GeoGebra in Romanian: the challenges of localising an educational software into a specific socio-cultural context

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ABSTRACT: This paper focuses on the aspects related to the localisation of the GeoGebra dynamic mathematics educational software into Romanian. The work was done during an internship at the Faculty of Education of the University of Brasília, along with the Ábaco research group. The need to localise it originated from an analysis made of the situation of the GeoGebra software in the Romanian context. Even though there have been some previous attempts to localise the software, none of them were finalised, which poses limitations to the usage of this powerful mathematical tool in Romania. This research work was produced in the context of the European Master in Media Engineering for Education (EUROMIME).

KEYWORDS: Didactical and media transposition, Geogebra localisation, informatics on mathematics education

1 Introduction

The educational software GeoGebra is a dynamic mathematics virtual tool that integrates dynamic geometry with concepts of computational algebra. Dynamic geometry was defined by Bellemain & Correia [BC04] as a study of the properties of the sets of drawings representing the same geometric figure or taking into account the same set of specifications. According to Isotani & Brandão [IB06], dynamic geometry represents a computational implementation in traditional geometry, where the term “dynamic” is to mean the opposite of the “static” structures used in traditional geometry constructions. The main advantage of using dynamic geometry is the possibility of performing an arbitrary number of tests on one same geometrical construction, as opposed to making use of the traditional ruler and compass [IB06]. In an educational perspective, these new models of geometry allow the learner to test and discover various properties and/or concepts related to geometry on his/her own, which contrasts the traditional teaching method where the teacher enunciates definitions, concepts and properties that the student passively intakes without being actively involved [IB06].

As previously mentioned, GeoGebra is a piece of educational software that makes use of dynamic geometry designed to give support to learning and teaching mathematics from elementary to a higher education level. Its functionality is evidenced by the way it fully connects geometry, algebra and calculus, which makes it a powerful technological tool for teaching and learning mathematics. By merging geometry and algebra, GeoGebra makes two distinct types of representations of each object. One type makes representations of numerical and algebraic components displaying the coordinate points, the equations, or the parametric form and the other type makes representations of geometrical forms displaying the actual object. The user is able to switch from one type the other [Hoh02]. These different mathematical object representations and the ability to switch from one type to another give rise to new possibilities of using the software in a dynamic mathematic environment to promote the understanding of various concepts in the teaching of mathematics, this takes place in a way that was completely unfeasible a few years ago [Pre08]. In terms of availability, GeoGebra is an open-source project provided under GNU General Public License, being downloadable for free at www.geogebra.org in about 35 languages; the number of localisation in other languages is rising, as one can notice in this investigation. Figure 1 displays an interface from Geogebra:

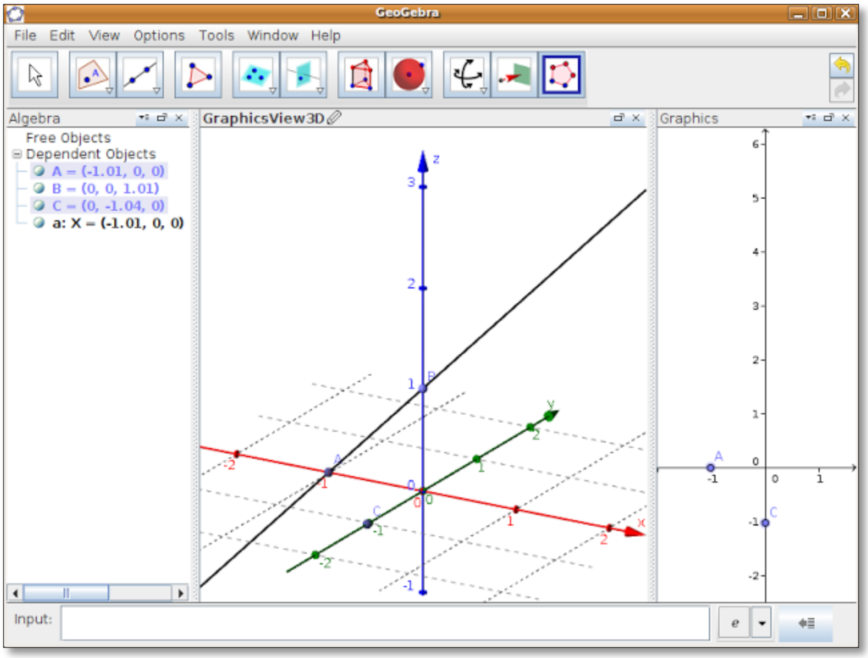

Figure 1- A GeoGebra screenshot in English

The above description of the software features, concepts and advantages makes it crystal clear that its Romanian version is going to prove a real asset for the community of Romanian students and teachers who deal with this subject. Even though this fact has been known for a long time, its entire localisation into Romanian has never before been delivered. Ever since GeoGebra was launched in 2001, some groups of enthusiasts have started localising it, but they have never been able to fully conclude the localisation process. As new versions of the software are constantly coming out, the software localisations in progress all fell out of date before their conclusion. Therefore, as the research findings have proved the positive impact GeoGebra can have in Romania by offering a fully localized version in the language of the country, it has been decided that a full valid localisation of the software should be implemented. With this aim, the following questions are to be answered:

What are the implications of a transposition process of a piece of educational software from a language or a cultural context into another?

What kind of precautions should be taken in such a language transfer process?

What are the phases of the localisation process of a piece of educational software from one language to another?

Can educational software be localised from one language into another in the same manner used in text translation?

2 The research subject

As it has already been mentioned, the object of this paper revolves around the localisation of the GeoGebra educational mathematics software into Romanian. The issues posed by this initiative are diverse and split into three main aspects. Firstly, a didactical problem was identified, followed by a methodological one, and lastly the transposition issue, that lies on the problematic of transferring didactical approaches into a media environment [GL10]

The first aspects worth mentioning are related to the didactical problem that arose from the localisation process. As GeoGebra is a piece of educational software used for teaching and learning mathematics, it arises a serious didactics issue when localising it into Romanian. It is, in fact, the most important aspect that was taken into account when producing the final draft into Romanian. A purely literal translation would not have been effective, because the explicit knowledge dealt with during the didactical transposition and which is involved in the teaching process is as relevant as an "object" involved in the educational process as the teacher or the learner [Che89]. Chevallard makes a very pertinent comparison in his paper, "Contrary to the physicist, who is content with explaining how and why stones fall, we [didacticians] are left with the burden of explaining how people explain the fall of stones..." [Che82]. Thus, even though GeoGebra is a piece of mathematical software it might, according to the comparison made by Chevallard, fall into the physics category. At the same time it is educational it also has to fulfil the purpose of "explaining how stones fall".

Moving on to the next dimensions of the project, the translation may seem at first just as a linguistic transposition of a software program designed and written in one language to another language. But this cannot be too distant from the reality: by being an educative mathematics software program, GeoGebra is more than a basic software tool; it can be perceived as a cultural object which determines interactions, which builds up knowledge, which helps on the elaboration of ideas, and which provides a way of approaching the world. By being educative, GeoGebra follows the concept of the didactical transposition developed by Chevallard. He started off with the premise that knowledge is made to be used, not taught, thus teaching this body of knowledge is an artificial undertaking.

So this "transition from knowledge regarded as a tool to be put to use, to knowledge as something to be taught and learnt, is precisely what I have termed the didactic transposition of knowledge" [Che89]. The key "ingredient" of the didactical transposition is the introduction of explicit knowledge in the equation of the teaching process. Without this new addition, describing teaching would seem similar to describing the relation a pianist has with his/her audience ignoring music, or between a waiter and his customers ignoring food [Che89]. The author views this didactical transposition as a great asset for the educator by permitting him/her to step back and examine the evidence, dig into simple ideas and disconnect from the familiarity (s)he shares with the field of study; or, simply put, to exercise his epistemological vigilance [Che82]. These are the theoretical reasons that partly determine the complexity of a localisation of a software program as GeoGebra. One cannot approach the introduction of an educational software program into a new cultural and linguistic context without thinking about the didactical transposition (s)he will determine in the new set it will be used.

Being an educative piece of software and thus a virtual tool used in the teaching process, we need to further address the didactical transposition aspects by taking into account the media transposition Garonce & Lacerda Santos [GL10] wrote about. They defined media transposition as a phenomenon characterized by a set of adjustments, influenced by human and technological factors, with a transposition of the conventional face-to-face classroom to the virtual one, where a connected presence relationship is established. So, in the case of this GeoGebra localisation project one can easily identify aspects of media transposition through the nature of the software that uses mathematics concepts that can be used in the classroom environment and transposes them into a virtual environment of teaching and learning. At the same time it is as a media transposition, it also happens to be a second order didactical transposition [GL10]; the knowledge being already transposed didactically, the media transposition is thus methodological and not epistemological [GL13]. Returning to the context of GeoGebra, one can observe that it should be regarded as a second degree media transposition: the didactic intentionality remains the same but the context changes. By localising the software into Romanian, the explicit knowledge it brings should remain the same, but the context changes substantially as it is transposed into the cultural setting of Romania, a setting which is characterized by its specific cultural aspects that may or may not be similar to the ones in the source version of the software program, thus bringing the need of taking them into account instead of simply doing a literal word by word translation.

3 Methodology

The methodology chosen for the GeoGebra localisation into Romanian was Research and Development (R&D). It seemed as the best choice to consider for the project, which is an improvement of an educational product available in a different language. The practice of R&D was initially done by mankind, in an informal way, with the first experiments of knapping flint to make tools in the stone age, for example [Hal06]. Formally, OECD[1]

[1] The Organization for Economic Co-operation and Development

defined research and experimental development (R&D) as “creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.” [Oec02].

There are three main stages in the R&D methodology: basic research, applied research and development. The first stage, basic research, is the process of acquiring knowledge without regarding its application; the second, applied research, is directed towards an specific objective, while the last, development, represents the work done on the results of the previous two stages and the creation of the desired products of processes [Hal06]. The localisation process of GeoGebra into Romanian was done according to this type of methodology, following the three stages mentioned above.

This undertaking on localising GeoGebra into Romanian was firstly situated in a theoretical context following the two stages mentioned by Hall [Hal06]. This work was started off by analysing the prospective work on a purely theoretical level, bearing in mind the whole context of the educational software. The second stage became more specific as the challenges and issues of the particular context where the localisation of GeoGebra was aimed at were then observed. All this was done in order to provide a version in the target language taking into account the cultural particularities of the country. Finally, we went to the development stage by realizing the localisation itself. This stage was naturally a result of the previous two phases that assured a working framework which supported and facilitated the activities involved in the project.

4 Development

The work was mainly developed following the methodological parameters described above, closely taking into account different factors and aspects specific to the context of the software and the cultural setting of Romania.

Lisbon, June 2012, the Ábaco research group from the Faculty of Education of the University of Brasília held a seminar to make a presentation of their work on GGBOOK[2], One Interface. It integrates the text and graphic environment in the GEOGEBRA [Nob12]. In fact it was the starting point of the localisation project of the software into Romanian. It was then the very first contact had with the GeoGebra software and dynamic geometry and also where the discussions about the possibilities of developing the whole project. In fact, it was when the project started to be problematized and therefore when the beginning of the basic research stage took place according to the R&D methodology.

After these initial discussions, further investigations into the problematic were made, and soon the basic research started corroborating with the applied research stage of the same R&D development process. The localisation of the educational software started being considered in order to have its adaptation made into the Romanian teaching and learning context. As soon as the project proposal was defined and settled, it was moved on to the last stage of the research part of the project, the approach towards the Romanian mathematics teaching context. At that time, there were some small groups of enthusiasts that had already started working with the GeoGebra English version in some universities in

[2] http://www.ggbook.com.br/

Romania, and they were considering using the software in mathematics programmes. These groups were contacted so that a deeper understanding of the situation then could be acquired. It was soon found out that the lack of a Romanian version was strongly felt. At that point there had even been some previous attempts of covering this gap. However, such attempts were given up on in the interim. Another important reason for entering in contact with these groups of professors was mainly because of the problematic cultural context that was needed to be taken into account during the whole development stage.

The last stage of the R&D process, the development itself, started during an internship at the University of Brasilia (UnB), this internship was coordinated by Gilberto Lacerda Santos and Jorge Cássio Nóbrega. The direct approach was chosen and used throughout the localisation project all the way through to the final product. Regarding the previously mentioned concerns about the cultural context considerations, the issue was tackled in two directions. The first was through the communications made with the Romanian professors of mathematics who were GeoGebra users. They provided a basic framework for understanding the differences and the particularities specific to the country. The second was to engage the Romanian student, Valentin Oros, in the project. As a native Romanian, he assisted the project by providing his point of view as a person who deeply understands his own culture and who also has studied exact sciences in Romania.

The unfolding of the localisation project took place in a natural way with a few specifications made here and there. The tool used was the GeoGebra[3] translation platform, which has been put in place by its developers in order to facilitate the work of the volunteers who are willing to contribute to the localisation of the software in different languages and cultural contexts. This localisation environment comprises the linguistic adaptations of the commands, instructions, menus and the GeoGebra platform has every piece of text organised by group. That is where the translator(s) can proceed with their work and type in the equivalencies in the desired language accordingly. The access to the platform is only available in a 'read-only' mode. For one to be able to actually use the platform and effectively carry out a localisation job, a system administrator account is needed.

Regarding the question of which source language the localisation is to be originated from, it is matter is the translator's own choice. That is so because it can be any of the languages the software is already available in. This fact is being mentioned because the initial choice of source language made at the planning stage for developing the project was changed. In other words, it was initially decided that the source language would be English, the localisation language pair would then be English-Romanian. That was so because among all the available source languages, English was the one Valentin Oros was the most proficient in. However, along the development of the project the source language option was changed and a miscellaneous of source languages was adopted. This language miscellaneous includes English, French and Portuguese. The main reason for including French and Portuguese as additional source languages, although it may seem unnecessary at first, is the fact that a literal translation of an educational software program is not adequate, as it has previously been discussed. Taking into account the cultural context of Romania means adapting, at times, the terminology according to the one used in Romania. As a Romance language, equivalencies in Romanian are supposedly easier to find if one is making use of another Romance language as the source language if compared to an Anglo-

[3] http://dev.geogebra.org/ggbtrans/props/view/

Saxon one, which is the case of English. The different cultural aspects involve both the use of specific terms used in the field of mathematics in the Romanian academia, and Romanian concepts used in the virtual world and software tools. With regard to the latter, terms related with the literal functionality of the software were adapted according to their use by the target audience. It was done in order to successfully complete the second degree transposition of the educational software tool.

The use of this localisation method did not keep issues from arising. Some of the issues encountered include the equivalence of graph types and graphics with names that vary a lot from country to country, or statistical descriptors and concepts that are very culture-bound. The simplest solution found was to leave these terms in a "tentative" mode and move on to resolve the issues in the following testing and validation phase. This last stage of the process was done in collaboration with some native Romanian professors of mathematics that hold a wider knowledge in the field of mathematics and, therefore, were more capable of correcting occasional mistakes, as well as to resolve the equivalence issues posed by the terms left in "tentative" mode.

The support given by the Romanian professors of mathematics was coordinated in two different manners. The first one was used with a professor that was also involved in the actual translation. It was done both by e-mail and through Skype conferences. She even agreed to perform the correction of recurrent mistakes such as different terms used in similar contexts, the usage of the same terms that represent the same concepts, as well as capitalization issues. The second manner was used with another professor that is a GeoGebra user and that checked the final product and proposed corrections where it was applicable. The collaboration with him was more distant and made through regular e-mail alone. The differences in the communication mode were due to the difference in engagement the two teachers had in the localisation process. The first had a more active participation, while the second had a more passive one. In order to achieve a reasonably good level of localisation, cooperation with the two Romanian professors was sought. It is worth mentioning that the first professor also took her own initiative to contact her peers for support.

One can now observe the two transposition stages occurred – the didactical and the media one. The first challenge was to convert content into explicit knowledge, as [Che89] describes, by using the language as a tool in the process. Just by simply translating the terms, we would have not come to a reasonable localisation as it happens to be an educational piece of software used in the teaching process. It was always necessary to take into account that the transfer from one language into another had to be under both an educational and a teaching perspective, as opposed to a simply linguistic one. Secondly, it was also necessary to overcome the challenges presented by the media transposition. Even if the didactic purpose is still the same in both the GeoGebra sphere of mathematical concepts and in the virtual environment used, context wise it is naturally different. The latter is virtual, a software tool used (or not) in a conventional face-to-face classroom context, for example. Both approaches took into account the cultural settings of Romania and the Romanian language, regarding the mathematical terms translated, or the specific technological terms used in the software itself. As we can see from the description of the process done, the transposition realized is a media one, as it was the case of a methodological transposition, the epistemological aspects remained unchanged. The second challenge was that as it happened to be a second degree media transposition the didactic aim still remained the same, whereas the context was a different one.

Figure 2 shows an interface of Geogebra in Romanian that is the object of the work described in this paper.

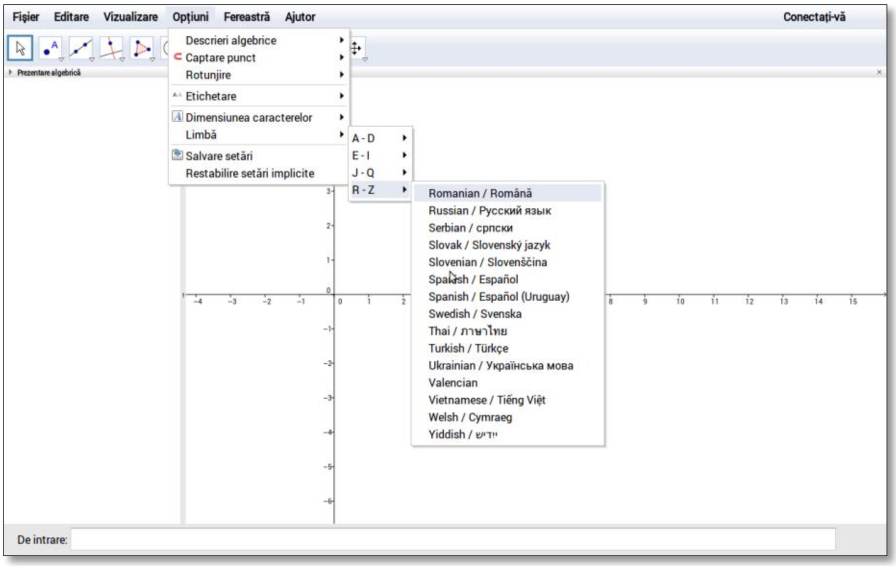

Figure 2 - GeoGebra screenshot in Romanian

5 Conclusion

All in all, the research and development processes realized by the authors generated a complex final product, which takes into account the various aspects that an educational software program is expected to comprise and that transcends the didactic transposition described by Chevallard [Che82] in relation to the second degree media transposition concept developed by Garonce and Lacerda Santos [GL10].

The completion of the localisation of the entire GeoGebra dynamic mathematics software in Romanian was managed. This localisation is going to enhance the visibility of the software in the country by offering a valid version transposed into a Romanian context. It is also going to promote the use of this didactical software to support the teaching and learning of mathematics in that country. The validity of the final product is assured by the consultation made with the Romanian professors of mathematics who gave their confirmation input and provided the final necessary corrections as a closing phase of the localisation project.

Even if at first sight the whole process seemed to be a mechanical and straightforward one, the complexity that arises from the fact that it happens to be an educational tool was not ignored. All the implications implied in the whole of the transposition process was discussed and dealt with. Even if a “classical” didactical transposition is initially observed, the explicit knowledge functioned as a propeller for the project development and helped it to be transcended into the concept of media transposition, which is clearly described by Garonce and Lacerda Santos [GL10]. It in fact happened to be a second degree media transposition. It is due to the fact that even if the context changed, the didactic intention remained the same. By concept, media transposition is already a second degree didactic transposition due to the fact that it does touch the epistemological grounds of the teaching scenario. But only the methodological ones, the whole process developed is a third degree didactical transposition. The translator of such an educational piece of software goes through three stages: firstly, (s)he appropriates himself/herself with the knowledge the program tackles and the teaching of such knowledge; next, (s)he converts this explicit knowledge into his/her target language without losing its didactical aspects and then goes on to the third stage by placing it into the final context, which completes the media transposition.

Some of the conclusions drawn from conducting the whole GeoGebra localisation project – here referred to as media transposition – can be used to guide future similar initiatives in the context of educational software program. One of the most important aspects is the attention that needs to be given to the final context of usage; at first it seems that a literal translation of terms would be enough to do the job, but a further look shows that without a proper adaptation to the cultural context of the final product, the latter would not be fit for use in the context it was created for – teaching and learning. This attention is needed because an educational software program is not a simple tool alone, it is also a cultural object that helps building knowledge and the elaboration of ideas, thus approaching the world in a philosophical point of view; it helps to reinvent the world and act as a consequence.

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