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DEVELOPMENT OF GIS TECHNOLOGIES AND METHODS IN EDUCATION

Abstract

The paper goal is to analyze GIS opportunities as constructive pillar for student performance. The presented methodology aims to explain spatial evaluation techniques through geo-tools, which could turn into a comprehensive strategy for student education. The paper aims to emphasize the vigor influence visual impact release on error checking. The analyses aim to create an optimized methodology toward a sustainable development process. Spatial tools as executable units and geo-databases as storage units are the future of modern technologies whose embracement leads the analyst into a higher level of control. Due to vast implementation in multiple fields and life routines GIS technology comes as an attractive discipline toward students' curiosity, easily to be absorbed and subject to further development.

1. INTRODUCTION

The explosive growth of the geo-web and geographic information contributed by users through various application programming interfaces has made GIS powerful media for the general public to communicate [1]. It is thought that universities must fulfill student requirements. In general according to students' requests academicals entities structure their curricula. Still the intention remains to offer the students high probability of a fast enrolling in a working environment.

The offered educational programs are required to represent and furthermore support the current situation of the country. In times of technological change they frequently reflect the impact of the opportunities afforded by evolving technology

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and the changing labor demands of the economy in which they sit [2]. In Albania issues such as natural hazards, pollution concerns, business development, and logistics management, strictly related to spatial extension require sustainable know-ledge about GIS technologies.

There is lack of GIS specialists, caused by weak policy followed by academicals institutions. Contrasting growing numbers for geo-specialists request reveal the uncertainty of students approach toward this discipline. Hence we must invert the trend with the goal of creating a new GIS generation.

Maps have always been the referring point from which has found support any analyzes developed related to earth phenomena. Spatial technologies such as Geographical Information Systems, Remote Sensing and Global Positioning Systems have turned into the pillar of many issues and human concerns. The "G" part of GIS is a two-dimensional or three-dimensional map representing real world phenomena, the "I" stands for the database supporting descriptive information, ending with "S" covering the model created by the assemble of hardware, software, methods and people [3]. Using GIS as a decision-making tool is a smart way of gathering all the things you already know and placing them in a single spot so you can see the entire picture [4].

Hence derive the primary key of success for such a complex geographical system. The right to "mix" into a single environment unlimited and diverse variables able to create the most complete panoramic of the studied issue. GIS tends to manage the ability to adapt multiple layers from multiple sources, to succeed by arranging geo-databases and statistical data into spatial extensions, conceive facilities by executing analytical queries.

GIS is quite usual to be absorbed without drawback from all levels of followers due to its massive deployment into every kind of institutional entity whether public, private or NGOs. Due to constant application of spatial technology in working environments' it comes quite natural to transmit and analyze GIS from a vast range of aspects.

With the development of communications and grid technology, mobile GIS and grid GIS technology have entered people's vision; mobile GIS combine co-mmunications technology to GIS to achieve Mobile Location Services.; Grid GIS based on grid technology, break all closure marginal and make GIS fully integrate into the Internet environment, is a completely distributed architecture [5].

2. GIS LEARNING METHODOLOGY

We assign two projects (fig. 1), the first concerns to spatial data management, the second relates to spatial data evaluation. For the first project the paper goal is to analyze a GIS based platform in order to create a self-learning environment by design (fig. 2). Deliberately we aim to improve apprentice's conscience by developing their skills in the management of spatial tools.

A GIS is a tool for supporting a wide range of spatial analysis techniques, including processes to create new spatial objects classes, to analyze object location and attribute, also model using multiple classes of objects and the relationships between them [6].

Learners get assigned specific tasks which require minimal GIS knowledge to be performed independently without interfering to the rest of the group. The collected data meet into a unique geo-database where overlapping information has been handled by the application code.

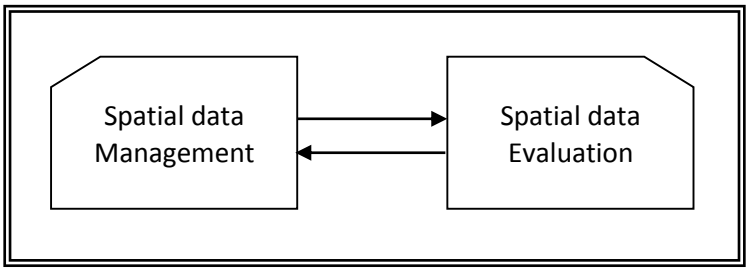

Fig. 1. Spatial interaction, learning methodology [source: own study]

The second project concerns to develop students spatial analytical skills to manage data evaluation. The experiments shown in the paper reveal three types of data inconsistency: spatial, temporal and attribute.

We simulate errors related to the country territory. The goal of the paper is to cultivate researcher's conviction that visual evaluation will always offer larger opportunities compared to numerical evaluation. Anyway geographical information systems are the ideal platform that involves both mapping presentation in-front also numerical presentation in-back. The offered possibility to integrate into a single platform statistical data associated with geographical entities should be considered an advantage for data analyzers. Researchers can benefit from both options.

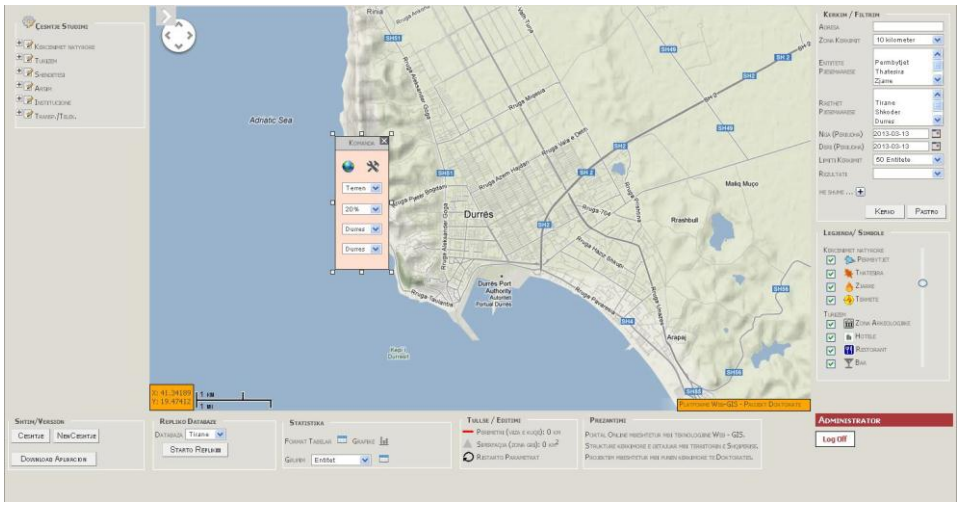

Fig. 2. Modularity backstage [source: own study]

3. SPATIAL DATA MANAGEMENT PROJECT

Students performance is monitored constantly, from their data input to the level of accuracy and update the selected information has been chosen. Still any error or misunderstanding can be recovered any time facilitating the operational procedure. The goal is to create a synchronous group with a satisfactory level of collaboration. Due to the online environment the platform relies on, it enables the extension of working hours beyond the institution limit, creating a pragmatic application fully adoptable in a vast variety of facilities and free from any time constrain.

GIS is a multi-concentrated discipline including a wide range of profiles that turns in the eyes of the students into an attractive and stimulatory trend to be followed and practiced. Experience show us that people specialized in GIS field benefit from larger opportunities to get involved into projects and institutional entities. Geo technologies allow students to study local to global phenomena and incorporates fieldwork [7].

They connect students to the real world, outbounding the institutional theoretical limit. By so we increase student awareness and promptitude toward the assigned task. Students are assigned into small groups, usually no more than the fields of the studied area. Figure 3 show the login process, where each student receives unique credential data, further can be personalized. The thematic chosen in this paper is Tourism. Five fields mean that five students are required to carry on the project.

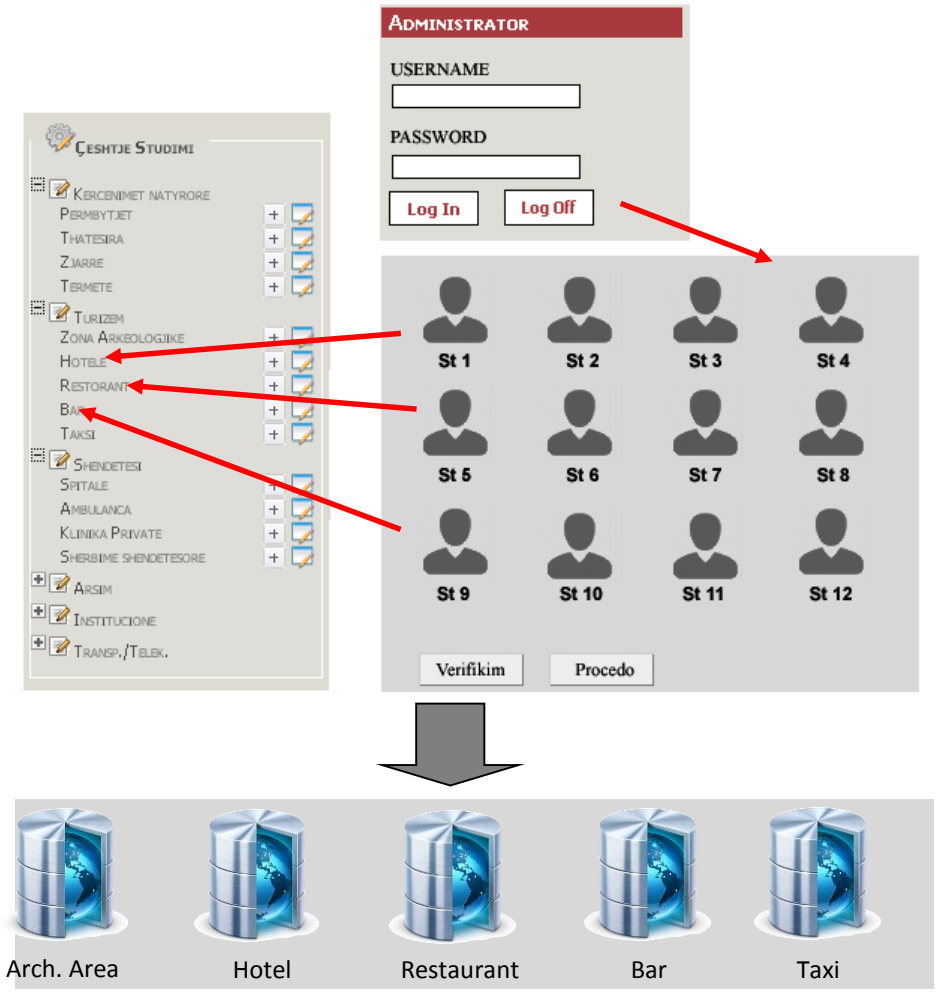

Fig. 3. Class management [source: own study]

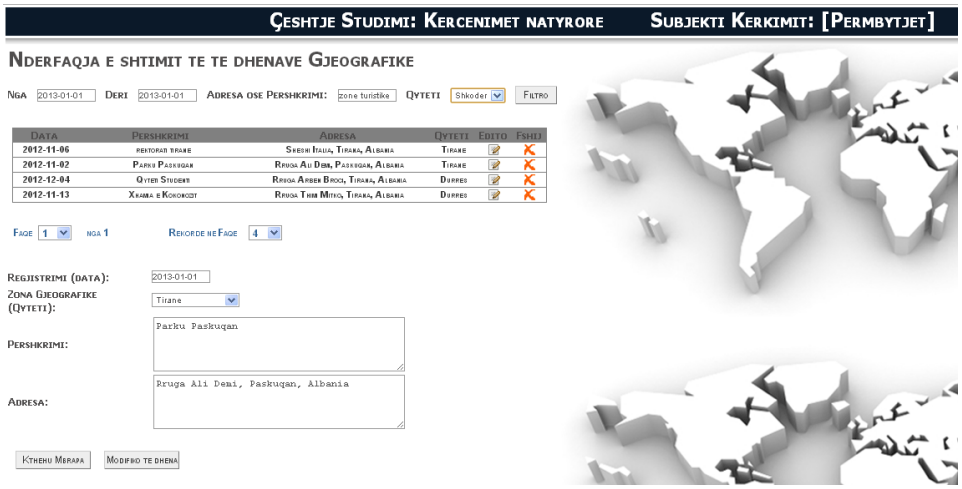

Fig. 4. Spatial data management module [source: own study]

The spatial area should not be much extended; this would require larger groups and multiple students for a single field due to the vast amount of geographical data to be processed. Taking into account the geographical area of the country, we assume that fragmenting the territory at district level is the most adaptable spatial extension. Hence it is required the student to have sustainable knowledge about the assigned area, by so the assignation process must be carefully conceived.

Further the student manages his own geo-database. Each storage unit is autonomous from other units with unique attributes. This creates an optimal environment for the student. Each row reflects the geographical coordinates and attributes of the object. The advantage of the application consist in that the student cooperate with each other as for geographical allocation concerns, still compile their personal environment where any executed query is applied without interference to each other work (fig. 4). As such it turns comprehensive to benefit from a clearly and distinct evaluation process of both collaborative and individual student performance.

The platform can be accessed online or downloaded to be subject of further investigation. The modularity structure of WGA creates the perfect condition to develop student performance and creativity. On the other side students are encouraged to enrich the platform with new modules according to the revealed issues during the projects development. GIS has the potential to enhance spatial thinking itself [8]. A new understanding, or a new narrative, or a new solution to a problem, could emerge from a map because we can so easily expand our frame of reference, which is the basis for spatial relations and spatial cognition [9]. The possibility to work both online and offline is a stimulus for a larger approach toward the platform.

4. SPATIAL DATA EVALUATION PROJECT

We could stare a table of numbers all day and never see what would be immediately obvious when looking at a good picture of those same numbers [10].Data quality can be assessed through data accuracy (or error), precision, uncertainty, compatibility, consistency, completeness, accessibility, and timeliness as recorded in the lineage data [11]. Large amounts of data expressed through statistical variations turn to be more difficult to interpret and analyze. It is expected that the level of complexity for error evaluation increase sharply with data acquisition.

The world is evolving at a rapid pace and in this environment, "information is considered power", and this is what GIS performs best, "manipulates information to provide better decision-making" [12]. Since the first steps GIS technology has contribute to bring problem perspective into a different level of management.

Map researchers developed continues efforts to present digital maps as a potential source of solution for multiple issues. Through digital mapping the researcher create a new approach exploiting the human spatial cognition abilities. Cognition of geographic information deals with human perception, memory, reasoning, problem-solving, and communication involving earth phenomena and their representation as geospatial information [13].

When it comes for error evaluation we notice two types of cognition, spatial and numerical. Numerical cognition involves anything that deals with numbers and figures. Here we mention any tabular data registered in complex storage units such as database management systems or spreadsheet applications. Numerical cognition requires specialized people to perform evaluation task and error detection.

It means that apart from personal knowledge about the environment which the current issue is being analyzed the researcher need to have substantial applicative skills in the field of software management. As for spatial cognition we claim anything concerned with the acquisition, organization, utilization, and revision of knowledge about spatial environments [14].

Anything related to spatial environment leads directly to mapping evaluation and as a result the need to exploit spatial tools into a geographical information system. Spatial cognition is the last step of a long process of data manipulation, strictly connected to cognitive agents to act and interact in space intelligently and to communicate about spatial environments in meaningful ways [14]. That’s why the advantage of spatial cognition is that it doesn’t necessary need GIS experts to perform the evaluation. In contrast with numerical cognition the researcher is basically required to own sustainable knowledge about the studied area.

5. EVALUATION METHODOLOGY

GIS gain much of their power from being able to collate and cross-reference many types of data by location; hence they can integrate many discrete datasets within a single system [15]. Hence multiple people can work on the same project, using multiple sources. By so the possibility for errors is highly probable. Meaning during mapping process the user must follow a continuous and rigorous checkup. According to Peng citation we can divide inconsistency into spatial, temporal, and attribute and inconsistency among any combination of space, time and attribute [16].

Spatial inconsistency refers to problems that emerge due to errors in the distribution of entities into a specified spatial extension. Temporal inconsistency is associated with the period which the geographical entities reveal or belong to. At last we claim attribute inconsistency related to mistakes developed on data elaboration mainly expressed through charts, diagrams, or geographical schema. Further we proceed to analyze each inconsistency model through the country territory paradigm.

Case one: Attribute inconsistency

Case one takes into account the most polluted shoreline zone in the country coastline. Coliform bacteria have been used to evaluate the general quality of water. Two other groups of bacteria that are present in feces are: fecal streptococci (FS) and Clostridium (FC) [17]. Our investigation considers the values obtained by the Public Health Institute which has set a limit rate of 100 for water pollution. The map reveals that the attribute data are structured improperly. As we see from the geo-database almost all checkpoints exceed the limit of 100, which means that necessarily the chart (fig. 5) must show high values for FS and FC indicators which in fact doesn’t seem to happen.

Case two: Spatial inconsistency

Case two refer to spatial inconsistency. We consider the population density of the country (fig. 6) at a comparative level. The analytical process comes to be much easier and approachable from the user's side not only to distinguish but also to define the areas that need correction or the type of errors that have been made [18]. The fact that the geographical data is expressed through digital mapping and not rough database rows increases the possibilities of perception that the map on the left is the correct one; meanwhile the one on the right contains corrupted data [18].The understanding of the analytical perception of the human choice for the current situation comes as a result of several factors:

– The user may have personal information (knowledge) about the country territory;
– The user may have a partial knowledge about the country; still he assumes that generally the highest population density lean near the capital and the surrounding areas, also toward coastal zones and that generally the density decrease moving from the center to the suburbs;
– Smaller the area extension, imply higher population density.

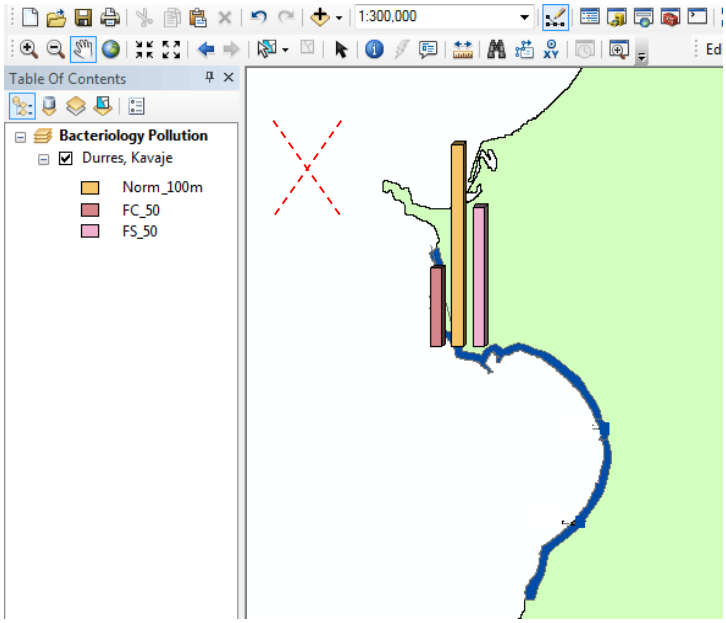

Fig. 5. Attribute (Logical) inconsistency, Albania Coastal Pollution [17]

Tab. 1. Coastline check values [source: own study]

22	23	24	25	26	27	28	29	30	31
54	91	95	112	112	159	318	325	404	460
20	38	39	56	50	56	256	177	296	326

FC-50,FS-50 values		
Ch. P.	FC-50	FS-50
1	1073	669
2	906	687
3	679	435
4	640	591
5	455	424
6	281	206
7	247	194
8	199	161
9	186	142
10	171	135
11	162	124
12	162	107
13	154	118
14	151	104
15	142	118
16	140	93
17	130	95
18	121	92
19	118	88
20	115	72
21	114	81
Av.	271	226
Norm	**100**	**100**

Consider to presume and define errors by performing data control through standard database. GIS claims the ability to associate tabular information with map presentation which turns to be a powerful tool compared to routine databases. That's why through spatial tools we developed the skill to reveal possible errors and data inconsistency. The relationship between spatial technology and human perception is the key for error evaluation.

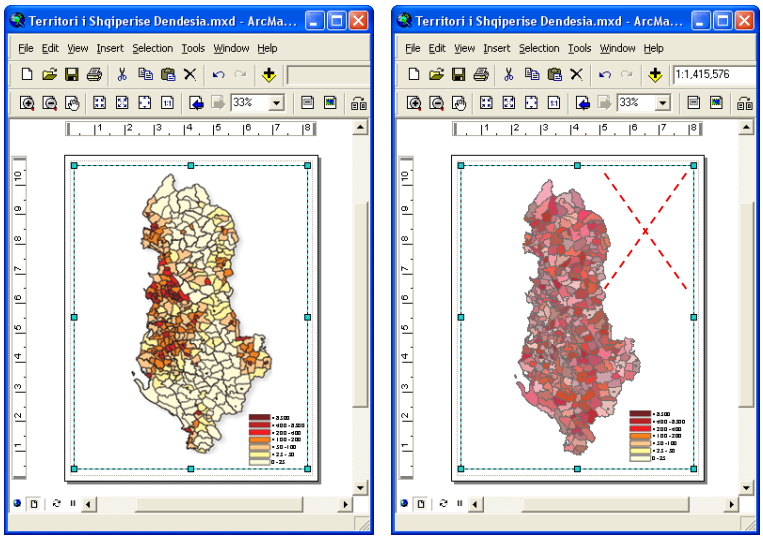

Fig. 6. Spatial inconsistency, Verified issue: Population density [source: own study]

Case three: Temporal inconsistency

We analyze the administrative division of the country (fig. 7) territory between two periods.

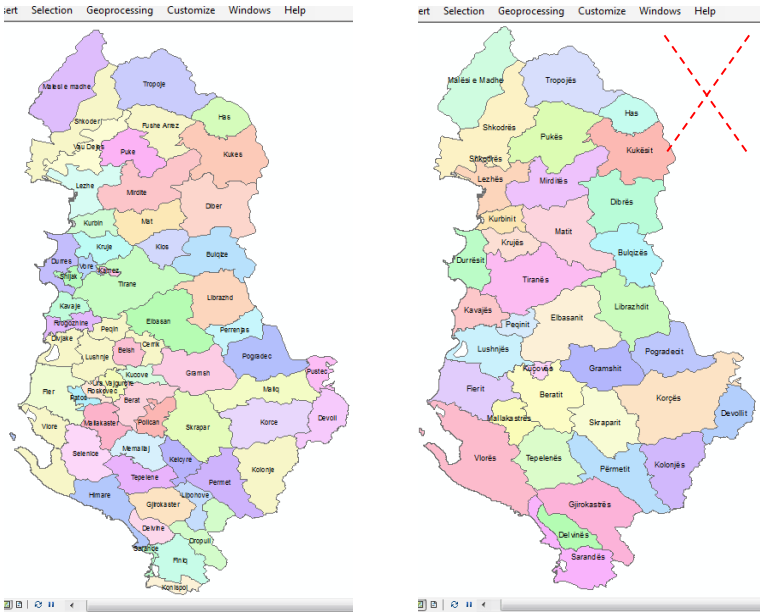

Fig. 7. Temporal inconsistency, Verified issue: Administrative division [source: own study]

Albania is divided into 12 administrative counties. These counties were further divided in 36 districts. Recently, the government introduced a new administrative division to implement in 2015. Districts so far considered as direct sub-units of counties with be suppressed in circumstances where municipalities are reduced to 61 in total, which mean that municipalities with become the new sub-units of counties and the term district with no longer exist. Hence it is possible that in its "infancy" the administrative map may turn into a source of confusion.

6. CONCLUSIONS

Geographical information systems (GIS) are computer systems developed for the collection, storage and processing of information referenced to some form of location coordinates, with this location information usually being a key element of any analysis [19].Today we perceive GIS technology as a powerful mainstream in various web-based maps such as Google Earth, position allocation devices such as Global Positioning System, remote sensing technologies such as satellite imagery, etc.

The field of GIS is rapidly encompassing previously disparate fields, incorporating tool and skill sets into a unification of technology and science [20]. In such an eager market GIS specialist can quickly find themselves into comfort-table positions, followed by a large number of duty assignment possibilities due to its chameleon singularity to be adapted and integrated into vast issues.

The paper present a web-based platform build for informative and communication purpose. Its modular structure allows the usage in the academicals sector. The application aims to improve students' knowledge on spatial technology. We analyze two projects concerning spatial data management and spatial data evaluation.

The first project present the process of compiling data for tourism issues through a selective group of students, each with specific and distinct assignments with the scope of evaluating their individual and collaborative skills. The possibility to modify the application code enables students to overpass the line that represent simple users allowed to insert and modify geographical data, by throwing the application into a higher level of complexity. This way they become owners of the proper GIS knowledge. By so we stimulate students' performance creating future GIS specialists.

The second project is structured into three subcategories: attribute, temporal and spatial inconsistency. Maps are becoming a determinant issue with a developed ability to transform numerical and statistical information into "visual" perspective, object to a much easier analysis and manipulation process [18]. The way people conceptualize space is an important consideration for the design of geographic information systems, because a better match with people's thinking is expected to lead to easier-to-use information systems [21].

The way people identify entities within a spatial extension turns to be a powerful tool in error detecting process. Every time analyze is performed there will always be room for mistakes. First of all we have to be good enough to notice something is wrong. The matter is how we are going to handle the verified situation.

Categories of people believe that relying issue evaluation into a spatial environment could be much more prolific than proceeding with numerical analysis. Research in GIS is like geographical data-the more closely one looks, the more interesting issues appear [6]. As such we induce in increasing student curiosity and willingness to enlarge their efforts for a closer approach toward GIS based issues.

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