

Roles of Variables and Strategic Programming Knowledge

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Background

Roles of variables [6] are a new concept that can be utilized, e.g., in teaching programming to novices. Roles represent programming knowledge on a higher level than simple programming language knowledge. Role knowledge has traditionally been tacit but it can be made explicit and thus help students to understand the ways variables are used in programs. Roles are easy to adopt in teaching, too: in one study, computer science teachers learned in less than an hour to recognize roles in their typical uses with 90 % accuracy [1].

Objectives

Roles of variables can be utilized in many ways, but current activities concentrate mainly on how they can be utilized in teaching programming to novices. The role concept is a unique way in structuring programming knowledge and one of my main interests is to find out how it can be best used in teaching novice level programming. To do that we will have to reveal actual influences of the role concept as a teaching method in action, i.e., to find out the effects of the role concept in gaining strategic programming knowledge when compared to more traditional teaching methods. I will study whether roles of variables will eventually help novices to gain deeper comprehension in programming especially in the beginning of their studies.

The main issue of my research work and the subject of my doctoral thesis will be to describe the effects of the role concept in the emergence of strategic programming knowledge, i.e., to find answers in questions like "how does the role concept effect in the progression of programming methods and comprehension strategies in programming at the novice level". Another research question is to study the effects of the role concept in strategic programming knowledge among expert programmers.

Research Work and Progress

The role concept has been utilized in a teaching experiment conducted in fall 2002. In this experiment the subjects were divided into three groups: one receiving normal lectures and exercises (the traditional group), one attending lectures with systematic use of variable roles throughout the course (the roles group), and one attending the same lectures as the roles group but using role-based animator in exercises (the animation group) [5].

The first main task in my research work has been to analyse the protocol task results of this experiment. The outcome of the tasks in the experiment consisted of two types: program summaries, and program construction speak-aloud protocols. As the whole idea of roles is quite new, the first stage in this ambition has been to discover and to develop appropriate methods for the analysis.

For the purpose of analysing program summaries we have tried out Good's program summary analysis scheme [3]. We have performed an inter-rater reliability analysis in order to see the applicability of Good's scheme for our purposes [2]. As this work is now in its final stage I will next concentrate on analysing the program summaries with Good's method. This method will at the very least reveal possible differences in the level of program information between students among the three groups.

Research methods concerning programming protocol tasks are still mainly at abstract level. One idea we have thought is to apply Rist's model [4] of focal expansion and plans in programming. Because we are mainly interested in the usage of variables, we have adjusted Rist's method so that the

analysis concentrates only on those lines of code which include any usage of a variable, i.e., we are trying to find programming plans which are related to the usage of variables.

From the videotapes which include programming protocol tasks I have gathered all actions which are in any way related to the usage of any variable. Therefore the data consists not only of those lines of code which have remained into the final program but also of those lines which has been altered or removed.

The data is now gathered and it consists of the lines concerning the usage of each variable in the program together with possible errors and their types. In the example below all variable names are Finnish words or their abbreviations. Text in the output line has been translated.

Variable name: lahin
Variable role: MWH cl (most-wanted holder, closest)

```
1 lahin : integer;
2 lahin := kokmin;
3 if (60 - kokmin < 60 - lahin) then
4 if ((60 - kokmin < 60 - lahin)) then (retypes line 3)
5 writeln('Closest to two hours was ', lahin, ' minutes. ');
6 if (abs(60 - kokmin) < abs(60 - lahin)) then (retypes line 3)
```

Based on this material I will try to discover programming plans related to the usage of variables. The main goal is to find if there are any differences in variable plan knowledge between the groups.

The methods we have adopted this far are measuring programming knowledge as a whole and there are still open questions about how accurately these methods measure those details we are interested in. So the process to find appropriate research methods still continues.

The research work is at its early stage and there are still more open questions than solutions. The primary open questions in my research work are:

- What methods to use to analyse the effects of the role concept concerning program creation?
- What kind of empirical testing is appropriate to find differences in teaching methods? Is there any methods that do not require long teaching periods with uncontrolled side-effects?

References

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