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# Research on Computer-Based Learning Environments: The Vitrine 2001

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**Abstract:** The Vitrine 2001 is a project devoted to the study of computer-based learning environments. *Computer-based* implies more than just the presence of a machine; in a true computer-based learning environment, the power of computers as tools which permit the creation and manipulation of information is exploited as much as possible. *Learning* environments because our primary concern is to create, for both students and teachers, environments which promote and facilitate learning. *Environment* includes all of the physical, cultural, human and computer components which may influence the user's activities.

The *Vitrine* project is working towards this vision of the future of educational computing and is based on the principle that children must be an integral part of the development process. Since March 1987, a team of researchers has been working with various groups of children from six to sixteen years of age to discover and create this future. The *Vitrine* was developed with the idea that computers could best be used in education to favour process learning over content, and as tools to facilitate communication and encourage creativity.

## WHAT IS THE VITRINE 2001?

The Vitrine 2001 is a research project of the Quebec Centre for Research in Educational Computing (APO Quebec). APO Quebec is a non-profit Quebec government corporation promoting applied research and development in educational computing. It serves the entire educational system, from nursery school to university, including vocational and technical programmes. It also aids and advises private industry working in the microcomputer field.

The Vitrine 2001 is a computer-based learning environment; in other words, an environment which has as its goal facilitating learning and teaching by using computer and other associated technologies. The concept *of environment* includes all of the physical, cultural, human and computer components which may influence the user's activities. These are *learning* environments because the primary focus is to create, for both students and teachers, environments which promote and facilitate learning. *Computer-based* implies more than just the presence of a machine; in a true computer-based learning environment, the power of computers as tools which permit the creation and

manipulation of information is exploited as much as possible.

The project is distinguished by its pedagogical approach, which draws on both Piagetian and Brunerian learning theories as well as the concept of micro-worlds as elaborated by Papert (1980) and Brown (1985). The learner is the starting point: the learner's interests, competencies, strengths, and weaknesses are the driving factors in how activities unfold. Combined with this is the learner's active role, achieved by using the computer as a tool to permit the student to be in control of the computer-user interaction.

*Vitrine* means showcase, and the project embodies two meanings of the word. The first, and more common use, is that of a setting or framework for exhibiting something, especially at its best. The second meaning which this project illustrates is that of a medium or vehicle for exhibiting a tentative offering or tryout of something. The *Vitrine* encompasses these two facets by using established technology while experimenting with new developments in both hardware and software. 2001 refers primarily to the street address (2001 St. Laurent Blvd.), but the futurist connotations evoked by this number were not unwelcome.

The Vitrine 2001 is also, by definition, an environment in a continual state of evolution. All of the aspects of the Vitrine evolve: the physical organization, the hardware, the software, the furniture, the teaching materials, etc. The individuals who work there evolve in terms of their actions, their observations, their research, and their learning.

As well as a functioning computer-based learning environment, the Vitrine is also a site which offers important possibilities for research. The project goal is to undertake learning-oriented research, in a context where the children's choices and their approaches are respected as much as possible. (For a more detailed description, see Winer et al, 1987.)

A static description cannot reflect the dynamics of the Vitrine full of children. When empty, it is simply a large space, roughly 30' by 36' at its largest, with fifteen to twenty computers,[1] arranged according to their uses, the tables available, etc. On the walls are examples of children's work, decorative posters (e.g., Leonardo da Vinci), aids for operating different software packages (e.g., the LogoWriter keyboard with commands and the image bank from MugShot), etc. On the tables and in the columns are instruction manuals, reference books (e.g., dictionaries), children's books, magazines (e.g., *Le petit debrouillard)*, and decorative objects (e.g., a collection of turtles). There is also an "annex" in the basement which houses three additional ICONs on the same network.

From October 1987 to June 1988, we worked with three groups of students. 1) Agrade two class from a multi-ethnic and multilingual inner-city neighborhood. The school had no computers, the teacher had no previous experience with educational computing, and none of the students had access to a com-

[1] We would like to thank Apple, Amisco, AT&T, Cameleon, Canadian Global Systems BLD Inc., CLASS Inc., Hexamedia-Televox, IBM, LCSI (Logo), Le Transit, Olivetti, Quebit, and Unisys for the loan of the materials used in the Vitrine 2001 project and for their continuing support.

puter. 2) A combined fourth/fifth grade class from an upper middle-class, francophone neighborhood. The teacher had been using computers for several years, there was a computer in the class, and the majority of the students had computers at home. 3) A group of ten adolescents in a provincial health care centre, all of whom had serious learning and psychological problems. The centre had a number of computers, but they were not being used as the previous experiences were judged less than satisfactory. The psychologist/ educator had no experience with educational computing.

## THE MOST COMMON QUESTIONS

1) According to our visitors, the most striking feature of the Vitrine is that among our fifteen to twenty different machines, we have eight different types."W7iy *do you have a multi-machine, multi-software environment?"* In reflecting on this question, we found three answers. In the beginning, the reason was quite simply opportunism. We began with borrowed machines, or ones unearthed in our basements, those of friends, etc. Later on, when we were able to obtain equipment loans from different companies, we did not want to refuse anyone. However, we have now realized the advantages of this kind of environment, and we would not want to function any other way. If we were forced to make a choice and use only one type of machine, we would be the losers.

The first reason is human diversity, found equally in children as in adults. From a cybernetic perspective, it is obvious that in order to be able to respond to the variety inherent in such a complex system of learners, an enormous variety capability must be present in the environment (cf. Ashby's Law of Requisite Variety, 1958). To be able to respond to all of the children individually, when they are of different ages, interests, cultures, and abilities, we must have the richest possible environment. Richness is not used as a quantitative measure (there is not even one machine per child), but rather in the intangible sense of qualitative richness. The validity of this argument can be seen in the fact that each of the machines has found its place; each one, without exception, is used.

Related to this first reason is the fact that each machine and each program has its own "culture." Physically, the way one interacts with the machine is different: a trackball, a mouse, a keyboard. The visuals are either in colour or monochrome. The information output is either through the screen, music, or movement (e.g., Lego). Even software packages which have the same purpose (e.g., graphic animation) encourage different approaches. For example, I-Paint on the ICON is oriented towards linear objects and the concept of horizontal planes whereas the program FantaVision on the Apple IIGS uses the concept of objects and exploits the interaction of sound and movement.

The third contribution which this environment offers is on a conceptual level. Because it is a comparative and non-competitive environment, it encourages the development of a hierarchy of concepts and draws out the concept of

"computer" rather than a specific machine. The child sees, by experience, which facts are applicable to a number of applications or machines, and which are those which have only limited generalizability. *"Thisprogram works in this way; all ofthe programs on this machine have this feature; all computers have this in common."* The child is placed in a context where she or he must make mental models powerful enough to accommodate the variety found in the environment.

Our findings to date are encouraging. The children explore the machines and the software and make comparisons between ways of doing. They discover the advantages and disadvantages of the differences. For example, a girl in fifth grade worked with I-Paint and did three films. At one point, she wanted to have two objects moving at the same time; she therefore switched to FantaVision which permits that. The counterpoint is a boy in the same class who, introduced to FantaVision by a classmate, returned to I-Paint because he preferred the trackball to the mouse.

Despite what many adults might have thought, the children have not become high tech snobs. They tell us that they want to write, to draw, to work with the Legos, etc.; they do not discriminate against a Max in favour of a Mac.

2) A second question concerns the influence that the children have on the environment. *"How do the children influence the changes which we make to the Vitrine?"* The Vitrine is in a continual state of formative evaluation and the children have influenced many different aspects. On the physical level, much of what is on the walls comes directly from the children (for example, the drawings or phrases). Indirectly, they have given us hints as to resources which would allow them to function more autonomously (e.g., translation of commands from English to French, instructions for starting the floor turtle), or which would make the use of a particular software package more efficient (for example, the posters of keyboards with the Logo Writer commands, the image banks for MugShot). They have given us suggestions for the location of the machines (e.g., separate the networked ICONs), and even for furniture (after observing that the children often squeezed two onto one chair, we commissioned a bench for two). The children have also had an impact on the software, either by specific suggestions (e.g., "we have x software package at school or at home and it's fun"), or by more or less explicitly expressed needs (e.g., "I want to create crossword puzzles"), or when we see a child who would be capable of going to a more difficult level, we try to find software which will permit more challenging interactions.

By the interests expressed and the difficulties encountered, the children have provoked modifications to the software itself (e.g., the development of *Canevas,* a program for making branching adventure stories on the Acorn; the translation of HyperCard into French and the creation of customized buttons; drawing and background banks which can be used to create animations with I-Paint), and even the creation of software (a LogoWriter program to control Legos with the Cam£l£on interface card).

The examples cited illustrate the ways in which the children have influ-

enced the structural aspects of the Vitrine. There is, however, another aspect, perhaps less visible but certainly as real: the operational. The environment changes each week, and often numerous times during the day with the different choices that the children make. What they do obviously affects our actions, our intervention strategies, and our preparations for future visits. For example, once several children are familiar with a program, we will not respond directly to questions, but rather encourage them to consult a peer. The tactic of answering a question with another question is also used liberally.

3) A third question concerns management. *"How can one manage different projects of many children at the same time?"* The advantage of such an environment is that it can accommodate teachers with different teaching styles (individualized, workshops, traditional, etc.), who hope to achieve different pedagogical objectives (socio-affective, perseverance, cooperation, technology mastery, language arts, etc.). The environment permits a flexible management structure, adapted to the regular functioning of the children and their teacher.

We currently use four principal means to facilitate the organization of the activities at the Vitrine.

a) At the beginning of the year, each child received a binder in which he or she could keep notes, drawings, copies of productions, diskettes, etc. It is a personal and private space which permits each child to organize him or herself.

b) Badges are used by two of the research groups. In the case of the second graders, we observed that the environment was difficult to represent on a two-dimensional board because the choices made by the children changed the environment itself. As a result, we changed our way of presenting the choices to the children. We offered the complete range of possible activities in the form of badges; the environment is then created by their choices. During the course of the activities, the badges serve a management function for computer access — the children are free to explore, but the badge identifies their "home base," where they have priority.

The combined fourth/fifth grade class was project-oriented; they used the badges in order to establish group identification. Project-related work has priority over non-project work for machine access. A project is not necessarily related to one machine or one software program in particular; the badges, in their case, indicated who was working on what project. An Explorer badge, valid for one week, was also available; it conferred project status on a child who wishes to try out unknown activities.

c) All of the children filled out co-researcher forms. The forms were modified to suit the level and capabilities of the different groups, and also evolved over time to reflect the evolution of the Vitrine and the

children. The forms have two purposes: 1) they are an important data-gathering tool; and 2) they are *a* tool for encouraging learning. In modifying the questions so that they correspond to the current level of the children, we tried to calibrate the questions to elicit reflections and provoke thinking.

d) The fourth means is what we call *"les pauses"*. These breaks are moments for relaxation when the children "center" themselves (controlled breathing) before doing something else for ten minutes. The pauses impose a distancing and, consequently, allow the child to gain perspective on his or her actions.

4) *"What kind of learning does such an environment encourage?" As* the school year has just finished, we are far from being able to announce final or definitive results, but we are able to draw two preliminary conclusions. The Vitrine is an environment which not only favours process learning and problem-solving, but it offers continual and real encouragement and reinforcement. The only time that failure is mentioned is when a child gives up. For example, three children, working in a group, lost all of their work because they initialized *a* diskette by mistake. As a result, they learned about and integrated the idea of back-ups, and they have been initiating their peers. Even though they had to start over from the beginning, no-one spoke of failure or of time wasted. In contrast, two other children from the same class started a project which involved programming a game in Logo Writer; after one week they wanted to quit because they felt it was too hard. At that point, it was treated as a failure because they were not seeing the learning process that they had embarked on; they continued their project.

We have also realized the power of modeling for learning in this kind of environment. The children see, live with, and suffer through the fact that the adults do not always have the answers, that there is not always an answer, or that sometimes more than one answer is possible. Confronted with these "alleged experts," there are a number of possible reactions. They could lose respect for the adults; they could say that it wasn't even worth trying because even the adults weren't able to succeed; or they could do what happened in the Vitrine, take on the responsibility themselves. They have learned that no one can know everything. The important thing is to know how to look for information, to have useful strategies for exploring or debugging, either by consulting reference books, hints, peers, other animators, etc.

## THE FUTURE — THE CHALLENGES WHICH AWAIT

We have just completed our first full year with children in the Vitrine and are analysing the data collected; results will be published as they become available. We can see that many of our efforts have started to bear fruit

recently; for example, a higher level of success and perseverance than the teachers had thought possible at the beginning of the year has been attained. We are satisfied, but at the same time are very conscious of the challenges which await us in the coming years. We believe in the vision of educational computing which the Vitrine lives. But it is clear that with innovation, new challenges also appear. The current challenges concern three different themes.

1) Watching the children in action, it is relatively easy to observe their learning and their progress. The challenge here is addressed to evaluators in the school system. Because we would like to see environments like the Vitrine integrated into the regular school system, we must find ways to follow the children and recognize their efforts and their achievements.

2) The second challenge is addressed to researchers. The richness and the variety of activities is difficult to grasp and analyse with traditional research methods and tools. We have already started working on the problem and are currently experimenting with the use of existing computer applications in innovative ways to respond to the particular needs of these new situations.

3) The third challenge is addressed to all those involved in educational computing. The new computer-based learning environments are creating new roles for all of the participants: the children have taken on the role of co-researcher; the teachers are leaving the role of transmitter of knowledge and are learning-facilitators in the same environments as their students; the animators still show others, but they also act by letting themselves be acted upon. These new roles are blurred; it is incumbent upon us to better distinguish and define them.

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