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ABSTRACT

This article proposes a categorization model for online distance education environments, based on two different aspects: interaction and content. The proposed categorization, which was based on the experience acquired in developing, implementing, and operating different remote training courses, is aimed at providing evidence to help educational professionals in choosing online environments that are more appropriate to their educational goals and strategies. The four quadrants of the distance education virtual environment classification model are described: Information (low interaction and poor content), Self Instruction (low interaction and rich content), Virtual Tutoring (high interaction and low content), and Collaboration (high interaction and rich content). Includes five figures and one table. An appendix lists functionalities of web-based online education environments. (Contains 22 references.) (Author/AEF)

EXPLORING DISTANCE LEARNING ENVIRONMENTS: A PROPOSAL FOR MODEL CATEGORIZATION

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SUMMARY

This article proposes a categorization model for online distance education environments, based on two different aspects: interaction and content. The proposed categorization, which was based on the experience acquired in developing, implementing, and operating different remote training courses, is aimed at providing evidence to help educational professionals in choosing online environments that are more appropriate to their educational goals and strategies.

INTRODUCTION

Web-based online education environments are now becoming very important educational tools [Schrum, 2000 and Farrel, 1999]. These online environments can be educational software packages available on the market, such as Lotus Learning Space [IBM Corporation, 2000] , WebCT [WebCT Inc, 2002], or experimental products developed by Universities, such as AulaNet [AulaNet Project, 2002] and WebCurso [Reinhard, 2000]. In addition to these online education environments, collaboration environments, such as eRoom [eRoom.Net, 2002], have also been used as virtual tools to support remote education.

Most of the Internet-based virtual environments that can be applied to remote education were developed through the integration of synchronous and asynchronous communication tools, such as chat, discussion forums and lists, and electronic mail. These projects range from developing specific tools that are fully integrated with the virtual education environment to using separate tools to create an on-line environment. WebCurso [Reinhard, 2000], Virtual-U [Harasim, 1999] and Lotus Learning Space [IBM Corporation, 2002] are examples of environments that are based on the integration of their own communication tools and the environment. Microsoft, for instance, adopts the separate tool-approach, which, although does not offer virtual application environment specifically directed towards remote education, provides all the required tools to create such environment.

These environments can include several tools and different features. *Appendix I – Functionalities of Web-based online education environments* presents a (incomplete) list of features that can be fully or partially found in most of the environments. Our proposal, which is presented below, states that these functionalities or features actually define how the virtual environments

can be used within the remote education and training context.

This article presents a categorization for distance education environments, based on the educational purpose and two different dimensions:—interaction and content. The proposed categorization was based on the experience acquired in developing, implementing and operating different distance education environments and training courses that will be used as examples. The proposed categorization is aimed at helping education professionals to select the most effective environment to meet their teaching-learning goals and develop educational strategies.

OTHER AUTHORS' PERSPECTIVES ON THE TOPIC

According to Sherry [1996], several researchers assign the same meaning, both to remote education and remote training, based on the idea that the main component is the distance—both in terms of space and time—between the teacher and the student and the teacher-student communication process is mediated by technology. Other writers, such as Valente [2002], assign different meanings to "remote training" and "remote education," that is, "training" means to provide information, and "education" means to capture information and allow knowledge building.

Harasim [1990] summarizes the characteristics of online courses as (1) time and place independence; (2) peer-to-peer communication, and (3) dependence on text-based communication to stimulate learning through understanding and reflection. The main strengths of such environments would be using synchronous and/or asynchronous communication, reaching a wide range of students regardless their location, and creating learning communities.

However, there are innumerous examples in the literature showing that the benefits of online courses are not easily reachable, considering that:

- Online courses are effective mainly for motivated students [Schrum, 1998] or previously educated students (able to process information) [Valente, 2002];
- Developing educational material for online courses can be a tremendous challenge, given the fundamental role it plays in the learning process [Schrum, 1998]; and
- Creating learning communities is a complex task, and the integration among students is always less intensive than expected [Wiesenberg and Hutton, 1996 and Reinhard, 2000].

Reid and Woolf [1997] have already discussed the different features of the online environments, such as access capability, student control, increased communication and the potential for creating a student-centered environment. Heeren and Lewis [1997] suggest that special attention should be paid to selecting the appropriate feature to each specific educational task, matching the media with the task.

Therefore, we are led to discuss environment-related features and technologies and their relation to educational activities. Estmond [1998] proposes three different types or sets of technologies that can have diverse impacts on the teaching-learning process:

- **Type 1—Traditional remote education supplemented by Internet-based activities.** The education process is based on printed material delivered to the students, self-study, and the Internet is used as a supportive resource, which includes e-mails, chats, conferences. As the Internet is not fundamental to the process, technology knowledge is not extremely important.
- **Type 2—Computer-based conference.** In this category, the Internet plays the main role in the communication and education processes. Although printed material can be used, the emphasis is on computer-based communication resources, such as chats, forums and boards, providing the students with synchronous and asynchronous communication opportunities. Written communication skills are important for the process, as well as technical knowledge of computer and Web resources. This type of technology requires great interaction among students and between the student and the teacher.
- **Type 3—Virtual courses.** This is an extension of Type 2, but the Internet plays the role of unique source of training material. Type 3 technology-based courses, which involve deep immersion in computer and Web resources, can provide constructionist learning and create learning communities. Remote interaction with the teacher (and the classmates) helps to provide alternative views and understanding of the learning process.

Another categorization proposed by Valente [1999 and 2002] is based on different distance education pedagogical approaches, which are defined by the different interaction modes provided by the environment and adopted by the educational professional:

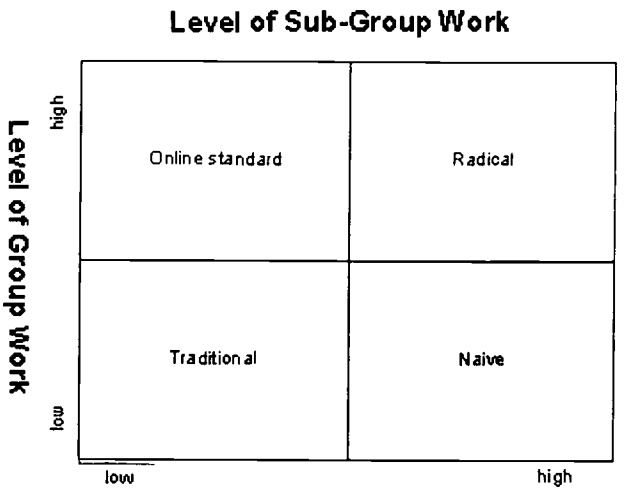
- **Broadcast.** Technology is used to provide information to the learners. The main characteristic is that, instead of interacting with the teacher, the student interacts with the material (content) prepared by the teacher. The teacher receives no (or little) feedback from the student, and has no idea on how the information has been interpreted or processed by the student. The cost of this category per student is extremely low; therefore, it is highly efficient for spreading information to a great number of students. The main role of the teacher is to prepare the educational material (or content).

- **Traditional school virtualization.** Technology is used to reproduce educational activities adopted by traditional classroom education. Here the main characteristic is the teacher-centered nature of the activities; the teacher possesses the information and provides it to the students. The interaction between the teacher and the student is intensive, allowing the teacher to deeply monitor the student's progress. This kind of interaction significantly reduces the number of students involved and increases the teacher's activities. The main role of the teacher is to create and deliver the educational material to the students as well as to provide feedback on the students' activities.

- **Virtual "get together."** Technology is used to present problem situations or projects to the students. The students try to solve the problems individually or within the group, and count on the teacher's coaching. Internet-based interaction aims at accomplishing "learning cycles" [Valente, 1999], which maintain the students involved with innovative activities, allowing knowledge generation. This approach was also called "learning network" [Harasim, et al, 1995]. According to Valente [2002], this approach is extremely complex because it implies high costs—the number of students is limited and the approach requires a supportive team of teachers—and, most important, it demands deep changes in the educational processes. The main role of the teacher is to create educational material, support the learners, and create and maintain a learning environment that is appropriate to knowledge building.

Considering the level of cooperation among students and between students and teachers, Roberts, Romm and Jones [2000] proposed a different categorization model to the Internet-based collaborative learning. For this purpose, they defined two levels of activities that can be accomplished within the online environment: the "group level" involves both the teacher and his/her students—and everybody participates in the activities and can benefit from the work developed by other classmates—and the "sub-group level," which includes small groups of student within the same class. These two kinds of activities define four different categories:

ILLUSTRATION 1
CATEGORIZATION MODEL
FOR THE INTERNET-BASED
COLLABORATIVE LEARNING



- **Traditional**. It is originated from traditional classes, that is, text material and explanations are used to transmit the content to the students. In the virtual world, the three main characteristics of this model are: the content is delivered through files and text, there is no interaction among students, and the interaction between the students and the teachers is usually through e-mails. The students have no (or few) opportunities to learn from their classmates, and the learning process strongly depends on the teacher's knowledge and skills.

- **Naive**. The group is divided into sub-groups with 3 or 4 members; the sub-groups operate as individual units, and are independent from other sub-groups. This method reduces the large groups of students so they

can effectively interact with the teacher; therefore, it is often adopted for practical reasons.

- **Online standard**. It is based on the workgroup model, rather than the sub-group approach. All the students in the group are involved in the activities: discussions, projects, chats, etc. Therefore, the students have the opportunity to learn both from the teacher and their classmates. During the development of the activities, the students tend to form sub-groups spontaneously.

- **Radical**. While the "online standard" and "naive" categories can use either the group or the sub-group model or both, in the "radical" approach, groups and sub-groups are always involved in all educational activities. The activities are accomplished at sub-group level, based on the interaction among the sub-group members, but are also developed at group level. The approach also includes activities developed among different groups. This category has very distinct characteristics:

  - Mandatory use of environment lists and/or e-mail as the only communication alternative available;

  - Online presentations prepared by the students and available within the environment;

  - The teacher divides the students in sub-groups, and all course tasks are accomplished by the sub-groups;

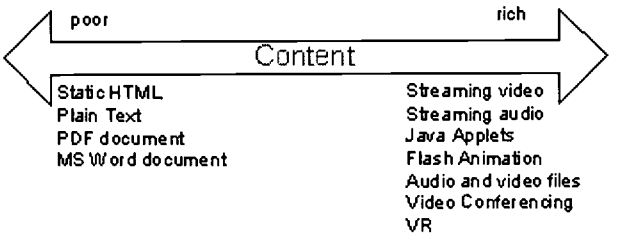
  - Evaluation is based on sub-group presentations and student activities.

OUR CATEGORIZATION PROPOSAL

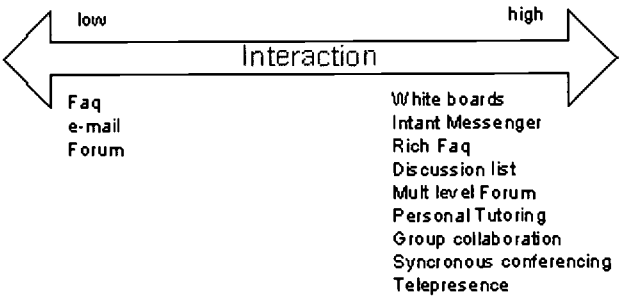
Although distinct, the three previously described approaches have one main common aspect: the interaction among students and between teacher and students. Also, they all state that to create a distance education environment to involve and stimulate the students requires intensive involvement of the teacher. Individual attention from the teacher is also required through private messages and continuous involvement within discussion group environments, in order to coordinate and direct the discussions toward the course goals.

We herein propose a different categorization model for Internet-based distance education environments. In addition to the interaction aspects, the proposed model considers the potential of the Web technology to create rich education material and classifies the environments based on two different dimensions: content and interaction:

- "**Content**" is herein defined as the subset of educational materials available to the students. This dimension is justified by the large range of resources provided by Web technology. These resources would allow the development of virtual educational contents that go far beyond the traditional textbooks. The content can be presented in different digital media formats, such as hypertext documents, streaming audio and video, animations, simulations, improving the materials with interactivity between students and the environment.

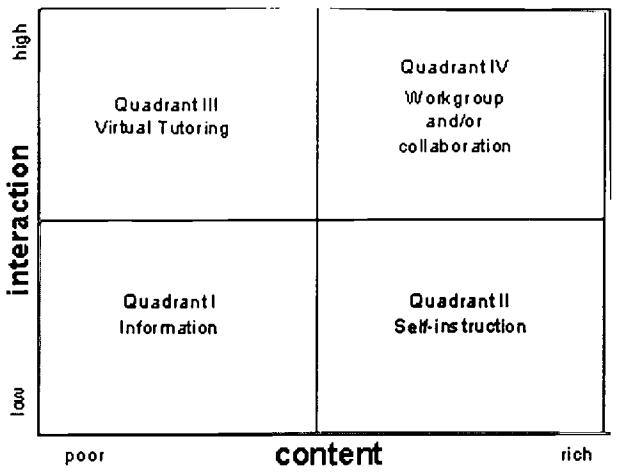


- "**Interaction**" is the mutual relationship among the students (peer-to-peer) and between students and teacher. Interaction can be herein understood as the frequency, as well as the volume of information exchanged among the students and/or between students and teacher.



Therefore, based on the two previously mentioned dimensions—interaction and content—and adopting two basic measures—low and high (Illustration 2)—we herein propose a distance education virtual environment classification based on the interaction level among the participants and the richness of the content available to them.

ILLUSTRATION 2
DISTANCE EDUCATION VIRTUAL ENVIRONMENT CLASSIFICATION MODEL



Quadrant I— Information (Low Interaction and Poor Content)

This category is characterized by the availability of simple text or files (.doc or .pdf). There is no interaction among the participants or the interaction is limited to common resources such as FAQs. This category includes remote training initiatives or standard information delivery. The student is fully responsible for the learning process.

As an example of this category, we implemented a Public Policies (http://www.msco.com.br/cpp) web site. The environment aimed at providing information on decentralized and participatory management to the members of Municipal Councils. The content includes only Word text files (or .pdf files) that can be downloaded to the student's computer. The content was a manual on the rules that regulate decentralized management. The interaction level is low and exclusively based on FAQs. The environment is a delivery tool to provide specific information on a specific topic.

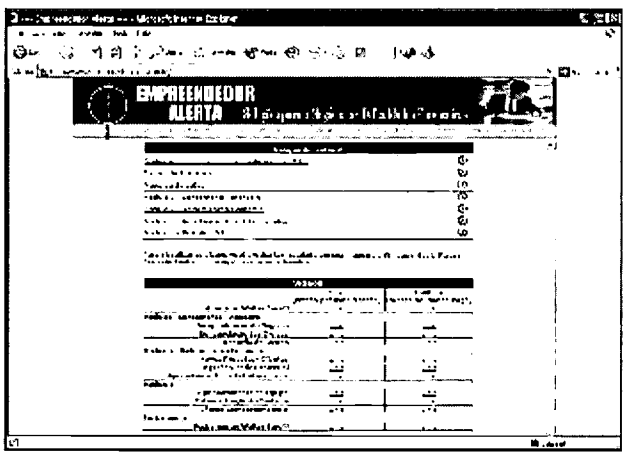
Quadrant II—Self-Instruction (Low Interaction and Rich Content)

It is characterized by rich and diverse content in different formats, but low interaction among the students or between the students and the teacher. It is appropriate to learning strategies aimed at providing the student with a rich virtual environment that allows him/her to learn by him/herself, guiding him/her through a previously defined sequence of actions. This kind of environment is appropriate to large group training initiatives, with fixed content and low feedback levels.

As an example of this category, we implemented two different projects: *Empreendedor Alerta* and *3Com Learning Center*. Both offer rich content using different communication tools.

The *Empreendedor Alerta* project is aimed at offering to small business owners different contents that teach them how to overcome eventual financial difficulties. The environment offers Adobe PDF manuals and Microsoft .asf streaming video files (*Advanced Systems Format* for Windows Media Technology)—see Illustration 3. The participant also receives a course kit by mail, including a course manual and videotape.

ILLUSTRATION 3
DISTANCE EDUCATION ENVIRONMENT—EMPREENDEDOR ALERTA
http://www.msco.com.br/empreendedor

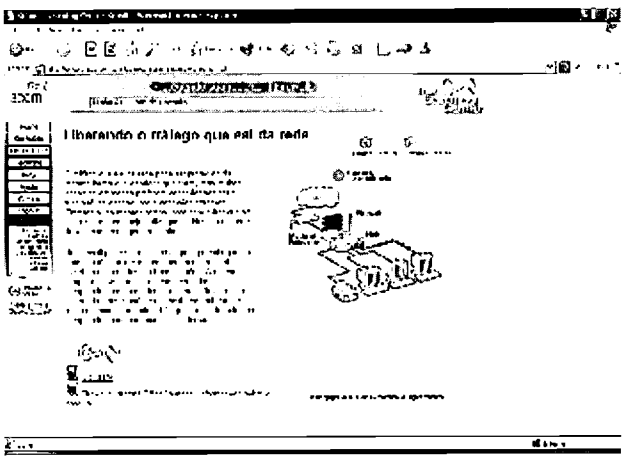


The environment counts on limited interactive supportive tools—a discussion forum and a specific area for receiving the student messages directed to the instructor or to the supporting team. In spite of environment limitations, 9,293 people registered for the course as of April 2001. Conceming the interaction among the students, only 57 message topics and 94 message answers have been included in the Discussion Forum. Considering both the interactions between students and the teacher team, 324 messages have been registered. These figures show low interaction between the students and the teacher team and also among the

students—we can notice low interaction among the students and between students and teachers, that is, 0.05 messages per participant.

Another example of a distance education virtual environment that would also be included in Quadrant II is the *3Com Learning Center Brazil P*roject (figure 5). The environment is mainly aimed at offering basic training on network technology; this is, teaching the basics of network technology. The environment is an adaptation of the equivalent program currently available at the 3Com University-USA web site. The environment includes 15 different courses on computer networks. The exhibition mode is standardized, and includes few different, but rich, content formats, using hypertexts and animations developed in Macromedia Flash. The interaction between the student and the environment consists of sequential navigation through the course HTML pages, enriched by Flash animations.

ILLUSTRATION 4
DISTANCE EDUCATION ENVIRONMENT—
3COM LEARNING CENTER—BRAZIL
http://www.msco.com.br/3com



The only interaction available is provided by a sophisticated FAQ system, that is, the answers to the proposed questions can go far beyond the traditional FAQs, and can be enriched by file attadimentes and illustrations. The student can also directly contact 3Com: by hotline or e-mail, although no contact is provided through the educational environment.

The *3Com Learning Center Brazil* is operating since June 2001. In April 2002, the number of enrolled students was 5.335. Over this period, only 35 student messages have been sent to the teacher team. The teacher team has sent 6 messages to the students. A series of questions presented at the end of each course allows the students to evaluate the courses. Course evaluation grades range from 1 (poor) to 5 (excellent), and are used to measure the students' perception of the course. Based on this evaluation tool, we know that 33.8% of the students consider the courses to be excellent, and 46.92% think the courses are good! Only 16.54% of the students think the courses are regular, and less than 3% classify them as poor. These figures show that student satisfaction levels concerning this kind of environment are high.

Quadrant III—Virtual Tutoring (High Interaction and Low Content)

The virtual environments included in this category are characterized by intensive coaching activities and some group work. Considering that the focus is on the interaction between the students and the teacher, the content does not have to be highly sophisticated in terms of audio and video resources. The focus is on tutoring actions, that is, providing the student with effective support during the learning process. Interaction becomes a critical success factor. Communication tools are intensively used by teachers, pedagogical coordinators, or facilitators to reinforce the learning process. Group activities can be adopted to increase the interaction and information exchange among the participants. Feedback is frequent and highly important in this kind of environment, requiring specific tools to monitor course activities and student progress. Small and mid-size groups—40 to 80 people (considering only one teacher)—can be appropriate to work within this kind of environment, considering that interaction between the students and the teachers tends to be high.

As an example of this kind of virtual environment, we can mention two remote education projects, VirtualCurso and Virtual-U. VirtualCurso (VC) is the most current implementation of WebCurso [Reinhard, 2000]. The environment offers several synchronous and asynchronous communication tools to be specifically applied to remote education. The environment can be configured according to the strategies applied by a specific teacher to a specific course.

From April to September 2001 a remote education program was offered to Mathematics teachers (at Primary and High School), mainly aimed at training them in using spreadsheets to teach Math. The course

content, which included a spreadsheet tutorial program specially aimed at developing the proposed content, was presented through Microsoft Word text files and HTML hypertext files, using ."gif" pictures and screenshots from the spreadsheet application. The main strategy consisted of:

- Proposing basic and individual tasks or activities, in which the teacher and/or the student would develop a series of activities using calculation spreadsheets (in this specific situation, Microsoft Excel) and present them to the pedagogical coordinator; and

- Proposing tasks, wich include how to create spreadsheet activities related to everyday life, and follow the same principles and contents used to guide the proposed activities. These files were stored in a transfer area (called the "Group Window"), creating a database that could be accessed by all the students.

- Helping to develop the interaction between the coordinator and the students. After the evaluation, the students were stimulated to improve their spreadsheets thorougt the addition of new data and the discovery of different alternatives to correct eventual mistakes.

The chosen strategy significantly increased the number of interactions among the students and between the students and the pedagogical coordinator. The course started with 120 students, was later reduced to 72 students, and ended with 51 students. Most of the interactions were made through e-mail and discussion forums, both directly integrated to the VC environment. The students sent 1.523 messages to the coordinator and 590 to other students. The coordinator sent approximately 2.500 messages to the student. Considering that 51 students concluded the course, the average number of messages was as follows: 29 student-to-coordinator messages, 12 student-to-other-student messages, and 49 coordinator-to-student messages. The Forum included 101 topics and 1328 answers to the proposed topics, that is, approximately 13 answers per topic.

At the end of the course, answering the course evaluation questions, the students said that they had learned a lot, including mathematical, pedagogical and computer-related content. All of the 51 students that concluded the course answered the evaluation questions. Forty-nine of them, (98%), said that participating in a virtual environment-based course was a pleasant experience, and they would participate again in a remote training course.

Quadrant IV—Collaboration (High Interaction and Rich Content)

This kind of environment is based on peer-to-peer collaboration, teacher-student cooperation, and work-group activities. Differently from quadrants I, II and III, which are aimed at a more individual learning process, quadrant IV is based on collaboration activities that support the group learning process. This situation requires a high level of interaction among the participants. Synchronous communication tools, such as audio and videoconference, are emphasized in this kind of environment, as well as online document sharing (e.g. shared white board). Asynchronous communication tools, such as discussion forums and lists, or even other tools that allow sending and receiving files (file download and upload area) to common areas are important within this context. This kind of environment allows the students to freely create groups and sub-groups. There is a wide variety of contents available because, in addition to the material provided by the teacher, the students also develop and provide course materials.

Java Collaborative Virtual Workplace (CVW) and PauliWorld [Su, 2001] are examples of collaborative virtual environments. CVW is used for distributed system analysis and distributed collaboration and offers a set of resources that allow synchronous and asynchronous collaboration through text mode-based chats, audio and videoconference, and shared whiteboard. According to Maybury [Maybury, 2001], CVW implements session persistence, which allows recording user interactions as soon as they occur within the "shared virtual room" context.

VirtualTeam also belongs to this category. This environment was created and developed aiming at facilitating the virtual integration among groups of students involved in traditional classroom courses. Although the environment does not include synchronous communication tools, such as audio and video-conference, to deliver sophisticated content, it offers a large set of tools to facilitate virtual interaction and communication. Its main characteristic is allow sub-groups while maintaining privacy. The material shared among different groups is based on a resource called "window." Operating since August 2001, it is currently being used by over 150 students registered in Internet Technology MBA courses at Faculdade de Economia e Administração, USP. The tool can be seen at http://www.virtualteam.com.br.

DISCUSSIONS AND CONCLUSIONS

Before presenting our conclusions, we think it is important to reiterate Valente's statement [2002], that the categorization approach is not the only alternative available and does not represent preferred technologies. The division into categories is just a useful resource to help educators choose the most effective environment, according to their educational purposes, their target audience (number and characteristics), and the related social and economical circumstances.

Concerning the categorization herein proposed, the following topics present indications for each of the presented categories (see Table 1).

It is not simple to classify the environments only on a single quadrant. The environments may cross quadrants boundaries. Illustration 5 shows some of the virtual environments mentioned in this paper.

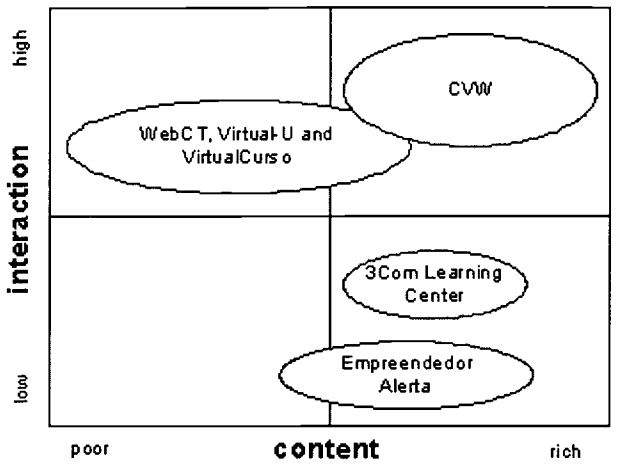
Each environment includes several features, and a specific feature can be implemented in different ways within different environments. For example, a FAQ system can vary from a simple list of answers in text format to a sophisticated multimedia tool associated to complex searching mechanisms.

All the examples presented to illustrate the different categories herein mentioned can be considered to be successful distance education applications. Although completely different, each one is appropriate for the intended educational strategy. Therefore, the educators are responsible for examining the characteristics of different educational environments and finding the most adequate to their pedagogical purposes, reach, resources and cost per student.

TABLE 1

Category	Indication	Example of use
Information	Large groups. Simple and specific topics. Requirement of low cost per student Appropriated to "continuous delivery." Content could be updated periodically.	Explain the new administrative procedures of a company.
Self-Instruction	Large groups. More complex topics. Low interaction between the students and the teacher. Adequated to "continuous delivery." Indicated for information courses.	Training on computer network basic concepts, or training on use of an administrative information system.
Virtual Tutoring	Small size groups. Focus on the teaching process. Interaction between the student and the teacher is the most important element. Indicated for development courses.	Teaching the use of Web on education and creation educational material for use on classroom
Workgroup or Collaboration	Small/Medium size groups. Focus on peer-to-peer collaboration. Adequate to knowledge exploration activities. Constant information exchange is required.	Teaching how to create and develop a business plan.

ILLUSTRATION 5
ENVIRONMENT
CATEGORIZATION EXAMPLE



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APPENDIX A
FUNCTIONALITIES OF WEB-BASED ONLINE EDUCATION ENVIRONMENTS

Resource	Description
Manual	Environment User Manual in text format or "contextual help" format.
Course material	Area for providing material to the students. Course material includes text, software, animations, e-books, etc.
Chat	Synchronous communication (text-based) for groups, with choice of persistence.
Instant Messaging	Synchronous communication (one to one), private, sensitive to presence within the system
Forum	Moderated or edited asynchronous communication.
Management Tools	Allow creating and monitoring groups and sub-groups, with controlled privacy to be managed by teachers.
News	News publishing system to be used by teachers/tutors.
Files (Database)	File storage system, including upload and download, also allowing the creation of private folders.
Message box (e-mail)	E-mail internal system for internal and external use.
Task Management	Assignment and control of student tasks.
FAQ – Technical	Frequently Asked Questions sub-system on environment technical issues, which shall serve as off-line technical support environment.
FAQ – Content	Frequently Asked Questions sub-system on pedagogical issues related to the modules.
On-line support	Through Instant Messaging, both text and voice.
Statistics	Statistics sub-system on environment usage by students.
Resource repository	Includes all the required plug-ins so the students can use the resources.
Evaluation of the Participants	Evaluation sub-system that implements "Student Activity Control Card," including Notes, Evaluations and Comments.
Bulletin Board	Sub-system that allows both searching information published by participants, and entering information to be provided to other participants.
Links	Area that allows entering URLs to be used by students, teachers and tutors; also including comments.
Latest Events	Environment monitoring system that allows providing updated information to the students, as of the latest entries.

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