

Development of an Educational Dashboard for the Integration of German State Universities' Data

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ABSTRACT

German state universities often only have little data about their students. Existing data includes study history data such as grades, module names, number of attempts, and dates. This data can be used to extract interesting information, although it is often not used. It is stored in various databases and systems in the universities, so that each university has to develop its own analysis tools. We have developed a tool that allows various universities to easily import the data and retrieve first visualizations of it.

Keywords

educational dashboard, student data integration, educational data visualization

1. INTRODUCTION

German state universities often do not offer any e-learning in addition to the usual teaching materials, so there is usually no data from interactions with an e-learning system. Only the study course data such as grade, module name, number of attempts, and date are available. Even if there are a few features, this data could be analyzed. Since state universities often have no educational dashboards or evaluation systems, the existing data is not used. The data is available in different database systems and formats, so each university would have to develop its own system to generate knowledge from its own data.

To solve this problem, we developed a dashboard which should be able to integrate data from different universities. The courses are usually organized in modules, which can be constructed in a hierarchical structure so that, for example, the module "Mathematics" is considered as passed if the submodules "Calculus I" and "Linear Algebra I" are passed. The system must, therefore, be able to integrate various hierarchical structures.

Once the data is integrated, it can be visualized and data mining procedures can be applied to it. The development of the visualization and data mining procedures can be done in a central place and does not have to be redeveloped at every university. The individual universities should only have to synchronize their data with our dashboard.

2. METHOD

To integrate data from different universities, we propose a simplified data model. Four of the required tables are shown in Figure 1. The *student* table contains all necessary students' data. The more attributes, the more information can be analyzed. However, the features *Completed*, *EnrollmentDate*, and *ExmatriculationDate* at least should be specified. *Completed* denotes students who have successfully completed their studies. Students who have an *ExmatriculationDate* and at the same time have the value *false* in the *Completed* field can be regarded as students who have dropped out of their studies.

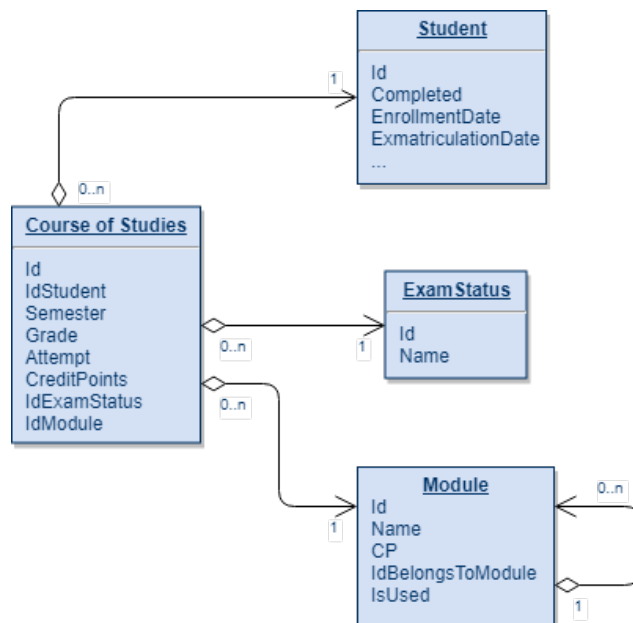


Figure 1: Simplified version of the model

To import the data, the universities only need to export two tables: students and *student achievements*. Table 1 gives

two examples of student data. The student with Id 1 graduated successfully and the student with Id 2 is still studying.

Table 1: Student Data

Id	Completed	EnrollmentDate	ExmatricualtionDate
1	True	2009/10/01	2012/09/30
2	False	2009/10/01	null

Table 2 shows the achievements of two examples in which the student with Id 1 passed two modules X and Y at the first attempt and gained a total of 20 credit points (CP) in the 1st semester.

Table 2: Student Achievements (Course of Studies)

Id Stud	Sem-ester	Att-empt	Exam-status	Mod-ule	Parent Module	CP
1	1	1	Passed	X	Z	10
1	1	1	Passed	Y	Z	10

The hierarchy of the modules can be extracted from this table based on the parent relation of the modules.

Each university is able to freely select the module hierarchy level that should be used for the analysis. We suggest that this should be chosen with a clickable treeview. Figure 2 illustrates how the module *Mathematics* containing the overall information of its submodules is selected.

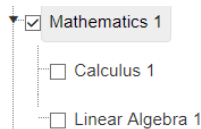


Figure 2: Selecting the required module for the data analysis

By combining the data from Tables 1 and 2, the model specified in Figure 1 can be filled in and the first analyses automatically created. Below are several practical visualizations that can be created from such data.

The heat map in Figure 3 shows students who dropped out their studies. Each row shows a student and each column shows how many exam attempts they had each semester. For example, we see that students who drop out in the first semester usually do not have more than 2 exam attempts.

To find out which combinations of exams are passed together, Venn diagrams can be used. Our dashboard generates Venn diagrams for the combination of selected drop out semesters and selected exams. The Venn diagram in Figure 4 visualizes which exams are passed by students who drop out in the 1st semester. For visualization, the four modules Calculus I, Linear Algebra I, Technical Computer Science and Operating Systems were selected, with Operating Systems not being part of the syllabus in the 1st semester. From Figure 4 we can see that students who pass Calculus I are also able to pass the other planned exams. For further information, one could compare this with a Venn diagram that shows the attempts made.

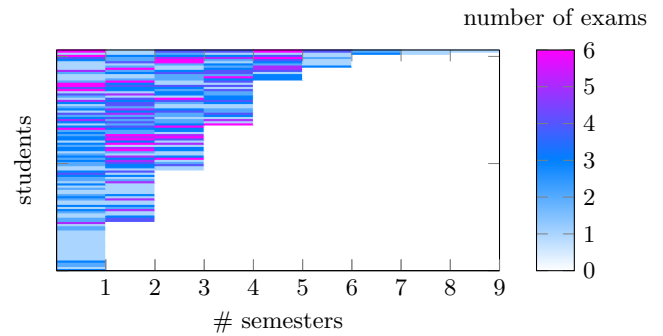


Figure 3: Heatmap visualization of study progress of students before they have canceled their studies. The number of exam registrations per semester is shown with colors in each row.

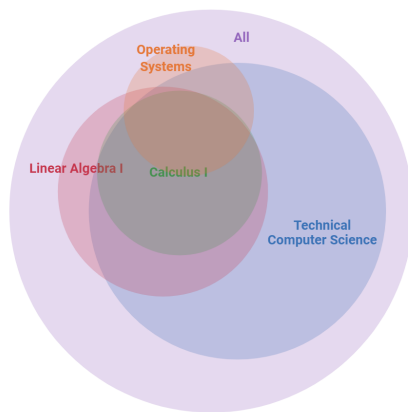


Figure 4: Exams passed in the 1st semester by students who drop out after the 1st semester

Figure 5 shows a violin plot of graduates and how many CP they have earned per semester. This visualization shows us that successful students with a few exceptions earned approx. 10-40 CP per semester. With the violin plots, averages and distributions for different features can be clearly visualized.

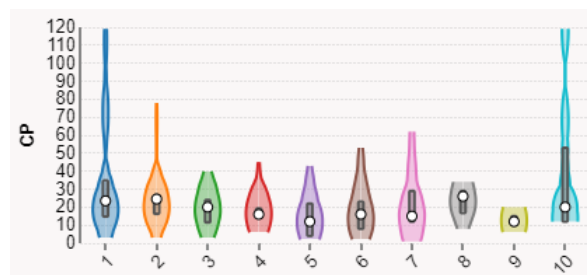


Figure 5: CP per semester of graduated students

3. CONCLUSION AND FUTURE WORKS

We have presented a first version of the dashboard that is able to import data from various state universities and to visualize the data. In the future, we will implement additional visualizations as well as add predictive models.