Title	Computer Simulations for e-Learning: A Case Example of "Organizational Structures".
Author(s)	David Ng Foo Seong, Chong Keng Choy & Lee Ong Kim
Source	*Teaching and Learning, 23*(2), 167-177
Published by	Institute of Education (Singapore)

Teaching and Learning, Vol. 23, No. 2 (December 2002) pp. 167–177

Computer Simulations for e-Learning: A Case Example of "Organizational Structures"

David Ng Foo Seong, Chong Keng Choy & Lee Ong Kim

Abstract

Learning need not be a serious matter. The use of computer simulations provides evidence that learning can be interesting, meaningful and engaging (Ng, 2001). In this paper, the authors explored the design and use of a computer simulation called "Organizational Structures" as an e-learning tool in the field of leadership preparation programmes. The simulation is able to provide the context and practice platform for learning the skills of configuring organizational structures.

Introduction

In the last decade, instructional methods in leadership preparation programmes have come under severe criticism in many parts of the world. The instructional approaches adopted by most leadership preparation programmes are dominated by lecture, readings, and group discussions. The effectiveness of these instructional methods has been questioned. As Leithwood and Steinbach (1995) noted, the degree of knowledge and skill transfer from the instructional program is "usually unknown or absent" (p. 168). Most of these programmes are also oriented towards providing mostly "inert" knowledge — facts that can be recited back on a test but put to little or no practical use.

While the international trend across academe has seen a rhetorical shift from teacher-centered to student-centered learning approaches, most leadership preparation programs remained heavily teacher-centered (Barr & Tagg, 1995). There are increasing calls for involving students in the learning process, eliminating student anonymity, and personalizing instruction (McCarthy, 1999). The need to rethink program delivery has been given further impetus by the call for changes in program content. Leadership preparation programs are increasingly emphasizing the development of highly interactive learning environments that involve inquiry, reflection, and professional problem analysis (Bredeson, 1996, p. 264). This article explores the usage of computer simulations as an e-learning tool that attempts to

create an interactive and student-centered learning approach towards leadership development.

Computer Simulations

There has been growing interest in reconceptualizing program content in leadership preparation programmes by grounding theoretical and empirical knowledge in problems of practice. These efforts were a response to the call to shift from the traditional discipline-based knowledge to that of "development of specific leadership competencies and skills validated through performance-based assessments" (Bredeson, 1996, p. 266).

As a result, innovative instructional strategies such as problem-based learning, simulations and games, microcomputer simulations, design studios, and reflective coaching began to emerge. These instructional strategies were clearly more skill and performance based as compared to traditional methods (Ng, 2001).

More recently, computer simulations are emerging as a new generation of e-learning tools. The reasoning that if you can use a flight simulator to teach someone to master the complexity of flying a Boeing 747, surely computer simulations can also teach someone to solve problems and teach behavioural skills. This reasoning has resulted in e-learning companies such as Indeliq, Ninth House, and Imparta investing heavily in designing computer simulation models based on business gurus and academic institutions for teaching business and educational related topics.

A simulation is an artificially created situation that is designed to enable learners to try out new behavior with no risk of punishment (Nadler & Nadler, 1994). Shannon (1975) describes a simulation as a model of a real system. Experiments could be conducted with it for the purpose of understanding the behavior of the system or of evaluating various strategies for the operation of the system. With the advancement in technology, many simulations can now be programmed into the computer.

Computer simulation is one of the training and learning strategies that falls under the rubrics of experiential learning pedagogues (Gentry, 1991), contextual learning theory, and information processing theory. The underlying thread that links computer simulation to these theories is that simulation is a model representation of the real world. This gives meaning to the word experiential learning or contextual learning because the individual's cognitive understanding of what is learned is in direct relation to the context of the experience of the individual. Since computer simulation models a particular aspect of the real world, one key advantage of computer simulation is that it provides the individual with a series of episodes that allow them to see connections between what is learned and what they actually experienced.

There are obvious pedagogical advantages of using computer simulations in training. First, computer simulations provide instructional experience with low

expense and less pressure. With reduced pressure from environmental factors, students can engage in an active process of thinking and problem solving. Second, computer simulations help students become effective learners. Through computer simulations, students can maximize their learning time, see the consequences of their actions immediately, and effectively employ selection and processing strategies. Third, computer simulations are helpful in achieving a wide range of objectives in a short period of time, because years of research, and experiences can be condensed to a simulation program. Finally, computer simulations can efficiently assess a student's learning process by recording it step by step. The instructor can then evaluate their students' performance and learning difficulties through analyzing the encoded data.

Design of "Organizational Structures" Simulation

In the Policy and Management Studies Group at the National Institute of Education, Singapore, a group of staff undertook to design a computer simulation to teach how leaders and managers structure an organization. The computer simulation, *"Organizational Structures"* was designed with the goal of creating an active learning environment that would stimulate the development of knowledge that could be applied and transferred. This contrasts with the more typical goal of "teaching about" a subject that characterizes the more common passive lecture and discussion methods used in preparation programs. The theoretical framework of the simulation is based on Mintzberg's (1994) framework of organizational structures.

It must be noted that a great deal of behaviour within administrative decision making involves both the conscious and unconscious selection of choices. In organizational decision making, at any moment there are a multitude of possible alternative actions. The deliberate process of narrowing down alternatives involves the integration of values and purposiveness. In the traditional way of teaching organizational structures through lectures or discussions, it is difficult to surface students' conscious or unconscious behaviour in relation to their choices. The design of this simulation is an attempt to allow students to understand their values and purposiveness intent in their decision making while configuring an organization.

An Overview Description of the "Organizational Structures" Computer Simulation

Every organized human activity has two common features: how tasks are divided and how these tasks are coordinated. Mintzberg defines organizational structures as the sum total of the ways in which its labor is divided into distinct tasks and how its coordination is achieved among these tasks.

"Organizational Structures" is made up of two simulations. These simulations will explore the interdependencies of different parameters in the structuring of

organizations. Various assumptions are built into the simulations. Users will work with a set of limited but interdependent parameters in order to configure the organization. Under each parameter, there are five different options. They will select only one option for each parameter.

Another assumption built into the simulations is the use of resources. Users will be required to assign a weightage in percentage to each of the parameters for carrying out the managerial and leadership tasks involved in managing the organization. The estimation is based on the typical workload of school administrators in carrying out their duties in the school. It excludes the number of teaching periods and vacation days in a given year.

Instructional Design Assumptions

Several instructional assumptions underlie the design of the *Organizational Structures* simulation (Bridges & Hallinger, 1993, 1995; Ng, 2001). These assumptions are as follows:

(i) The goal of training about structure configurations in organizations should be *to develop knowledge that leaders can apply in the workplace.*

(ii) A *problem-based approach* (PBL) to learning new concepts would yield greater results given the goal of developing usable knowledge.

(iii) A key facet of PBL posits that knowledge and skill transfer will be enhanced if the *content is learned in the context of a realistic problem.* (Bridges & Hallinger, 1997).

(iv) An *interactive simulation* in which learners can develop, apply and see the results of different strategies for configuring organizations would be effective at developing capacities for higher order thinking about structuring organizations.

(v) Given the scarcity of time for formal staff development outside the workplace, the design *of the simulation should incorporate substantial "cognitive scaffolding"* so users can learn at their own pace inside and outside of formal training.

(vi) Since learning to apply any sophisticated conceptual framework takes time, it would be advantageous if *the simulation design made it convenient for learners to engage in multiple opportunities for practice.*

(vii) A simulation that mirrors the complexity of configuring organizational structures in the real world should foster open-ended thinking about organizations and model the assumption that *there is no one best change strategy that will work in all organizations.*

(viii) The simulation should incorporate a *mix of multidisciplinary resources drawn from theory, empirical research and practice.* Next, an elaboration in relation to how these assumptions are woven into the instructional design of the simulation is discussed.

Fig. 1. Selction of interdependent parameters.

Instructional Design

Instructional design for the first simulation is discussed.

(i) *The problem comes first.* The simulation offers the opportunity for users to participate in reflective analysis and abstract generalization through safe experimentation that is based on an authentic context. Consistent with the tenets of problem-based learning (Bridges & Hallinger, 1995), the simulation begins by requiring users to describe their own organizational context and set their own goals of what they hope to achieve in the organization. The purpose is to elicit a realistic response from users based on a context that they can easily relate to and thus offers an authentic learning context for them.

(ii) *Interactive simulation and multidisciplinary resources drawn from theory, empirical research and practice.* Immediately after typing in the context and goals, users proceed to the next page where they are presented with nine parameters *(Fig. 1)*. These parameters are interdependent factors which they could manipulate to configure an organization structure that will address the context and achieve the goals that they have set. Users will be able to read the description of each parameter by pointing the mouse at the button corresponding to the

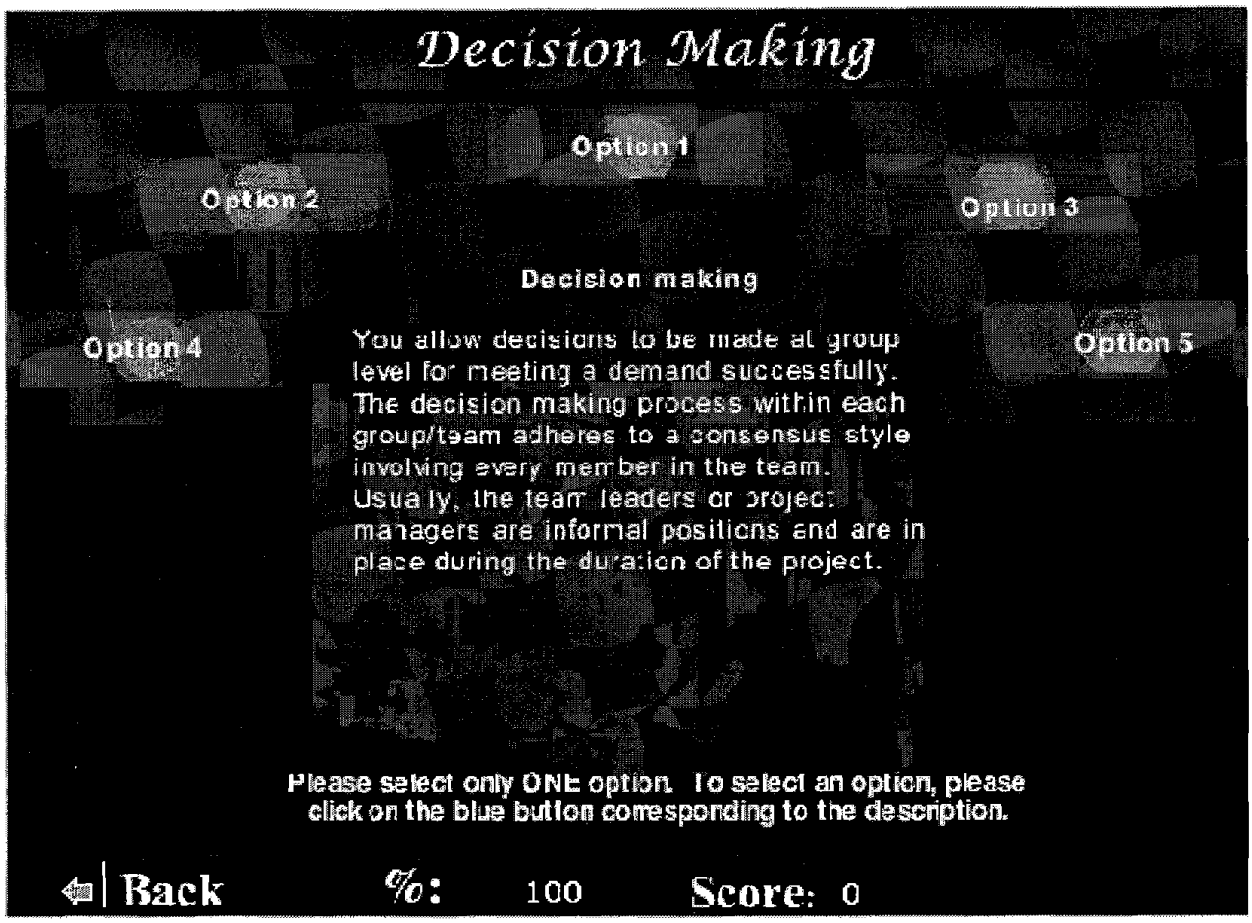

Fig. 2. Selection of options.

parameter. When they click on any of the parameters, they will be presented with 5 different options *(Fig. 2)*. Again, they can point their mouse over the options and read the description of each option.

Users will then proceed to select the option that is closest to their own described situation. For example, in "Option 1" of decision making, it reads as follows:

"Making decisions based on staff members' valuation of good practices. You relegate most of the operative, and strategic decisions to your staff members. In this respect, you allow your staff members to have a great deal of say about what they do and how they do it. You, however, will make your administrative decisions through political and/or consultation means."

To select and implement the option, they will have to click on the option. They will then be prompted to assign a weightage in percentage that they consider necessary to implement the selected option in a given year. Next, they will be prompted to type their rationale and assumptions for selecting the option in the space provided. To implement the option, they will click on the "Apply" button *(Fig. 3)*.

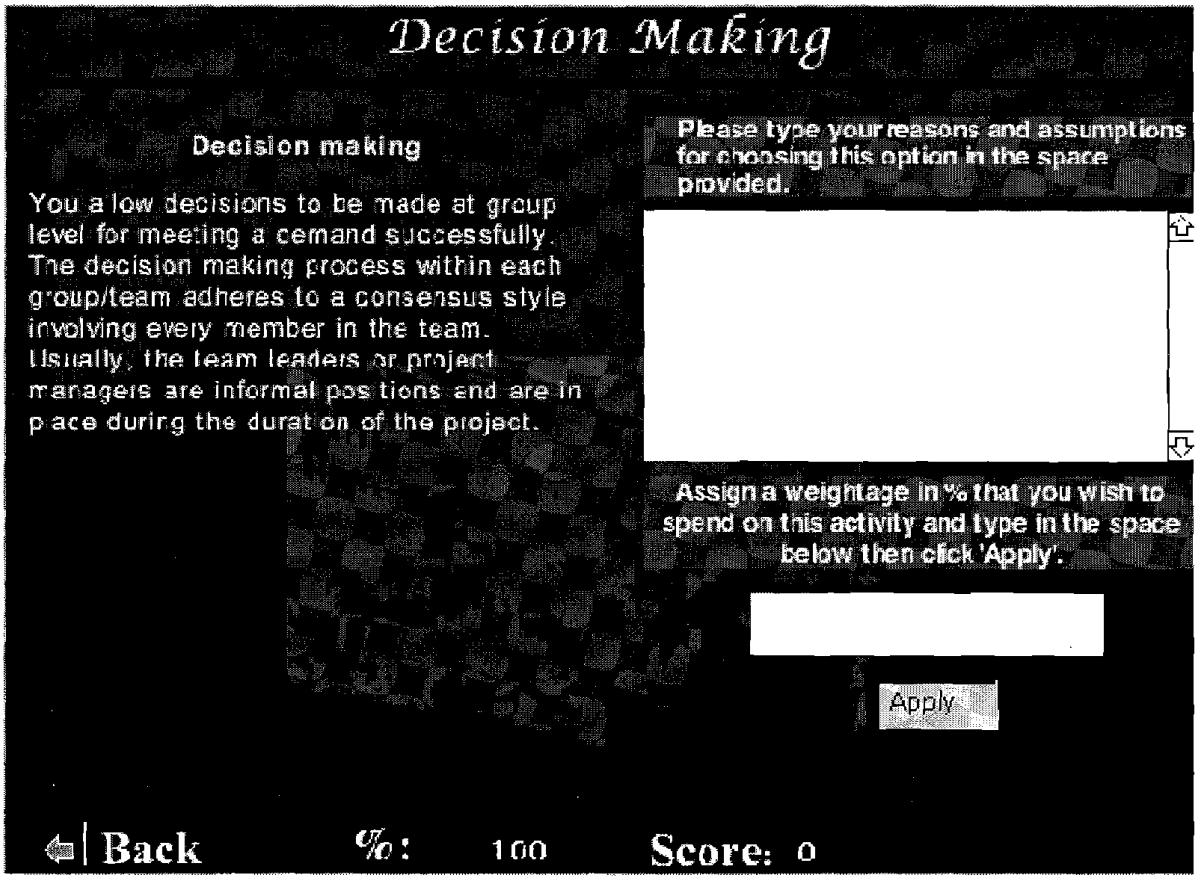

Fig. 3. Stating rationale and assigning weightage.

Two things will happen when users click on the "Apply" button. First, they will receive an immediate feedback on the likely impacts based on the option. For example, the feedback related to the above option on decision making reads as follows:

> *"Making decisions based on staff members' valuation of good practices may have the following impacts: 1) Staff members feel a sense of great responsibility because of participative decision making. 2) Conflict of strategic decision may occur between staff and upper management. 3) Students are encouraged to take pride in their work because of high personal stake. At the same time, students' work may lack creativity".*

Next, the resources, percentage, will be deducted according to the percentage that they have assigned. The process of selecting the option, surfacing the rationale and assigning a weightage is repeated until eventually an organization structure is configured. When users have finished selecting all nine parameters, they will be able to see the consequence of their choices. A feedback that tells them the type of structure that has been configured will appear *(Fig. 4)*. For example, if the configuration is a hybrid of two structures – simple structure and professional bureaucracy, the following feedback will appear:

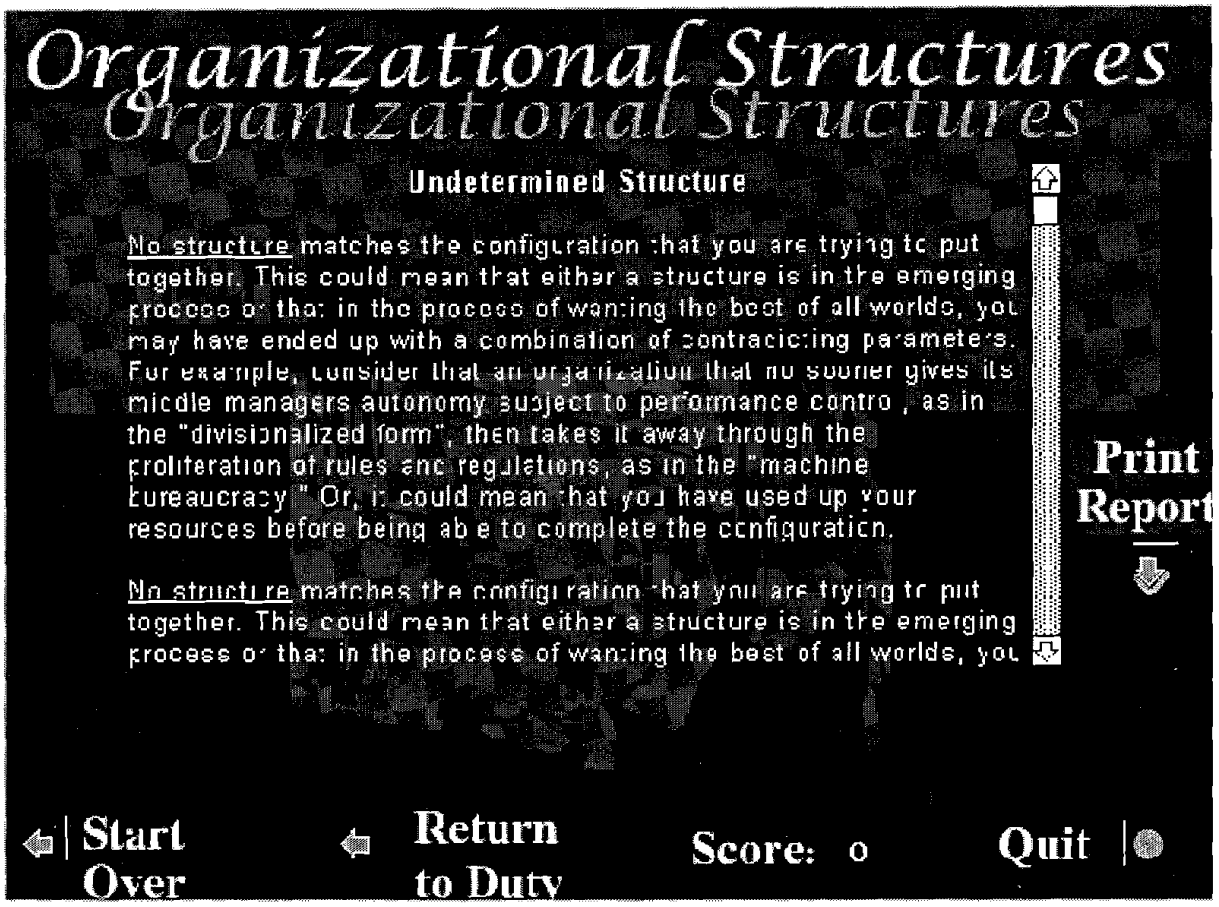

Fig. 4. Configured structure.

"The configuration that you have put together is most likely that of an emerging "simple professional bureaucracy". This is a combination of a "simple structure" and "professional bureaucracy". The hybrid structure will likely exhibit two pulls — the pull toward the strategic apex and the pull toward the operating core. What this means is that you will likely want to retain control over decisions and direction of the department. At the same time you want staff members to have some autonomy in their work.

Question: Is that what you want based on the context that you have described?
Conditions relevant for a simple structure are:

1. *The environment tends to be simple and dynamic.*
2. *A technical system that is evolving and is nonsophisticated and nonregulating.*
3. *The organization is usually a new organization in the early stage of development.*

Question: Does your organization fit the above conditions?
If the above conditions prevail, it is more likely that you will adopt the simple structure. However, if and when staff members have enough knowledge and expertise to handle the work, then a gradual move toward simple professional bureaucracy may occur".

(iii) *The simulation incorporates substantial cognitive scaffolding and there is no one best strategy suitable for all organizations.*

An important feature in learning is receiving useful feedback. A number of studies have supported the practice of giving feedback consistently and that immediate feedback was more effective than delayed feedback (Kulhavy & Stock, 1989; Kulik & Kulik, 1988). The simulation is designed with the model-tracing approach that has the capability of diagnosing and evaluating the performance of subjects. The result is that it is able to generate relevant feedback in correspondence with the choices that they make in configuring the organization. Through the process of planning, doing, getting feedback, reflecting, and acting, users see the evolving results of their strategy in configuring an organizational structure into their workplace. The instruction is designed so that users develop the desired conceptual frameworks out of their experience in using the computer simulation. That is, the type of structure that is configured depends upon the right mix of the interdependent parameters and that each structure will determine the behaviour of how staff members' works are coordinated. Users will realize through the feedback that there is no one best structure for all organizations.

Usefulness of the Simulation

One of the goals of designing *"Organizational Structures"*is to create an active learning environment that would stimulate the development of knowledge that could be applied and transferred. The simulation offers the opportunity for leaders and managers to participate in reflective analysis, and abstract generalization through safe experimentation in learning how to configure an organization.

The simulation was used in the "New Diploma in Departmental Management" program at the National Institute of Education, Singapore. Initial feedbacks from Heads of Department who have used the simulation indicate that they felt confident, in control, and were very engaged while using the simulation. On the issue of feedback provided by the simulation, users reported that they were realistic, and that the diagnostic feedback was very useful. Users also reported that they have learned a lot about their own management behaviour while using the simulation.

A number of suggestions for improving the simulation particularly in the definition of some parameters were also given by users. For example, the parameter on "Training and Development" was understood by the Heads of Department in a different manner than portrayed in the simulation. In the simulation, this parameter refers to the intention to ensure that staff members develop the necessary behaviours before beginning work as well as to reinforce desired job-related skills and behaviours while working. Heads of Department tend to interpret that their chief responsibility refers only to the latter – that is to ensure that staff members received the necessary training and development while on the job.

Future Development and Research

As with any software development, the first versions will always need improvement and modification. The first version of "Organizational structures" will need to be revised and modified to enhance the teaching of declarative and procedural knowledge. There is a need to systematically determine users' perceived functionality of the simulation. "Talk-back" information should also be provided as part of the analysis procedure to allow the developer to receive feedback from users. These analyses will provide useful information to improve the simulation and determine where concepts need to be further explained, and indicate which portions of the explanations need to be expanded.

In the area for research we should extend our understanding of leadership cognition. We will need to enhance our understanding of how educational leaders make decisions. Since the simulation was designed with users specifying their own context, and explaining their rationale/values in the decision making process, evaluation of learning in a situated learning context will be useful. This will involve a dynamic, continuous assessment process that includes such measures as diagnosis, summary statistics, and portfolios. The design of the simulation "Organizational structures" offers the availability for data collection, specifically in the strategy records (report generated from the model tracing feature of the simulation), for the purpose of diagnosis and summary statistics analysis that will yield potentially important information on the decision making process of leaders.

Conclusion

Learning need not be a highly intellectual and serious matter. The use of computer simulations provides evidence that learning can be interesting, meaningful and engaging (Ng, 2001). The use of computer simulations as an e-learning tool in the field of leadership preparation programmes shows promise for such meaningful learning. The simulation is also able to provide the context and practice platform for learning cognitive skills. Learning becomes more meaningful when "learning results from the process of working towards the understanding or resolution of a problem" (Bridges & Hallinger, 1997, p. 11). Sounds, animation and graphic display provided by the simulations also has a strong effect on attention and keep learners more engage while learning.

Issues of assessment also represent an important consideration in the design of any e-learning programmes. Feedback is fundamental to learning and opportunities to receive feedback must be provided for in the learning process. The use of well-designed computer simulations offers a viable architecture design that provides for such assessment and immediate feedback. Specifically, the tracking feature in the simulations and the feedback provided for successful and unsuccessful performance offers an effective cognitive model for learning.

Dr. David Ng Foo Seong is an Assistant Professor in the Policy and Management Studies Academic Group at the National Institute of Education, Singapore. His areas of specialization include training of principals, school leadership, and computer simulation programming.

Dr. Chong Keng Choy is an Associate Professor in the Policy and Management Studies Academic Group at the National Institute of Education, Singapore. His research interests include the management of organizations, human resource development, and futuring. His research has been widely published internationally in books, monographs, and journals.

Dr. Lee Ong Kim is an Associate Professor in the Policy and Management Studies Academic Group at the National Institute of Education, Singapore. His specialisation and interests include Measurement, Evaluation, and Statistical Analysis (MESA), Rasch Analysis, and Educational Research Methodology.

References

Bredeson, P. V. (1996). New directions in the preparation of educational leaders, in K. Leithwood, J. Chapman, P. Corson, P. Hallinger, & A. W. Hart (Eds.), *International handbook of educational leadership and administration*. (pp. 251–274). The Netherlands: Kluwer Academic Publishers.

Bridges, E., & Hallinger, P. (1997). Using problem-based learning to prepare educational leaders. *Peabody Journal of Education*, **72**(2), 131–46.

Bridges, E., & Hallinger, P. (1995). *Implementing problem-based learning in leadership development*. Eugene, OR: ERIC Clearinghouse.

Bridges, E., & Hallinger, P. (1993). Problem-based learning in medical and managerial education, in P. Hallinger, K. Leithwood, & J. Murphy (Eds.), *Cognitive perspectives on educational leadership*. (pp. 253–267). New York: Teachers College Press.

Gentry, J. W. (1991). *The guide to business gaming and experiential learning*. East Brunswick, NJ: Nichols.

Kulhavy, R. W., & Stock, W. A. (1989). Feedback in written instruction: The place of response certitude. *Educational Psychology Review*, **1**(4), 279–308.

Kulik, J. A., & Kulik, C. C. (1988). Review of recent research literature on computer-based instruction. *Contemporary Educational Psychology*, **12**, 222–230.

Leithwood, K., & Steinbach, R. (1995). *Expert problem solving: Evidence from school and district leaders*. Albany: State University of New York Press.

Mintzberg, H. (1994). *Structure in fives: designing effective organizations*. Englewood Cliffs, N.J. : Prentice-Hall, c1983, c1993.

Nadler, L., & Nadler, Z. (1994). *Designing training programs: The critical events model* (2nd Edn.). Houston, TX: Gulf.

Ng, David F. S. (2001). *Impact of an intelligent simulations system on knowledge acquisition among school leaders*. Doctoral dissertation. Vanderbilt University.

Shanon, R. E. (1975). *Systems simulation: The art and science*. Englewood Cliffs, NJ: Prentice-Hall.

Simon, H. A. (1997). *Administrative Behaviour*. New York, NY: The Free Press.