# An Application Model for Digital Television in e-Learning

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## ABSTRACT
The current E-learning applications for use in different Digital TV standards are still, in general, very incipient. Based upon studies on several applications available in the American, European and Japanese scenarios, we have identified their main features and contributions in order to develop a model that aims to take advantage of those applications for the Brazilian System of Terrestrial Digital Television (BSTD-TV). The methodology adopted includes an analysis of existing strengths, weaknesses, opportunities and threats (SWOT) in the Brazilian market as a basis for the proposed model. Finally, it presents critical success factors and some recommendations for the application of this technology in the e-Learning field.

## Keywords
Interactive Digital Television (iDTV), e-Learning, Distance Education.

## 1. INTRODUCTION
Television, as we know it, is going through a major worldwide renewal spurred by the gradual implementation of the digital system. This change has already induced a deeply changed scenario, imposing new business models and new habits for their users. Television is nowadays the broadest means of communication. Winck [1] presents an interesting report that, there are more TV viewers today than the sum of readers in all Western History: around four billion people. For Zuffo [2], the Brazilian open television model is an instrument of national cohesion, being accessed by more than 90% of the urban population.

The Brazilian System of Terrestrial Digital Television (BSTD-TV) was created with the purpose of guaranteeing digital inclusion through interactive resources that enable Internet access and the democratization of access to information. iDTV will bring about a real revolution, since that new technology will offer resources that are as yet unknown to users. In this paper , we will evaluate potential contributions of iDTV, considering its features and peculiarities as an instrument for Distance Education initiatives by means of iDTV, also named t-Learning.

Section 2 explores the main features and concepts of iDTV and introduces some of its main applications. In Section 3, the methodology used in this study will be presented. Section 4 approaches the concept of *t-Learning* and its main peculiarities, emphasizing the currently available technologies. In Section 5, we propose applications of iDTV resources for e-Learning and, after analyzing a set of cases, a SWOT analysis is developed and presented together with the main Critical Success Factors (CSFs) and recommendations based on iDTV current scenario, as well as the advantages to be derived therein. Section 6 introduces the proposed model for iDTV application in e-Learning, its potentialities and limitations and, in Section 7, final considerations and suggestions are presented for further.

## 2. INTERACTIVE DIGITAL TELEVISION (iDTV)
Interactivity along with portability and mobility enabled by BSTD-TV are the competitive advantages in relation to the other existing systems: the American System (ATSC-T), the European System (DVB-T), and the Japanese System (ISDB-T).

Many authors establish possible interactivity levels from iDTV [3, 4, 5]. Lemos [4] identifies five interactivity levels that start at a minimum level – that is, reduced interaction with the TV set –, until a level where the user can effectively interact with the content. Montez and Becker [5] add three more interactivity levels to the ones proposed by Lemos, starting at the interaction of the TV viewer with a program created by the TV channel, up to a higher level, where the TV viewer contributes with content creation.

Interactivity can be made available, basically, in three ways [6]: locally (without return channel); interactivity by means of a unidirectional return channel; and interactivity by means of a bidirectional return channel. The higher interactivity levels demand bidirectional return channels and implicate higher implementation costs.

The focus of this paper is on the utilization of iDTV interactivity resources for e-Learning. For this reason, only services and applications that can be used in activities developed for this field will be included here.

## 3. METHODOLOGY
The methodology adopted to elaborate this study can be summarized in Figure 1. Taking as a starting point the current situation in the world scenario, 21 cases of utilization of *t-Learning* technologies were analyzed, from Europe, Japan and the United States. Then, a SWOT analysis was developed, identifying the *Strengths*, *Opportunities*, *Weaknesses* and *Threats* of the scenario of Digital TV implementation in Brazil. Based on the results of SWOT analysis, we identified the main Critical Success Factors (CSFs), and offered recommendations that should be taken into account in the BSTD-TV model, and also in the application of iDTV for e-Learning.

From the information acquired in the previous stages, a model was created that presents the main relevant components for the application of iDTV in e-Learning. The proposed model is analyzed and discussed highlighting its main contributions to the theme. Finally, potentials and limitations involved in these applications are identified.

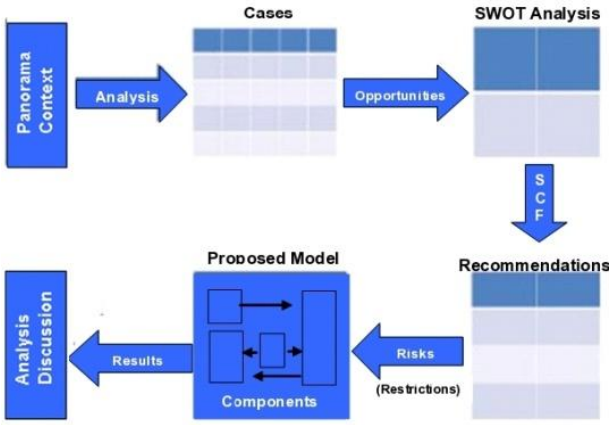


**Figure 1: Methodology adopted in this study**

## 4. E-LEARNING

According to Bates [7], even though the expression *e-Learning* is used for learning via Internet through the use of a personal computer, it can be employed to express any way of learning that uses a digital electronic device.

Its development is very dependent on the access device of the hardware/software and on the Internet provider availability. For Bates [7], although not completely reliable, content delivery is easy and demands only minimum technical knowledge to operate the computer.

T-learning reached significant importance lately, and emerges as a potential medium to create opportunities for learning at home [8]. It can be highly effective in regions where Internet access is scarce. For that matter, digital terrestrial television (DTT) is restricted to social inclusion issues. As an educational platform, interactivity via DTT is the key to reach wider audiences [8].

Bertoti [9] explains that the following factors also contribute to the use of television in e-Learning:

- *Usability:* Since it is a household appliance that has been in use for decades, the main functions of a television set (change channels, adjust volume, turn on and turn off) are already known by the population;
- *Transmission Quality:* Important media in distance education, such as audio and video, are transmitted with quality to television sets. However, that same quality will not be acceptable for e-learning applications until wideband access is universally available;
- *Information Vehicle:* unlike the computer, that can be considered a work tool, people consider the television set an appliance for information and entertainment;
- *Collaboration:* watching a TV program can be considered a social experience, in which the television program acts as mediator for interaction and collaboration among the TV viewers.

## 5. CURRENT APPLICATIONS OF iDTV IN E-LEARNING

Bates [7] surveyed 21 distinct applications of Digital Television in e-Learning with different interaction levels. The cases differ in terms of applicability, product, interactivity level and target audience. Distinct applicabilities were shown: service installment and information, support to educational activities, content reinforcement in some subjects, reading incentive, memorizing, and solving problems, among others. As to the final product, most of the cases have teaching and learning as their main focus. Other modalities were also present: information, entertaining, services and development of capabilities for children.

The 21 cases were classified using a simplified version developed by Crocomo [3]. Accordingly, there are three interactivity levels: "level 1", or local, does not need a return channel, and the user can navigate through several options. Interactivity "level 2" demands a return channel, allows for return messages, although not necessarily in real time. In interactivity "level 3", the return channel is mandatory, and it is possible to send and receive information in real-time. Almost all cases operate at the smallest interactive level; only 4 cases explore interaction in real-time (level "3"). Finally, regarding the target audience, the models cross over all age ranges, being specific in some cases, by varying the levels of difficulty in the proposed exercises.

### 5.1 SWOT Analysis

Using the implementation of BSTD-TV in Brazil as a baseline, a SWOT matrix was created, identifying the *strengths, opportunities, weaknesses and threats*, and the combination of its relations regarding *leverages, limitations, vulnerabilities and problems.* This SWOT analysis is fundamentally important for the understanding of open issues, and the submission of proposals for *t-Learning* models and services. Our evaluation is represented by the SWOT matrix in Figure 2.

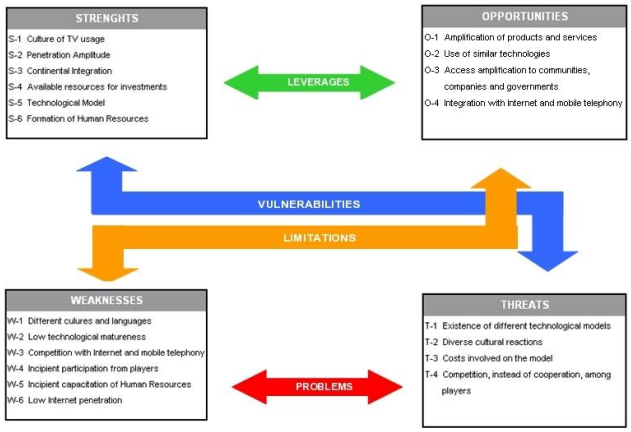


**Figure 2: SWOT Matrix**

### 5.2 Critical Success Factors

After developing the SWOT matrix applied to the scenario of the Brazilian Digital TV implementation project, we turned to the related Critical Success Factors (CSFs), in order to offer the following recommendations for the use of iDTV in e-Learning:

**Table 1: Critical Success Factor and Recommendations**

| Critical Success Factor | Recommendations |
|---|---|
| Commitment of international and regional organisms | To involve the international regulation and development entities, in order to guarantee research financing; integration and interoperability of the technologies applied in the different global models; and the inclusion of poor communities and poor/developing countries |
| Development of models, frameworks and common standards | To facilitate the expansion of products, services and competitive applications with strong global penetration potential, thus reducing costs, increasing the offer portfolio and reducing market absorption time. |
| Mobilization of research, education and development entities | To foster the creation of models, lines of credit and the availability of specialized labor to build models, standards, products and services, as well as the generation and diffusion of iDTV contents. |
| Technological integration among Internet, iDTV and mobile telephony | To develop the digital convergence necessary to the application and use of different media for the process of t-Learning in a dynamic and integrated way. |
| Incentive to the expansion of iDTV audience in poor communities | To develop policies and models for the digital inclusion of excluded communities, through the diffusion of community usage models, equipment financing, and interactivity processes in iDTV. |
| Partnerships and alliances between technology and content providers | To stimulate the involvement of software, hardware, communications, education and broadcasting companies to accelerate the awareness and diffusion of offers and usage of iDTV interactive technologies by the Brazilian society. |
| Enhancement of public policies | To regulate the development of models, frameworks, computer applications, not to mention the protection of author rights and the use of iDTV content. |

The SWOT analysis complemented with the Critical Success Factors (CSFs) and related recommendations leads to the identification and development of projects and public policies that will enable the application of t-Learning solutions using the interactivity of iDTV. Those pieces of information, along with the consideration of risks and existing restrictions in the current Brazilian model (BSTD-TV), will be the building blocks of a model for the development of iDTV applications for e-Learning, which will be presented next.

# 6. PROPOSED MODEL FOR THE APPLICATIONS OF iDTV IN E-LEARNING

The conception of a development model for interactive Digital Television applications in e-Learning, which meets the diverse needs imposed by the wide range of applications required in the Brazilian scenario, calls for different communication possibilities.

Even considering the low penetration of the Internet in Brazilian households, that type of access has to be contemplated in any project aimed at significant share of the population. Other media such as fixed and mobile telephony, PLC, WiFi networks and other existing networks must also be considered. Finally, we cannot forget traditional communication modes, which can be personal or through the mail, and mandatory for remote communities.

Nakayama [10] defines three essential components in an e-Learning application: the *content author*, the *content provider* and the *students*. *Content authorship* can be in charge of an organization or in charge of teachers. The *content provider* systems are, generally, provided by specialized companies or organizations. The *students* can be citizens, public or private institution employees or students of teaching networks.

The model proposed in this study, adapted from Santos [10], encompass all these diverse modes of communication that complement the iDTV application in e-Learning activities. Figure 3 represents potential interrelations between the components of the proposed model.

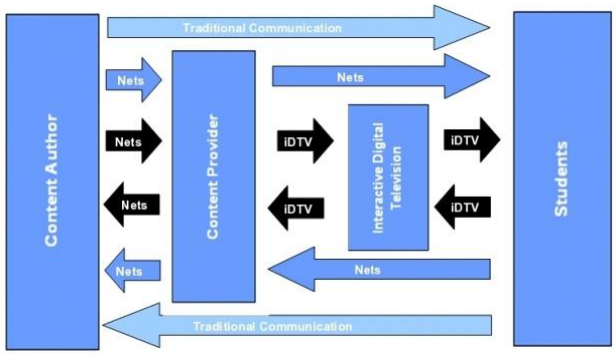


**Figure 3: Proposed Model for t-Learning (adapted from [10])**

iDTV's role in this model is the mediation between the content author and the students. The need for a content provider can be explained by availability and ease-of-use of authoring software , and by the flexibility of the model, including its availability through several existing local networks. In the proposed model, the content authors use network resources and the content provider to create and prepare the educational material. That material is then treated by the content provider work groups and the iDTV companies for the further diffusion of the material through open television. The model also includes the interaction between students and content providers, by means of iDTV return channels or by the Internet, or by other means of communication. The insertion of iDTV in this model increases considerably its range not only by its extensive household penetration but also by the lower operational cost for the students.

## 6.1 Potentials and Limitations of e-Learning Applications in iDTV

Santos [11] considers that, potentially, e-Learning will be able to reach a larger populational slice using iDTV than computers. This is due to the fact that computers are available in 12% of households, which is significantly lower than television, now

available in more than 90% of all households, according to research carried out in 2004 by IBGE – Brazilian Institute of Geography and Statistics,. Another enabling factor is that t-Learning is developed using experience acquired in years of research on e-Learning applications, due to media convergence.

The main difficulty, and the limiting factor found in the adaptation of e-Learning applications, according to [11], is that many computer input devices will not be available for iDTV Web navigators (e.g. keyboard and mouse), the size and resolution of the screen where the data will be viewed, among others.

Santos [11] also indicates that, with iDTV, the user needs to interact with the TV set, becoming an active element in the communication process, as in e-Learning programs. iDTV applications must encourage students to communicate with each other and with the teachers. Interactivity is a concept that does not exist in traditional analogical systems. In that respect, the Brazilian population is not used to interacting with television, which raises an obstacle for the successful implementation of t-Learning programs. The ideal scenario for t-Learning is one where all students have access to a return channel that provides full and free interactivity.

## 7. FINAL CONSIDERATIONS

In spite of the incipient use of e-Learning technologies in iDTV and the low current interactivity in the European and North American systems, as presented in the cases surveyed in this study, the BSTD-TV has, in its interactivity proposal, a very interesting potential for the evolution and development of applications and services. As a referential contribution for this process, the e-Learning models applied nowadays, if replied, offer relevant time savings in the selection, modeling and implementation of new applications and services for iDTV. One of the fundamental critical factors in that process is the equalization of models and public policies related to bidirectional interactivity by the Brazilian government.

The use of the SWOT analysis matrix enabled us to identify that the leverage of results depends on the continued investment in the development of models, standards, frameworks, applications and uses of iDTV in e-Learning, and on the increased allocation of resources for infrastructure and education of human resources. In order to minimize vulnerabilities, we proposed that the effort is focused on replying and adaptating existing models in other systems or markets, and the incentive for the development in partnerships and global consortia. As a complement to reduce the identified limitations, we propose the development of specific public policies and solutions for the digital inclusion of the poorer social layers and of specific communities.

The cases presented here confirm the technological feasibility of the application of iDTV solutions for e-Learning. The SWOT matrix and the Critical Success Factors work in an environment where those technologies are integrated with the daily life of the society. It is important that any iDTV application model in e-Learning considers the true protagonists in this process: the authors of the e-Learning process, the content provider and the students.

Further studies along these lines may investigate the application of the proposed model in a private organization or at a Higher Education institution, aiming to improve it. A research project can be conceived whereby the needs of each of the three components of the model will be evaluated, describing some technological applications that can fulfill those needs, having e-Learning as the focal point.

## 8. REFERENCES


[1] WINCK, João Baptista. *A promessa do audiovisual interativo*. TransInformação, Campinas, 19(3): 279-288, set./dec., 2007.

[2] ZUFFO, M. K.: *TV Digital Aberta no Brasil: Políticas Estruturais para um Modelo Nacional*. Available at: http://www.lsi.usp.br/interativos/nem/tv_digital.pdf. Accessed in August, 2008.

[3] CROCOMO, Fernando. *TV Digital e Produção Interativa: a comunidade manda notícias*. Florianópolis: Editora da UFSC, 2007.

[4] LEMOS, André L.M. *Anjos interativos e retribalização do mundo. Sobre interatividade e interfaces digitais*, 1997, Available at: <http://www.facom.ufba.br/pesq/cyber/lemos/interac.html>. Accessed in December, 2008.

[5] MONTEZ, Carlos; BECKER, Valdecir. *TV Digital Interativa: conceitos, desafios e perspectivas para o Brasil*. Florianópolis: Editora da UFSC, 2005, 201p.

[6] CPQD. *Cadeia de Valor - Sistema Brasileiro de TV Digital.* Campinas, SP, 2004. Available at: http://www.fndc.org.br/arquivos/MapeamentoCadeiadeValor-CPQD.pdf. Accessed in December, 2008.

[7] BATES, Peter J. *T-learning Study: A study into TV-based interactive learning to the home*. PJB ASSOCIATES (Inglaterra). Available at: <http://www.pjb.co.uk/t-learning/t-learning%20Final%20Report%20-%20Main%20-%205-05-03.doc>. Accessed in June, 2009.

[8] SANCIN, Chiara et al. *T-learning for social inclusion.* Available at: <http://www.elearningeuropa.info/files/media/media18506.pdf>. Accessed in June, 2009.

[9] BERTOTI, Giuliano Araujo; ALMEIDA, Felipe Afonso de; BACCAN, Davi D´andréa. *Educação à Distância Mediada pela Televisão Interativa: Panorama Atual e Perspectivas para o Brasil.* Available at: <sbie2004.ufam.edu.br/anais_cd/extras/anaisvolI/vDigital/artigos/5544.pdf>. Accessed in June, 2009.

[10] NAKAYAMA, Minoru; SANTIAGO, Rowena. Two Categories of e-Learning in Japan. Educational Technology Research and Development Journal, Vol.52, N.3, 2004.

[11] SANTOS, Davi Trindade dos. Estudos de Aplicativos de TVDi para Educação a Distância. Dissertação (Mestrado) da Universidade Estadual de Campinas - Escola de Arquitetura e Engenharia,Campinas, SP, 2007.