# Rationale for the Intergeo quality assessment process

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**Abstract**

The quality assessment process implemented on the i2geo platform aims at supporting teachers' integration of dynamic geometry (DG) in the classroom practices. The platform does not impose constraints on characteristics of contributed resources but rather provides tools enabling users to review and comment on resources, which affords an easier access to relevant resources as well as their continuous improvement. In this contribution we explain the elaboration of a quality review tool that relies on a questionnaire addressing all possible aspects of a DG resource. The design of the questionnaire draws on general criteria for pedagogical resource evaluation and theoretical considerations on the use of ICT, and more specifically DG in classrooms: intertwining of student's conceptual and technical work framed by the instrumental approach, math education theoretical frameworks, mainly the theory of didactical situations and specific knowledge about potentialities of DG for mathematical teaching and learning. For example, DG added-value dimension of a resource relies on research results regarding possible ways of taking advantage of DG in teaching activities, like soft and robust constructions or different functions of the drag mode. The aim of questions related to this dimension is twofold: describing more precisely how a resource takes advantage of DG and making authors and users reflect on possible ways of using it. The questionnaire helps users better know the reviewed resource (its strengths and limitations), which favours its appropriation for classroom implementation. Thus, quality reviews are a way to support integration of DG into teachers' practices.

**Keywords**

Dynamic geometry - Quality process - Pedagogical resource – i2geo platform

## Introduction

Despite the availability and accessibility of ICT tools and despite the recommendations in math curricula to use technology in many countries in the world, teachers are reluctant to use these technologies (Artigue 2002). Several reasons explain this resistance. The most important is certainly the shift in considering mathematical activity and teacher profession caused by the introduction of ICT into mathematics classroom (Lagrange and Hoyles 2006). However, other obstacles to using ICT by teachers can not be neglected. In particular, it is hard to find pedagogical resources appropriate to a specific educational context. This is mainly due to a huge amount of scattered resources available on the Internet and to the lack of metadata, providing an accurate description of the resource content. Moreover, available resources do not often have a sufficient quality to be used in a classroom. The difficulty a teacher faces when evaluating resource quality and adequacy to her/his specific context is an obstacle to the ICT integration. Therefore, tools for indexing resources and evaluating their quality appear essential. European project Intergeo[1] proposes solutions to this problem in the case of resources using dynamic geometry systems.

## 1 Claim for a quality review tool in Intergeo

The i2geo platform does not impose constraints on characteristics of uploaded resources. The choice of an open server is a way to overcome the scattering of resources and to rapidly build a large and rich collection (already 2500 resources on i2geo in June 2010). Thus, any user can easily contribute resources, which makes i2geo a place where resources are easily shared. But this choice results also in a very heterogeneous and non organized collection of resources. In order to be usable, such a collection needs tools that help a user in identifying adequate resources regarding her/his aims and context of use, but also that allow resources to improve. The i2geo platform provides two such tools: a search tool based on a mathematical notions and competencies ontology and a quality review tool, which is the focus of this contribution.

Resource evaluation relies on the definition of what a pedagogical resource is (Noël 2007). The most often used definition is "… *any entity, digital or non-digital, that may be used for learning, education or training*" (LOM standards 2002, p.5). Moreover, in order to enhance learning, a resource (learning object) has to possess a pedagogical intention (Flamand and Gervais 2004). Referring to the instrumental approach (Rabardel 2002), a resource can be viewed as an artefact that needs to be transformed into an instrument by a teacher in the process of its use in her/his classroom, the usage of a resource being a condition for its existence. Thus, for the purposes of the Intergeo project, we consider as resources those "entities" (DG figures, texts…) for which pedagogical intention is specified. They are living entities that evolve through their usages and the quality assessment process of Intergeo aims at enabling their continuous improvement.

The quality of a resource depends on its intrinsic characteristics, as well as on its adequacy to the context in which it will be used. A given resource can be "good" in one

[1] http://i2geo.net

context and "poor" in another. Thus clarifying its educational goals and the school context in which its use is intended is also essential in determining and improving the quality of the resource.

The quality assessment on i2geo regarding DG resources consists of reviews and comments by users. Resources are also peer-reviewed by groups of teachers supervised by math education researchers; these reviews are based on an a priori review, a use in a class, and an a posteriori review of the resources (Bourgeat *et al.* in these proceedings). Combining user and peer-review processes is a type of evaluation rarely encountered according to Mahé and Noël (2006).

On the i2geo platform, the tool for supporting resource reviews is a questionnaire, described in the following section, that can be used by all platform users, be they ordinary teachers or math education experts, provided they are logged in on the platform. We chose to design a common tool for all i2geo users for two reasons. First, Intergeo intends to develop a community of DG users all over Europe and the i2geo server is a way to support it. Teachers as well as other users (DG software designers, teacher educators, researchers…) are members of this community. In order to support the community development and cohesion, tools that can be shared by this community have to be designed. The quality questionnaire can therefore belong to the shared repertoire of this community of practice (Wenger 1998). Second, the questionnaire is also a means to make the i2geo users reflect on notions, criteria and ways of using DG in a classroom that they would not have thought about themselves (Trgalova *et al.* 2009). We assume that with a questionnaire relevant independently of the user's expertise, all i2geo users may improve their practices.

# 2 Design of the questionnaire for quality review

Critical aspects of a resource to take into account in the evaluation process have been identified (Mahé and Noël 2006): technical aspect, content, design aspect and metadata. Criteria we have set up for the quality assessment process of DG resources draw from these categories, as well as from theoretical frameworks suitable for resource analysis: (1) didactical theories, namely Brousseau's theory of didactical situations (1997) offering tools for analysing pupil's activity and teacher's role, and Chevallard's anthropological theory (1992) to address issues of resource adequacy to institutional expectations, and (2) instrumental approach (Rabardel 2002) providing a framework for instrumented activity analysis.

## 2.1 Design methodology

We started by listing characteristics of a resource related to its mathematical, didactical, pedagogical, instrumental and ergonomic quality. We attempted to obtain a list as complete as possible. These characteristics were classified into nine dimensions considered as relevant indicators of the resource quality: metadata, technical aspect, mathematical dimension of the content, instrumental dimension of the content, potentialities of DG, didactical implementation, pedagogical implementation, integration of the resource into a teaching sequence, and ergonomics. Criteria associated to each dimension have been formulated by a statement (sometimes a few) to which a reviewer is

supposed to answer by giving her/his opinion in terms of a four-level range of agreement. Considering the importance of interactions between design and use (Rabardel 2002), our design process has also included a strong experimental part. We set up successive phases of use with ordinary and expert teachers aiming at identifying quality criteria spontaneously mentioned by teachers (Jahn *et al.* 2008), testing criteria formulations and understanding by teachers (Baudoin 2009) and evaluating questionnaire usability and utility with a group of expert teachers (Bourgeat *et al*., these proceedings).

## 2.2 Theoretical underpinning of some items of the questionnaire

In what follows, we give some details about theoretical considerations that gave birth to criteria referring to instrumental, DG added-value and didactical dimensions of a resource.

*Instrumental dimension of the resource content*

When a resource includes a DG file, it is necessary to check the coherence between the proposed activity, intended mathematical learning and the DG figure: "*The figure behaves consistently with the activity*"[2]. In addition, the figure should behave as expected: *"The figure shows no ill effect"*. These criteria result from studies concerning the intertwining of conceptualization of mathematical notions and technical work within a learning environment (Artigue 2002). Indeed, if the dynamic diagram do not behave according to mathematical theories and didactical goals, the user should be warned.

*Potentialities of dynamic geometry in the resource*

Numerous research studies on DG put forward its potentialities and the diversity of its contribution to the learning of geometry (Laborde 2002) and proof in geometry (Mariotti 2000). Criteria related to this dimension aim first at evaluating how these potentialities are exploited in the resource, and more specifically to what extent DG contributes to improve learning activities comparing to paper and pencil environment: *"The activity can not be transposed to paper and pencil"*. The items address specific features of DG offering an added value to the resource e.g., *"DG leads to understand geometrical relations rather than numerical values"*. They also focus on the role and use of the drag mode, for instance "*Dragging is used to exploit validity conditions of a theorem*" in reference to soft constructions (Healy 2000). Even if a resource cannot benefit from all DG potentialities, we consider a resource that does not take any advantage of DG is of a poor quality. As teachers perceive DG mainly as enabling to drag points to illustrate invariant properties (Tapan 2006), the proposed items aim at making teachers acquaint themselves with and reflect on other possible ways of using DG.

[2] In italics are items of the questionnaire.

*Didactical implementation of the resource*

Trouche (2005) points out that a successful integration of ICT requires a specific organization of pupil-computer interactions, which he calls "*classroom orchestration*". The author emphasizes the importance of instrumental processes management in relation with learning mathematics. For this reason, we are convinced that a quality resource should provide a kind of assistance related to the classroom orchestration by means of elements concerning mathematics learning management with technology, which would help the teacher in organizing favourable learning conditions. The following items address this issue: *"Hints are given on ways to make students start solving the activity"*, *"Advices are given to determine how and when to synthesize findings"*. The notion of feedback provided by the "milieu" (Brousseau 1997) underpins items like *"Feedback provided by the software and useful in the activity is discussed"* or *"Feedback provided by the software helps students in the problem solving activity"*.

### 2.3 Flexibility of the questionnaire to the user expertise

The questionnaire items cannot be homogenous from the point of view of expertise required to understand them and to be able to provide a sound answer. Thus, reviewers are not supposed to evaluate all aspects of a resource, but rather to focus on those that correspond to their own expertise and their own representation of what a quality resource is. Given the length of the questionnaire (over 60 items), it was necessary to propose to the reviewers first a light version focusing on a few more general questions (one per dimension) addressing globally each aspect of the resource. At any time, the reviewer has the possibility to deepen her/his analysis by answering more precise items related to aspects s/he wishes to analyze further, according to her/his expertise. Moreover, s/he is given opportunity to go back to the evaluation repeatedly.

Finally, we expect that a resource will be reviewed many times, by different users. Therefore we can suppose that each dimension of a resource will be evaluated at least by some reviewers. The quality of a resource and the process of resource ranking take account of all provided reviews and assign a weight to each one relying on the reviewer's declared expertise.

## 3 CONCLUSION

The i2geo quality review tool described in this paper enables every user to review and comment on any resource. From the point of view of resource collection, reviews and comments provide feedback to resource designers and users for regulation and continuous improvement of the content of resources and their metadata. The output of quality reviews is used to display results of a search in a way to enhance access to best quality resources. By improving each resource, the whole collection will gain from the reviews and comments. For this reason, reviews and comments constitute a key element of the quality process of Intergeo.

From the point of view of a user, producing reviews and comments or having access to existing ones regarding a given resource supports a better understanding of the resource

teaching and learning potentialities, its strengths and weaknesses. Indeed, in the experiments we have carried out, teachers admitted that the questionnaire has made them focus on important aspects of the resource to look at, such as implementation of the resource or added value of DG, in particular the role of drag mode. The questionnaire thus contributes to the appropriation of resource and its efficient use in classrooms.

Finally, since i2geo platform is an open server, it differs from other academic, school or personal sites offering teaching resources. Indeed, the majority of servers content is organized and controlled by an entity (a group or a person), therefore the quality of the content is implicitly inherited from the group expertise; hence only resources satisfying these quality criteria are deposited and their further evolution is not actively supported. i2geo content is rather organized through contributions – resources and reviews – of its users and can evolve following users' reviews and comments. Quality criteria are thus shared by the community around the platform, in a web 2.0 philosophy. Based on the Intergeo experience, we are convinced that the existence of a user review system is a necessary condition for an open pedagogical resource collection to exist and to be used.

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