Title: An exploratory study of the impact of systems thinking on physical education student teachers

Author(s): Ian R. Haslam

Source: MERA-ERA Joint Conference, Malacca, Malaysia, 1-3 December 1999

This document may be used for private study or research purpose only. This document or any part of it may not be duplicated and/or distributed without permission of the copyright owner.

The Singapore Copyright Act applies to the use of this document.
AN EXPLORATORY STUDY OF THE IMPACT OF SYSTEMS THINKING ON PHYSICAL EDUCATION STUDENT TEACHERS

Ian R. Haslam
Nanyang Technological University, Singapore

Abstract: The purpose of this paper is to explore the nature of an electronic mindtool (Jonassen, 1996) in teaching physical education student teachers to think. A comment on the historical roots of knowledge instruction and knowledge construction (Ammentorp, 1996) will be followed by an explanation of systems thinking (Richmond, 1994). Experimental units of instruction using systems thinking software were established in the computer applications and sport management information systems modules in the School of Physical Education. Results suggested that systems thinking provoked deeper levels of understanding of the problem of fitness development in Singapore schools, increased curiosity about the subject, significantly greater research work and appeared more enjoyable than traditional methods of problem solving.

Introduction

There is a module in the School of Physical Education at Nanyang Technological University that has to do with Computer Applications in Physical Education. It deals with physical education for schools and as such looks at hypermedia applications for teaching physical education to children. In many respects it is a curriculum and instruction class as the basic premise of the course is that physical educators should use technology to help them to improve the efficiency and effectiveness of their program. They should not use it just because it’s a neat thing to do. However, the module also lends itself to the use of computer applications to enhance the thinking skills of physical education teacher educators. The infusion of thinking skills in education in Singapore has brown in popularity since Singapore hosted the World Conference on Thinking in 1997. However most of the interest has been directed at school age children and not at the development of thinking skills in either initial teacher training or further teacher training. The purpose of this paper is to describe some exploratory attempts at using systems thinking to create a deeper understanding of fitness development for children in Singapore schools.

Electronic mind tools: systems thinking

The notion of thinking systemically about issues and problems in education and physical education is compelling. It requires that a person attempt to define the elements that might make up the system under consideration. Then to attempt to look for the relationships and interrelationships among the elements that might make up the system. What makes this mode of thinking even more provocative is that organisational systems generally exhibit dynamic behavior over time. Systems thinking then is the art and science of making reliable inferences about behavior by developing an increasingly deep understanding of underlying structure. It requires an ability to view the pattern as well as the event in other words keeping an eye on both the forest and the trees (Richmond, 1994)! It involves three components including causal thinking which views the structure of a system as the cause of problem behaviors rather than seeing the problems from outside the structure. In the case of say skill development in physical education one could argue that the Ministry of Education does not give schools enough time in the curriculum for physical educators to develop skills. On the other hand it might be that the physical education department does not use what time they have
wisely enough or do not approach the teaching of skill development from the appropriate perspective. A second component is *closed loop thinking* will reveal that the structure of the system is interdependent and reciprocal in nature. One aspect has an impact of varying magnitudes on another. For example in physical education one could say that due to the high levels of physical skills of the class there fitness levels are higher than average. At the same time one could reverse the notion and suggest that children with higher levels of fitness have higher than average skill levels. Lastly, *operational thinking* reflects the the closed loops structure in a dynamic model which includes (at least in ithink Analyst 5.0 and STELLA software) stocks, flows and connectors (See Figure 1).

**Figure 1: Operational thinking icons (Richmond, 1994)**

To formalize the ability to engage in systems thinking a student must move from serial thinking (sometimes-called laundry list thinking or factor thinking) to dynamic thinking. For example, if a football coach were to be asked to draw a *concept map* of the dynamics of keeping possession of a soccer ball during game play it might look like Figure 2.

**Figure 2: Serial thinking and the dynamics of possession in soccer**

This would be an example of serial thinking or surface learning of facts and information associated with the question. On the other hand if another soccer coach asked the same question but was thinking systemically he/she would consider the relationships between each of the elements and keeping possession. That is, that a players technical ability will have an effect on their seeing open spaces and using them. Player’s physical strength and power will influence their ability to move off the ball to create spaces and then to receive the ball or pass or dribble the ball (technical skills). The problem is now more complicated than before involving a dynamic mix of elements associated with keeping possession of a soccer ball during team play (Figure 3).
Instruction v Construction

The traditional notion of physical education teacher education has always had its fair share of instructional content organized on the basis of education and sport science sub-disciplines like sociology, philosophy, physiology and psychology. These areas of knowledge have been the (almost) private domains of university professors who instruct students on the content of their area based on an almost static perception of both knowledge and student. These disciplinary model of the ‘ivory tower’ of learning is now being threatened by a knowledge explosion (Sterman, 1985) as more and more highly trained people work outside the university and college academy. The fuel for the fire of the knowledge economy is information and communication technology or an electronic community of new learners and life long learners (Sveiby, 1997, Stewart, 1997). These learners actually construct knowledge, which is relevant and meaningful to them and to their work and lives. This new knowledge crosses traditional information of discipline boundaries and is characterized by closer interaction between business, science and technology. Construction can be visualized in the form of teachers and students traversing an information landscape in search of solutions to problems related to their field of enquiry (Ammentorp et al, 1996, Jonassen, 1998). Constructivist learning theories support the move to rethink learning environments for initial teacher physical education training.

The main proponents of constructivist theories of learning include Piaget, (1973), Vygotsky, (1978), Bruner (1966) and Resnick, (1989) who view learning as a process of assimilation of new learning into past experiences. A compelling feature of constructivism is the need for students to be actively involved in learning rather than passive participants in lecture style classes and work together in groups to resolve problems in the area (Spiros, 1992).

Statement of the Problem

The purpose of this exploratory project was to determine if a systems thinking process was more effective than a serial thinking process in helping physical education student teachers understand the problem of fitness development in local schools.
Research setting

Ten physical education student teachers were organized into two random groups of five with three male and two female teachers in each group. All students were involved with computer applications in physical education class and had been exploring ways of using hypermedia to enhance the teaching of physical education in schools. The basis for the module was that technology should be used to augment practical physical education lessons when and where appropriate. However, an added dimension of the class was that in fact technology might also be used to help resolve curriculum problems confronting PE in Singapore. In short there were technological possibilities in physical education but there were also technological applications that could be used to help teachers think more deeply about curriculum in physical education (Jonasson, 1996).

The question the students chose to consider was fitness development in children in local schools. As a departure point all students were asked to use a concept mapping approach to brainstorm their ideas on the topic of fitness development in physical education (Trochim, nd).

A concept map is a pictorial representation of the group’s thinking which displays all the ideas of the group relative to the topic at hand, shows how these ideas are related to each other and, optionally, shows which ideas are more relevant, important, or appropriate (Trochim, nd, p.2).

At its more sophisticated level multivariate statistical analysis is used as well as multidimensional scaling and cluster analysis is applied to the information. This was not undertaken in this case as the project simply required a basic schemata of the main ideas associated with fitness development of children in schools. The subjects were then asked to discuss their individual concept map and develop a group map around the consensus of the team. The group concept map was then presented to the entire study group along with the story that supports the map.

Following the concept mapping explanation the experimental group were then given an additional session on the theory and practice of systems thinking. For this project the group was not to build a computer generated dynamic model but to map the relationships between the variables that could be used in a model at a later date. Rather similar to the basic concept map but with the additional benefit of being alerted to the importance of feedback loops and causal relationships between elements. They were also told that they were to present the model to class.

Findings

The concept-mapping group produced the following map and proceeded to explain their thinking behind the map (Figure 4).

Maintaining Fitness: One of the obligations of the school physical education program is to maintain a minimum level of physical fitness among children in Singapore.

Intensity of Physical Work: It was acknowledged that for fitness gains to be attained certain levels of intensity of physical work had to be achieved for there to be any change in fitness levels.
**Teacher Expertise:** Not all teachers are qualified to design fitness programs for children of mixed ability and many are not sure what principles of training are required for a training effect on different aspects of fitness.

**Time:** It was felt that a minimum of three periods each week was required and that each of these periods was on different days of the week if possible.

**Facilities:** School facilities needed to be conducive to training and exercise.

**Monitoring Fitness through NAPFA:** For exercise training programs to be properly designed testing did need to occur but this testing was as much to be feedback to students about their level of development and a basis for future exercise. The concept mapping and systems thinking group produced the following map and also explained their rationale behind the map (Figure 5).

**Enjoyable PE Lessons:** The frequency of success in every lesson for every child was seen to be the key to shaping children’s attitudes to physical activity. Positive attitudes lead to more physical activity each day or each week.

**Physical activity at home:** Physical activity homework was deemed as important as math homework for the development and maintenance of fitness.

**Variability of practice and content:** To attempt to meet the differing needs and interests of all students a variety of activity content and practices was considered an important fitness variable.

**Three periods each week:** Fitness development requires a frequency of activity, which amounts to at least three periods each week and all on a different day.

**Information rich lessons:** Infusing thinking skills in physical education will lead to empowerment, confidence and possibly greater commitment

**Student Centered Lessons:** Lessons where students were asked to take and intellectually active role in the class were deemed more motivational than performance oriented classes where students were tested one against another.
Student Centered Feedback: Was considered more important than public performance measures where results were posted for all to see. Rather individual feedback for information and future planning purposes was seen as a more educational appropriate tactic.

Figure 5: Systems thinking map of fitness development in local schools

![System Thinking Map]

Obviously the discussions were much richer than the brief synopsis of this data presented here but the basic ideas behind the thinking become clear. In an attempt to try to be objective about the quality of the two presentations three independent experts were asked to assess the students thinking.

Expert Assessment

To determine the quality of the two maps a group of physical education curriculum experts (Ford & Sterman, 1997) were convened including two heads of physical education departments (one male and one female). They were graduate students on a Master of Science Program and a professor of Physical Education with expertise in Pedagogy. They were asked to evaluate the depth of thinking in both presentations and determine which model provided the most informative assessment of the challenge of fitness development in local schools.

The three experts worked according to set criteria involving:

- the clarity of the presentation,
- the relevance of the issues to the development of fitness in schools today,
- the utility of the model in explaining the nature of fitness development in schools,
- the depth of thinking that was evident in the model.

There conclusions were unanimous in that both maps showed a good understanding of a range of issues that effect the development of fitness in schools. The first group took the principles of exercise training and development and expounded on them in relation to the conditions of teaching physical education locally. Each issue was relevant and appropriate but the model did not do much to help reconcile some of the issues. It was a surface learning model and presented the obvious more than anything that could be used for reforming the system. The second model on the other hand highlighted issues that perhaps could lead to change. The most compelling was the need for enjoyable physical education lessons. The feeling here was that the development of positive attitudes to physical education was essential in children’s fitness development. If students felt good
about activity they would do more of it on their own time and thus get fitter. The second element that links to the first was the notion of information rich lessons, which is currently not the case in many schools (Haslam 1999a). Neither handouts nor hypermedia-laden lessons are used much in local schools (Haslam, 1999b). The reason behind this was also evident in the latter model and that was the attitude toward homework in physical education by the experts and the group generally. The experts felt that children get enough homework from other subjects and thus do not need more in physical education. Hence the group changed the label to better reflect the nature of the suggestion being home based physical activity. Homework as a term has negative connotations among most students. The final point was the relationship between the variables. Take for example the relationship in the model between information rich lessons and student centered feedback. This suggests that if students are to be asked to ‘intellectualize’ on physical education topics they should receive feedback which is personal to them and used in the future planning of their physical education program. Assessment in physical education is not seen to be very important other than national fitness assessment and the experts themselves were not convinced that assessment was necessary. They did concede, however, that to move forward both in terms of educationally defensible experiences and quality control in the physical education curriculum this issue needed to be addressed.

Summary

This was an exploratory action research project involving ten physical education student teachers and the notion of serial and systems thinking in physical education. Experts were used to assess the depth of thinking that appeared to support two models concerning the development of fitness in local schools. The experts were unanimous in their thinking that although both models were interesting and relevant the systems thinking model appeared to be more useful in understanding some of the main issues behind the development of fitness in local schools. Not only did the model reflect the main issues but also within the discussion of the model were keys to the solution of some of the problems. Solutions were not readily forthcoming from the serial-thinking group. The conclusion from the students point of view is that they need to be taught systems thinking as well as dynamic modeling earlier in their program of study such that they might be able to use the facility to help them in other classes in their program.

References


