# BRAZILIAN SOFTWARE NEEDS FOR MULTIMEDIA MATHEMATICAL LEARNING

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## INTRODUCTION

In order to create appropriate learning environments for the twenty-first century, it is imperative to have at first appropriate software. After an overview of future tendencies and the present situation of computer-based education in Brazil, this article brings some considerations about software needs in mathematical sciences. Some factors affecting cost-effectiveness of online education are: the number of students in a course; the number of courses offered; the amount of multimedia components in online courses; the amount of instructor-led interaction; the type of online education platforms; the choice of synchronous vs. asynchronous online interaction; completion rate; prohibitive Internet connection costs; and inadequate technical infrastructures (JUNG and RHA, 2000). In the case of computer based mathematical education in Brazil, maybe the two biggest cost factors are the ones related to interfaces of software (in general in any language but Portuguese) and a need of several software for several different themes of Mathematics (one license of use per computer for each software in use). This preliminary work suggests appropriate software characteristics for multimedia learning in mathematical sciences.

## FUTURE TENDENCIES AND THE PRESENT SITUATION

The program "Information Society in Brazil"[3] has as one of its objectives democratize the access to information technologies and contribute to decrease the disadvantages of the country in the world market. The main goals for education are: enhancement of learning schemes, continued education and Internet based distance education and curriculum changes implementation in order to propel high quality pedagogical efficiency in all levels of education. Intending to cut costs with software licensing and in order to decrease the dependency of the Brazilian state of Rio Grande do Sul from software suppliers, the project "Free Software RS" mandates a preference for open-code software, an act that brought public schools to use in their pedagogical project the Linux platform and Sun's StarOffice in the hope to reach until the end of 2001 something like 2000 state schools (LOPES, 2001). With US$ 2,000,000,000, the United Nations intend to help poor countries to decrease the digital exclusion; nowadays only 5% of the world population is online (LA INSIGNIA, 2000). In Brazil, a project of a low cost computer prototype from the federal government intends to universalize Internet access to poor Brazilians (BRAGA and OLIVEIRA, 2001). Distance learning is booming in Brazil: the UniRede[4] consortium will be composed by at least 62 public universities and intends to

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reach 100,000 students per year; the project intends to offer, between others, complete undergraduation and graduation courses; training of teachers from primary and secondary level, a major problem in Brazil, is also between the priorities. The "Partnership in Global Learning"[5] is a project to develop advanced methodologies in delivering distance learning programs. Highly respected universities from Latin America and the US like UNICAMP[6] already participate in the project. By the year 2001, the initiative will be extended to include the top universities in the European and Asia/Pacific regions[7]. The Inter-American Development Bank[8] helps to accelerate economic and social development in Brazil supporting projects like IVEN - International Virtual Education Network, which was designed to develop multi-media based modules for the teaching of mathematics and science in secondary schools. Mathematics is fundamental for the development of software (JACKSON and KARKI, 2000) and there is a general consensus that a better job should be done at encouraging and preparing young people to enter technical education and careers in the new digital society (MEARES and SARGENT, 1999). In this sense, it has been indicated briefly that there are several initiatives in course in Brazil to develop education and to increase access to the new information and communication technologies; due to the importance of mathematical sciences in the preparation of an appropriate digital work-force, the following considerations about Brazilian software needs for multimedia mathematical learning are appropriate and will contribute to the debate on software development targeting the Brazilian educational market.

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Educational software for geometry, for example, in general stimulate students to pass through several levels of geometrical thinking: visualization, analysis, informal deduction, formal deduction e rigorous development of the problem under consideration. Traditional teaching books don't stimulate students to explore geometry in a visual way, something that discourages them to try new solutions and a better understanding. In this context, software can sometimes be more appropriate to the expression of a natural mathematical thinking allowing students to first try possibilities even by intuition and later demonstrate complex proofs in a logical manner (MISKULIN, 1999). After experimenting the usage of several different software for multimedia mathematical learning for students of different levels specially at LAPEMMEC laboratory[9] the two main cost factors related to the most commonly used software in Brazil are: the one related to the deficiencies of most interfaces of software (in general in any language but Portuguese); and the need of several software for any different theme of Mathematics (one license of use per computer for each software in use). It was detected that most students had no fluency in foreign languages which disturbed them while trying to operate most of the software; also, the high costs of buying licenses of usage for several different software, a main concern in a country with

[5] http://grove.ufl.edu/pgl
[6] http://www.unicamp.br
[7] http://training.lucent.com
[8] http://www.iadb.org
[9] http://www.cempem.fae.unicamp.br/lapemmec

scarce resources like Brazil, are as significant as the costs of training both teachers and students in the operation of several different software, one for each theme of mathematical sciences. Also, most of those software don't generate a content that could be part of a web page easily; in most of the cases, the contents are in a format that can be opened just by the same authoring software, obligating students connecting the Internet at home to buy copies of the software of interested even if they want just to access an animation or resolution prepared by a teacher. Another problem common to most software in multimedia mathematical learning is that the user interface is not of an automatic understanding: students, in their first trial tended to get disappointed with the difficult commands necessary to accomplish very simple tasks on the screen. Intelligent and customizable user interfaces could use artificial intelligent techniques and agents to accelerate the acquaintance of users to commands in a visual environment turning the experience less frustrating. The ideal would be, in the near future, to allow both students and teachers to use voice recognition to operate educational software in a more intuitive way. This preliminary work suggests that, in Brazil, an appropriate software for multimedia learning should be customizable in order to be used both by students intending to explore mathematical concepts and by teachers intending to deliver virtual classes or activities; computer-aided software engineering should help teachers to generate multimedia mathematical content in an Internet compatible format with a minimum effort, allowing this content to be fully accessible through an Internet browser after upload delivery; the interface should be user-friendly and in Portuguese; platform independence should be also mandatory. This software should offer different modules for each theme of mathematics or related subjects and also accept modules created by eventual users.

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