

Learn to query databases in an interactive and engaging way

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Abstract

Databases in general and relational database queries in particular are increasingly a topic in schools. However, teachers often lack suitable, open, high-quality, modular, interactive, and reusable database learning materials and data. Also, existing SQL editors are often too complex for students and do not provide enough helpful feedback for solving specific queries. In this workshop, we present an approach to teaching and learning SQL in an interactive and engaging way. Our approach is based on our experience from two projects in which we developed a database MOOC and the responsive web tool 'aDBenture' that allows students to solve adventures with SQL game based in different domains.

Keywords

Relational Databases, SQL, MOOC, Active Learning, Gamification

1. Introduction

The subject area of databases and thus the handling of relational databases is anchored in some curricula, at least in Austria [1]. However, teachers often find a lack of suitable, high-quality and available learning materials and sample data. For students, existing SQL editors are also often too complex and do not provide enough feedback when solving concrete tasks. We are currently working on two projects that focus on training students in databases: In the eInformatics@Austria project [2], we are developing an interactive and engaging MOOC on the topic of "databases". In the aDBenture project we are working on a web-based and responsive tool that allows learners to work with SQL in a game-based way.

The goal of the workshop is to learn in the discussion with workshop participants how databases in general and SQL in particular are currently taught in schools, and to get feedback on our interactive SQL learning environment aDBenture as well as our learning materials under development.

Participants will be able to play a prepared adventure with aDBenture and provide us with feedback on the design and their own user experiences. In the role of teacher, participants will view analyses of the game results. They can also create a small adventure themselves and test each other's adventures. The motivation of the workshop is to support the teaching and learning of relational databases in an interactive and engaging way. We would also like to find some beta testers for aDBenture.

2. aDBenture – A game-based approach to learn SQL

aDBenture can help teachers motivate their students to learn SQL - anytime, anywhere. In aDBenture, adventures can be solved by writing SQL queries. An adventure consists of several tasks that need to be solved using SQL. Each task has predefined sample queries that are used to evaluate the

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correctness of the applied queries and to give intelligent feedback in case of errors. There are some predefined adventures in aDBenture, which are set in different domains. For example, there is a database of criminal cases to make adventures interesting for students as players. In addition, teachers can flexibly create their own adventures in the role of the author, they can reuse and adapt existing adventures and also upload their own database on which their adventures are based. Multiple relational databases are supported. In addition, teachers can also analyze the learning progress of their students.

In the role of a player, students have the opportunity to solve adventures in a browser responsible and without any installation effort. As there are stored sample queries defined behind the tasks, learners can immediately recognize the correctness of their solutions and differences from the expected result. They can choose to play 'anonymously' or make their results analyzable for their teacher as logged-in users. Two master theses are currently focusing intelligent error messages and solution recommendations for players and using aDBenture for exams.

3. A Database MOOC meets aDBenture

In the project eInformatics@Austria [2] we are working on the development of a German database-MOOC. The aim in this project is to develop reusable open and motivating learning resources on various levels of Bloom's taxonomy [3]. The special feature of our database-MOOC are animated learning videos that embed database knowledge in the context of a police station where criminal cases are solved using a database (for a Bloom level 2 example see [4]; for a Bloom level 1 example see [6]). The videos are also supplemented in the MOOC with interactive H5P elements [7]. So, the design of the database-MOOC considers proven didactic methods. Interactivity, multimodality and the opportunity to become active as a learner, play an important part in the MOOC. This is where aDBenture is used also in the database-MOOC context.

But aDBenture can be also used completely independent of the MOOC. Sometime it makes sense to use it together with learning materials available on the web via a URI. Thus, lessons from the database MOOC (made available via iMooX [5] in summer 2023) can also be integrated and used in topic-specific adventures of aDBenture. These database MOOC videos will also be available on Youtube (with English subtitles) and can then be embedded via links in aDBenture as well. In this way, SQL fundamentals can be consumed by students in the context of solving adventures.

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Tangible Computer Science

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Abstract

Using of simple materials such as cards, strings, foam cubes, crayons, and a lot of moving around we can educate students about computer science fundamentals. This kind of popularization is called Computer science unplugged. Through well-designed activities and suitable questions, we can visualize even the abstract concepts of the main principles of the computer. The activities introduce students to underlying concepts in a way that is suitable to their age and level of comprehension, without technical details. The main purpose of the workshop is to describe a set of learning activities that are connected to each other's focused on how the data are going through the monitor, computer, and converter to the Internet. Activities were found suitable for non-formal learning environments, but we use them even as a part of classes in formal education. Activities that look more like games than education motivate students actively create self-knowledge. Computer science unplugged is a good solution to reveal the computer science abstract even to the public. Most of our activities are new developed, one of them is taken from other source and updated to new concept of gaining the important information.

Keywords

Computer Science Unplugged. Constructivism. Engaged games.

1. Introduction

The visualization of abstract concepts through experiential teaching is an issue that could change the view on the not very popular parts of computer science. It has been shown that the elements of non-formal education are helpful [1]. Learning by playing the games is suitable for kids, students and even for adults, especially in STEM education [2]. Activities that look more like games than educating motivate students actively create a self-knowledge. Computer Science Un-plugged (CSU) is a collection of free experiential learning activities that teach Computer Science through engaging games and puzzles that use cards, string, crayons, and lots of running around. These activities rely on kinesthetic principles and involving teamwork [3]. Learning becomes more informal that is a vital part of instructional practice [4]. Manipulation with physical objects is typical for CSU.

2. Tangible activities

The workshop aims to present an interactive popularization constructivist activity, with a focus on computer science. The main purpose of our workshop is to describe a set of learning activities that connected to each other's focused on how the data are going through the monitor, computer, and converter to the Internet. The activities introduce underlying concepts in a way that is suitable to their age and level of comprehension, without technical details. The concepts are presented only using LEGO bricks, paper cards, foam cubes, wooden boxes strings, crayons, and lot of moving around (Figure 1.).

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Activities are effective as the first information about how computers see (store) different type of information, such as numbers or text. After that abstraction is more comprehended.



Fig. 1. Teachers aids for computer science unplugged activities

2.1. Set of learning activities

Through the well-designed activities and suitable questions, we can visualize even the abstract concepts of the main principles of the computer. We prepare activities focused on:

Communication – Activity aids: LEGO bricks. Activity is focused on communication rules. There are three players, the watcher, the builder, and the informer. Using LEGO bricks students need to build the construction. There are special rules for communication between the players.

- Binary digit - Activity is focused on explanation of binary coding of numbers. Understanding binary can lift a lot of the mystery from computers. By regrouping the foam blocks according to the paper cards with the predefined dots students create the knowledge how to convert the number from decimal to binary form.
- Binary counting - At a fundamental level the computers are just machines for flipping binary digits on and off.
- Encoding of characters – Understanding the representation of characters using coding standards. By using own coding table students need to encode the message for the next group. The receiver needs to be able to decode sender message.
- Converting from digital to analog form and vice versa – Using seven cards with number one on one side and zero on the other and tailor rubber (elastic string) we explain the transformation of the digital signal into the analog (pulse) signal.
- Furthermore, we have activities focused on searching in sorted and unsorted data.

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