VC + EL = VL

Enrico Y. P. Hsu, New Jersey Institute of Technology

FOREWORD

The above equation says: When you use VC ("Virtual Classroom"TM)) for EL ("Experiential Learning,") you are working in a VL ("Virtual Laboratory.") Virtual Classroom is a fast developing educational technology. Experiential Learning is the major concern of this society. "Virtual Laboratory" had its humble start in 1986. It seems appropriate to introduce VC and VL here at this time. VI. may become an important appendage to "Experiential Learning." It may even lead "Experiential Learning" toward a totally unexplored direction.

WHAT IS VC?

In her own words, Dr. Roxanne Starr Hiltz, the Principal Investigator of the "Virtual' Classroom" [TM] Project explains: "The Virtual Classroom [TM] uses computer and telecommunications technology to construct an interactive teaching and learning environment that is accessible We around the clock and around the world. The Virtual Classroom [R] is a "groupware" system for learning and communicating via connected computers [9]. It consists of software to support asynchronous group-oriented learning processes for distance education, particularly at the college level. Good groupware is designed in response to the needs and purposes of those using it. It responds to, supports, and even evokes human potential, rather than controlling, coercing, or forcing it into preconceived patterns [101. With major support from the Annenberg/CPB Project, New Jersey Institute of Technology constructed a prototype of a "Virtual Classroom" teaching and learning environment 'located within the EIES (Electronic Information Exchange System) computer conferencing system and evaluated its use in a small number of courses. Using a quasi-experimental design of matching traditional and Virtual Classroom (VC) sections, it was determined that the technology is a viable option for increasing access to and the effectiveness of post-secondary education [2,3]. One way to understand the software which comprises the Virtual Classroom is with an architectural analogy. Rather than being built of bricks and boards, this classroom environment is constructed in software. Think of all the different kinds of learning tools and spaces and ritualized forms of interaction that take place within a traditional classroom, and within an entire college campus or high school Open 24 hours a day, seven days a week, there are "spaces" for lectures, class discussions, doing assignments (individually or collaboratively), private communication with the instructor or other students, taking tests, chatting informally in the student center or "cafe", and more. All of these things exist within a Virtual Classroom, too, except that all of the activities and interactions are mediated by computer software, rather than by face-to face interaction. Students who have used the prototypes rate the Virtual Classroom, on the average, as delivering a more convenient and better quality education than the traditional classroom. Mastery of material as measured by grades was as good or better than that obtained by students in traditional classes. These outcomes establish the viability of The Virtual Classroom as mode of delivery of college-level courses. The ratings for courses which used a mix of Virtual Classroom and face-to-face meetings tended to be higher than those which used either one alone. Based on the software prototypes and results of the first phase of *this* project, NJIT developed a new family of computer-mediated communication systems with Virtual Classroom enhancements, which can be installed on a variety of minicomputers and mainframes at other universities. TEIES [TMJ (Tailorable Electronic Information Exchange System), can be acquired and used by any college or university with an IBM "super-mini" or mainframe utilizing the VM operating system. EIES 2 operates on UNIX systems. At the same time, NJIT is completing development of an initial version of "Personal TEIES[TM], micro-computer based "front end" to the systems which the individual student or faculty member can use to manage the composition, display, and communication of mixed graphics and text materials. The initial version of Personal TEIES will operate only on IBM-compatible personal computers. Because it is located within a Computer-Mediated Communication System (CMCS), interaction among teachers and students in the Virtual Classroom is also asynchronous, with the computer storing waiting communications for each participant. This means that the members of the class typically arc not present at the same time or at the same place. They may be, by chance or by plan, but usually the interaction is spread out in both space and time. The Virtual Class is a rolling present" that goes on around the clock, seven days a week. Each student types and reads at the pace and time that is most convenient. Students generally do not receive a response to questions or comments immediately, but rather the next time they sign online, someone will probably have responded. This different rhythm of interaction takes some time to get used to. Without waiting for everybody involved to be present, simulations and role-playing exercises can move faster and allow more variations than traditional "laboratory" exercises. A collaborative learning [11] environment that is computer-mediated can support some types of activities that are difficult or impossible to conduct in face-to-face environments. Since students may "work together" asynchronously, they can do joint projects or collaborate in other ways even though their schedules make it difficult to work at the same time."

HOW EL TOOK PLACE IN VC?

As one of the five pilot courses, one section of NJIT's 0S471 Management Practices was taught in 1986 in a "mixed mode" of VC. The students met in

the traditional classroom for a reduced amount of time, and did most of their laboratory assignments, discussion, and an "organizational simulation" in a "virtual laboratory." That was the first experiential learning exercise that took place in VC. The experiment was reported to Decision Science Institute conferences [5,6] and other occasions [7,8], even though ABSEL should have been a more appropriate forum. In the final evaluation of VC project, 05 471 Management Practices course was the most successful use of VC technology. This provided some legitimacy to Virtual Lab.

HOW VL EVOLVED?

A logical next step of experiential learning was a professionally designed management game, thus adding the quantitative aspects of the organizational function as well as its interpersonal interactions. The management game chosen was the collegiate edition of "Business Sirnulator" designed by Realities Technologies and distributed by South Western Publishing Company [121.

Choice of Management Game

The design objective of "Business Simulator" is to progress through three phases of the life cycle of a business - start-up, growth. and independence. The decisions to be made in each phase are:

Phase I: Start-up:
  Price
  Advertising
  Units purchased
Phase II: Growth:
  All phase I decisions
  Factory construction/expansion
  Factory production
  Long-term debt sold
  Common stocks issued
Phase III: Independence
  All phase I and II decisions
  Sales force size
  Commissions paid
  Percent of sales on credit
  Research and development
  One-year loans
  Supplier payment period
  Common dividend per share

These decisions are processed through "Business Simulator," resulting in a set of operating results: units sold, back orders, ending inventory, market share, operating income, income tax, net income, CEO's networth, company book value, etc. 'Business Simulator" can be used for individualized (one player/team basis) learning of business concepts. terminology, strategy and decision-making by playing against the four built-in companies who are robotics subsidiaries of Apple Computer, Inc., Hewlett-Packard Corp., Texas Instruments and Tandy Corp. Thus the industry of household robots consists of five companies in total, each endowed with the same start-up capital and product source. The real-world management philosophies of these four companies have been built into "Business Simulator." It can also be played by two players/teams. In this case, only three other player/team basis. Two student-organized teams or companies, named Robotrons, Inc. and Robo-More, Ltd., played the game against the other four companies in separate and independent games. Robotrons and Robo-More were free to formulate their strategies independently to compete in their own game.

Simulated Organizations

Robotrons and Robo-More were organized by two student leaders selected by the class after a short campaign. Each company was then assigned a private conference on the EIES Computer-Enhanced Conferencing System. Each company was encouraged to consider the types of decisions to be made and to set up a functional organization to make the required decisions for each fiscal year. The CEOs role was to moderate the discussion among the functional managers and to endorse the decisions. Since each student had a set of simulation game diskettes and the accompanying manual, they could each test the consequences of their decisions to a certain extent. Through discussions, deliberations and group decision support software tool [1] provided in the Virtual Lab," the team members arrived at an agreed set of decisions. Thereupon, the CEO declared the final decisions and processed the decisions through his "Business Simulator." An official "save diskette" was kept for the instructor's verification. Each of the two companies proceeded with year-by-year decision making with an emphasis placed on strategy formulation before the decisions and review of operating results after processing. Four weeks later, some students began to complain about the lack of challenge, because phase I decisions were few and simple and because playing on a single-team basis did not provide the excitement that live competition would bring. As a result of a class-wide discussion, we decided to play the game on a two-team basis. Furthermore, we decided to extend the competition beyond phase I and to continue as far as time permitted. Instead of the CEOs, the instructor had to process the decisions as presented by the two companies on a pre-determined schedule. This way, we had two factors of uncertainty to deal with. First, each team did not know how the other company would play the game. Second. the simulation model was probabilistic in nature rather than deterministic. Hence, testing on your own system did not guarantee the same results as when the instructor ran the game with the two teams competing against each other. Precisely because of the probabilistic model, the performance of the other three companies, Hewlett-Packard, Apple Computer and Tandy Corp., varied from play to play, but generally in line with their management philosophies. The important part of the simulation was the deliberation of decisions by the pertinent functional managers. For example, the Marketing Manager should decide on the advertising costs, substantiate the decision by an action plan covering advertising media, commercial' slogan and promotional frequency, and negotiate with other functional departments (e.g., more advertising led to more sales which would require higher inventory). All these activities took place in the company's private conference in the EIES system.

On the designated day of the week, the CEOs submitted their final decisions in their private conference. The instructor picked up the two sets of numbers from the two conferences, inputted them into his set of "Business Simulator" and ran the

game. Within minutes, the instructor published the operating results and financial reports in the class conference, a "public domain for all the students of the class. Each student company discussed the results in its private conference to see whether the outcomes were comparable to expectation and search for possible reasons for deviations. GJs comment represented a typical review item: "1st, we did not expect Robo-More to advertise so low... Maybe we should either leave ours same or lower it. 2nd, they did not expand their factory and guess who is taking their business!! Maximum they can sell now is 300K units. 3rd, let's make our price a little more competitive this time. If I remember correctly, Apple and HP prices were $50.xx something...so we can raise to $47 or $48. 4th, since we expect to gain the market share this year, we might want to produce to maximum capacity. Can we all try to communicate results on EIES and experiment to see if we can come up this years numbers by ONLY discussing online. No face-to-face meeting! What do you all say?" Such review led to a new strategy for the next fiscal year. For example, JW commented on GJ's strategy thus: "1 like your thoughts so far. I think we should keep the advertising where it is, if we are to push up the prices to $50. I also feel we can push production. I believe the figure for units to produce is around 400-450...420 sticks in my mind. Perhaps we can buy back some more stocks... we bought back a max last time, I think we should go along the same principles." Each week represented one year's operation. Students' activities inside their private conference recycled once a week. As they progressed through start-up phase, growth phase and independence phase, the decisions became more numerous and more complex. 'Business Simulator' provided an excellent on-line tutorial' and on-line analysis to assist the students in decision-making. They were convenient sources of additional learning. The students who played the game had a tendency to work out the numbers to win the game without really understanding the meaning of the numbers. Therefore, it was necessary to give frequent quizzes and exams to guide the students attention to the significance of the numbers. For example, if Robotrons market share were 21.1% and they actually sold 24,500 units, students ought to know the total market size. If they spent $27,000 on advertising and the unit-selling price was $24.00, they ought to know the advertising expense as a percentage of the selling price. Quizzes and exams with real scores were the most elective ways of driving home these concepts. As expected, only a handful of students on each team were actually active in playing the game. Others tended to be free riders. After a while, the active students felt the injustice of the situation, and began to consider leaving their companies to form their own. AS GJ wrote: "Professor, I wanted to bring this up for the past few days. Few people from our team and from other team are not happy with what their teams as a whole is doing or being run by their CEO. There is talk about coup d'etat! We would like to either start our own company or buy out the other company or hostile take over. We realize it is little late into the semester and would like to hear what you have to say?" With a tacit agreement from the instructor, these entrepreneurs resigned from their respective companies, leaving their CEOs and other students. They called themselves Galaxy R Management Group. This group posed a new threat to both pre-existing companies. Since a maximum of two

players/teams could play "Business Simulator" in a game, we had to devise a new rule for the new situation. Galaxy was instructed to submit two sets of decisions: one in the name of Robotrons and the other in the name of Robo-More. The instructor intended to run the game three times for the same fiscal year:

  (1) Robotrons vs. Robo-More
  (2) Robotrons vs. Robo-More as played by Galaxy
  (3) Robotrons as played by Galaxy vs. RoboMore

While Robotrons and Robo-More were expected to continue to play their games, Galaxy could make profits by accumulating the favorable differences in performance through their supposedly superior decisions. In other words: Galaxy's performance =

  [Robo-Mores results of (2)- Robo-Mores results of (1)] +
  [Robotrons' results of (3) - Robotrons'
   results of(1)]

Unfortunately, the resignation of key personnel created so profound a confusion in Robotrons that Robotrons failed to reshape their organization and keep up with the preset schedule of decision making for the Business Simulator" game. The instructor gave Robotrons repeated warnings on the possibility of losing their rights of playing the game, if they did not submit numbers on time. In due course, the instructor declared that Galaxy R Management Group had taken over the operation of Robotrons as far as 'Business Simulator" was concerned. With their superior skill, Galaxy was able to recover from the low point of performance of Robotrons and became top performer in the industry. In a final debriefing, the instructor explained the realism of people leaving the company - particularly in high-tech industries - to form their own and how the company executives should be aware of that possibility and devise some safeguard against leaks of technical information.

CONCLUDING REMARKS

Business Simulator" in "Virtual Lab" did provide a unique experience to the students, as JW wrote: "1 had an interview today, and all I could talk about was 05 471! Explaining what I had learned, EIES, the Business Simulator, and so on. The overall 'experience' I gained in a simulated company.... the guy who I was interviewing with was impressed with what the class seemed to offer. I hope he was that impressed with me! *grin "Business Simulator in "Virtual Lab" also raised students' interest in the subject matter of management, as witnessed by NT: "...this business simulator game sure is fun. I know it's going to help me a lot when I ever have to make business or management decisions in real situations. I treasure the concepts I learned from you and what we learned in class, and the business simulation game, which will definitely benefit me in the future," JJ preferred "Virtual Lab" to a pure textbook reading type of course: "1 did an add/drop in the beginning of the semester and got into this class and I am so glad it didn't turn out to be just another read from the textbook course." *WS'* deliberation whether to stay with Robo-More or to join Galaxy R Management Group was a realistic life experience: 'I was disappointed in the leaving of my co-workers, but I have to think about myself also. I think the

departure of the vice-president gives me a good chance to get her job. I think for me to stay at the company, would be a wise thing to do. I had a chance to leave also, but I think I would not have had the opportunities that I have now. I would have to prove myself over again. " The results as reflected by the students were made possible by the combination of a management game, the organizational simulation and the "Virtual Lab." A competitive and realistic management game provided challenges, excitement and opportunities of making quantitative decisions. Organizational simulation provided specific group structure, which had an impressive impact to the game performance. "Virtual Lab" , of course, was the essential environment to house the group members and to structure group interactions [4]. "Virtual Lab" eliminated spatial and temporal barriers and left a textual record of the interactions for later analysis. Our next step is to evaluate to what extent the "Virtual Lab" enhanced the group learning outcomes.

REFERENCES

[1]   DeSanctis, G., and Dickson, G. (1987)" GDSS Software: A shell system in support of a program of research. "Proceedings of the 19th Annual Hawaii International Conference on Systems Sciences, January, 1987.

[2]   Hiltz, Starr Roxanne (1988 a). "Learning in a Virtual Classroom, Volume 1 of A Virtual Classroom on EIES," Research Report 25, Center for Computerized Conferencing and Communications, NJIT, Newark NJ.

[3]   Hiltz, Starr Roxanne (1988 b). "Teaching in a Virtual Classroom," Research Report 26, Center for Computerized Conferencing and Communications, NJIT, Newark NJ.

[4]   Hsu, Enrico Y. P., (1989) Role-Event Gaming-Simulation in Management Education: A Conceptual Framework and Review," to appear in Simulation and Game, Vol. 20, No. 4, December 1989.

[5]   Hsu, Enrico Y. P. and D. T. Geithman, (1987) 'Virtual Lab' and Management Education: An Experiment in the Use of a Computer Mediated Conferencing System," 16th Annual Conference Proceedings of the Northeast Decision Science Institute, Atlantic City, NJ. April 2-3, 1987. pp. 107-109.

[6]   Hsu, Enrico Y. P. and D. T. Geithman, (1988) "Virtual Management Practices Lab" Revisited: A Research Up-Date, 17th American' Conference Proceedings of the Northeast Decision Science Institute, Newport, RI. March 23-25. 1988. pp. 278-280.

[7]   Hsu, Enrico Y. P. and D. T. Geithman, (1988) Computer-Mediated Conferencing System: An Application To The Business Curriculum," Proceedings of the 1988 North American Conference of the International Business Schools Computer User Group Miami University, Oxford, OH. July 26-29, 1988. pp. 1-6.

[8]   Hsu, Enrico Y. P. and D. T. Geithman, (1988) "Experiential learning in Management Education: Virtual Lab," Management Games and Group Decision Support System," 6th World Productivity Congress Proceedings. Montreal, Quebec, Canada. September 25-28, 1988. pp. 507-527.

[9]   Johnson-Lenz, Peter and Johnson-Lenz, Trudy (1982). "Groupware: The process and impacts of design choices," in Kerr and Hiltz, eds., "Computer-Mediated Communication: Status and Evaluation, pp 45-55. New York: Academic Press.

[10] Johnson-Lenz, Peter and Johnson-Lenz, Trudy, (1989). "Islands of safety for unlocking human potential." Abstract of submitted to the Third International Guelph Symposium on Unlocking Human Potential via Computer-Mediated Communication, University of Guelph, 1990.

[11] Slavin, R. E., (1986) "Cooperative Learning: Where behavioral and humanistic approaches to classroom motivation meet? Paper presented to the AERA. San Francisco, April', 1986.

[12] Spero, Leslie L. Business Simulator. Collegiate Edition South-Western Publishing Co., Cincinnati, Ohio. 1988.