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Environmental Impacts of Depopulation: The Case of Aragon, Spain

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Abstract: This investigation is part of the research done by a group of Secondary and High school teachers in Zaragoza, Spain. It deals with the use of Geographical Information Systems (GIS) to achieve skill learning. We are working on depopulation. Consequences of this depopulation process are quite evident in Aragon. The depopulation process is the result of a resource reallocation; the redistribution of human resources, done by the market. Reallocation implies important environmental problems: depopulated places were inhabited and modified by human for centuries until they became "anthromes": biomes whose survival essentially relies on human activity. The human activity disappearance may have led to environmental collapse, due to the inability of natural elements to rebuild themselves and to the risks linked to unpredictable evolution in them. This paper is orientated to the achievement of environmental citizenship and improves educational strategies to "sustainability", managing didactical strategies, the use of GIS and the implementation of new pedagogical ways of active working. These resources can be found at https://arcg.is/lvufeK and belong to a wide website about depopulation http://bit.ly/Despo_HU.

Key words: GIS, demography, depopulation, sustainability, environment, anthromes

1. Depopulation Concept

Depopulation is understood as a process in which the territory loses population until it is depopulated or "empty". Nevertheless, this definition needs to be in some way qualified. A decrease in the number of inhabitants, even when the place gets empty, does not necessary mean that human activity has stopped for good. It usually happens that depopulation processes are the result of changes in people location but not in the spaces used by them. We will go through this later on.

All depopulation processes imply:

A severe and lasting depopulation decrease. This reduction is, in Spain, more noticeable in rural and mountain areas, especially in those named as less-favored areas.

These losses in young and adult population imply aged population structures, that have missed their capacity to be renewed. Index population growth is very little or even negative.

Disappearance of human intervention on territory. Depopulation as an environmental problem.

Depopulation is commonly used to refer to an intense decrease of population of these areas, reaching the total emptiness or not.

This does not consider whether if human activity is maintained in that area or not. In fact, one part of depopulation settlements was depopulated because inhabitants moved to larger ones (with more services and accessibility) but these inhabitants did not abandon the resources and land-uses in that area.

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This residence reallocation process may not be considered as depopulation to the extent that human activity is still maintained.

To have a real depopulation process, we must talk about a certain size of these areas, about soils quite difficult to be cultivated and few transport infrastructures. All of them make human intervention impossible. Not viable with an intensity that allows those areas to be considered as human societies. The depopulation process, therefore, has to imply a significant decrease on population and an important decrease on human intervention in that area.

Therefore, the reallocation of Spanish population on the territory were made of massive rural exodus from the interior to the largest cities located at the coast line (except for Madrid, Zaragoza, Pamplona, Valladolid and few other cities with less size). But this interior decrease on population has not implied a proportional reduction of the Usable Agricultural Area (UAA) nor of the meadows or forest activities.

Only at the areas where depopulated areas where one next to the other, reaching great size and with very poor accessibility, we can observe a significant abandon of human use and human activities.

In the province of Huesca, these areas are located at the Media Bassin, at the South part of inner Sierras and at the exterior Sierras of the Pyrenees. The transport net was made of rural paths, not by roads or motorways. If we compare how they were and the uses they had and how they currently are and the uses they have, we will be able to notice that in those areas human intervention has disappeared: Agrarian use of soils has been abandoned and substituted by the expansion of bushes and trees, ancient settlements are ruined, paths are abandoned...

1.1 Depopulation and Demographic Deserts

To understand depopulation processes and their consequences, it is important to distinguish between demographic deserts and depopulated areas. The former are those areas which, due to physical factors (altitude, climate, etc…), have always been known as non-ecumenic areas, and for this reason, following Ellis (2010) [1] terminology, there has been little or no anthropic modification.

So, therefore, they are considered as natural or wild areas and not as anthropogenic biomas. The importance of this consideration relies on the fact that modified biomas by human societies have been formed by the inter-relations between the physical environment and human ones, generating interdependence between both.

1.2 Depopulation and Environment

From the last consideration, relevant aspects on environmental sustainability of depopulation processes can be deduced: to the extent that those processes minimize human intervention on the environment, they call into question, the continuity of those biomas.

Natural factors cannot generate natural biomas (in a potential or climax sense) by themselves. Natural areas (wild ones) are the result of a long-lasting process of adaptation to environmental changes that happened from the last glaciation. Thereby, anthropogenic biomas, especially hose which have been severely modified by human action, when this human action is severely reduced, come into a critical point [2]: natural factors cannot reverse ecosystems to their wild or natural previous state.

If his reversion happens, it will be a reconstruction which will never become a natural ecosystem previous to agricultural and cattle development. Human help will be needed so as to make “the process that promotes the reestablishment of an ecosystem that has been harmed or destroyed” [3].

It is about helping Nature by regenerating harmed ecosystems, reintroducing native vegetal or animal species, deleting others… to find a balance and “letting Nature find its own way”, avoiding the recreation of ancient landscapes or ecosystems nor rebuilding nature as if it were possible [4].

In this sense, the most recent line of natural reforestation, on the one hand, plans strategies to restore natural ecosystems harmed by human intervention and, on the other hand, reintroducing natural species (vegetal or animal), but adapted to current environmental reality [5].

When these species are not here anymore, genetical or hybrid processes can be used to achieve similar ones. In summary, it is about using human intervention, to begin the "recreation" of these natural ecosystem in abandon areas but adapted to environmental, social and cultural current realities. Another problem is caused by the persistence of human intervention, although it has little or very little intensity, on depopulated areas. This "natural reforestation" processes come into conflict with those persistent human activities [6]. It is exemplified by the reintroduction of wolves or bears and their competence with traditional cattle activities. It is an evidence that this recreation of wild biomas, in order to be sustainable, needs the connivence, with societies that surround those areas. Connivence does not only depend exclusively on the grade of environmental consciousness but also that it is essential that economic activities are not set to dissapear, implying the increase of depopulation processes. This connivence has to be achieved from the implementation of good practices by farmers to make compatible their productive activities with the reconstrauctio of the environment where they are being developed or even by some other ways, such as the substitution of some activities by using subsidies to balance incomes and expenses.

Human activities dependence on anthropogenic biomas. Ancient biomas could minimize the effects of natural hazards by the collaboration of natural factors and human action. These are those interdependence relation we talked above. Forest fires, debris flow, meteorological phenomena, floods…

All of them have severe consequences when humans not inhabit them any more and they do not operate in them any more. It is not only there is not technological action to prevent those hazards, it is also that environment has been modified or anthropized by limiting its capacity to response to those hazards on its own. Physical elements (woods, bushes meadows..) are now abandoned and exposed to more risk (much more than before).

So, it is not only that abandon settlements have lost the intensity of human action but also the ability of society to protect them has been reduced (natural hazards are likely to be produce and their consequences may be stronger.

In this case, the idea (which is very ingenuous from our point of view) of depopulation as the possibility of returning to a pristine and ideal natural spaces not polluted by human action fades away.

Evidentially, the reduction of pollution and of negative impacts of human actions are essential to maintain sustainable economic and environmental behavior, but, the disappearance of the intervention of this society does not imply the automatic return to natural/wild environment but we think it may result harmful to natural elements. For example, it is interesting to see what has happened to those areas that suffered from early depopulation (before 60's of 20th century): the damage of human) has been accompanied by European policies of natural protection and "risk" species, taking as result the increase of wild animals (mountain goats, grizzly bears, wolves, wild boards, deer) which had survived to human depredation [7].

This increase has crashed to structural changes in the environment where these species are developed:

- Some of them do not have the proper size to survive as natural areas are fragmented.
- Extinction of top links in food chain has erased natural restraint factors of growth.
- Extinction of bottom links in food chain has lead to the loss of natural food sources.

This mentioned extinction has led to the loss of natural feed resources.

Overpopulation and illnesses are affecting the herds and authorities are designing strategies to avoid

extinction. Besides, animal behavior tend to humanizer. Animals tend to feed themselves in crops, herds and frequently in waste disposal sites and dumps.

Something similar happens to vegetation such as the invasion of bushes in abandon crops and sometimes the invasion of meadows [8]. Those bushes and meadows should be one step in order to reach potential forest but they do not go through to them and they stopped growing, increasing erosion. They have more probability to suffer from fires. At the Pyrenees, most part of woods are the result not of the natural reconstruction but of the reintroduction of non native species of highest performance and quick growth (such as eucalyptus and conifer trees), to produce timber and to stop erosion. They burn quite easy.

2. Models on Depopulation Process at Rural World

From the research done in the province of Huesca, we have stablished six models or ways in which depopulation is developed depending on spatial factors.

Model 1 is the most common. It affects rural lands without special features and it can be extensible to the inner rural Spain. In this model two processes are produced at the same time:

Rural competes with other areas that offer more employment, more income, more and better services. All of them are accompanied by a negative and pejorative vision of life in rural areas. Rural is a synonym of ancient and little productive and it is blamed on rural inhabitants. These visions do not only come from urban people but also from rural societies.

Agrarian activities began to update looking for more income and more productivity by introducing mechanization, abusing of fertilizers, joining plots, increasing irrigation…. All of those measures implied less labor force.

Otherwise, this market agriculture led to a productive specialization which increased the crisis of the self-consumption model and integral exploitation of land. This generalization came to Spain when international market orientated to globalization was introduced.

The result of these processes was a migrant stream or flow of young adults from rural lands to urban ones, specially to major cities and its surroundings. This stream severely affected scattered settlements, little settlements and little productive areas in which update we mentioned above is quite difficult to be developed.

As rural population was going down and ageing was growing a vicious circle was created: consumption habits were being adapted to aged population and to low income whereas the number of consumers was being reduced. Services supply was not profitable and had to move to urban settlements. Those services known as basic necessity moved to county centers.

A second model is the one happening on disadvantaged areas in which, due to the low accessibility to the places where updating was going on, hindered or even prevent from changes in economic activities.

Here, migrant stream was really severe, leading to complete abandon of buildings and agricultural activities. Only few uses related to forest or extensive cattle and sheep movements were maintained.

Model 3 was held on rural areas next to areas where updating processes were developed (urban settlements or rural lands with bigger size). We can identify two sub models:

Model 3.1, Population moved to rural areas to these developed areas, abandoning buildings, buildings that would be reused as storages, secondary residences or as rural tourism accommodation.

Land also suffered from these changes: traditional uses were held but with some modifications such as meccanization or part-time farming.

Model 3.2, This developed areas with updating processes assimilate rural areas modifying them in two ways (Corine Land Cover):

- By absorbing these territories as new blocks, integrating them into the city and changing it rural shape.
- By reusing these territories to build new residential areas or industrial ones or even large shopping centers, while agricultural lands were reducing and disappearing.

Model 4 is associated to irrigation and "technification". The results are:

- Reduction on labor force (depopulation)
- Changes in this labor force (more qualification, part time jobs, immigrants…)
- New allocation models of this labor force that tends
- to concentrate at big size settlements well connected
- by means of transport.
- Increase on the size of farms related to the increase on income. Ancient settlements are replaced by agricultural lands.

Model 5 is produced by enormous civil engineering and public works such as dams and reservoirs which have a tremendous impact on environment and on these areas:

They flooded settlements and agricultural areas which are essential to maintain incomes.

They spread agricultural land with some other uses such as reforestation in order to prevent landslide and debris flow or erosion (that will lead to damn clogging) For all these reasons, depopulation implies breaks on economic structures …

These public works are usually conducted by public administration which has the ability to land expropriation with low prices that lead inhabitants to other settlements.

At last, we can talk about the existence of a model 6 the abandon of ancient activities related to inhabitants. Activities that disappeared when there was no people to use them such as taverns, mesons, water mills, police stations, railway stations….

3. Cartography and Depopulation Perception

How to map depopulation? What type of map should be used? What about the scales? What would be the information to use? These are quite difficult questions to be answered. In fact, we can find several methods if we take a glance at bibliography. The problem is that the answer we choose depends on how depopulation process is presented and understood and it is a key point on teaching and learning approaches which lead to skills learning:

Let's have a look to different models:

It was very common to find, some years ago, maps presenting provincial population (EU NUTS III). Provinces with less population meant intensive depopulation process. It had a very big problem: the map did not present where depopulation process were held. Inside a province, we can find, at the same time, depopulation and increases in population as we have seen in Huesca province.

The most common way is to present population in settlements with a scaled color band. This is a more accurate way than last one but it also has problems: the size of municipalities is not homogeneous (the Northern ones are smaller than the Southern ones in Spain) and some municipalities are formed by different settlements such as the capital, scattered settlements, no scattered settlements… this model does not allow to locate depopulation processes related to physical factors or to bigger depopulation movements …

Shaped grids are being used in recent years. These maps present in a very visual way the population distribution but, they do not present depopulation processes that happened in Spain from late 19th century.

It is quite common, at schools, to present the population distribution related to concepts such as ageing, population growth… Relations among these concepts are quite evident and it is easy to find objective data… We think we can use this model by using any type of settlements (scattered and no scattered) because any of them has a foot print on the environment. It is necessary to present depopulated

settlements but also those settlements which may be at risk. To achieve that, we have done this ranking (following the criteria stablished by the European Commission): From 2 to 5 inhabitants there is an elevated potential risk of depopulation and from 6 to 10 a high potential risk of depopulation due to its ageing processes and negative growth.

4. Depopulation: A Geographical problem

Mass media are giving special interest on depopulation processes in rural areas of Spain. Nevertheless, this problem is vaguely explained in school curricula.

But… Why should Geography and no other subjects cope with the learning and teaching contents related to population? Just because Geography has, as its main goal, the knowledge of the territory; and this is the main aim is to know the inter-relations between societies and the spaces occupied by them and the transformation of this spaces. Depopulation and repopulation processes are key elements in territory creation.

There is another key factor to be taken into account: identifying; understanding and analyzing depopulation problem require learning skills related to relief, climatology, natural resources, demographic dynamics and economic activities and their spatial representation…

To sum up, depopulation problems in rural areas may perfectly became a central axis of curricula content in geographical teaching and learning processes and it can be achieved by the study of what surrounds students: the context in which his/her life is developed; past processes that have shape his/her way of thinking and future problems.

Can't we say that ageing, environmental conservation and spatial inequalities are not related to depopulation? Besides, these problems have an interesting added value with a formative bias because they deal with the knowledge of spatial context as something that is not neutral: researching in depopulation/repopulation is not only have a knowledge on it/them, it is also to recognize that resources are not equally distributed or not allocated by social or environmental quality criteria.

5. Depopulation: A Geographical Problem, School Resources, "Environmental Impacts of Depopulation Process — The Case of Aragon (Spain)".

5.1 Teachers Creating Resources

Teaching resources (are hosted at https://arcg.is/1vufeK and are part of a wide set that deals with depopulation in a more complete way http://bit.ly/Despo_HU). The content we present is coordinated through environmental impacts of depopulation and try to achieve a skill learning based on GIS and new technologies, looking for the collaborative participation of the students without forgetting some activities with recreational approach to boost the students empowerment (the only one tool to learn how to learn and to choose the right decision to face problems).

This set of resources has been created, by authors of this paper, with the collaboration of a working group formed by Secondary and High Education teachers with central axis on Digital Cartography as a method to achieve skill learning.

This work has two main aspects: debate and collaboration in order to stablish which contents should be studied and the establishment of educational strategies in order to shape how to do it. We have tested these resources at real classroom as we were creating them by using Maps, Story Map Cascade and Map Builder Apps challenging students with questions related to physical environment, demography, urban processes and economic spaces (agrarian ones).

We have worked on these resources presented as digital book with the following index:

Human action on territory: different ways and intensities of this human action by comparing

vegetation between 1990 and 2012 at depopulated areas (using CORINE land Cover)

May depopulated or abandon spaces become natural ones? This question leads to environmental content by following two research areas:

Has environmental quality improved? The answer comes from the analysis of Net Ecological Potential, biodiversity and forest fire risks.

How has depopulation affected the forest map? This is done by comparing maps of 1966 and 2017 by the App Map Builder, allowing students to check their investigation. This chapter ends with a reflection on vegetation changes in high mountain areas, medium mountain areas and Ebro basin.

Depopulation as a chance to improve environmental quality is the end of the book. We talk about concepts such as natural reforestation and the necessity of human intervention in order to reach the recovery of natural ecosystems. This final section has three parts: natural ecosystems are the result of a large adjustment to a changing environment from late glaciation; physical features are not the same as they were in that late period and depopulation areas have some modification introduced by human in centuries of occupation and at last, natural reforestation and human interest: conflicts and the necessity to incorporate humans in this process.

GIS approach. Teachers work group decided to work with GIS technology, in this particular case with ArcGIS due to its technological capacity and its alignment to school purposes and also because it is offered for free to schools.

Working with GIS allows students to create or to analyze a map from different layers[1] which display inter- related information. Properly used, GIS technology generates skill based learning which allows to perceive the space as the result of interaction between elements [9]. By doing this, these teaching and learning approaches develop the multiple intelligence model [10]. In this sense, the research done by Binkely (2012) is quite interesting. It deals with the skills related to those technologies and it has been endorsed by ICT companies (CISCO, Intel and Microsoft):

Ways of Thinking

- Creativity and innovation
- Critical thinking, problem solving, decision making
- Learning to learn, metacognition

Ways of Working

- Communication
- Collaboration (teamwork)

Tools for Working

- Information literacy (includes research on sources, evidence, biases, etc.)
- ICT literacy. Living in the World
- Citizenship — local and global
- Life and career
- Personal & social responsibility — including cultural awareness and competence

GIS are currently, as we are using them, much more than mere map creators. The possibility to create apps allows GIS users (student in this particular case) not only to see and analyze the map from its layers and legend but also to interact with it by[2]:

- Drawing on the map to highlight, to identify, to allocate.
- Adding information which may be found at the Internet (elaborated in advance or modified by them). These processes need to be guide by the teacher but they are also a learning activity as

[1] A great example may be the map of "Climate change and migration: http://arcg.is/OSyPH, last visited 26th June 2019, where the location of abandon settlements is related to the fire forest distribution, also dealing with the location of Natural Protected Areas, Forest map and reforestation allocation.

[2] As an example, we cite this application: https://arcg.is/04LO8m, last visited 27th June 2019, devoted to vegetation changes between 1966 and 2017. Toolbar gives the chance of student work: choosing which layers to be seen, changing the base map, following some tasks in order to solve the problem set by the teacher, using the drawing tool to highlight something on the map, printing the image (in pdf or jpg format), adding data found by the own student, creating marks or making zoom to some spaces, measuring distances, comparing to layers by using the swipe tool, etc..

students need to learn how to look for information and how to select it.

- Comparing two maps of different date but related one to the other (swipe window).
- Extracting statistical information from maps and elaborating graphs with it.
- Choosing different types of information by using the tool "filter".
- Using different maps as basic map to analyze the layers.
- Printing or publishing, as pdf or jpg, the activities done by them.
- Being guided by concepts help, and by guidelines giving with in the map.
- Working in group (ArcGIS allows to create groups with students and their teacher in order to supervise work or to learn from the work of others…).

We have also used GIS: a way to present information (story map) because[3]:

- They are immersive: by using immersive windows the student is guide through the information
- They organize time and sequences of how information should be presented by planning tasks, by offering this information in different formats, by interacting with mobiles phones taking data *"in situ".*

The resources we have developed let teachers choose what they want in a very flexible manner by:

- Using maps as they have been created.
- Using the apps to make the student work with the map.
- Using the resources as a whole just to teach or to learn (or both).

[3] As an example of these immersive applications (the user is introducing into the story that is being told or into the problem that has to be solved. This lead the student as the main character of his own learning), in this resource focused on "Depopulation and environment: http://arcg.is/1vufek, contents are displayed by maps, images, videos and activities done by students or by the comments on maps as it was mentioned above. A similar example could be found at https://arcg.is/084m1y, last visited 23rd June 2019.

5.2 Working Strategies with Students

We have taken "bimodal curricula" [11] as the beginning point, which searches for updating learning strategies in order to adapt educational processes in information society, looking for success measured by the quality and value of the learning achievements.

This learning has two items:

Concepts to be learnt and understood by students.

Skills achieved by doing: know how to do, how to solve, how to learn.

From these ideas, the resources we present are divided into two categories: concepts and skills in a circular form. Skills reinforce concepts and if some concepts are not well understood, students can be able to make the tasks and activities, and even though they do not stop to learn.

5.3 Students Work

The main objective of these resources is to make the student competent to identify, understand, analyze and response to real problems, especially those related to depopulation and its consequences.

We have realized that students have reached learning such as:

- Spatial allocation
- Element identification
- Inter-relations between those elements
- Causality between elements and understanding of causality
- Empowerment to make hypothesis and propose solutions

We have also realized that, as a group, they have developed ability to:

- Make conclusions and justify them
- Critical thinking to choose arguments
- Build explanations
- Work in a group

In order to evaluate the learning in a more objective way, we have created an evaluation rubric extract from Binkley (2012). We analyzed aims and contents to

compare the learning students have before and after the work with these resources.

Table 1 Assessment and teaching of 21st century skills.

Students with similar performance expected		Antes	In material experimentation
Ways of thinking			
Creativity and innovation	Raises hypotheses	5	7
	Uses new ideas to face challenges	3	5
	Is interested in new technologies as tools to learn better	6	8
Critical thinking	Understands a problem raised	5	6
	Identifies causes and consequences	4	6
	Seeks solutions to problems	4	5
Learning to learn	Uses concepts and tools of various subjects to solve geographic problems	3	5
	Solves problems by resorting to previous learning	4	5
Ways of working			
Communication	Uses different formats (oral, written, images, videos, etc.) to communicate	5	7
	When communicating, uses a sufficient amount of information	4	6
	Communicates in a logically ordered way	4	4
	Communicates using empathy strategies	2	4
Collaboration	Collaborates with your colleagues when you work as a team	5	7
	Critically eva luate your approaches and those of your colleagues	4	5
	Understands your position in the group	3	6
Tools for Working			
InformationI literacy	Can identify sources of information	3	5
	Knows how to select objective and relevant information	3	5
	Knows how to treat information to represent way	3	5
	Knows different formats in which the information is presented	4	6
	Evaluates the advantages and disadvantages that each format has to present information	3	4
ICT literacy	Easily manages text editors, spreadsheets, image and video editors	6	6
	Uses ICT tools to solve problems	5	7
	Differences between communication networks and information sources	3	5
Citizenship			
Life and career	Does the entrusted works	4	6
	Accepts your mistakes and try to correct them	5	7
Personal & social responsibility	Evaluates objectively the social and environmental problems raised	3	5
	Poses solutions to the social and environmental problems raised	5	5
	He/she feels responsible for his behavior	4	6

Table 2 Assessment and Teaching of 21st century.

Students with similar performance below expectations		Antes	In material experimentation
Ways of thinking			
Creativity and innovation	Raises hypotheses	2	4
	Uses new ideas to face challenges	2	4
	Is interested in new technologies as tools to learn better	5	6
Critical thinking	Understands a problem raised	3	5
	Identifies causes and consequences	2	4
	Seeks solutions to problems	4	4
Learning to learn	Uses concepts and tools of various subjects to solve geographic problems	2	3
	Solves problems by resorting to previous learning	2	4
Ways of working			
Communication	Uses different formats (oral, written, images, videos, etc.) to communicate	5	6
	When communicating, uses a sufficient amount of information	2	4
	Communicates in a logically ordered way	2	3
	Communicates using empathy strategies	3	4
Collaboration	Collaborates with your colleagues when you work as a team	4	5
	Critically eva luate your approaches and those of your colleagues	2	3
	Understands your position in the group	2	3
Tools for Working			
InformationI literacy	Can identify sources of information	2	4
	Knows how to select objective and relevant information	3	4
	Knows how to treat information to represent way	3	5
	Knows different formats in which the information is presented	4	5
	Evaluates the advantages and disadvantages that each format has to present information	1	3
ICT literacy	Easily manages text editors, spreadsheets, image and video editors	4	4
	Uses ICT tools to solve problems	4	6
	Differences between communication networks and information sources	2	4
Citizenship			
Life and career	Does the entrusted works	1	5
	Accepts your mistakes and try to correct them	3	5
Personal & social responsibility	Evaluates objectively the social and environmental problems raised	3	4
	Poses solutions to the social and environmental problems raised	2	4
	He/she feels responsible for his behavior	4	5

Previous evaluation extracted data from:

Teachers who, in a private way, fulfill the information from what they have been working with their students

Teachers leading the research Evaluation after the experimentation was based on final results and everyday work of students. In a scale from 0 to 10, learning acquisition was displayed in 4 and after experimentation in 5.64. Except for three items, every

single item improved they punctuation, five in one point and twenty in two or more.

As we can see from the table, the features not modified were: “communicates in a logically ordered way”, “easily manages text editors, spreadsheets, image and video editors”, “poses solutions to the social and environmental problems raised”. Modified by one point: “understands a problem raised”, “seeks solutions to problems”, “solves problems by resorting to previous learning”, “critically evaluate your approaches and those of your colleagues”, “evaluates the advantages and disadvantages that each format has to present information”.

What we really want to highlight is that we have not evaluated contents and behaviors but learning measured by skill acquisition.

To go through it, we have also evaluated the results of students who usually reached results below expectations (Table 2). In this case, students move from 2.79 to 4.36 (in the same scale from 0 to 10). It is true that this punctuation is below 5 (adecuated mark) but it is an substantial improvement.

Features in which students had more difficulties or where students obtained minor punctuation (3 or less) were: “uses concepts and tools of various subjects to solve geographic problems”, “communicates in a logically ordered way”, critically evaluate your approaches and those of your colleagues”, “understands your position in the group” and “evaluates the advantages and disadvantages that each format has to present information”. But we can conclude that these resources have improved group work by inclusion and motivation strategies.

Students have shown an improvement in skills such as “learn to learn” because they were able to use in a very autonomous way the GIS technology, even suggesting how to use GIS in other contexts or subjects.

We may say we have succeeded and students have obtained more qualified learnings.

Our first proposal was to understand, to interpret and to interfere cartography but lack of time and difficulties have made activities in this way impossible to carry out. The idea was to empower students to make them able to generate viable proposals of transformations.

6. Conclusions

6.1 GIS

Using GIS is a really efficient way to promote skill learning, especially if two items are considered:

-They look for identify elements, inter relations and landscapes.

-They are embed in educational strategies: the main objective is to learn how to use this technology in order to reach skill learning as it has been said by Buzo (2016): “Geographical InformationTechniques (GIT) must accompanied a methodologicalchange, this change has to put student in the center, no the teacher. This change has to end with exposition and lecturing and has to allow students to be known as builders of their own knowledge, integrating GIT as the key tool in active geographical learning.”

On the other hand, SIG have moved forward to offer new and more efficient ways to communicate in spatial themes: from the map we can integrate different ways of communication such as images, videos, texts, graphs, tables…. Currently the Hyper Text Markup Language, allows to articulate sets of contents, being displayed as digital books or Story Maps. They are immersive, attracted students and guide and help them.

6.2 Using Active and Collaborative Didactics

We think we have chosen the proper strategies from the conversation we have maintained with several teachers. Learning has not been replaced by a leisure spectacle but we have tried to generate learning that make more skillful students.

We have created those resources in order to include any type of students by working in groups. Teaching is an activity where students participate.

In summary, we agree with the idea of De la Calle Carracedo (2013) who says that an active geographical teaching must be supported by a an active methodology, by a methodology that uses different computer tools and a methodology that helps not only to acquire geographical theory but also abilities and skills of this subject to be conscious of the world that surrounds the student and to empathy with close and far away problems that affect him/her.

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