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Title of submission:

Effects of an intelligent simulation system on knowledge acquisition among school leaders.

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Abstract

EFFECTS OF AN INTELLIGENT SIMULATION SYSTEM ON KNOWLEDGE ACQUISITION AMONG SCHOOL LEADERS

Objectives

Over the past decade there have been extensive and persisting calls for change in the methods by which we prepare teachers for formal roles as school administrators as well as for school leadership more generally. In particular, scholars (Bridges & Hallinger, 1993; Goldring & Rallis, 1993; Leithwood & Steinbach, 1995; Murphy, 1998) have argued for the adoption of approaches that will increase the capacities for students to acquire the skills to *identify, think about and solve* important problems in the workplace. Scholars, practitioners and program developers have responded with an array of new programs and instructional approaches (Murphy 1998). These include case-based learning, problem-based learning, simulations, computer-simulations, and apprenticeships.

This research explored the effectiveness of using a problem-based computer simulation called, 'Making Change Happen!' as an instructional tool for teaching declarative and procedural knowledge to school leaders. The study used the conceptual framework of the ACT-R theory to extend our understanding of how school leaders acquire knowledge.

The second objective of this research was quite practical: to design and evaluate the usefulness of an intelligent simulation system as an instructional tool for teaching and training school leaders about leading change in schools. Training is often thought of as a human-to-human process, yet school leaders are often too busy to partake of all of the training that they might like. This research proposes the architecture of incorporating an intelligent tutor into an existing computer simulation. The resulting intelligent simulation system provides a practice platform for learning how to lead change and also provides a means for a personalized form of training. This will allow busy school leaders to structure the use of the simulation at their own time and place.

Theoretical Framework

Teaching and learning in the field of educational administration have been largely dominated by lectures, readings, and group discussions. Although the use of case studies, 'learning-in action', in-basket exercises and simulations are steadily gaining in importance, there has been little assessment into the effectiveness of such instructional methods used in the field. The research base that is supposed to provide grounding for these strategies and programs in the field of educational leadership are fairly weak. There is also a distinct lack of studies that have adopted a cognitive

perspective (Forsyth & Willower, 1999). As a result, there remains a significant gap in our understanding of the effectiveness of skill transfer and knowledge acquisition through the use of the above instructional methods.

Cognitive science appears to hold promise in understanding the meta-rational behavior of educational leaders. From a cognitive science perspective, individuals have differences in problem solving skills, attention, temperament, maturational stages of development, existing knowledge, memory organization, cognitive style of expectancies, and motivation. Instruction from a cognitive perspective involves organizing learning contexts that enhance meaning and contribute to the acquisition of domain knowledge and problem-solving skills.

The process of skill acquisition is described in detail in Anderson's ACT-R theory. According to the theory, skill acquisition involves the transference of declarative knowledge into procedural knowledge (Anderson, 1993). The basic assumption of the ACT-R theory is that cognitive skills are composed of production rules (Anderson, 1993). Production rules are a particular framework to explain human cognition. ACT-R theory states that skill is first acquired in the declarative knowledge form. Declarative knowledge is then converted, or compiled to procedural knowledge (productions) through practice. Anderson justifies the requirement for this compilation process in terms of the adaptability of the human cognitive system. Procedural knowledge controls behavior, thus, it must be tested out and proven before it is internalized.

Procedure

The research compared the use of both these simulations in a workshop setting involving 61 school leaders at the University of Malaya, Malaysia. Subjects were randomly divided into two groups. Group one used the computer simulation with a live instructor. The second group used the intelligent simulation system where the intelligent tutor provided pedagogical support for learning.

Data analysis is based on Anderson's ACT-R theory that posits that declarative and procedural knowledge can be measured. Since declarative knowledge is factual and reportable, this research used a 25-item objective test to measure subjects' level of declarative knowledge prior to and after using the intelligent simulation system. The items in the objective test are from the domain knowledge components from the teaching module called "Change Management".

Procedural knowledge is knowledge about how to accomplish tasks. It cannot be directly reported but only be inferred from performing a task. Procedural knowledge can best be described through a production system. In the production system, there are production rules of condition-action pairs that guide the performance of a task. These condition-action pairs are described as IF-THEN rules. The IF part of the rule contains a condition that specifies when the rule is to apply. The THEN part is the action, which specifies what to do when the IF condition is fulfilled. The numbers of successful IF-

THEN rules and simulation score results become the basis for procedural knowledge measurement.

Conclusion

Conclusions drawn from this research indicate that both groups were able to successfully acquire declarative and procedural knowledge. The study also suggests that the intelligent simulation system is just as effective in teaching declarative knowledge as compared with the use of the computer simulation with a live instructor. In terms of procedural knowledge acquisition, the use of a live instructor with the computer simulation appears to be more effective than the intelligent simulation system.

This research also provides evidence of the usefulness of production rules in explaining and understanding procedural knowledge acquisition among school leaders. The salience of representing procedural knowledge in the form of production rules and the results of this study appear to provide some possible answer to the concerns raised on principal preparation programs. The concerns raised center on whether graduates of these programs have the necessary knowledge, skills, and competency to lead schools into the future. This research provides limited evidence on the viability of developing a problem-based instructional tool in the form of a computer simulation to foster the development of practical knowledge for leading change in schools.

Sources

Anderson, J. R. (1993). Rules of the mind. New Jersey: Lawrence Erlbaum Associates Publishers.

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. New York: Teachers College Press.

Goldring,-E., & Rallis, F. (1993). Principals of dynamic schools. Newbury Park, Calif. : Corwin Press.

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