USING THE INTERGEO PLATFORM FOR TEACHING AND RESEARCH

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*We describe the key achievements of Intergeo, a project co-funded within the eContent*plus *programme of the European Union, and their impact on teacher education, based on the technical and educational concepts of the Intergeo Platform.*

THE INTERGEO PROJECT

The Intergeo project started in October 2007 and will be funded until September 2010. Its main concern is the propagation of Interactive or Dynamic Geometry Software throughout Europe. Interactive Geometry is a way to improve mathematics education by using computers and Dynamic Geometry Software (DGS) and there are many advantages in comparison to “classical” geometry without DGS [Kortenkamp et al. 2009]. Figures can e.g. be easily manipulated [see e.g. Roth 2008] and thus virtually be brought to life.

The Intergeo Project tries to break three major barriers that have a negative impact on the use of Interactive Geometry in classrooms [Intergeo Consortium 2008]: Missing search facilities for existing resources, lack of interoperability caused by the various amount of different programmes and file formats for Interactive Geometry, and missing quality information about the classroom suitability.

To change this situation, Intergeo will enable users to easily find the resources they are looking for in a searchable portal, and provide the materials in a format that can be used with different DGS systems, and ensure classroom quality. Furthermore, Intergeo attends to a topic that is mostly neglected but of high importance nonetheless: the question of intellectual property rights.

Consortium and External Partners

The Intergeo Consortium consists of software producers, mathematicians, and mathematics educators of seven European countries. The participation of External Partners, as *Associate Partners*, *Country Representatives*, and *User Representatives* is the basis for the sustainability of the projects’ goals as mentioned above.

Several key actors in interactive geometry throughout Europe, including software producers, mathematics educators, governmental bodies, and innovative users that can provide additional content or serve as test users for the first content iterations already joined the project; a list of all external partners can be found at [Intergeo

Project 2009]. Furthermore the different roles of participation and their project contributions are explained in detail in [Kortenkamp et al. 2009].

MAJOR ACHIEVEMENTS

The I2Geo Platform

The central place of exchange of interactive geometry constructions is a web-platform; the i2geo.net platform is becoming a server where anyone with interest to interactive geometry can come to search for it and to share it. It is based on Curriki, an XWiki-extension tuned for the purpose of sharing learning resources: strong metadata scheme, quality monitoring system and self-regulated groups. Being based on a wiki platform, Curriki offers an online editing and inclusion facility and thus also makes collaborative content construction possible.

The i2geo platform has three major adaptations compared to the tools provided by Curriki: the search and annotation tools based on the GeoSkills ontology, the review system based on a Quality Framework developed for interactive geometry resources, and the support for interactive geometry media based on a common file format and API for various geometry software systems.

Content Collection

All of the more than 3000 interactive resources identified before the start of Intergeo have been collected and transformed into assets that are searchable and tagged with meta-data. The available content ranges through all ages and educational levels, and also mathematical topics and competences. See http://i2geo.net to access and use the content. Also, a major issue with content re-use and exchange is the handling of intellectual property rights. This affects not only the copying of resources, but also the modification and the classroom use. Thus, all content that is added to the Intergeo portal has a clear license, usually of the creative commons type allowing for modification and free (non-commercial) use.

Cross-Curriculum Categorization and Search

Most geometry resources rely on graphics instead of text and could be used in any country with little or none translation work. Thus it is desirable to offer a *cross-curriculum search* for resources, that does not care about the language of the meta-data items and accompanying texts.

For cross-curriculum matching to work, a language of annotations is needed that encompasses the concepts of all curriculum standards and that relates them. Careful observation of the current curriculum standards (see [Laborde et al. 2008]) has shown that topics, expressed as a hierarchy, and competencies are the two main type of ingredients that are needed. Thus, contributors can specifiy the competencies (such as "know characteristic property of perpendicular bisector" or "apply bisection method") the resource requires from the students using it and the mathematical topics (mathematical notions, such as "angle", "perpendicular bisector", "triangulate", …) at stake in the resource.

The corresponding ontology of topics, competencies, and educational levels called GeoSkills has now been completed for several school-years in French, English, and Spanish curriculum standards. A dedicated web-based tool *CompEd* has been developed to make it possible for the complete German, Spanish, Czech, and Dutch curricula to be encoded by the Intergeo partners [Kortenkamp et al. 2009].

Using a collaborative approach, all European competencies shall be covered by Sep. 2010. If a CompEd user identifies an element in his curriculum that he considers as important for the database, he first searches in CompEd by using key words in his language whether it already exists in his language (first case), or only in a different language (second case), or no similar competency to his element exists (third case). In the second case, he can translate the existing element into his language. In the third case, the element and more information about it can be added easily online.

Quality Assessment Framework

As described by Mercat et al. (2008), a Quality Assessment Framework for interactive geometry resources was set up based on a questionnaire filled freely by the users, i.e. teachers, themselves. This assessment is both meant to rank resources in searches as well as identify resources that can serve as best practises or need improvement. The questionnaire is easy and deep at the same time, as it can provide a light 2 minutes assessment as well as a deep pedagogical insight of the content. This is achieved by a top-down approach asking for eight broad statements that can be answered on a scale from "I agree" to "I disagree". All of these questions can be opened up by the reviewer to give more detailed feedback on issues of interest for him, such as "Dragging around, you can illustrate, identify or conjecture invariant properties" in the "Interactive geometry adds value to the learning experience" section [Kortenkamp et al. 2009]. The quality framework has been implemented on the Intergeo platform and is now ready to use in seven European languages.

Common File Format

A wide variety of interactive geometry systems, each using proprietary and incompatible file formats, exist nowadays. The Intergeo file format aims to be the convergence of the common features of the current DGS together with the vision of future developments and the opinion of external experts. The specification of the first version of the Intergeo file format has been released by the end of July 2008 [Hendricks et al. 2008]. It specifies only a restricted subset of possible geometric elements, which however lead to an agreement on the structure and basic composition of the format (see [Kortenkamp et al. 2009] for further details).

As soon as version 1 of the file format got more concrete, some software developers started to investigate its practical usage by integrating it (partially) into their software. It was possible to move simple content between several of the packages in the project. The gained experiences influenced the further steps: the development of the next version of the file format is ongoing and will be released before summer. The development of a common API for the file format has started and will soon be available to all developers to simplify their implementation work.

Another part is a test suite composed of several test cases for the different elements and/or constraints, that serves to define a level of “i2geo compliance” that can be recognized automatically.

Details about the file format are available in the corresponding deliverables and in an upcoming article that will be submitted to the 22nd OpenMath Workshop 2009 in Grand Bend, Ontario [Abanades et al. 2009].

CONCLUSIONS AND IMPACT ON TEACHER EDUCATION

Although mainly targeted at teachers and students as primary users for the content made available through Intergeo, the achievements listed in the previous sections can have a major impact on teacher education. It is obvious that the *availability* of material is of importance for teacher students. The vast set of resources enables everybody to give lots of examples in lectures and seminars, both good and bad. In the same way as teachers can find appropriate content for their teaching, students and lecturers can find content to illustrate their reasoning easily.

The theoretical work behind the project is even more important, in particular the quality assessment framework. The standards and the associated questionnaires can serve as a *guideline for research work* done by students (in seminars and final examinations), for in-service training of teachers, and of course as a starting point for young researchers. In fact, the standardized and translated questionnaires bear the potential to have a pan-European improvement of evaluation of content.

The benefit for teacher education of the – primarily technical – achievement of the i2g file format is less obvious. Because concepts can be taught independently from a specific DGS application and also in comparison between several systems, attention is focussed on the mathematical structure of a problem and the competences that are necessary to understand a certain circumstance. The instrumental approach does not limit the mathematical understanding in this case. This situation can be compared to general IT teaching, where it is important to teach the concept “text processor” instead of giving a tutorial on the specifics of using Microsoft Word.

The general trend to pay more attention to competences than the content that is used to convey them (e.g. KMK 2004 for Germany) is also supported by the ontology and meta-data facilities of the platform. Each resource is categorized not only by its mathematical topic, but also by the competences that are necessary to work with an activity and those that students can acquire by working with them. This structural view on curricula makes it possible not only to understand this approach better, but also to compare different educational systems and theories.

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