Public Policy for the Use of Free and Open Source Software in Education at the University Level: The Case of Brazil

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Abstract
This paper analyses the definition of free and open source software (FOSS) and discusses the public policies and measures adopted by the Brazilian Government in order to disseminate it in education at the university level. In Brazil, the right to education requires the adoption of public policies that stimulate the use of FOSS and promote digital inclusion. An important point is that the Brazilian Government recently adopted some measures to stimulate the use of FOSS, principally in public education. FOSS improves access to information, as it allows the teacher to provide selected content from the Internet for students, and it also functions as an instrument of social inclusion.

1. Introduction

Education can be analyzed as the process that creates the possibility of the production or construction of knowledge [1]. In this sense, education does not reduce itself to the mere transfer of knowledge. In a globalized and digitalized world, computers and their programs - software - cannot have their role reduced to the mere support of knowledge transfers. The digital world can and should create the possibility of the production and construction of knowledge itself. For this to occur, it is necessary to secure access to both computers and computer programs - free and open source software - to make possible the production and construction of knowledge through capacity building, awakening the curiosity of teachers and students, and the construction of networks of knowledge sharing. The role of the State is therefore fundamental in developing public policies that assure access to computers by means of open source software and that furthermore promote digital inclusion in a more amplified form.

The goal of this paper is to reflect upon Brazilian public policy for the diffusion of open source software in education, considering that technological progress should respond to human interests on a fundamental level. To do this, we will first define open source software and study its fundamental characteristics. We will then analyze the public policy of open source software and the role of the Brazilian State regarding both the use of open source software in education and the more general issue of the public policy of digital inclusion. Special attention will be given to the priority of use given to open source software and capacity building in open source software.

The focus of this paper does not reside in the repercussions of the use of free and open source software (FOSS) in the teaching of technology courses, whose importance has already been clearly demonstrated by the regular improvements made to source code and furthermore by the sharing of knowledge between researchers, professors, and students, in the form that the ideas of one can be reformulated and improved upon by others. The emphasis of this paper resides in reflecting upon the role of open source software in education at the university level - classroom teaching, online distance learning, and a mixture of the two - and in the strategies that the Brazilian Government has adopted to foment its use.

2. FOSS and its Fundamental Characteristics

In Brazil, Law n. 9.609/98 defines a computer program (software) as the expression of an organized set of instructions in natural language or code, contained in a device of any nature, of necessary use in automatic machines for handling information, devices, instruments, or peripheral equipment, based upon digital or analog technology, to make them work for determined ends. The first law in Brazil regarding software was Law n. 7.232/84 that deployed a National Computer Policy, establishing laws that specifically dealt with this material. Afterwards Law n. 7.646/87 established intellectual property protections for computer programs and their commercialization, being further regulated by Decree n. 96.036/88. With the arrival of the administration of President Collor, the application of this legislation was ended due to the liberalization of the Brazilian economy and was replaced in 1998 by Law n. 9.609/98 (the Software Law) and Law n. 9.610/98 regarding authors' rights [2].

Computer programs, also known as software, can be "free" or not. Therefore in opposition to proprietary software, whose source code is only known by the business that developed it, free software is based upon a philosophy shared knowledge, whose source code of can be freely accessed by its users, with the goal of modifying and improving the code. The rights to the code do not belong to an individual, because countless users contribute to its improvement. While Brazilian Law prohibits patenting software in itself, the National Institute of Industrial Property does allow patents when a piece of software has a technologically innovative effect, in other words when a piece of software is part of a process that creates a specific industrial effect. This distinction is nebulous. In reality, proprietary software receives a copyright like protection, although there are demands to treat software as a patentable invention or to create a sui generis form of protection specific to software [2].

There is a difference between free software and open source software. Open source software as defined by the Open Source Initiative requires: (1) free redistribution, (2) access to the source code, (3) permission to create derived works, (4) integrity of the author's source code, (5) no discrimination against persons or groups, (6) no discrimination against fields of endeavor, (7) free distribution of license, (8) license must not be specific to a product, (9) license must not restrict other software, (10) license must be technology neutral. Free software can be considered open source, but free software follows the ideals of the Free Software Foundation. In the other hand, the Open Source Initiative is more receptive to market related software initiatives.

In relation to the free and open source software model, one of the classic definitions is provided by the Free Software Foundation [3], which provides four essential requirements for free software:

(0) the freedom to run the program;
(1) the freedom to study and change the program in source code form;
(2) the freedom to redistribute exact copies; and
(3) the freedom to distribute modified versions

These definitions are the essential basis of free software, whose licenses never contain restrictions regarding the issues of use, copying, alterations, or distribution. It is important to be clear that free software is always associated with licenses that have express provisions regarding aspects of these general freedoms. It is an opportunity to exercise the curiosity for the program's use, study, possibilities of alterations, and the solidarity of distributing copies, giving everyone the opportunity to enjoy the changes made. The exercise of curiosity in a process of teaching, as Freire points out [1], summons the imagination, the intuition, the emotions, the conjectural capacity, and the ability to compare and contrast in the search of the outline of the object or in finding its reason of being.

While the free software model allows for the exercise of these four freedoms, proprietary software prevents the user from any possibility of using the ideas contained in the software's source code, which limits the possibilities of learning, improvement, and adaptation. Overall, the proprietary software model forces the user into a state of dependency upon the software provider, due to the difficulties created by the lack of interoperability between different platforms [2].

It is important to consider the term "free" in regard to free software. There is a strong tendency to associate the word "free" with the economic sense of the word, as in without cost. The correct term for this type of software is freeware. The term "free" when applied to software is more associated with the concept of liberty. The expression Free and Open Source Software is based upon a philosophy that opposes the privatization of knowledge and foments solidarity and cooperation in a community endeavor that develops a network of creation based upon open source norms.

Generally free software is without cost and therefore benefits the whole population, including those who lack the means to consume. If technology has an enormous potential to stimulate and challenge humanity, especially the most favored classes [1], free software can be used as an important tool for teaching and digital inclusion, aiding in the breaking down of barriers that prevent less privileged classes from equally benefiting from technology.

It is important to highlight that the FOSS movement, understood as a movement based upon the principles of knowledge sharing and solidarity practiced by the collective intelligence connected in the global computer network [4], looks to capture the energy of new users to share knowledge and innovate, which can be very useful for developing nations.

3. Public Policy, FOSS and the Role of the Brazilian State

The use of free software in education, particularly in schools, can aid in the digital inclusion of citizens, especially when such programs are without cost, resulting in lower expenditures for the government. The utilization of computers and software cannot be restricted to the parts of society that have the economic means to purchase them, and the government cannot become hostage to a technology by paying licenses for use that can prevent to goal of digital inclusion. Therefore public policies that promote the large scale use of FOSS are necessary and aid to disseminate the freedoms that are the essence of open source computer programs.

In this sense, it is necessary to understand the significance of public policies the Brazilian State in the promotion of FOSS. Garcia [5] considers pubic policies as principles, the collective goals that direct the activities of the State in the furtherance of the public interest. Here is the foundation of state action in fomenting the use of FOSS, especially in education, allowing all citizens access to computer programs and the ability to equally contribute in the development of such programs, aiding in the sharing of knowledge.

In relation to the juridical nature of public policies, it is important to highlight that Bucci [6] analyzed this question, determining if policies consisted in activities, programs, coordinated actions, processes, or norms. The author defines public policy as a program of government action that results in a process or a set of processes regulated by law (such as electoral processes, planning processes, government processes, budgetary processes, legislative processes, administrative processes, and judicial processes) to coordinate the means of the State and the private sector toward the achievement of politically determined socially relevant objectives. Ideally, public policy should aim at achieving a defined set of objectives, expressing a weighted selection of priorities, within the budget necessary for success and the time allotted for the goals to be achieved. Analyzing a working hypothesis defining public policy as a norm, Bucci [6] understands that laws are characterized by their general and abstract nature, while politics is neither general nor abstract, but aims for the achievement of specific goals. Under this argument, the author denies that public policies are a category defined and instituted by the law, but are complex arrangements typical of political and administrative activity, and that legal science should be eager to describe, understand, and analyze them, with the goal of integrating political activity with the methods and values of the judicial universe. In reality, public policy can be a way to promote the effective insertion of FOSS in teaching, accomplishing the goal of digital inclusion.

3.1 Teaching and the Use of FOSS

To ensure a better future for long distance learning, Armengol [7] has argued that Latin American societies should reform their educational systems making them more responsive to social, scientific, and technical needs, while at the same time preventing schools from reinforcing current inequalities in status and wealth. It cannot be forgotten that decades ago, distance learning was done primarily by correspondence or using traditional means of communication. Paine [8] cites diverse examples, including a Scottish case study - the “Campus Radio”, a series of programs entirely compiled by educational institutions and members of the teaching profession which provided

traditional night school courses at no cost over the radio. Over the last decades distance learning has expanded due to technological advances, taking advantage not only of personal computers and the internet, but also cellular phones, notebooks, and smartphones.

FOSS is not only used intensively for distance learning, but can equally be observed in traditional live instruction and mixed live online teaching by the availability of complementary material within a determined platform and the existence of computerized libraries and computer labs. FOSS can also be an important tool in the teaching of computer science, because it is possible to both study the software and to modify it.

The analysis of the source code of FOSS by computer science students allows them to identify the goods points, certainly resultant of alterations made by other programmers, and also points that still can be improved, allowing the students to consider what would be the best option to refine the logical construction and to further develop the code. Innovation shows itself here as sequential and complementary.

In both computer science and other university courses, using either distance or live instruction, FOSS can increase students' access to information. With the internet, the amount of information available is vast, but the role of the teacher in selecting appropriate information and allowing the student to advance in a rapid and effective manner is of great importance. As a matter of fact, Silva [9] points to the existence of a vast doctrine recognizing the importance of information as a fundamental element for the development of critical thinking, the exercise of citizenship, and the development of the nation, and Freitas and Efing [10] recognize the undeniable importance of the use of new technologies (including the internet) in the daily life of citizens, acting as true instruments of social inclusion and contributing to the development of the rule of law.

3.2 Public Policy for Digital Inclusion: The Priority of FOSS Solutions and FOSS Training

The adequate development of the public policy for digital inclusion requires, with the agreement of Suaiden [11], the creation of a thorough diagnosis regarding the informational needs, with the use of decision making techniques, to elaborate a strategic plan compatible with the social reality. Beyond this, it is fundamental to understand that digital inclusion cannot be reduced to merely the buying of computers and the teaching the use of certain software programs. The technological infrastructure represents only one of the elements that produces digital inclusion or exclusion. In reality, a computer literacy should be provided that enables citizens to identify the need for information, to organize and apply it in practice, and to integrate it into a pre-existing knowledge base allowing for the solution of problems [12].

Carrying out a preliminary inventory of Brazilian public policy regarding digital inclusion, it is possible to highlight the following initiatives produced by the Federal Government: Broadband Program for Schools, Home Brazil, Computers for Inclusion, Workshop for Digital Inclusion, Observatory for Digital Inclusion, Connected Citizen Project – A Computer for All, The Electronic Government Citizen Service, Program for the Implantation of Multifunctional Resources Rooms, Computer Project for Social and

Digital Inclusion, National Program for Continued Formation in Educational Technology (Integrated ProInfo), Communitarian Telecenters Program, Telecenters.BR, Digital Territories and A Computer for Every Student [13]. The State Government of Sao Paulo has implemented the Access for Sao Paulo Program for Digital Inclusion [14], while the City of Sao Paulo is executing its City of Sao Paulo Digital Inclusion Plan [15]. This list shows the quantitative level of government programs.

Digital inclusion, however, will not be able to be accomplished if it is not accompanied by policies that promote the increased use of FOSS that can both contribute in terms of infrastructure and in respect to digital literacy. This is because the sharing of software and other products of collective intelligence is decisive for the democratization of the benefits of technology and needs to be incentivized [4]. It can be observed none the less that the Brazilian government has chosen to prioritize FOSS solutions.

This way, Decree n. 7.243, of July 26, 2010, created the Student's Computer Program (PROUCA) and the Special Regime for the Acquisition of Computers for Educational Use (RECOMPE). Article 2 § 3 of this Decree establishes that for the RECOMPE program, free open source software without license costs will be given priority, conforming with directives of the education policies of the Education Ministry.

RECOMPE allows for tax exemptions for businesses winning bids to provide computers to public schools and to non-profit schools for the disabled. The taxes exempted are the Industrial Products Tax (IPI), the Contribution for Intervention in the Economic Domain and contributions to the Social Security system (PIS/PASEP and COFINS).

In the other hand, on October 5th 2010, Decree n. 7.325 promulgated the Memorandum of Understanding between the United Nations Conference on Trade and Development and the Government of Brazil for training in free open source software for developing nations, which was signed in Tunis, on the 16th of November, 2005.

Among other forms of expected cooperation stated in the memorandum, the highlights are:

- Training individuals with the skills necessary for using, customizing, and developing FOSS applications;

- Establishing new and strengthening existing mechanisms for collaboration in the distribution and development of software;

- Improving both national and international policies regarding FOSS;

- Concentrating efforts to aid local training initiatives, which do not require, but can greatly benefit from partnerships;

- Promoting digital inclusion by developing initiatives creating telecenters based upon FOSS, especially in Africa, Latina America, the Caribbean, and the Community of Portuguese Language Countries;

- Providing training in communities and universities interested in FOSS solutions;

- Providing technical and organizational training to promote the use and development of FOSS in government administration and online government initiatives;

- Concentrating resources to spread FOSS, creating distance learning and knowledge sharing platforms;

The utilization of FOSS by the public sector has been increasing in recent years and is essential to guarantee that public school students will have access to the benefits of instruction with FOSS. In reality, as Silveira maintains [4], digital inclusion is a first step for socially excluded populations to appropriate technology for the end of breaking the cycle of poverty. In this sense, FOSS favors the spread of information that is one of fundamental pillars of education.

4. Conclusions

The benefits gained for utilizing FOSS in education at university level, especially in technology classes, are indubitable, as it allows students to analyze and improve a source code which is open to the whole community. The use of free software can also benefit live format and distance learning in all university courses, especially by the use of no cost platforms, which increase the level of access available. It can be highlighted that the availability of complementary materials in FOSS platforms, working both in live instruction and part online instruction, revolutionizes teaching methodologies, by giving students access to a diverse range of resources, which include internet articles and games that allow for practice and testing of concepts learned.

The table below shows Brazilian public policy for digital inclusion, analyzing whether they focus on education and FOSS:

Policy's name	Focus on education	Focus on FOSS
Broadband Program for Schools	Yes	No
Home Brazil	No	Yes
Computers for Inclusion	No	No
Workshop for Digital Inclusion	No	Yes
Observatory for Digital Inclusion	No	No
Connected Citizen Project – A Computer for All	No	Yes
The Electronic Government Citizen Service	No	Yes
Program for the Implantation of Multifunctional Resources Rooms	Yes	No
Computer Project for Social and Digital Inclusion	No	No
National Program for Continuing Education in Technology (Integrated ProInfo)	Yes	No
Communitarian Telecenters Program	No	No
Telecenters.BR	No	No

Digital Territories	No	No
A Computer for Every Student	Yes	No
Access for Sao Paulo Program for Digital Inclusion	Yes	Yes
City of Sao Paulo Digital Inclusion Plan	Yes	Yes
Decree n. 7.243	Yes	Yes
Decree n. 7.325	Yes	Yes

Table 1. Analysis of Digital Inclusion Public Policy

This way, the means adopted by the Federal Government, and also by Sao Paulo State and City Governments, in order to foment the use of FOSS, are fundamental for the dissemination of these computer programs and demonstrate the government's desire to intensify the use of FOSS in public schools and universities.

FOSS promotes the full realization of democratic goals, by means of sharing source codes, permitting effective interaction between a program and its user, and aids in the democratization of the gains from technology. Because of this, education policy should strive to spread its use.

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