaffolding GIS model, students can correctly plan and design a rural building as using various categorized aspects and taking favors from it. Besides, the model proposed can support students who request communication from teachers and experts in a dispersed location. Therefore, the web-based scaffolding GIS teaching/learning model can be an approaching method to evaluate the competence and efficiency of using scaffoldings in encouraging learning activities for design students.

2. Materials and Methods

The work aims at examining the potential of the web-based scaffolding GIS teaching/learning tool for the spatial planning mostly on the site analysis of design students' projects. To achieve this objective, a case study area (Hervas, Spain) has been used with a simple spatial methodology in a unique web framework as shown in Figure 1. In the study region, it has many areas with high scenic, biological and recreational value, which are tourists' attraction, and has turned the region for the place increasingly destined for weekend residence. Besides, rural buildings' developments have amplified together with significantly increased constructions of rural houses and new hotels during the last decades [29]. Remarkably, it shows that total numbers of housing involving formal and second housings have been increased along with the population trends in the data on housings, whereas empty homes have been decreased as depicted in Figure 2 [32]. Because of that, it was interesting to try this area for using to planning and designing a rural building in the design studio.

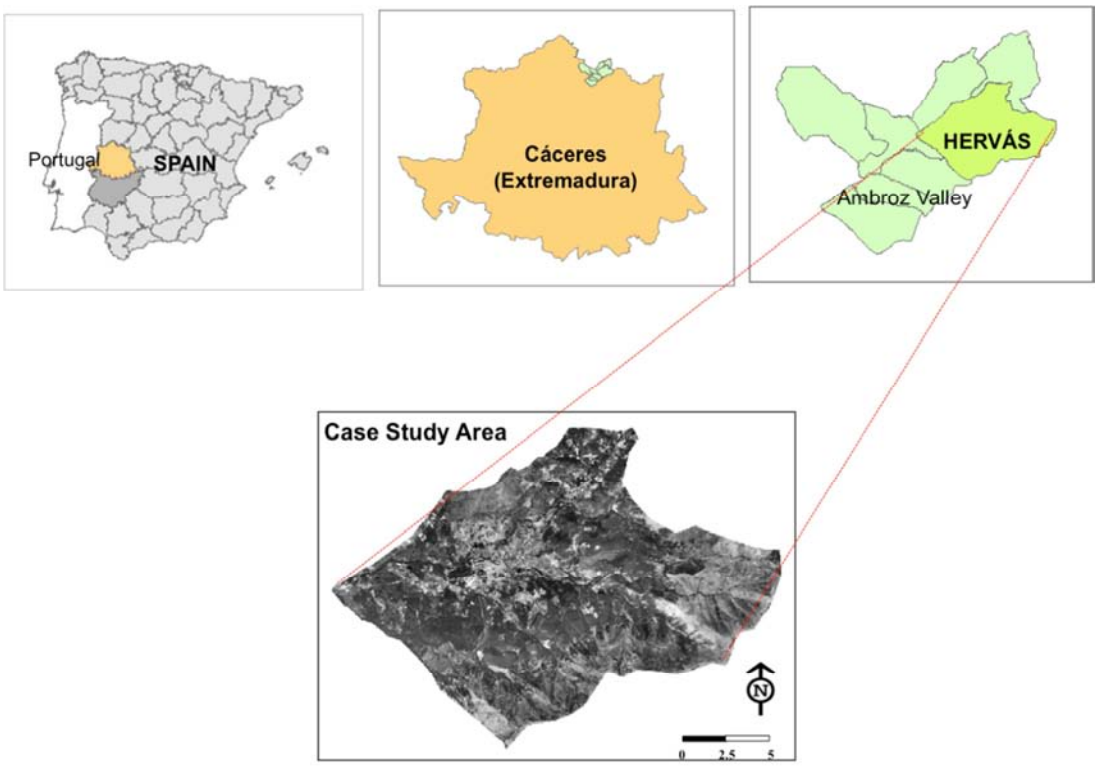

Figure 1. *Location of the study area used in developing the prototype.*

2.1. Web-based Scaffolding GIS Teaching/Learning Model for Spatial Planning

The usage of web proposes new alternative probabilities to traditional method and a communication means though the web still not offers equal opportunities to participate [17, 33]. The web-based scaffolding GIS teaching/learning tool was designed and implemented to support architecture, urban and landscape design undergraduate students' ability in resolving spatial planning problems, particularly site analysis and selection. The general structure of this tool proposed is a client/server scheme, defining the collaboration and communication between clients/servers [22, 34]. Here, we applied precisely the model-view-controller (MVC) as a scheme architecture pattern, which can be object-oriented system. The framework tool profoundly consists of general overview part, visual assessment part and a knowledge map section. Thus, it is in the consistent attempt of a single user interface thru the Internet that is congruous with other web browsers.

2.1.1. The Conceptual Framework

The conceptual framework of the web-based scaffolding GIS teaching/learning model is proposed as a solution to the better integration of rural buildings and their landscapes. It basically consists of a general overview part, a visual assessment area using multi-criteria GIS spatial decision supporting system part and a knowledge map part in the consistent method of a single user interface thru the internet as described in Figure 3.

2.1.2. Web-based Scaffolding GIS Teaching/Learning Model

The web-based scaffolding GIS teaching/learning model was designed and implemented to promote architecture, urban and landscape design undergraduate students' ability in solving spatial planning problems, especially site analysis and selection. The overall structure of this proposed web application is a client/server system. The client/server model defines the communication between clients and servers [34]. Here, we applied the MVC as a system architecture pattern to be object-oriented system. The tool framework fundamentally consists of three parts.

First, the general overview part gives introductory information, contact information, user manual, and registration form by which architecture, urban and landscape design undergraduate students can entirely access the system, and enable access to other resources also. Second, the visual assessment part consists of two major sections: the introduction page and the site analysis. Visual assessment systems for the building site analysis support the complicated spatial processes by presenting this model. Accordingly, each step has its own purpose to verify their knowledge throughout comment transcript in the bottom of the main working area. Through the integration process, participation for architecture, urban and landscape design undergraduate students is a learning experience and should be considered from the learning theory point view [35]. We might expect that a single person could not have the entire aspect and in-depth experience and knowledge of visual integrations and

its individual implications. Finally, the knowledge map part absorbs all parts of application including comment transcripts and personal tacit knowledge [36], and represents the final resource for sharing and reusing them among users, teachers and students. Therefore, students enhance their own experiences and tacit knowledge through the knowledge mapping process.

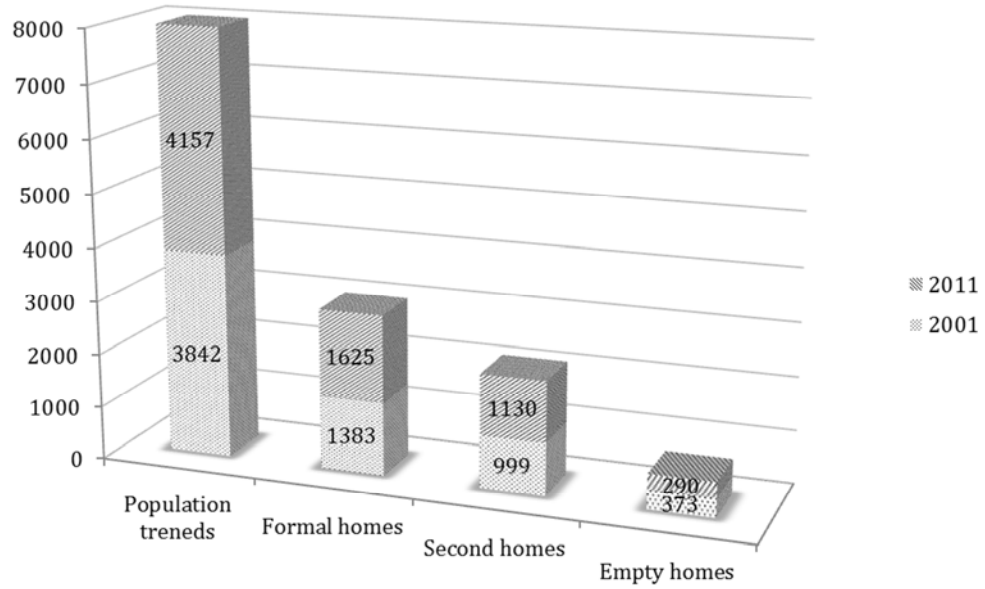

Figure 2. *Population trends and divers housing diagrams in Hervas between 2001 and 2011 census.*

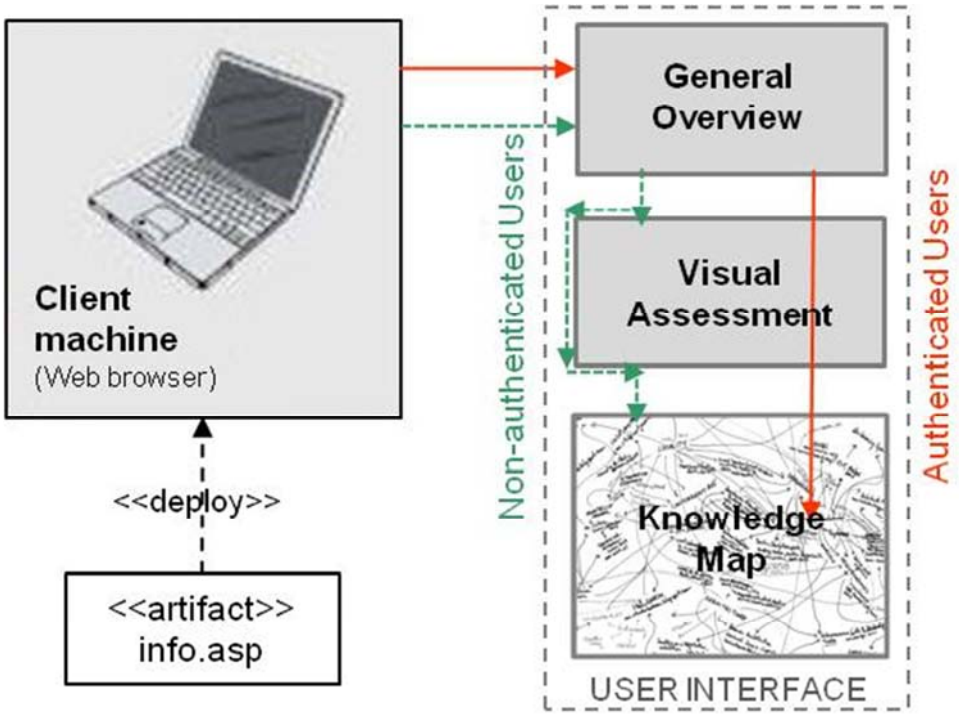

Figure 3. *The conceptual framework of the web-based scaffolding teaching/learning model.*

2.2. Design Studio Application

The study will be conducted in two design studios of the same design complexity. The design project was to design a rural building in the proposed case study area. To measure more students' responses, we will apply to two different design studios for the study. Afterwards, in the final analysis, we will perform an objective comparison with two design studios that are not used the web-based scaffolding GIS teaching/learning tool. In that way, the direct effectiveness of the tool will be assessed. For the spatial planning of the site analysis/selection with the tool as a reference, the architecture, urban and landscape design undergraduate students will have their projects sites of approximately the same area size from different zones in the case study region.

3. Results and Discussion

The web-based GIS tool as currently implemented uses the information to enable students to make decisions on the issues of analyzing the site for rural buildings and their components within landscapes. The study aims at investigating the potential of the web-based scaffolding GIS teaching/learning model for the spatial planning on the site analysis of students' design projects.

First, a visual assessment of multi-criteria spatial planning as a technology-enhanced scaffolding corresponds to the analysis of a site location using multi-criteria methodology. Here, students can explore the pilot area of rural buildings and other components integration of landscapes and then express their preferences on where it can, should and should not be located and for what building components can, should and should not be used, depicted in Figure 4. The approach for selecting the location is to provide students with information about which locations are technically feasible for a rural building and ask their opinions. This input is to be the comparative importance of the decision criteria that determines the assignment of feasible sites to the categories. After assessing all decision criteria, a final page shows the classification of the selected possible site. In this moment, architecture, urban and landscape design undergraduate students are more conscious of the task, which they are working in and are better able to judge the relationships between rural building location and its landscape.

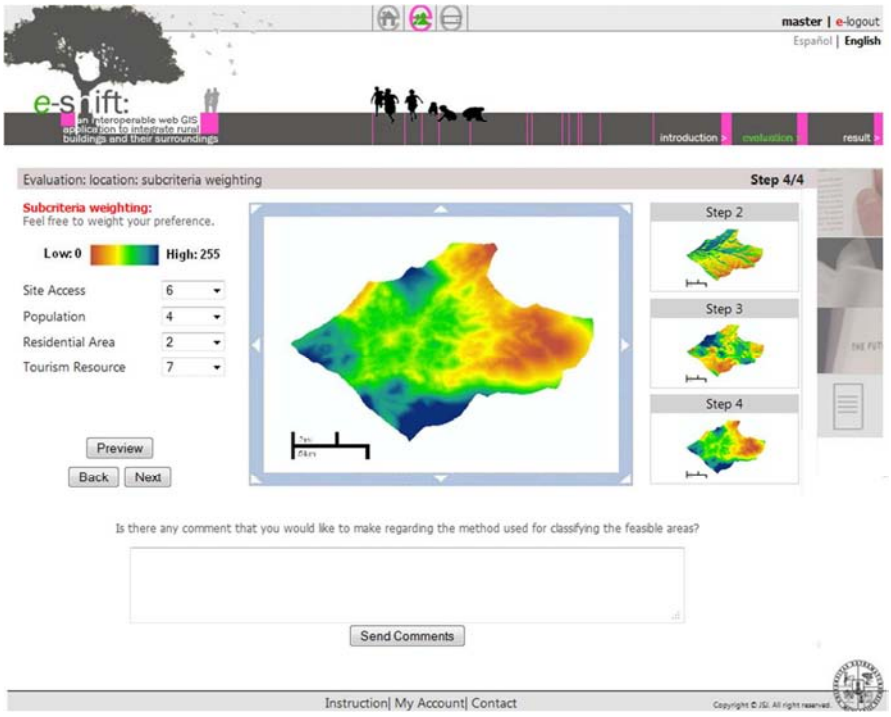

Figure 4. *Web page that depicts the multi-criteria spatial planning as a technology-enhanced scaffolding.*

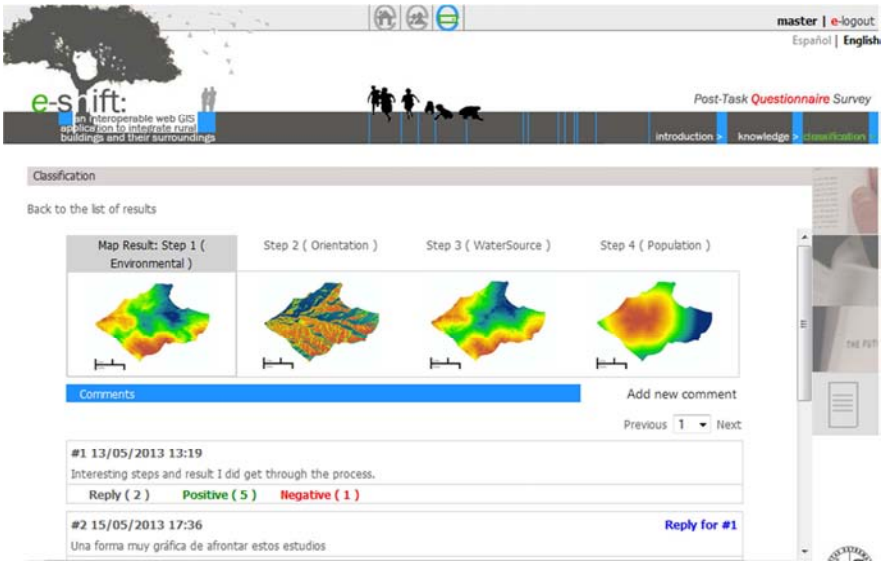

Figure 5. *Web page that depicts the knowledge map as an expert-technology-enhanced scaffolding.*

Then, a knowledge map part as an expert-technology-enhanced scaffolding offers a knowledge map that is a documentation of other students' results and to help communication on each student's classification (refer to Figure 5). The knowledge map part is the final archive and resource of this application for sharing, documenting, and reusing it among architecture, urban and landscape design undergraduate students. All commentaries between teachers and students are saved in a database, which are the record of personal tacit knowledge sharing, and will be available for students in the exchange at a later date to retrieve them for sharing the tacit knowledge that is conveyed. At the time of communication, tacit knowledge and experience can be transferred and applied other students' procedures. For instance, architecture, urban and landscape design undergraduate students read previous contributions, and learn about other students' perspectives on the suitability of locations, might wish to revisit, possibly revise, and make their own classifications again. All comments made in this section were saved afterwards in a database and this secure knowledge will be transferred and applied to other students' design processes.

4. Conclusions

This article presents a web-based scaffolding GIS teaching/learning model described to issue and facilitate practicalities for architecture, urban and landscape design undergraduate students' spatial planning process for site analysis. It is within a unique web framework that supports architecture design students' design process and fosters students' interaction effects and learning outcomes in a collaborative learning context. The proposed web model incorporates three elements: a general overview part, a visual assessment part and a knowledge map part. The methodology shows the effectiveness of using scaffoldings in fostering students' learning activities, the enhancement of knowledge acquisition with respect to spatial planning for site analysis within the context of a collaborative learning project.

Therefore, the research represents the proposed tool in order to introduce new spatial planning potentials, starting from site analysis, other than what are currently used in the field of design education in higher education research. It is to enhance meta-cognitive consciousness and as well as knowledge achievement with respect to spatial planning processes in a dispersed design environment. Also, it is to satisfy a mix of students with different needs in a collaborative learning project context. The research completes to firm results of the web-based scaffolding GIS teaching/learning tool use in the design studio, and moves further to open new research topics and venues.

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