

# BlocklySQL - A new block-based editor for SQL

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## ABSTRACT

This paper introduces *BlocklySQL*, a new block-based editor for SQL. BlocklySQL was developed on the basis of Google's JavaScript library *Blockly*, a tool for developing own block-based editors, which comes with several technological and pedagogical advantages. BlocklySQL is also integrated into the learning platform *dbup2date*, which provides daily updated databases for the use in CS classrooms.

## KEYWORDS

Computer Science Education, Block-based programming, Databases, SQL

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## 1 INTRODUCTION

Block-based programming is a popular approach to introduce learners to programming. In comparison to textual programming, it prevents tedious syntactic errors (e.g. missing semicolon at the end of a statement). These kinds of errors can lead to high frustration in the learning process of students. By avoiding those kinds of errors block-based programming promotes a higher emphasis on the semantics of a programming task.

## 2 RELATED WORK

### 2.1 Students' Problems with the Learning of SQL

In multiple studies [1][2], Ahadi et al. investigated students' errors of writing database queries (SELECT-statements) in SQL. Their sample consists of more than 161000 queries from more than 2300 (undergraduate) students. The queries have been collected and assessed with the online tool *AsseSQL* [5].

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The analysis of the data reveals that the students' SQL queries included many syntactic errors (54%). When investigating these errors more closely, the top three errors are: wrong syntax (21%), undefined column name (13%), and wrong use of GROUP BY-clause (10%) [2]. The high percentage of syntactic errors shows that a block-based editor, which tries to eliminate such kinds of errors, might be useful for the learning of SQL.

### 2.2 Existing Tools

Unsurprisingly, other researchers have already developed tools which combine block-based programming with SQL. One popular example is *SQLSnap!*. *SQLSnap!* is an extension of *Snap!*<sup>1</sup>, which provides blocks for the creation of SQL queries in *Snap!*. These queries can be committed to a MySQL database. Data can either be used from the example databases or included from .txt-files.



Figure 1: Example of a SQL query with *SQLSnap!*: It returns the top five students with the best grades of all courses (in German).

### 2.3 Advantages

Compared to other block-based editors for SQL such as *SQLSnap!*, *BlocklySQL* provides technological and pedagogical advantages:

- Technological
  - **Flexibility & Extensibility:** Users can customise their version of *BlocklySQL* to fit their needs. For example, new blocks can be added (or manipulated) easily either manually using JavaScript or with the help of *Google's Developer Tools*.<sup>2</sup>
  - **Open Source:** Publicly available code allows developers to use *BlocklySQL* in their own websites and projects.

<sup>1</sup>*Snap!* can be found online under <https://snap.berkeley.edu/>, last accessed 19th June, 2019.

<sup>2</sup>For further information on the *Blockly Developers Tools* go to <https://developers.google.com/blockly/guides/create-custom-blocks/blockly-developer-tools>, last accessed 19th June, 2019.



Figure 2: Example of a SQL query with BlocklySQL: It returns the locations of weather stations, where more than five gale-force winds (wind speed > 32.7 m/s) have been recorded (in German). Queries can also be attached with comments and blocks can be collapsed (e.g. FROM-clause) to improve readability.

- Pedagogical
  - **Adequacy of purpose:** Whereas SQLSnap! is meaningful when using results of database queries in a programming exercise, the purpose of BlocklySQL is to support beginners in learning SQL. Less blocks are presented to reduce the cognitive load of the students (you could even develop different levels of difficulty) and they do not have to deal with empty clauses as in SQLSnap! which could even reinforce students' misconceptions.
  - **Exportability:** Block-based programs can be extracted to regular SQL syntax and displayed in the browser to simplify the transition from block-based to textual SQL statements.

### 3 IMPLEMENTATION

BlocklySQL does not (yet) support the whole syntax of SQL. Because of our curriculum, we focused on the following elements of the SELECT-statement:

- with one table
- with two or more tables using joins
- using aggregate functions (COUNT, SUM, AVG, MAX, MIN)
- using GROUP BY (with HAVING)
- using ORDER BY
- subqueries using IN

### 4 EXAMPLE PROJECT: INTEGRATION INTO THE ONLINE LEARNING PLATFORM "DBUP2DATE"

The project *dbup2date* at the University of Bayreuth, Germany developed a learning platform for the use in CS classrooms, which provides daily updated databases for the topics *football* and *weather*. This learning platform is quite popular in Germany. In 2018, more than 300000 SQL queries were committed to the database *football*. 80000 SQL queries were committed to the database *weather*. Additionally, the platform was also used for downloading the database files (either as .sql- or .csv-file): 92000 download for the database

*football* and 25000 downloads for the *weather*.

On this platform, SQL queries can be typed into a text field and sent to the server via an HTML-form. The server conducts the SQL query and returns the corresponding result. In cooperation with the University of Bayreuth, we extended the learning platform by integrating BlocklySQL as an alternative interface. The learning platform is available here<sup>3</sup>. SQL queries in BlocklySQL can be transformed to regular SQL syntax and saved to or loaded from .xml-files.

### 5 OUTLOOK & FUTURE WORK

This paper presented BlocklySQL, a new block-based editor for the learning of SQL. Future work consists of evaluating our tool with teachers and students and extending it with new features. Even though INSERT, UPDATE, and DELETE-Statements for data manipulation are also part of our curriculum, we decided not to include them in BlocklySQL so far as, because of the user permissions of the database management system (DBMS) in *dbup2date*, students cannot perform any manipulations on the data in our database and consequently the statements would not have any effect. Regardless, this would be possible with the right user permissions.

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<sup>3</sup>The learning platform *dbup2date* is available online: <https://dbup2date.uni-bayreuth.de/blocklysql/> (until now only in German), last accessed 19th June, 2019.