Using Soft Systems Methodology to Fight Against Info-Exclusion: The Experience of a Brazilian University

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Abstract The aim of this paper is to apply a systemic methodology to analyse the concept of info-inclusion which can guide strategic actions of institutions within civil society and within several levels of government. The paper provides a plan of action that, integrated with other tools, aims at fighting the technological and social gap. We apply Soft System Methodology (SSM), because it provides a holistic approach to info-exclusion. SSM is often used to analyse and resolve problems in complex social studies such as *info-exclusion*. An *info-exclusion* reduction project, developed by a university in the country region of Sao Paulo will be provided as a case study. This project is one of the several Brazilian initiatives to solve the problem of limited access to information technology tools. We start by contextualising *info-exclusion* in Brazil and follow with a review of SSM. We then introduce the concept of *info-inclusion* and apply SSM to it. We end with a discussion of the results obtained and with some suggestions for action and possible improvements.

Keywords Soft system methodology · Info-inclusion · Info-exclusion · Information technology · Education

Introduction

The phenomenon of info-exclusion will be analyzed in this paper using a systemic methodology. Information and communication technologies especially Internet access, have been

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presented as an important part of citizenship. It opens up the possibility to overcome geographical barriers and to make it possible for governments to offer better services to citizens, with more transparency and democracy. However, a large proportion of the population never use a computer or access the Internet. Instead of generating hope about an "information democratic society," this technology can create more distance among social classes.

Unequal distribution of power and income can be stronger where there is info-exclusion. According to Iizuka (2002), info-exclusion refers to the different levels of access to information and communication technologies and the use of the Internet between individuals, families, companies and geographical areas and in different socioeconomic levels. Silveira (2001) states that "info-exclusion occurs when people are deprived from three basic instruments: the computer, the telephone line and access to an Internet provider."

Info-exclusion is a form of serious social exclusion in Brazil. Info-inclusion helps to promote active citizenship and, above all, the development of a competitive position in the global market. Technological knowledge is increasingly becoming a part of society, from voting in electronic urns to the electronic cards of Bolsa *Escola*[1] For a young person, basic computer knowledge is a passport to their first job. Therefore info-exclusion, when it affects the learning ability of people, and their potential to stay connected and spread information, leads to severe consequences in all aspects of an individual's life (Silveira, 2001).

One of the possible fast solutions to info-exclusion is to share technological infrastructures within the community. In Brazil, the creation of public access to the Internet has become possible through *Info-centres* (Iizuka, 2002), which are places available to people who have limited or no opportunity to use and learn these technologies. The case we review here is based on a work group comprised of university students and teachers in Franca, São Paulo, Brazil. This work group has set out a project to reduce info-exclusion in local communities through voluntary work and by using information expertise and computer laboratories available in the university. This study is intended to evaluate such an initiative and to develop a generic model that can be adopted by teaching or similar institutions. Firstly, we will examine the increasing incidence of info-exclusion in Brazil. Secondly, some mechanisms that can be adopted to promote info-inclusion will be discussed. Thirdly we will present an overview of SSM and apply it to identify weak points in the project and to suggest possible improvements. Fourthly, we will formulate a generic model.

Info-exclusion in Brazil

Neri (2003) generated a *Digital Exclusion Map* from data of the "2001 National Research by Sample of Homes" and from a sample of the "Demographic Census 2000," both collected by the Brazilian Institute for Geography and Statistics. It shows the access to information and communication technologies in several regions of Brazil and not only considers the physical structure of the technology (hardware and software), but also the human capital (education and training). It reveals a digital apartheid in Brazil. Only 12,46% of the Brazilian population has access to computers and only 8,31% haa Internet access. Most info-inclusion (about 97%) is concentrated in the urban area. Data of the System of Evaluation of Basic Teaching, from the Education Ministry, reveal that students' performance is better among those who have computers at home. The same happens with children and young people who have home access to the Internet. Based on Neri's data, one may observe the following:

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[1] Bolsa escola is a social assistance programme of the Brazilian government. It provides financial resources to low income families to keep their children in public schools.

- Although Brazilian women possess a higher level of education than men, the same does not hold true for info-inclusion;
- Info-exclusion among children and teenagers is greater than in any other age group;
- The lowest ratio of home-based info-inclusion is found in poorer areas or areas with low population density;
- In terms of access-to-computer ratio, 12.42% of the population living in urbanized areas are info-included, while in rural areas, only 0,98% are info-included;
- The expense in computers and accessories in info-inclusion areas corresponds to 2.62% of the family budget;
- The average income of people in info-included areas is about US$600 per month compared with the average income of US$200 per month for the entire Brazilian population.

According to Neri (2003), the best form of eliminating info-exclusion is investing directly in schools, so that the students can have early access to the new technologies. This means that info-inclusion not only incorporates new information and communication technologies, but is allied with education and plays an important role in building a creative and enterprising society. Info-inclusion is a way to promote quality of life, to guarantee larger social freedom and to generate knowledge. However, due to the late recognition of its importance, there are few diagnoses of the Brazilian context of info-exclusion.

The causal relationship between income and access to information technology is not clear. A larger income may lead to greater expertise and use of information technology, but the opposite is also possible, that is, greater expertise and use of technology generates larger income. However, it is more likely that knowledge generates wealth and that information and communication technologies are increasingly more necessary for the accumulation of and access to knowledge (Baggio, 2000). Neri (2003) states that there is a relationship between wealth and knowledge and that info-exclusion tends to explain in part the differences in income distribution.

Info-inclusion and social policies

In general, social policies can be organized in two groups: compensatory policies (in Brazil, these are represented by such policies as work goups, negative income tax programme, employment insurance and food distribution) and structural policies (such as info-inclusion, education, micro-credit policy, land reform, health and investments in basic infrastructure). The main advantage of compensatory policies is their speedy effects. Yet these effects are often fleeting; when the policies are discontinued, the situation tends to return to its original state. Structural policies, on the other hand, address a need by "providing a fishing rod rather than a fish". In other words, they teach how to generate an ongoing income. Yet, they are slow in generating the desired effect.

In spite of some structural programs, such as computer courses with credit or the donation of equipment that have showed more immediate effects, these policies in general take years until they reach significant indexes. For instance, traditional education policy results appear only when the individual begins to work (about 24 years of age); besides, investments in infrastructure frequently causes imbalances in their results. process of the investments inspection. The problem is not just how policies involve the transfer of income flows, but their social implications in the short and long term. The problem of Brazilian social policy is the preponderance of the compensatory aspect which does not transform peoples' lives. Once the programme is interrupted, its clientele returns to the original marginalised status.
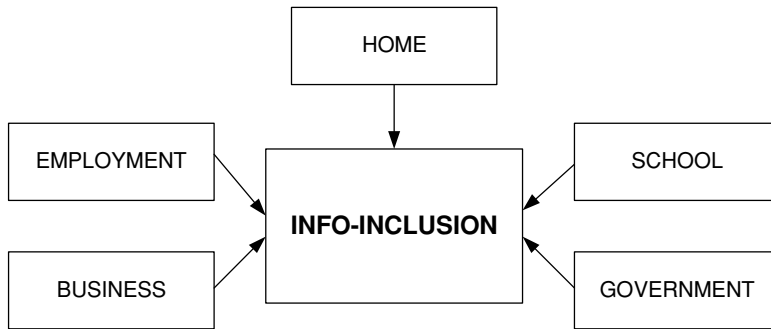
Fig. 1 Main info-inclusion channels

An alternative approach by Neri is shown in Figure 1, here the main channels identified to promote info-inclusion. They are: domestic and community access to digital technology at home, at schools, at work, in businesses and in public services in general.

Reduction of info-exclusion in Franca-case study

Among the 641 cities of the state of São Paulo, Franca, in info-inclusion terms, occupies the 157th position. According to the Map of Digital Exclusion (Néri, 2003), only 10,7% of the population have access to ICTs. In the region of Franca, the situation is still more serious: Pedregulho City is in the 323rd position, just 6,5% of the population are not digitally excluded; Ribeirão Corrente City is in the 358th position, with 6,2%; Cristais Paulista City in the 375th position with 5,8%; Restinga, in the 488th position with 4,1%; and Jeriquara is in the last place, with 0,1% digitally included. Therefore, a group of students from the University of Franca, interested in contributing with voluntary community work, formulated, with the support of some teachers, a project for the reduction of info-exclusion in the local community.

A plan was made to identify institutions of local public teaching, to verify their main needs and establish action lines and appropriate models for regions. Visits were made to two large public schools in Franca and the general education offices of Ribeirão Corrente, Franca, and Cristais Paulistas. During these visits, education secretaries, school principals, teachers and the mayor were interviewed. All the public teaching institutions of the area have computer laboratories with about 20 computers with multimedia, system software, offices applications (like word processor, spreadsheet, electronic presentation), specific application softwares (Mathematics, Geography, Physics and Portuguese) and Internet.

Although the laboratories are well equipped, the teachers do not know how to use them. They do not feel comfortable to prepare their classes and guide the students in practical activities. Besides, there is fear of damage or misuse of the equipment. So, most of the time the laboratories are locked.

The students identified two action fronts: (a) to make more effective use of the local computer laboratories, and (b) to train teachers and students to use and maintain the laboratories. Two groups of voluntary students and teachers were formed, each one responsible for presenting actions to realize one of the two fronts.

On the first front of action, voluntary students worked in the laboratory of each institution and identified the software that needed to be purchased, equipment that needed to be repaired

Table 1 Results of the local survey

Fear of using the computer	
Yes	26%
No	65%
No Answer	9%
Sex	
Male	48%
Female	52%
Age (in years)	
9–15	61%
16–20	22%
Above 20	13%
No Answer	4%
Educational level	
Basic	80%
Intermediate	20%

and the training of instructors. On the second front, a basic computer training programme was developed. In both cases, the local laboratories were used. The municipal councils city halls became responsible for the reproduction of the teaching material, investment in software and hardware and the transport of the instructors (voluntary university students).

However, due to the difficulties in transporting instructors, the university decided to use their own laboratories for computer classes. Therefore, instead of promoting training in the local centers (computer laboratories of the public schools), students were taken to the university for training. The University has six laboratories with 25 computers each. Their use is concentrated in the morning and at night. Thus, three of the laboratories were reserved for the project in the afternoons. Teachers,instructors and monitors started to design the curriculum. A survey was conducted to establish the characterisics and expectations of the particpants and to the design of the course programme. The results are listed in Table 1. The survey established that most of the students involved in the program would be young, with only a basic level of education;but a fair proportion of them (65%) would not be afraid of using the computer. The institutions involved (cities councils, education offices and schools) selected the participants (the students).

In the first year, 2002, a total of 150 students were trained. All students learned basic concepts in computer, Internet and games. Besides, students in literacy process used drawings software. The adolescents and literate adults used word processors and software for electronic presentation. With a computer for each student, the classes had also projection resources. Some activities involving the use of microphones, sound editing, cameras and image editing were also realized. Besides those groups, there were two others, 40 students came from social programs including offenders' recovery, chemical dependents and victims of violence.

In 2003, the number of trained students increased from 190 to 450. In 2004, they reached more than 700. All monitors (university students – volunteers of the project), were prepared by the coordinators of the project. They learned methodology and diadactics. Students were divided in pairs. Each couple worked with one or more groups of community students. Theoretical classes, exercises, projects and practical activities were supplied for all groups, and evaluations made. Finally, the general content was defined and each pair of instructors could complement it with resources and techniques they considered more appropriate.

Based on interviews with the instructors and observations in the classroom, it can be said that the students of the project interact and learn how to work with the computer. Interviews were carried out with teachers, secretaries of education offices and students of the group of

2002. They pointed to positive results: "Besides their concrete learning, children feel they are valued and compete to particpate in the next groups", the secretary's of education of Ribeirão Corrente City testify. "The initiative is important and it should be expanded" attests the secretary of education of Jeriquara.

SSM applied to the case study

The detailed elements and procedures of Soft Systems Methodology are well documented (Checkland, 1981) and need not be repeated here. SSM consists of seven steps or stages which have be applied to the problem of info-exclusion and which we describe below.

The problem situation unstructured

This stage requires that the problem situation, rather than the problem(s), be described without reference to any methodology. Thus, the setting of info-exclusion has already been described in Section 3.

The problem situation expressed

This stage requires that the situation be expressed in terms of a set of problem definitions. Our problem definitions are:

- *Evaluation of Project Results*–there are no explicit expectations or measurements of results regarding the reduction of info-exclusion.
- *Structure Definition*—although the university donates its computer laboratories, the institution's involvement with the project is superficial. It is restricted to providing laboratories and awarding a certificate to the volunteer instructors and students. Although the project has been announced on the Internet, newspapers, radio and local television stations, is technically supported by the teachers and students involved and the university employees are aware of its existence, there is no normative structure that incorporates it into the university.
- *Replacement of Instructors*—the first group of volunteer students (instructors) kept up their interest throughout the project. As they graduated from the university, some promotion, including workshops, was carried out to enlist new instructors and thus continue the project. Yet these actions were unsuccessful and failed to attract new students. This resulted in the number of new instructors being insufficient to meet the demand.

Root definitions of the relevant systems

Root definitions are precise definitions that express the system's relevant changes to deal with problematic situations. To attain the desired objectives, the definitions must show an impartial balance between the organization's mission and its activities and the problem's owners. In doing so, the following subjects were identified:

Evaluation of the project's results

The project's continuation is dependent on the availability of free basic computer classes. An issue is if the classes are a mechanism for info-inclusion or just an entertainment or a

knowledge resource. Although the project courses are adapted to the children's' age level, it is not known whether the computer knowledge gained is used by them after the end of the course. The city education office shows interest in the continuation of the project, but there is no official planning for it.

According to Afonso (2000), info-exclusion is attained through four means: training, infrastructure, funding and expertise. Training is restricted by the lack of knowledge gained from the Internet due to the offers of services and products not being available in the local language (Portuguese) and a shortfall in information democratization. Nevertheless, the project has gone a significant distance in addressing the problem of limited access to information technology tools.

The infrastructure, funding and expertise for the project are provided by the university. It is the university's responsibility for creating, expanding and maintaining laboratories and they are available free for students. Thus, within the framework of Afonsos theory, the project deals with training and the university should contribute by making computer usage available to the wider community and by providing the technical design and upkeep of computer services and systems.

The info-inclusion process requires the following chain of actions (Afonso, 2000): individuals and the community must have access to information technology; it must be financially viable and equally accessible to all; it must be sustainable in the long term and finally, it must be available for entertainment. Yet all this is dependent on the project being able to guarantee the availability of resources. Laboratory access should be unrestricted and near the involved communities. Regrettably, this is not the case. According to the concept of infocentres Mancadar, 2002, the community must create and maintain its centres.

Structure definition

The university is developing some citizenship programmes, and although they are promoted in the local press, most of them are not sufficiently long lasting. The university administration did not get involved with the project. Although such involvement was suggested in the beginning, there was no interest. Therefore, the students and instructors sought support from the university's academic rather than administrative staff. They made access to the laboratories possible and continue to support the project until the present time. It is clear that the university administration is not interested in the info-inclusion project.

The university suffers from a short-term policy syndrome. The new management define the university agenda not in terms of investing in long-term quality education but on the necessity of increasing revenues in the short-term. A few years ago, the university rapidly expanded its resources, which could be seen as making it viable in the long term. However, this initiative did not result in the same expansion in the number of students and the university has had to reduce its costs by hiring fewer teachers and employees. To compensate for this, the university is at present resorting to marketing its activities and especially its community actions. Yet, the search for immediate and superficial effects generates mistrust in the community. Long-term results that are more effective could be obtained if community actions were based on individual efforts from teachers and students without involving the organizational bureaucracy

Recruitment of instructors

The above difficulties flow on to recruitment. The absence of a normative structure is a barrier to stimulating student participation; promotion is too restricted and dependent on isolated

actions. If the work of the instructors succeeds, it is due to the sincerity and commitment of the students who volunteer to perform it. Without them, it would be unlikely that the project would survive.

Catwoe analysis

For a root definition to express adequately a transformation, it should incorporate six elements. These are listed below:

Clients

They are represented by the poor communities in Franca (Sao Paulo) and in the cities around it.

Actors

They are the people who carry out the activities in the system, in this case, the volunteer students, teachers and university employees.

Transformations

These are the changes brought about by the implementation of the system. The change will be in the knowledge of computer use; the input will be represented by the children who lack computer knowledge; the output will be the children who, because of the system, are now able to work with computers.

Weltanschauung

This represents how clients, actors and the external world see the organization.

- Perception of the clients: to the students who participated in the project, the university symbolises a distant world. For most clients who participated in the study—although there are laboratories in the local schools—this has been the first contact with the computer. The attitudes of the participants demonstrate an almost mythical vision of the computer and they almost unanimously regard the classes as important. The level of absenteeism is unfortunate; however, the natural enthusiasm of the younger groups has led to an intense effort to learn. Participation in the project is competitive and many see it as a reward, especially since the demand for places is larger than the number of positions offered. There are frequent requests for advanced courses and technical support for the laboratories in the locality. There is also a demand for larger numbers of admissions.
- Perception of teachers and instructors: the classes are a voluntary activity that contributes to the local community's development. The project could also become the topic for research as well as a tool for curriculum enrichment. For the instructors, participation in the project provides supervised learning and a way to acquire teaching experience. Although most of the university students are middle class, at least four students gave up participating in the project because they did not have enough money for transportation. At least one of them could have remained in the project if the university had offered a partial scholarship. For others, flexibility granted by the university was enough to make their participation

feasible. Finally, both instructors and teachers experienced a certain degree of alienation and indifference for local community problems on the part of the university.

- Perception of the external world: the quality of the service of private universities in Brazil is, with rare exceptions, distrusted. A significant fraction of its students have failed the public university exams, which is regarded as the accepted standard. This produces a heterogeneous student body, and the university spends little time and dedicates few resources to forming a strong student community. However, this makes for a circular problem; heterogeneity among students is one of the main reasons that makes management and administration such an arduous task. The administrators have to deal with the ambiguity of interests of the students: both to assure quality and bring students to the level of obtaining credentials and knowledge. It is difficult for the university on the one hand to satisfy the market demand and the quality required by professionals and deal with the temptation to pass students to keep financially viable. This situation is better handled by universities in neighbouring cities than in Franca. During the collection of data, people repeatedly expressed their distrust in the university. In the wider community, the university activities are seen as being superficial and short-lived marketing campaigns.
- Owners: they are the individuals and organizations responsible for the existence of the system, in other words, those who administer the university.
- Environment: this represents the external factors that may influence, but not control, the system; it comprises the involvement in the project and recognition of its results by members of the community.

The conceptual model

The conceptual model should graphically represent the activities necessary to obtain the changes described in the essential definitions. The following considerations need to be taken into account:

- It is necessary to define a model of performance which takes advantage of the students, teachers and employees potential to contribute to the reduction of info-exclusion and which can use the infrastructure of information technology (mainly laboratories with Internet access) common in Brazilian universities with the minimum of interference in their normal activities.
- Investment should be moderate and affordable to the owner to ensure the viability of the project. Effective activities that promote the project are a social audit, campaigns to promote community participation and the recognition of the right for them to participate. The ideal situation would be for the system to be transferred to the community that directly benefits from it.
- The organisation supporting the initiative should be as independent as possible of the teaching centre. It should depend on the actors' action and especially on the customers. This model should be developed in a similar way to the Brazilian info-centres where the actual owner (University) assumes the sponsor's role.
- Incentive politics for students who participate in the project should be developed, such as certificates of qualification; recognition for involvement in projects of a scientific nature and, if possible, some financial help such as discounts in the monthly fee and free transportation and food.
- The project should incorporate methodological support in various ways: training approaches for students of different ages, technical support to form and maintain local info-centres and data collection and analysis for further research.
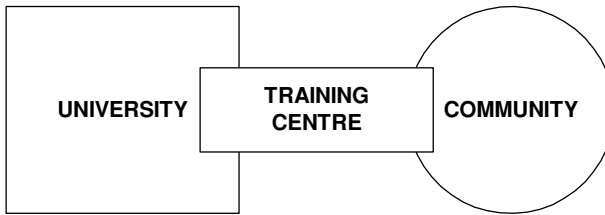
Fig. 2 Proposed model

Figure 2 shows the "academic info-centre"; the teaching centre partially overlaps both the community and the university, supporting them in attaining common interests in a viable manner. By doing this, the objective of promoting digital inclusion would be accomplished, and a viable, relatively autonomous and durable structure for the system would be established.

Evaluation

The planned changes should be evaluated according to the agreed on criteria of effectiveness, efficiency, effectiveness, ethics and elegance.

- Effectiveness: the conceptual model helps attain the objectives of the project, gets the best conditions for performance and promotes info-inclusion in the marginalised regional communities. Autonomy will make such attainment possible through the provision of technical support for the local info-centres. This ensures the availability of technological resources to the community and their access to users. This is one of the most important aspects in reducing info-exclusion.
- Efficiency: the possibility to use the infrastructure already established in teaching centres greatly reduces the costs of starting up info-centres, since these are the most costly. It also utilises the instructors' knowledge about information technology gained through their university studies.
- Effectiveness: as proposed, only the involvement of the community can ensure a continuing motivation necessary for the project. The conceptual model specifies the necessary community involvement.
- Ethics-the changes are morally acceptable.
- Elegance-the proposed solution is harmonious since the efforts are balanced by the expected benefits.

Comparison

A comparison should be made between the result attained by the currently operating info-centres (the current model) and the project results. The projected info-inclusion will be attained by an iterative evaluation and adaptation of the present info-centres assisted by the community's effective participation. Thus, we recommend the implementation of a process to collect data, and to research whether the project meets the established criteria in order to reduce regional info-exclusion. Another suggestion is to verify the application of the knowledge acquired by students in their spheres of learning and activities.

Actions

The actions should be a further development of the comparison stage. This essentially means developing the community's participation in the formulation and structure of the project and an increased understanding of the sponsor's role by the teaching institution. The main actions identified are:

- Seek greater participation of the communities in the development of the project, especially in understanding the experiences of the info-centres and their methods.
- Increase the adoption of the sponsor's role by the teaching institution.
- Increase the incentives for instructors' participation.
- Define, document and adaptat the methodologies for training, technical support and organization of data.

Conclusions

Info-inclusion is a concept that includes the new information and communication technologies as these play an increasingly important role in the construction of a creative and enterprising society. Info-inclusion is an important way to promote and improve the quality of life, to guarantee larger social freedom and to generate knowledge and information. To ignore them is to perpetuate the differences between social classes.

Our model shares the character of social policies that "give a fishing rod instead of giving the fish." The use of the infrastructure and knowledge already available in the teaching centres reduces the costs of the info-centres. Private companies must recognize their social responsibility as something that transcends mere paternalism and employ resources in order to redistribute them for the benefit of society. Creating academic info-centres incorporates social responsibility into teaching institutions, with the long-term benefits of reduced investments and significant returns for the community.

The application of SSM was an effective and productive way to define actions that led to benefits for local communities and reduction of info-exclusion. Following these actions could, in the future, guarantee the effectiveness of such projects and open the possibility of generalising its methodology.

References

Afonso CA (2000) Internet no Brasil: O Acesso a Todos é Possível?, Policy Paper, no. 26, set/2000. <http://www.fes.org.br> (accessed Jun/10/2004)

Baggio R (2000) A sociedade da Informação e a Infoexclusão, Ci. Inf., Brasília, v. 29, n. 2, p. 16–21, maio/ago. 2000. <http://www.ibict.br/cienciadainformacao/include/getdoc.php?id = 584&article = 286&mode = pdf> (accessedm Jun/2004)

Checkland PB (1981) Systems thinking, systems practice. Chichester, Wiley

Ferrari FM, Fares CB, Martinelli DP (2002) The systemic approach of SSM: The case of a Brazilian company. Systemic Proactice and Action Research, vol 15, number I

Gomes E (2002) Exclusão Digital: um problema tecnológico ou social?. Instituto de Estudos do Trabalho e Sociedade, Rio de Janeiro: Trabalho e Sociedade, ano 2, número especial, Dez/2002

Iizuka ES (2002) A Exclusão Digital e as Organizações sem Fins Lucrativos da Cidade de São Paulo: um Estudo Exploratório, SEMEAD

Mancadar AM, Reinhard N (2002) Telecentros Comunitários Possibilitando a Inclusão Digital: um Estudo de Caso Comparativo de Iniciativas Brasileiras, SEMEAD

Neri MC (2003) (coordenador); Mapa da Exclusão Digital, publicação da FCV/IBRE, CPS. Available in <http://www2.fgv.br/ibre/cps/mapa_exclusao/apresentacao/apresentacao.htm,> accessed May /2004

Silveira SA de (2001) Exclusão Digital: a miséria na era da informação. Fundação Perseu Abramo, São Paulo

Tapscott D (1999) A crescente e irreversível ascensão da geração net. Makron, São Paulo