Teaching SQL — Which Pedagogical Horse for This Course?

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Abstract. A student with a Computing Science degree is expected to have reached a reasonable level of expertise in writing SQL. SQL is a non-trivial skill to master and is taught with different degrees of success at different institutions. When teaching any skill we have to take both previous learning and experience into consideration as well as the best possible way of teaching the skill. When learning a new skill humans form mental models of particular problems and formulate internal patterns for solving these problems. When they encounter the same problem later they apply these previously internalised patterns to solve the problem. This reality has to be taken into account when selecting a teaching approach because changing an existing mental model is difficult and much more difficult than encoding the correct model in the first place. This paper considers two different pedagogical approaches to teaching SQL and compares and contrasts these in terms of mental models and cognition. We conclude by making recommendations about the tools that should be used in teaching SQL if the afore-mentioned mental models are to be constructed to support a coherent and correct understanding of SQL semantics and not merely the syntax thereof.

1 Introduction

It is an indisputable fact that many students have difficulty learning SQL. Database educators have been teaching SQL for many years and this problem tends to persist throughout the years. This is partly due to the nature of SQL, and the fact that it is fundamentally different from the other skills students master during their course of study. However, we feel it will be beneficial to take a closer look at different pedagogical paradigms involved in teaching SQL to see whether we can come up with some recommendations about how SQL ought to be taught and the tools that should be used in teaching it.

In this investigation the results obtained from two completely different paradigms used for SQL teaching are discussed. When contemplating issues such as these we need to consider mental models and cognition. Humans form mental models, or previously internalised patterns, in order to understand common problems, and apply these patterns to solve previously encountered problems. In comparing these paradigms we want to identify effective and efficient ways of teaching SQL and also find explanations for the failure of paradigms that are not as effective.

It is not easy to draw comparisons between teaching paradigms at different institutions because student dynamics differ not only between institutions but in the same
institution in successive years as well. There are also other factors, such as different teaching styles and concepts being taught at different levels to students with varying abilities. However, it is still useful to examine these teaching paradigms to draw valuable lessons from them and, in the end, to find out how best to teach SQL.

Before considering the different teaching paradigms we introduce, in Section 2, the idea of pedagogical patterns, a way of formulating specific teaching approaches which enables educators to share and publish effective teaching practices. Section 3 will explore human mental models and learning in general. Section 4 will compare and contrast the teaching of SQL at the different institutions. Section 5 considers the connection between the teaching paradigm, the mental model support and the results attained by students at the two institutions. Section 6 concludes and identifies further research in this area.

2 Pedagogical Patterns

A notion which is emerging in teaching circles is the use of pedagogical patterns to formulate teaching of a particular concept [1]. Pedagogical patterns attempt to focus the educator on important parts of the pedagogical process, and on finding the best possible way of teaching a particular concept, with a view to sharing this knowledge.

The concept of a pattern as being a perennial solution to a recurring problem originated in the field of architecture, based on the work of Alexander [2]. Patterns have been taken up in various fields, including software engineering and human-computer interaction. Each particular field has its own specialized vocabulary and structure. However, the notion of a pattern as a generalised, core solution, which can be applied to resolve the forces in the recurring problem, is pervasive. A related concept is that of anti-patterns, which are commonly used solutions that yield undesirable results. Coplien describes an anti-pattern as something that looks like a good idea, but which backfires badly when applied [3]. Thus some pedagogical patterns may actually be anti-patterns without the educator realising it.

Pedagogical patterns commonly consist of issues, strategies and implementation. The issues in these patterns are concerned with the transfer of knowledge of a particular type. The strategy is the design which aims to transfer that knowledge in a particular way and the implementation delivers material in the way specified by the strategy.

It would be helpful to database educators if tried and tested pedagogical patterns to teach SQL were formulated. There are many approaches that can be taken and the educator does not initially know whether a particular pedagogical pattern is a true pattern or an anti-pattern. To better understand the efficacy of two particular approaches Section 4 will compare and contrast the teaching of SQL at two institutions. However, before doing this we need to discuss relevant issues pertaining to human cognition and learning in the following section.

3 Mental Models and Learning

Mental models are small-scale models of reality constructed to anticipate events, to reason and to underlie explanation [4]. Models can represent abstract notions such as