Principles of Instruction for Problem Solving

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Abstract

Problem solving is the highest level of cognitive skills for thinking. However, this skill seems to be lacking among graduates from higher institutes of learning. In addition, there does not seem to be many instructional models for teachers to teach problem solving and little research on it in Malaysia. Early research on problem solving focused on the psychological processes, definitions and heuristics for solving problems and were limited to the individual in the attempt to make explicit the internalized processes. Studies on generalized problems were limited to solving problems in not much on teaching problem-solving strategies. The purpose of this paper is to discuss an approach for teaching problem solving in authentic and meaningful situations so that learners can acquire problem-solving skills to be successful at the workplace. In order to develop an overall strategy to solve the different types of problems, several principles of learning for teaching problem solving are discussed. Technology can support the existing models of problem solving. Further research is required to determine if these principles of learning can be applied to all problem types, in different subject matter, and to what extent teachers are applying these principles in their instruction in Malaysia. Models of instruction for problem-solving specific to the Malaysian context can be developed and evaluated for its suitability for teaching problem solving skills.

Keywords – problem-solving; instruction; technology; principles of learning; strategies

1. Introduction

The lack of higher order thinking skills among students in Malaysian schools and in higher education has been a cause of concern. Both the Malaysia Education Blueprint in higher education and from preschool to post secondary, note that there is a need for development of thinking skills among students[1, 2]. A major reason is that employers report that graduates lack the thinking skills required for the 21st century [1]. In particular, the aspiration in the Higher Education Blueprint is for students to have thinking skills as they are able to appreciate diverse views, to think critically and be innovative, have problem-solving initiative, and an entrepreneurial mindset. In order to achieve this, Shift 1 in the blueprint aims to develop holistic, entrepreneurial and balanced graduates, so as to fulfill the requirements of the job market [1]. Problem solving is the highest level of cognitive knowledge in the Bloom’s taxonomy [3]. There has been many definitions of problem solving and many methods for studying problem solving in the field of psychology [4,5,6, 7]. However, there seems to be little research in teaching and developing models of instruction for problem solving in the Malaysian context. While the processes for problem solving have been categorized as analogizing, modeling, reasoning causally, and arguing, studies to analyse these processes in instruction and to determine to what extent these processes are used in the Malaysian classroom for problem solving is lacking [8].

The introduction of technology in education has allowed the tools for critical thinking, or Mindtools, for developing problem solving skills [9]. However, not many teachers seem to use technology for teaching and more specifically for developing higher order thinking skills especially in science [10, 11]. In this paper, a cognitivist view of thinking and problem solving is used for discussion of the definitions, types of problems, processes and strategies for instruction of problem solving.

2. What Is A Problem?

2.1 Definitions

A problem is a situation in which the solution is not immediately evident, and that several tasks may be needed to be done to achieve the solution. Early definitions have divided a problem as having three components: the ‘givens’, the ‘goals’ and the ‘obstacles’. The givens in a problem is provided at the onset, and is a certain state with certain conditions, objects, and pieces of information; the goals are the desired or terminal state which is achieved by transforming from given to the goals; and the obstacles are the ways of changing the given state to achieve the goal of the problem [6]. This definition encompasses