

I2GEO.NET: AN ANALYSIS OF RESOURCES IN SPANISH

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Abstract

After almost three years since the beginning of the project Intergeo, the most visible result and the one that will be the key for evaluating Intergeo's impact in the future is the platform in which the resources are collected. Concerning the impact of Intergeo's repository, the aspects related to the presentation of resources will be important and also the facility of search, the speed of response in order to find what is being searched for, the pertinence of the answers the platform offers with respect to the different queries, etc. But perhaps more important, in my opinion, is the quality of each of the resources, not only regarding the technical accuracy of the provided geometric construction, but also considering the accompanying textual or visual documentation.

The purpose of this paper is to analyze from this perspective the resources of the platform that are written in Spanish, estimating the percentage of those that come with documentation to facilitate their use in classroom tasks. That is how many (Spanish) resources are better than just a well-made construction?

Keywords

Dynamic Geometry, Intergeo, Evaluation, Spanish Secondary

Abbreviations

DGS: Dynamic Geometry System

Intergeo: Interoperable Interactive Geometry for Europe

1 Introduction

I decided to make this work after randomly browsing the web i2geo.net (Intergeo-1 2009). The first resource that I selected was an applet without additional information and I could not conclude from playing with it except that I could drag all the points. Yet I thought, as usual, that there were some hidden (to me) ideas in this resource that could be obvious to more clever persons.

Up to this moment, I believed that many of the current resources in i2geo.net were self-explanatory (for a teacher) or well documented, so that the constructions were valid tools for the development of the curriculum. But then I started questioning the validity of such belief, and thus I decided to start systematically analyzing some resources, particularly, those written in Spanish.

After a superficial browsing of these resources, I decided to approach this content analysis from a double point of view: first, comparing the i2geo contents with those provided by traditional textbooks and, then, searching for resources related to mathematical competencies. I will also take into account some indications given in i2geo.net to reviewers and evaluators of resources.

Section 2 of this paper presents a general analysis, from different points of view, of all Spanish resources in i2geo.net, after removing those which, for different reasons, are not suitable to our purposes. Section 3 contains a comparison between the contents of the Spanish resources and textbooks. Section 4 deals with resources related to the recent trend in mathematics education related to competencies. Last Section presents a collection of criteria that could be used to classify as successful a given resource, and provides some examples accomplishing such criteria.

2 Universe

There are two reasons why I decided to study the resources of i2geo.net in Spanish, namely the knowledge of the language and knowledge of the organizational structure of Spanish education system and curricula.

Defining the universe of study turned out to be easier than collecting its members. On April 15, it was impossible to list, with just one click, the resource written in Spanish. Therefore, I decided to realize the task of selection manually. On April 19, I downloaded the list of 1840 visible resources of the platform that day ¹. I selected all the Spanish resources (written in Spanish, in Galician and in Catalan): 146 in total. After the first analysis, I state the following facts:

¹¹ A few weeks later Paul Libreht sent us a direction that should provide access to all Spanish resources, but we only saw the first 25 due to an error.

2.1 Rejected resources

- 21 (14,4 %) resources are repetitions of others. (Not considering repeated resources those treating the same contents in a similar way) Annex 1.
- 9 (6,2 %) resources with broken links. Annex 2.
- 9 (6,2 %) resources containing documentation (documents of Intergeo, the Spanish curriculum, helps or guides about the platform, etc.). Annex 3.
- 2 (1,4 %) resources are text of problems. Annex 4.
- 22 (15,7 %) resources correspond to topics that do not belong to the curriculum of secondary nor primary education. Annex 5.

The total number of these resources is 63. (43,15 %). If we reject them, we still have 83 for analysis (Annex 6). The following paragraphs show relevant and objective information about these 83 resources.

2.2 Types of resources

Most of the authors (81%) declare that their resources are of the type Exp/Lab. There is no response in three cases. The table shows the distribution.

Table 1: Distribution of resources attending type

Exp/Lab	Anim/Sim	Exer/Deb	Nc/Ns	Total
67	9	4	3	83
80,72%	10,84%	4,82%	3,61%	

2.3 Educational Grades / Ages

The table shows that information about the age appears more frequently than grade information of students. It is prominent the fact that there is no response in 21 cases.

Table 2: Resources with information about Grade or Age

Age	Grade	Nc/Ns	Total
51	11	21	83
61,45%	13,25%	25,30%	

The distribution according to educational levels or age of the 62 resources that have this information is showed in the table 3.

- The first row shows the resources that are only for a certain educational level. The following ones show the number of resources that are useful for more than one educational level, as their authors declare.
- The last column shows the total of resources for each of the previous categories (62 resources).
- The last row shows the total number of resources corresponding to each educational level. It must be emphasize that for the resources declared for more than one level, no discrimination has been made in terms of a resource belonging to a concrete activity in a certain level. It is worth remarking that there only exists one resource for primary education and that the majority of the resources are for the secondary mandatory education (12-16 years).

Table 3: Number of resources of each Grade

Age	6-12	12-13	13-14	14-15	15-16	16-17	17-18	Resources
Level	Primaria	1º eso	2º eso	3º eso	4º eso	1º bach	2º bach	
	1	1	3	1	1	2	3	12
		9						9
			1					1
				12				12
					5			5
						3		3
					4			4
		3						3
		10						10
			1					1
				1				1
		1						1
								62
	1	24	28	30	38	19	14	

2.4 Evaluation

Only 27 of 83 examined resources have been evaluated.

Table 4: Evaluated resources

Evaluation	Not Evaluation
27	56
32,53%	67,47%

The final result of these evaluations was:

Table 5: Result of the evaluation

**	***	****
3	9	15
11,11%	33,33%	55,56%

Only one resource was evaluated in two occasions (2 and 4 stars) (XeoDin Grupo-1 2009)

2.5 Type of content

Dynamic Geometry starts being more than geometry, as it can be estimated in the next distribution of resources:

Table 6: Contents of resources

Arithmetic	Algebra	Functions	Calculus	Geometry	Statistics
7	2	12	6	54	2
8,43%	2,41%	14,46%	7,23%	65,06%	2,41%

2.6 Connection with other areas

A small portion of the resources (13,25 %) present the mathematical content related to situations referred to diverse areas in the curriculum

Table 7: Connections of resources

Art	Astronomy	Natural Sciences / Physics	Not Connected
4	1	6	72
4,82%	1,20%	7,23%	86,75%

3 The textbook: a traditional resource

From my experience as student and as teacher, math textbooks at this level are always more useful to the teacher than to the student. The pupil is in the habit of using them almost exclusively like source of exercises and the teacher, besides this, as a useful script for development of contents. We study in this section if there is a similarity between the contents of the platform and the contents in a manual.

If we ignore the anecdotal, textbooks are divided into chapters (lately called units) that contain explanations on the content that is the object of study, solved exercises, proposed exercises, applications of the content and auto evaluation..

The following paragraphs will show that many of the resources can be seen as Explanations and Solved Exercises similar to those of the texts. Some resources also include Proposed Exercises and Auto evaluations. Calculators are a new class of resources that, for evident motives, do not appear in textbooks though they can appear, at present, in the attached CD's. There exist also some resources that show Simulations, and Applications of the contents to situations related to the reality.

3.1 Textbooks

Though there are some resources of wide contents, there is no resource that looks like a textbook because there is none that includes so many diversity of topics: algebra, calculation, geometry, etc., but there are resources similar to the textbook. For example, *Course of Geometry* (Arranz 2009). This resource contains the topics, organized like a textbook, belonging to the block of Geometry of the Secondary Obligatory Education (12-16 years). (Fig. 1) The menu on the left side is like the table of content of a manual. The principal window shows an explanation similar to the one that can be seen in any book. The page of the Fig. 1 might be confused with that of any book of text. The only difference is the dynamism of the construction. Another similar resource to this one is *Geometry in Primary Education* (Miguel Díaz 2009).

Fig. 1 The structure of this website is like that of a textbook

3.2 Explanations from Solved Exercises

An example of this type is *Introduction to derivative* (Bujosa 2009). When the explanations are not text like in Fig. 1, they are given by means of a solved exercise. This example solves the exercise that consists of the tracing of the secant line to a curve in order to explain an interpretation of the concept of derivative, by means of using the dynamism of the figure (Fig. 2). There are many other examples of this type. The included documentation consists of a small text without additional activities nor auto evaluations nor another type of explanation. Again, the contribution of the DGS is the dynamic property of the construction. The teacher must be the manager of the didactic exploitation of the resource, since the students would have a hard time obtaining the conceptualization on their own

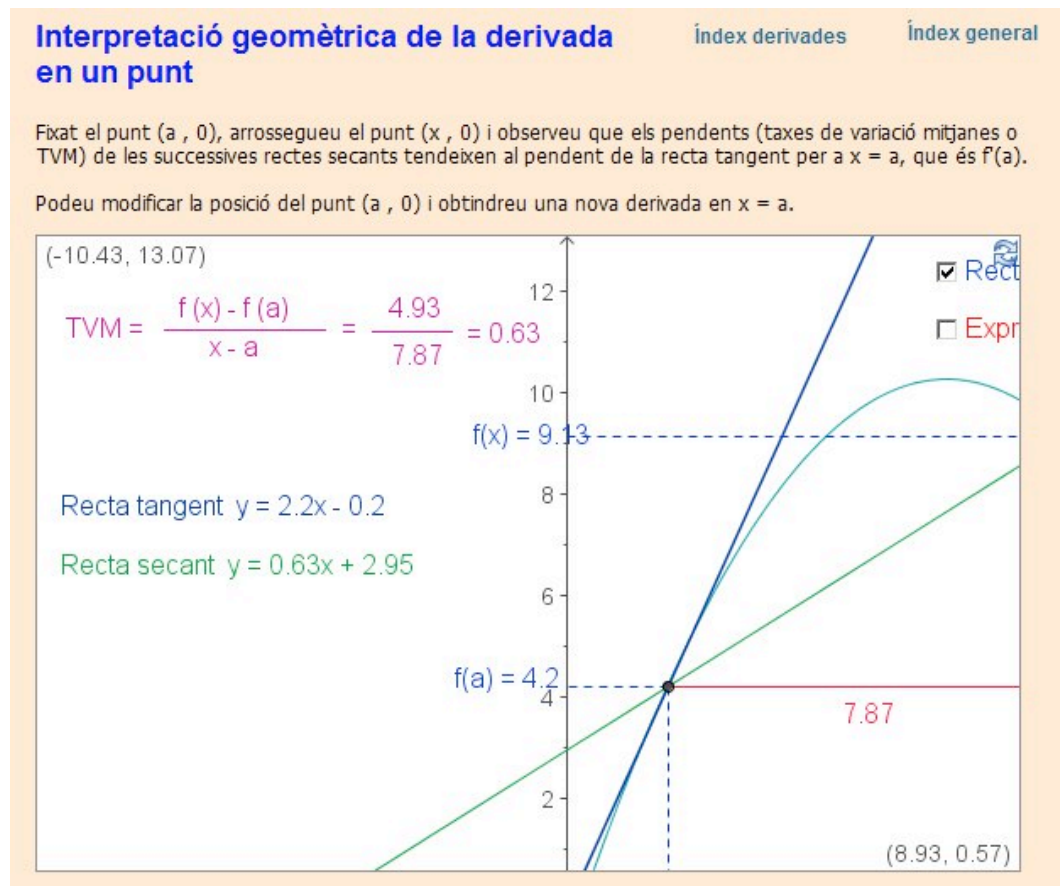


Fig. 2 This page shows a solved exercise about derivative concept

3.3 Solved exercises

Many of the resources are not any more than solved exercises. For example, *Reciprocal Function* (XeoDin-1 2010) shows a window with a construction of an exponential function and its logarithmic reciprocal (Fig. 3). The parameters of the exponential function can be modified. There is no documentation in this resource, like many of this type. Major usefulness of this type of resources might be like support to an explanation though there is in this case overabundance of information in the window.

Some resources of this type show visual proofs of geometric and algebraic properties (theorem of Pythagoras, areas of polygons, square of a sum, etc.) that are almost self explanatory in which it avoids the employment of algebra. The dynamism of the constructions is the plus with respect to the same proof made with pencil and paper.

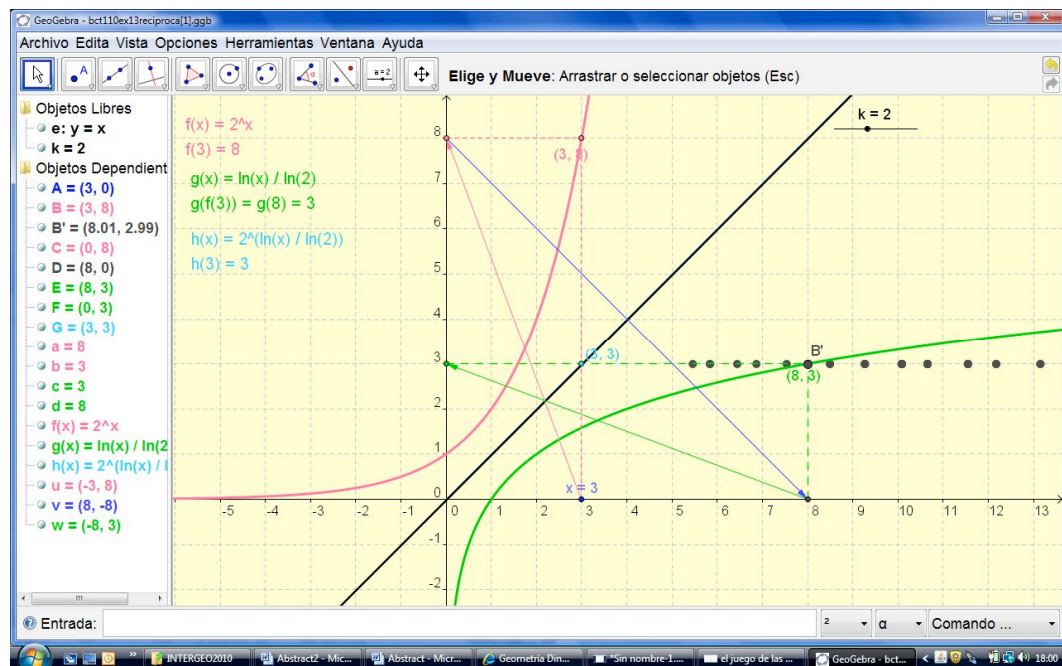



Fig. 3 A solved exercise about reciprocal function

3.4 Proposed Exercises

The game of the functions (Losada-1 2009) is an example of proposed exercise, in which the dynamic geometry provides an added value if we compare it with similar exercises that appear in the textbooks. The aim is to relate the graph of a function with its equation. The exercise consists of calculating the equation of a function from a given graph. It is a standard exercise that can be solved using algebraic methods if it is realized with pencil and paper.

The author of the resource proposes a non algebraic tactic. He presents the graph of the function of which he wants to know the equation, and also shows other one of the same type that can be changed depending on some parameters (Fig. 4). The student must change the values of the parameters in order to get that the graphs coincide. Dynamism and interactivity enhance the process of resolution of the exercise, if we compare it with the same activity realized in paper.

En la siguiente figura puedes jugar a buscar la función morada: cambia el valor de los parámetros a , b y c hasta que las dos gráficas coincidan. Para volver a empezar, haz clic sobre el icono  de arriba a la derecha.

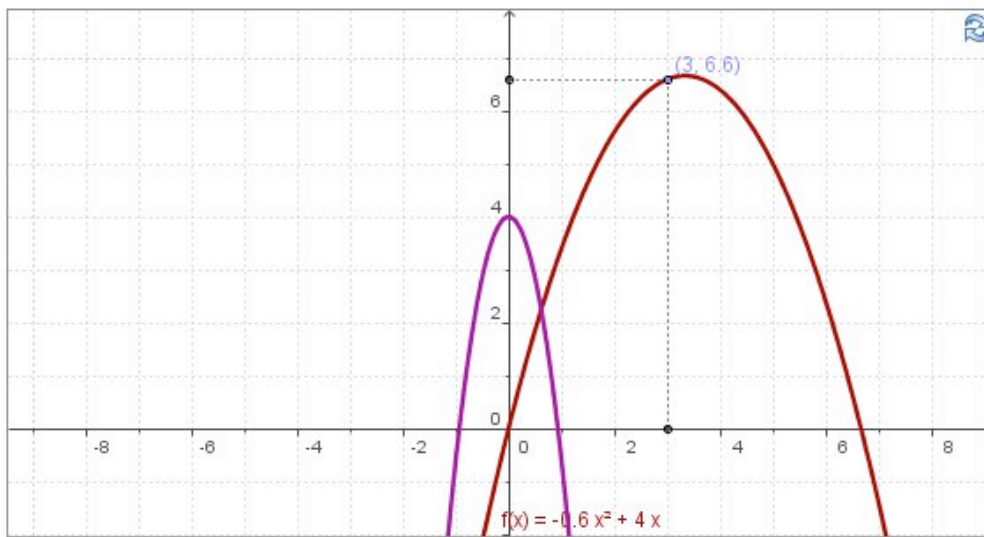


Fig. 4 Proposed exercise for knowing the equation corresponding to the left graph. The right graph must match with the left graph

3.5 Auto evaluations

Straight lines and notable points of the triangle (Espina 2009)), contains the activity whose title is An Auto evaluation (Fig. 5), consisting of multiple choice test, similar to many that appear in the textbooks.

There are other resources that contain auto evaluations that are of the same type. The only possible advantage of these is the immediacy of the checking of the response, though also it can be considered to be a disadvantage since it encourages to give answers at random until finding the correct one, which hinders the process of reflection that is probably the base of the competence of autonomous learning (to learn to learn).

RECTAS Y PUNTOS NOTABLES DEL TRIÁNGULO

Tabla de Contenidos

1. Mediana
2. Altura
3. Bisectrices
4. Medatrices
5. Recta de Euler
6. Recta de Simson
7. Autoevaluación

Autoevaluación

1. Relaciona cada uno de los puntos notables del triángulo con las rectas cuyas intersecciones definen a los mismos.

a) Ortocentro

b) Circuncentro

c) Baricentro

d) Incentro

2. En un triángulo isósceles baricentro, ortocentro y circuncentro siempre coinciden.

a) Verdadero

b) Falso

3. Marca los puntos que definen la recta de Euler.

a) Ortocentro

b) Incentro

c) Baricentro

d) Circuncentro

Fig. 5 This auto evaluation is a standard multiple choice test, like many other in the textbooks

3.6 Applications

The base of the current mathematical curriculum is the concept of mathematical literacy that is to say: the capacity that individuals must have to apply the mathematics in situations of their environment.

There are enough examples of this application of mathematics in i2geo.net. *Hyperbolic navigation* (Losada-2 2009) shows (Fig. 6) an application of the conical curves to find the location of a ship.



Ahora el barco recibe señales **sincronizadas** procedentes de tres radiofaros (Cabo de Peñas, Santander y Donostia). La diferencia de tiempo entre cada par de señales lo sitúa en una hipérbola. La intersección de estas hipérbolas determina la posición del barco. (La mayoría de veces, bastan dos hipérbolas; la tercera se comprueba en casos dudosos.)

Fig. 6 How can we localize a ship, using properties of hyperbolas?

3.7 Calculators

Some of the resources can be considered to be specialized calculators. There are calculators to compute operations with functions, generate tables of functions, calculate terms of succession of Fibonacci, solve inequations with an unknown, etc.

3.8 Simulations

If we use a wide criterion, we can say that all the resources contain simulations of points, straight lines and other geometric objects. We refer here to simulations of real situations: for example *The book of mirrors* (Losada-3 2009) (Fig. 7)

The simulation acquires an added value when it simulates a difficultly accessible process in real conditions. This one is not the case, since the books of mirrors are attainable and accessible, but the dynamic geometry contributes to what the reality does not contribute easily: the quantification of the variables that intervene in the process that, let us not forget, is necessary in order so that the science could be applied.

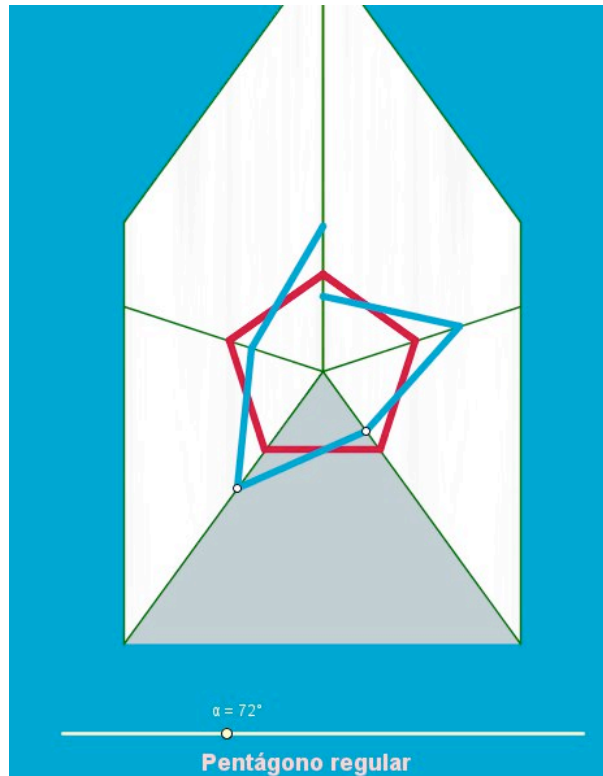


Fig. 7 A simulation of Book of mirrors that shows the value of angle

4 The trend of the school mathematics

The first educational reform that affected me was that of the so called Modern Mathematics. While I was rereading some texts of reference of that time (Dieudonné 1964), (Dieudonné 1973) (Hilton 1973), (Thom 1971), (Choquet 1964), I thought such discussions were strange: if axiomatic or not, if categories, if the royal way for the geometry is not the triangle but the parallelogram, if mathematic of triangle is useless and pedantic, etc. It has nothing to do with what one now discusses. It is clear that the social and technological changes are behind the trends of the mathematical education for the general population (OECD 2005). The concept of mathematical literacy (OECD 2006) is imposed, understood as capacity of individuals to apply it to situations of his natural, social and cultural environment. This functional use of the mathematical knowledge needs general capacities such as to think and to reason; to argue; to report; to construct models; to formulate and to solve problems; to represent; to know and to use technical language; to use tools; etc. According to this trend the secondary education should gravitate around the development of these capacities.

i2geo.net platform can show, during the search procedure, math skills inherent to the resource that is being searched. These skills are general capacities concretions mentioned above. For example, *Analysis of relationships and properties of figures in the plane, parallelism and perpendicularity* (Intergeo-2 2009) is a concretion of the capacities to think, argue, inform, and so on. We do not mean, in this paper, i2geo.net competencies, but those defined in PISA/OECD.

The question that arises naturally is: does the use of resources promote the development of those capabilities? My answer is that, potentially, the use of DGS encourages the development of skills, but it should be pointed out that, on their own, or in the form of resources without a user guide showing and promote student activity and orientation to the teacher about the objectives pursued, they lose much of their effectiveness. To obtain this goal it is necessary that resources include instructions about the managing of the tools, present diverse problematic situations to be resolved together with instructions for its resolution.

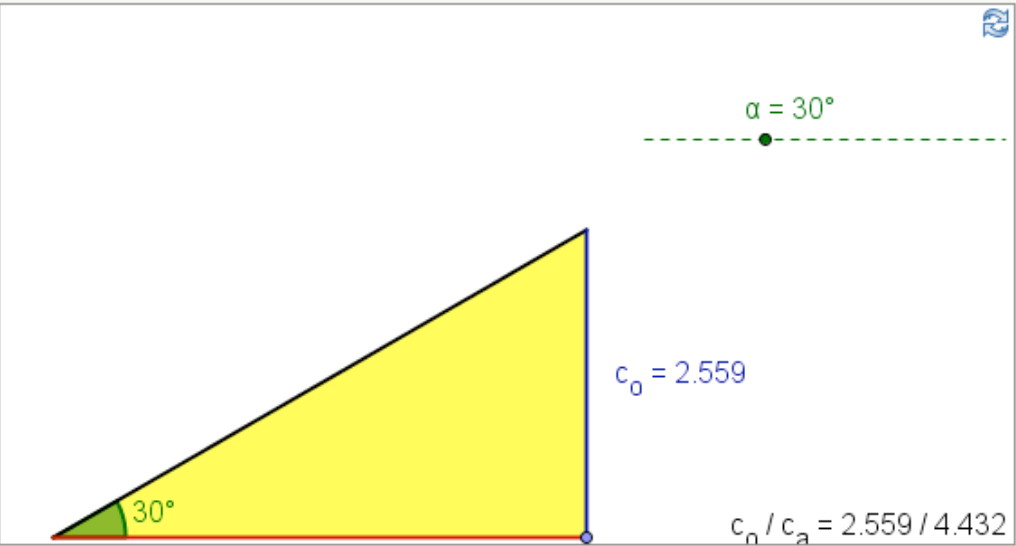
Only one of the resources analyzed instructs the student through a video (animation) on the management of the DGS (Espina 2009), with the aim that the student is capable of solving some simple exercises. As it was said in the previous section, many of the resources are solved exercises that are in some cases accompanied with guides that promote the use of the capacities mentioned before.

4.1 Think, reason, argue and report

Fig. 8 of resource *Trigonometry* (Sada-1 2009) shows a dynamic construction about the concept of tangent of an angle. The student is guided by means of questions, in a process of reflection about the geometric property being taught. The structure of this resource exemplifies the form in which the capacities such as thinking and reasoning, arguing, to report, to represent, to know and to use technical language and to use tools can be put in practice.

There exist few resources in which it could be exercised the model construction and the formulation and resolution of problems, which is not strange since these capacities belong more to professionals than to apprentices.

Tangente de un ángulo agudo



- Desliza el punto verde y describe los cambios que observes.
- Deja el valor del ángulo en 30° y desliza el punto azul. ¿Qué medidas cambian y qué valor permanece invariable?
- Haz lo mismo para un ángulo de 45° . Repítelo para 15° .
- ¿De qué depende, en un triángulo rectángulo, el valor de la razón entre los catetos?

En un triángulo rectángulo, la tangente de un ángulo agudo es igual a la longitud del cateto opuesto al ángulo dividida por la longitud del cateto adyacente.

- Comprueba el valor de la tangente de 22° ($\text{tg } 22^\circ$)
- ¿Cuánto vale $\text{tg } 60^\circ$? ¿y $\text{tg } 45^\circ$?
- ¿Cuál será la amplitud de un ángulo cuya tangente valga 2?
- ¿Cuáles son los valores máximo y mínimo posibles de la tangente de un ángulo agudo?

Fig. 8 The proposed activities of this resource, guide to students towards the trigonometric concepts

4.2 Construction of models and use of tools

A weak version of the model construction that the apprentices can attain using the DGS is the construction of geometric objects fulfilling certain given conditions. There are many solved exercises of this type (baricentre, circumcentre, polygons, etc.), which show the capacity of a DGS for this task, but there are no exercises proposed with which the students could be trained.

4.3 Represent

Looking in the mirror (Losada-4 2009), *Horizon Earth* (Losada-5 2009), *Horizon Moon* (Losada-6 2009), etc. are solved exercises in which there is a representation of the reality (Fig. 9) that serves as example of how DGS can be used for the development of representation capacity.

I did not find any exercise proposed for the accomplishment of a representation of a real situation. If they existed, the aim of such exercises proposed for the pupils would have to be related more to geometric simple representations than to the previous examples.

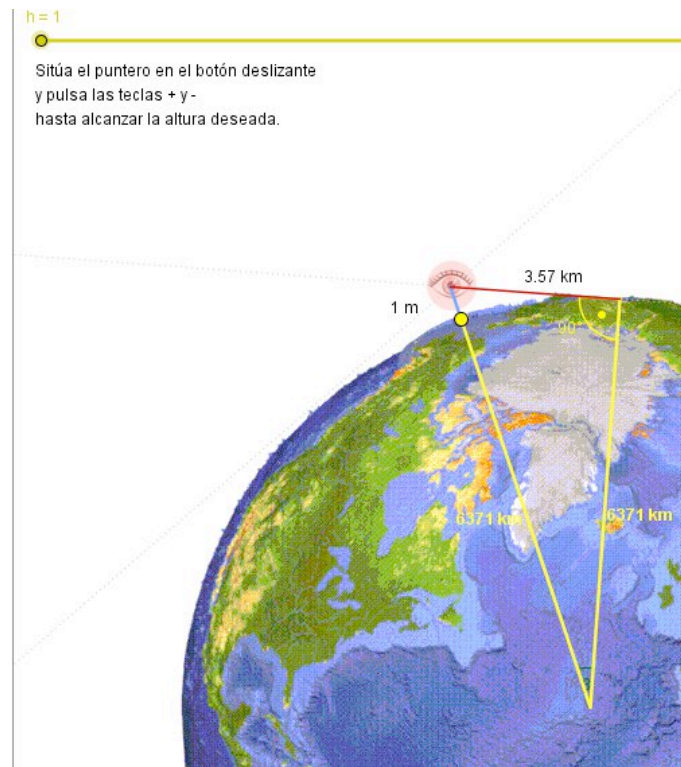


Fig. 9 An application about computation of distances

4.4 Generalize

DGS are specially endowed for the exploration of properties and for the generalization, which has been verified by many teachers while they recalled the forgotten geometry. It is improbable that a student could use this quality of the DGS because they have nothing to remember. The resource *Application and generalization of the theorem of Pythagoras* (XeoDin Grupo-2 2009) shows a right triangle with the squares constructed on its sides and a checking of the Pythagorean property. The students can also verify the property when there are regular polygons of 10 sides or less constructed on the triangle sides.

One similar resource *Theorem of Pythagoras* (Sada-2 2009) contains three solved exercises and a guide to induce a generalization of the theorem (Fig. 10)

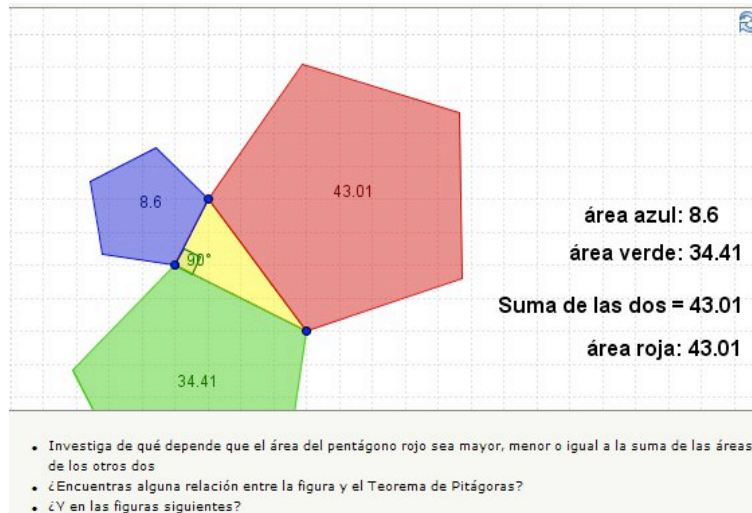


Fig. 10 The questions in the text of this resource, guide to students to the generalization of Theorem of Pythagoras

5 Success

The intention of this section is to provide criteria to say this resource is a success. If we use the criterion of its didactic efficiency, the decision will always be subjective because I do not believe that can be objectified the educational value of a resource. I also believe that this is not a question of democracy (it does not depend on the opinion of the majority, since it is enough that it is useful once).

Therefore, we will not try to put here in question the potential didactic usefulness of the resources. This is taken for granted, the same as the courage to the soldiers. In spite of it, we need to classify the resources. We will bear in mind both previous sections and also what the documentation of the program Intergeo establishes to consider, a priori, a resource like successful.

- The utilization of the structure and contents of the current text books like reference is due to the need to look for a connection with what it is familiar to the teachers. Therefore, it is important that structure and contents of resources do not mean a break with known. In general, one can say that authors, conscious or unconsciously, maintained that connection.
- This one is not the forum to discuss the virtues and failures of the trend of the mathematical education in primary and in secondary education. The aim is to give an opinion on the capabilities of the existing resources to favour the development of some capacities.
- There are seven points in the orientations that the documentation of the program Intergeo offers to the revisers of the resources. Five of them are related, more or less, to technical or aesthetic questions, but the remaining two say (Intergeo-3 2009):

1. *A resource is easier to use when the document is structured, into text, such as an introduction, questions, explanations, conclusion, and into peripheral figures or pictures.*

2. Reification is the main pedagogical added value of interactive geometry: Does this construction make real and concrete an abstract notion that the learners should understand? Does it help to embody an interesting abstract property as a tool that they can manipulate, play with and explore?

In consequence I established the following criteria:

Criterion 1. A resource will be classified as success if it fulfils some of the requirements indicated in 1 or if it is compatible with any paragraph in the Section 3, provided that also check point 2.

It is here where the subjectivity appears since it is the criterion of the reviewer (my criterion) the one that is going to decide when the conditions have been fulfilled. The aims of the resource and what it is possible to do with it must be explicit. In other way, the user must be able to deduce it. There is not valid a resource that would provoke comments as the following one:

"How can we use this activity? There is no indication on its use in class with the professor and the students pupils! What do student have to do? What do students have? This can become interesting with indications on the utilization in class. I wait for them eagerly. Forgive me for my Spanish and the accents that I do not know to put with my keyboard." (Intergeo-4 2009)

Criterion 2. The resources must give information on educational level or group of age.

The first thing the teacher looks for when he examines a text book is the level to which it is directed. It is something that any teacher must expect from the resources, but only 62 of them have this information.

Criterion 3. The resources must favour the development of the capacities indicated in the Section 4.

In Annex 6, there is a table with 83 studied resources and the result of applying the three criteria to them. The following table summarizes the results:

Table 8: Number of resources that verify criteria

Criterion 1	Criterion 2	Criterion 3	Resources
			25
			2
			11
			2
			1
			2
			24
			16
			83

MSC: 97U99

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http://i2geo.net/xwiki/bin/download/Coll_xeodin/Funcionreciproca/bct110ex13reciproca.ggb Accessed 25 April 2010.
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Figure Legends

Fig. 1 The structure of this website is like that of a textbook.

Fig. 2 This page shows a solved exercise about derivative concept.

Fig. 3 A solved exercise about reciprocal function.

Fig. 4 Proposed exercise for knowing the equation corresponding to the left graph. The right graph must match with the left graph.

Fig. 5 This auto evaluation is a standard multiple choice test, like many other in the textbooks.

Fig. 6 How can we localize a ship, using properties of hyperbolas?

Fig. 7 A simulation of Book of mirrors that shows the value of angle.

Fig. 8 The proposed activities of this resource, guide to students towards the trigonometric concepts.

Fig. 9 An application about computation of distances.

Fig. 10 The questions in the text of this resource, guide to students to the generalization of Theorem of Pythagoras.

Tables

Table 1: Distribution of resources attending type

Table 2: Resources with information about Grade or Age

Table 3: Number of resources of each Grade

Table 4: Evaluated resources

Table 5: Result of the evaluation

Table 6: Contents of resources

Table 7: Connections of resources

Table 8: Number of resources that verify criteria

Annexes

Annex 1. Repeated resources

Resource	URL
Flores	http://www.iespravia.com/rafa/flores/flores.htm
Actividades de Geometría para 3º ESO con Cabri	http://www.pnte.cfnavarra.es/~iesozizu/departamentos/matematicas/recursos/infos/aula%20ordenadores/mis%20actividades%20con%20Cabri/cabri3.zip
6 en 1 primera parte	http://www.iespravia.com/rafa/12graficas/01/funciones01.htm
Análisis de obras de arte	http://geometriadinamica.es/Tabla/Investigaciones/Arte-y-Geometria-analisis-de-obras-de-arte/
Análisis de obras de arte	http://geometriadinamica.es/Tabla/Investigaciones/Arte-y-Geometria-analisis-de-obras-de-arte/
Análisis de obras de arte	http://geometriadinamica.es/Tabla/Investigaciones/Arte-y-Geometria-analisis-de-obras-de-arte/
Actividades de geometría para 3º de ESO con Cabri	http://geometriadinamica.es/Tabla/Investigaciones/Arte-y-Geometria-analisis-de-obras-de-arte/
Arcos en arquitectura	http://jmora7.com/Arcos/index.htm
Calculo diferencial Idea gráfica de derivada e integral	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/derivadas.htm
Principio de Huygens	http://www.iespravia.com/rafa/huygens/huygens.htm
6 en 1 Segunda parte	http://www.iespravia.com/rafa/12graficas/02/funciones02.htm
Simetrías del cubo	http://geometriadinamica.es/Geometria/Cuerpos/Simetrias-del-cubo.html
Puntos y rectas notables de un triángulo	http://docentes.educacion.navarra.es/msadaall/geogebra/triangulos.htm

6 en 1 Primera parte	http://www.iespravia.com/rafa/12graficas/01/funciones01.htm
Geometría analítica: vectores y rectas	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/vectores.htm
6 en 1 Primera parte	http://www.iespravia.com/rafa/12graficas/01/funciones01.htm
Actividades de Geometría para 3º ESO con Cabri	http://www.pnte.cfnavarra.es/~iesozizu/departamentos/maticas/recursos/infos/aula%20ordenadores/mis%20actividades%20con%20Cabri/cabri3.zip
G4D Geogebra	http://i2geo.net/xwiki/bin/view/Coll_Group_cantabria2geo/G4D
Omnipoliedro	http://geometriadinamica.es/Geometria/Cuerpos/Omnipoliedro.html
Mi primera construcción	http://i2geo.net/xwiki/bin/download/Coll_tomas/miprimeraconstruccion/miprimeraconstruccion.ggb
Medidas de ángulos	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/angulos.htm

Annex 2. Broken links

Resource	URL
Actividades de geometría para 3º ESO con cabri 21/04/2010 18:00	http://www.pnte.cfnavarra.es/~iesozizu/departamentos/maticas/recursos/infos/aula%20ordenadores/mis%20actividades%20con%20Cabri/cabri3.zip
Simetría rotacional. Evaluación 21/04/2010 23:50	http://jmora7.com/Evrot/00simrot.html
Teorema central do límite 21/04/2010 23:50 04/05/2010	http://www.udc.es/dep/pdce/XeoDin/Distrib_prob/24_teorema_central_limite.ggb
Geometría de los mecanismos 22/04/2010 00:20 04/05/2010	http://jmora7.com/Mecan/mecpral3.htm

Semellanza. Lonxitudes e áreas 22/04/2010 19:20	http://www.udc.es/dep/pdce/XeoDin/TS_01.htm
Billar Error al abrir el fichero	http://geometriadinamica.es/Geometria/Movimientos-planos/Billar.html
Simetría axial. Evaluación 06/05/2010	http://jmora7.com/Evsim/a00asimetria.html
Recta de Euler y círculo de los 9 puntos 06/05/2010	http://i2geo.net/xwiki/bin/download/Coll_segido/RectadeEuleryelcirculodelosnuevepuntos/EulersLineAnd9PointsCircle2.wiris
Actividades de geometría para 3º de ESO con Cabri 01/05/2010 18:00	http://www.pnte.cfnavarra.es/~iesozizu/departamentos/maticas/recursos/infos/aula%20ordenadores/mis%20actividades%20con%20Cabri/cabri3.zip

Annex 3. Documentation

Resource	URL
Spanish curriculum	http://i2geo.net/xwiki/bin/view/Coll_segido/SpanishCurriculumESO1234
Spanish curricula	http://i2geo.net/xwiki/bin/view/Coll_segido/SpanishCurriculumlinkstoCompEd
Intergeo beta tester manual	http://i2geo.net/xwiki/bin/view/Coll_segido/IntergeoBetaTestersManual
Wiris Cas	http://www.wiris.com/demo/en
Test	http://i2geo.net/xwiki/bin/login/XWiki/XWikiLogin?srid=k2nv1TfQ
Guión demostración intergeo	http://i2geo.net/xwiki/bin/download/Coll_Group_cantabria2geo/GuiondemostracionIntergeoEspañol/CUCIEMdemoSEgidoSpanish.html
Test	http://i2geo.net/xwiki/bin/view/Coll_segido/test_0
Charlas	http://i2geo.net/xwiki/bin/view/Coll_Group_cantabria2geo/Charlas

Prueba geogebra	http://i2geo.net/xwiki/bin/download/Coll_JesusEscribano/Pruebageogebra/prueba-upload.zip
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Annex 4. Word problems

Resource	URL
Problema de geometría 2 IMO 1959	http://mrueno.com/geo/node/13
Mathematical olimpiad Madrid 2008	http://i2geo.net/xwiki/bin/download/Coll_segido/MathematicalOlympiad2008Madridproblems/013olimpiadasmaticas.pdf

Annex 5. Non – curriculum content

The following resources were dismissed because they do not match the curriculum content for secondary or primary:

Resource	URL
Flores	http://www.iespravia.com/rafa/flores/flores.htm
Cuerdas vibrantes	http://geometriadinamica.es/Geometria/Arte/Cuerdas-vibrantes.html
LAD Lugares geométricos. Descubrimiento	http://nash.sip.ucm.es/LAD/LAD.html
Hexagrama de Pascal en circunferencia	http://i2geo.net/xwiki/bin/view/Systems/DisplayCabri2D?asset=Coll_mabanades.HexagramaDePascalEnCircunferencia&xpage=plain
Principio Huygens	http://www.iespravia.com/rafa/huygens/huygens.htm
Superficies	http://geometriadinamica.es/Geometria/Superficies/Superficies-Coleccion.html
Teorema de Ceva	http://i2geo.net/xwiki/bin/download/Coll_segido/TeoremaDeCeva/TeoremaDeCeva.zip
Hexagon de Pascal	http://i2geo.net/xwiki/bin/download/Coll_segido/HexagonDePascal/HexagonDePascal.zip
Triangle de Euler	http://i2geo.net/xwiki/bin/download/Coll_segido/TriangleDeEuler/TriangleDeEuler.zip

Recta de Simpsom	http://i2geo.net/xwiki/bin/download/Coll_segido/RectaDeSimpson/RectaDeSimpson.zip
Teorema de Menelau	http://i2geo.net/xwiki/bin/download/Coll_segido/TeoremaDeMenelau/TeoremaDeMenelau.zip
wiris	http://i2geo.net/xwiki/bin/view/Systems/DisplayWiris?asset=Coll_segido.Synchronizedrawingboards&xpage=plain
Biyección del segmento unidad y el cuadrado unidad	http://i2geo.net/xwiki/bin/download/Coll_juliovh/BiyeccionGCantordelsegmentounidadyelcuadradounidad/Biyeccion1D2D.html
Simulación de un sistema dinámico al regimen caótico	http://i2geo.net/xwiki/bin/download/Coll_juliovh/Simulaciondelatransiciondeunsistemadinamicoalregimencaotico/Viajealcaos.html
Cicloides y trocoides	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/trocoides.htm
Teorema isoperimétrico	http://geometriadinamica.es/Geometria/Areas/Teorema-isoperimetrico.html
Tonalidades musicales	http://geometriadinamica.es/Geometria/Arte/Tonalidades-musicales.html
Triangle ortic	http://i2geo.net/xwiki/bin/download/Coll_segido/TriangleOrtic/TriangleOrtic.zip
Trinagle de Morley	http://i2geo.net/xwiki/bin/download/Coll_segido/TriangleDeMorley/TriangleDeMorley.zip
Icosaedro de Fuller	http://geometriadinamica.es/Geometria/Cuerpos/Icosaedro-de-Fuller.html
Reloj	http://geometriadinamica.es/Geometria/Elementos-basicos/Reloj.html
EVAM	http://www.wiris.net/upc.edu/collection/

Annex 6. Resources analyzed

Ci= Criterion i

Resource	URL	C1	C2	C3
Familias de Funciones	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/funciones.htm	Y	15-17	Y

elementales

Composición de funciones	http://i2geo.net/xwiki/bin/download/Coll_xeodin/Composiciondefunciones/bct110iniciaisex11compuesta.ggb	No		N
Función recíproca	http://i2geo.net/xwiki/bin/download/Coll_xeodin/Funcionreciproca/bct110ex13reciproca.ggb	N	N	N
La elipse	http://www.ginerdelosrios.org/pizarra/mates/geo/elipse/elipse.html	Y	N	Y
6 en 1 1ª parte	http://www.iespraviva.com/rafa/12graficas/01/funciones01.htm	N	14-16	N
Rectas y puntos Ntables del triángulo	http://i2geo.net/xwiki/bin/download/Coll_pebrito/Rectasy puntosNtablesdeltriangulo/RECTASTRIANGULO.zip	Y	N	Y
Cálculo diferencial. Idea básica de curva derivada	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/derivadas.htm	Y	16-18	Y
Análisis de obras de arte	http://geometriadinamica.es/Tabla/Investigaciones/Arte-y-Geometria-analisis-de-obras-de-arte/	Y	12-18	N
La mitad del cuadrado	http://geometriadinamica.es/Tabla/Investigaciones/Arte-y-Geometria-La-mitad-del-cuadrado/	Y	12-18	Y
Arco capaz	http://i2geo.net/xwiki/bin/download/Coll_segido/ArcoCapaz/ArcoCapaz.zip	N	2º3º4º	N
Circunferencia goniométrica	http://i2geo.net/xwiki/bin/download/Coll_xeodin/Circunferenciagoniometrica/206circunferenciagoniometrica02mod.ggb	N	4º 1º	N
Area del trapecio	http://i2geo.net/xwiki/bin/view/Coll_tomas/Areadeltrapecio	N	2ºeso	N
La GD para el análisis de obras de arte	http://jmora7.com/Arte/arte.htm	Y	N	N
Arcos en arquitectura	http://jmora7.com/Arcos/index.htm	Y	Secu n	Y
Curso de Geometría	http://mimosa.pntic.mec.es/clobo	Y	Secu n	Y

Medidas astronómicas	http://www.xtec.cat/~jbujsosa/GeoGebra/astroNmia/astroNmia.htm	N	N	Y
Construcción del omnipoliedro	http://jmora7.com/miWeb2/home2.htm	Y	12-18	Y
Coordenadas y funciones	http://jmora7.com/Coord/coorpral2.htm	Y	12-18	Y
Mirándote en el espejo	http://geometriadinamica.es/Geometria/Semejanza-y-Tales/Mirandote-en-el-espejo.html	N	12-15	Y
Dualidad cubo octaedro	http://geometriadinamica.es/Geometria/Cuerpos/Dualidad-cubo-octaedro.html	Y	12-16	Y
Operación producto	http://geometriadinamica.es/Investigaciones/Los-numeros-reales/8.-Operacion-producto.html	N	14-16	N
Navegación hiperbólica	http://geometriadinamica.es/Geometria/Conicas-y-otras-curvas/Navegacion-hiperbolica.html	Y	15-17	Y
Falacia del jugador	http://www.iespravial.com/rafa/azar/azar.htm	Y	14-16	Y
Dualidad icosaedro dodecaedro	http://geometriadinamica.es/Geometria/Cuerpos/Dualidad-icosaedro-dodecaedro.html	N	12-16	N
Geometría analítica. Vectores y rectas	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/vectores.htm	Y	15-17	Y
Un problema de optimización	http://www.iespravial.com/rafa/escuela_MG/derivada/42b.htm	N	16-18	Y
Caja con araña y mosca	http://geometriadinamica.es/Geometria/Cuerpos/La-arana-y-la-mosca.html	Y	14-16	Y
Problemas de optimización	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/optimacion.htm	Y	17-18	Y
Tablas de funciones	http://www.iespravial.com/rafa/tabla/tabla.htm	N	12-16	N
Movimientos y transformaciones en el plano	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/movimientos.htm	Y	14-15	Y
Introducción a la	http://www.xtec.cat/~jbujsosa/GeoGebra/	N	N	N

derivada	derivades/Derivada.htm			
Igualdades Ntables. Demostraciones visuales	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/Ntables.htm	Y	14-16	Y
Operación resta	http://geometriadinamica.es/Investigaciones/Los-numeros-reales/5.-Operacion-resta.html	N	14-16	N
Simetrías del cubo	http://geometriadinamica.es/Geometria/Cuerpos/Simetrias-del-cubo.html	N	12-14	N
TrigoNmetría	http://docentes.educacion.navarra.es/msadaall/geogebra/trigoN.htm	Y	15-18	Y
Rosetones Coimbra	http://geometriadinamica.es/Geometria/Movimientos-plaNs/Rosetones-Coimbra.html	N	12-14	Y
Clasificació segon angles	http://www.wiris.net/upc.edu/collection/example059.html	N	N	N
Operación cociente	http://geometriadinamica.es/Investigaciones/Los-numeros-reales/9.-Operacion-cociente.html	N	14-16	N
Autodualidad tetraedro	http://geometriadinamica.es/Geometria/Cuerpos/Autodualidad-tetraedro.html	N	12-16	N
Horizonte Luna	http://geometriadinamica.es/Geometria/TrigoNmetria/Horizonte-Luna.html	N	15-16	Y
El juego de las funciones	http://geometriadinamica.es/Funciones-y-Graficas/Familias-de-funciones/El-juego-de-las-Funciones.html	Y	15-18	Y
El teorema de Pitágoras	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/pitagoras.htm	N	14-16	Y
Cubo espejo	http://geometriadinamica.es/Geometria/Cuerpos/Cubo-Espejo.html	N	12-14	N
Cónicas	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/conicas.htm	Y	16-17	Y
Programación lineal	http://www.iespraviva.com/rafa/semiplaNs/entrada.htm	Y	17-18	Y
Operación suma	http://geometriadinamica.es/Investigaciones/Los-numeros-reales/4.-Operacion-suma.html	N	14-16	N

Mosaico semiregular	http://geometriadinamica.es/Geometria/Movimientos-planos/Mosaico-semirregular.html	N	12-16	N
El libro de espejos	http://geometriadinamica.es/Geometria/Movimientos-planos/El-libro-de-espejos.html	N	12-14	Y
Sucesión de Fibonacci	http://geometriadinamica.es/Aritmetica-y-Algebra/Numeros/Sucesion-de-Fibonacci.html	N	15-18	N
Horizonte Tierra	http://geometriadinamica.es/Geometria/Pitagoras/Horizonte-Tierra.html	N	14-15	Y
Aquiles y la Tortuga	http://www.iespraviva.com/rafa/zeNn/index.html	Y	14-18	N
Calculadora de funciones	http://geometriadinamica.es/Funciones-y-Graficas/Familias-de-funciones/Calculadora-de-Funciones.html	N	15-18	N
Anillos olímpicos	http://geometriadinamica.es/Geometria/Circunferencia/Anillos-olimpicos.html	N	12-14	N
Derivabilidad	http://www.iespraviva.com/rafa/escuela_MG/derivada/42.htm	N	17-18	Y
Punto de Fermat	http://geometriadinamica.es/Geometria/Triangulos/Punto-de-Fermat.html	N	14-16	N
Cine (el ojo de Londres)	http://geometriadinamica.es/Geometria/Semejanza-y-Tales/Cine.html	N	12-14	N
La necesidad de medir	http://geometriadinamica.es/Geometria/Elementos-basicos/La-necesidad-de-medir.html	N	12-14	N
Coordenadas 2D	http://geometriadinamica.es/Geometria/Geometria-analitica/Coordenadas-2D.html	N	12-13	Y
Criba de Eratóstenes	http://geometriadinamica.es/Aritmetica-y-Algebra/Numeros/Criba-de-Eratostenes.html	N	12-17	Y
Desarrollo plano de un prisma recto	http://i2geo.net/xwiki/bin/view/Systems/DisplayGeoGebra?asset=Coll_gonzalelm.Desarrolloplano-de-un-prisma-recto&xpage=plain	N	2º eso	Y
Torre Hércules	http://i2geo.net/xwiki/bin/view/Systems/DisplayGeoGebra?asset=Coll_fernandoz	N	N	N

	acarias.TrigoNmetriaPieNaccesibleAlturaTorredeHercules&xpage=plain			
Maximización del área dado el perímetro	http://i2geo.net/xwiki/bin/view/Systems/DisplayGeoGebra?asset=Coll_fernandozacarias.Optimizaciondelareadadoelperimetro&xpage=plain	N	1º-2º bach	N
Cónicas	http://i2geo.net/xwiki/bin/download/Coll_Group_cantabria2geo/conicas/conics.html	N	N	N
Geometría Primaria	http://platea.pntic.mec.es/~jmigue1/	Y	Primaria	Y
Pentagon regular	http://i2geo.net/xwiki/bin/download/Coll_segido/PentagonRegular/PentagonRegular.zip	N	N	N
Construcció del polígon de 17 costats	http://i2geo.net/xwiki/bin/download/Coll_segido/ConstruccioDelPoligonDe17Costats/ConstruccioDelPoligonDe17Costats.zip	N	N	N
Aplicación y generalización del teorema de Pitágoras	http://i2geo.net/xwiki/bin/view/Systems/DisplayGeoGebra?asset=Coll_xeodin.AplicacionygeneralizaciondelTeoremadePitagoras&xpage=plain	N	2º-3º eso	N
Medidas de ángulos	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/angulos.htm	Y	12-14	Y
Orthocentre	http://www.wiris.net/upc.edu/collection/example114.html	N	N	N
Construcción del baricentro	http://i2geo.net/xwiki/bin/view/Systems/DisplayGeoGebra?asset=Coll_runaway.Construcciondelbaricentro&xpage=plain	N	N	N
Incentre	http://www.wiris.net/upc.edu/collection/example115.html	N	N	N
Baricentre	http://www.wiris.net/upc.edu/collection/example112.html	N	N	N
Clasificació per longitud dels costats	http://www.wiris.net/upc.edu/collection/example058.html	N	N	Y
Transformaciones de funciones	http://docentes.educacion.navarra.es/msadaall/geogebra/transfunciones.htm	Y	16-17	Y
Circuncentre	http://www.wiris.net/upc.edu/collection	N	N	N

	/example113.html			
Areas de polígonoNs	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/areas.htm	Y	12-14	Y
Estadística	http://recursos.pnte.cfnavarra.es/~msadaall/geogebra/Nrml.htm	Y	15-18	Y
Inecuaciones de grado meNr que 2	http://i2geo.net/xwiki/bin/download/Coll_xeodin/InecuacionesdegradomeNroigualseque2conunavariablen/inecuacionsgrao201dm.ggb	N	4º-1ºbach	N
Cuatro puntos forman un rectángulo?	http://i2geo.net/xwiki/bin/view/Systems/DisplayGeoGebra?asset=Coll_JesusEscribaN.CuatropuntosformanunrectAngulo&xpage=plain	N	N	N
6 en 1 segunda parte	http://www.iespravial.com/rafa/12graficas/02/funciones02.htm	N	14-16	N
Arbelos	http://i2geo.net/xwiki/bin/download/Coll_segido/Arbelos/Arbelos.zip	N	N	N
Una prueba	http://i2geo.net/xwiki/bin/view/Systems/DisplayGeoGebra?asset=Coll_tomas.una prueba&xpage=plain	N	2º eso	N
Area de un triangle	http://www.wiris.net/upc.edu/collection/example117.html	N	N	N
