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Semantic-Map-Based Approach to Designing an Insight Problem Solving Assistant

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Abstract

In the current study the concept of an insight problem solving Assistant is developed. Assistant will be able to help students in solving problems by offering general strategies while taking into account student's emotional and cognitive state, evaluated based on behavior and self-report. At the core of the assistant is a semantic map, that assigns motivational and emotional appraisals to particular strategies, stored in the database. In this study, a prototype of such semantic map was constructed. 11 participants took part in the questioning, which aim was to collect the ranking of strategies on several subjective scales. The ranking data was subject to the principal component analysis. Results revealed the semantics of main dimensions of the map. Principles, on which the Assistant based on the built semantic map will operate, are described.

Keywords: insight, cognitive model, semantic map, teaching assistant

1 Introduction

The phenomenon of an insight is known in cognitive psychology as a key moment in problem solving, usually connected with a rapid alteration of the problem representation in the solver's mind, which may lead to an immediate finding of the solution, and is accompanied with vivid emotional experience [1]. Accordingly, an insight problem is a problem that allows for "insight moments" during its solution. It was proved that solvers' emotions of approaching solution differ for insight and non-insight problems [2].

The ability to solve insight problems is strongly connected with divergent thinking and the ability to break rules of standard approaches [3]. A plenty of tests are known, based on various problems and puzzles, aimed at measuring and developing one's quick-wittedness and the ability to think "outside of the box". Nevertheless, these tests by themselves are not always helpful in assisting in problem solving, because each insight problem is different, and usually cannot be solved by analogy with a previously encountered case. The solver may switch strategies and approaches very rapidly – or may get stuck on a misleading strategy. The inability to solve a given problem after multiple attempts can

make the student lose motivation for further thinking about the problem. Preventing such outcomes is one of the tasks for the problem solving Assistant.

The idea of the Assistant developed here is as follows. The Assistant should be able to help a student to find a correct solution to the problem, without using any actual knowledge of the given problem or its solution. Therefore, the assistant cannot give a hint based on the problem itself, but may suggest a strategy from its database of general strategies, applicable to most problems in general. The choice of this strategy is based on solver's own assessment of his or her emotional and cognitive state, including characteristics like the attitude toward the problem (whether student sees new ways in its solution or still regards the problem as tough) and the like.

In order to be able to offer new strategies to the solver without contradicting the solver's style of thinking, the Assistant needs to use a semantic map, on which the current state and the trajectory of the solver, along with all available strategies, is represented. This semantic map was constructed in our study based on the results of student questioning, and is described below. Participants were asked to rank different strategies on the Likert scale with 10 values. In the current study the analysis of built cognitive model is presented.

2 General concept

Many researches and experiments (for example, [1]) proved that human is tend to simultaneously change his way of thinking about solving of a problem he does not now the algorithm of getting the right answer. Sometimes, such a spontaneous sequence of decisions can lead to the wrong answer or even to losing interest to the problem. Thus, the future assistant must be able to accompany solver from the point in time when he sees the problem for the first time to the point he is ready to give an answer. In between these points solver may face the challenge of choosing further actions or even functional fixedness [4].

The Assistant has to take into account several significant aspects:

- Solver's emotional state (whether he is ready to continue or give up; whether he has ideas or ran out of ideas)
- Which strategies has already been applied

The assistant has to offer a strategy on the basis of this data. This way, student is advanced to the solution by application mental process simulation.

Strategies being suggested do not depend on particular sort of the problem.

3 Methods

Subjects. 11 volunteers took part in the questioning. All of them are bachelors studying program engineering at NRNU MEPhI. 6 of participants are males, and 5, correspondingly, are females.

Materials. Every participant was asked to examine 45 strategies. A strategy is literally an approach to a problem solving or an approach to preparation for solving. Every strategy had 10 scales of assessment, one scale included 10 intervening levels. Participants had to decide, was the strategy rather conservative or revolutionary, passive or aggressive, concrete or abstract, easy or difficult, related to details or related to the meta-level, related to the statement or related to the solution, weak or strong, opening or closing, basic or redundant, perspective or retrospective.

In the Figure 1 the question example is presented.