

Development of Interactive Database Courses Using aDBenture, H5P and Storytelling

Nina Lobnig, Claudia Steinberger, Andreas Bollin

University of Klagenfurt
{firstname}.{lastname}@aau.at

Abstract. The ability to work with data is increasingly vital in today's digital age, and databases are still an essential part of computer science education. The key concepts are part of beginner university courses and secondary school classes. However, many current courses and textbooks contain dull examples, and the motivation to learn about databases doesn't seem particularly strong. In this submission, we want to present our approach in developing two massive open online database courses. We pursue a playful storytelling approach and work with H5P elements and aDBenture (an online tool for SQL queries) to make learning more interactive and motivating and utilize some of the advantages of game-based learning.

Keywords: database education · database teaching · game based learning · massive open online courses

1 Motivation and Background

Databases are omnipresent in the age of digitalization - they are needed whenever data is stored, retrieved, and analyzed. In this respect, relational databases are still the most widely used and form the foundation [4]. Understanding and managing the storage of large amounts of data is still (increasingly) important, whether as part of general education, computer science studies, or in emerging professional fields (like data science). Learning about databases should, therefore, be well-designed and organized in a way that motivates learners.

In 2020, we got the opportunity to develop a two-part open online course for databases as part of a project¹ named *eInformatics@Austria (publicly called Ing0)* where five Austrian universities worked together in designing, creating, and evaluating massive open online courses (MOOCs) for introductory computer science topics. The target audience was freshmen students in higher education, interested students, and secondary school teachers. The goal was to make the learning material interactive and motivating so that it differs from the often uninspiring examples in textbooks and courses. Additionally, we wanted them to be easily reusable so that it is possible to use parts of the course(s) and use the course in different settings. In the following, we describe the concept behind our database courses and how we tackled all these ambitions.

¹ This project was funded under the 2019 Call 'Digital and social Transformation in University Education' by the Federal Ministry of Education, Science and Research.

2 The Concept behind our MOOCs

Competencies and Course Content. First, we designed the MOOCs in a way that requires no special prior knowledge. To adapt the course content to the relevant target groups, we based our selection of content on the competencies of the ACM/IEEE Computer Science Curriculum 2013 [1] and the core concepts from the database courses at our university, which largely also align with the school curricula. From this, we narrowed our target competencies and defined our underlying competence model with three resp. four levels (based on Bloom's taxonomy [8]). We have learning materials that provide theoretical knowledge using small examples in which the learner takes on the role of a mere listener (level 1). Then, we have those in which the learner participates in a story and can demonstrate their understanding of the content through small interactions and have solutions explained to them (level 2). There are also exercises for solving tasks independently and applying or combining learning content (levels 3, 4).

Regarding the content: The first course² is about the design of a database - from modeling with UML diagrams to relational schemas as well as the quality of those schemas and corresponding anomalies. The second course³ is mainly focused on SQL databases - from a brief introduction to relational databases and mathematical basics (Relational Algebra) to the creation and querying of SQL databases. Learning how to write multiple SQL queries (including aggregate functions and subqueries) forms the central part of this course.

Structure of the Course Units. We focused on a coherent content structure and free access and navigation between units when organizing the courses. The first unit is an overview and introductory unit. Each unit contains an introductory short text and a list of keywords and questions that can be answered after completing the unit (as recommended by Handke [7]). This provides a good overview, creates the possibility of differentiation for participants, and makes it easier to find content again. Each unit starts with a task (in the context of a story) defining a goal we want to achieve. This should provide an impulse to engage with the learning materials (as their content is needed to solve the task) and also help to activate and motivate learners. It also contributes to differentiation, as learners can try to solve this task directly and thus have a good indication of whether the unit's content is relevant to them or whether they have already mastered it. The task solution is given for comparison and reference. Each unit also ends with a multiple-choice quiz on its main content, marking the unit as completed.

Activating Learners through Storytelling, aDBenture, and H5P. Our main focus is activating and motivating learners. That's why we don't have a professor explaining content in a classroom setting. Instead, our animated (female) expert, Sam, appears in different settings, like a police station or outdoors.

² The courses are in German, but description available in English as well:

<https://imoox.at/course/Datenbankentwurf>

³ <https://imoox.at/course/SQL-Datenbanken>



Fig. 1. Screenshot from a video with our expert Sam and the police duo

She explains content while walking through a park or chatting with friends in a bakery, usually embedded in a storyline. Storytelling is a central part of our learning materials, and learners are often involved in helping the police. E. g., they have to solve several criminal cases at the police station using SQL queries, such as finding a dog kidnapper based on evidence from the threatening letter. This storytelling approach is also part of the online tool we used for our querying exercises in SQL (although it was also possible to work with PGAdmin). It is a free online web tool called aDBenture⁴ that is made for SQL exercises using storytelling and uses parts of the advantages of game-based learning [3][11].

Our videos focus on the person speaking, including eye contact, moving away from continuously visible slides, and the focus on displayed code. This follows recommendations for videos regarding decreased concentration in slide presentations without face-to-face contact [6]). For the same reason, we kept the duration of our videos relatively short. To further engage learners, we take advantage of H5P elements. All our level 1 and 2 contents are either interactive H5P videos or interactive H5P books with multiple choice questions, gap fills, drag-and-drop, and other task types. The interactions encourage thinking along and deeper learning, breaking up the content designed to keep concentration high. Research has shown that it drops significantly after about 10 minutes and can thus be improved [2][6].

(Re)Use of the Course. We also paid particular attention to possible uses and reuses of the course and its learning materials. MOOCs can be used in various settings: As a standalone, as an additional resource, or as a main driver in a course at a university or school (e.g., in a flipped or inverted classroom setting) [5][9]. In addition to that, we also considered modular use to facilitate the individualization and reusability of the course. For example, by allowing teachers to use only parts of the course in their teaching without compromising the usefulness and comprehensibility of the content. To achieve this, we designed and built our course in a particular, competency-based, modular way (according to the competence-oriented MOOC life cycle [10]), and our stories only cover one learning object at a time. Additionally, we licensed everything as open educational resources (under CC-BY). Overall, this makes the courses easy to maintain and extend, as content can easily be adapted or changed.

⁴ Note: The Webtool is available in three languages, we used it in German

Other Aspects. All our videos have available subtitles and are supplemented with an alternative text document (transcript with the most important images from the video) to be more accessible and enable participation for different learners. The gender and diversity aspect was important to us as well. That's why we deliberately created a female, non-white role model in our expert Sam, and the mixed police duo Lara Fischer and Amar Kovač play a central role in our stories. We take great care to avoid recurring stereotypes and distribute the parts of speech evenly - or sometimes intentionally female-dominated (with the idea of reversing the roles, following the deconstructivist approach in gender research).

3 Conclusion

Our MOOC has been carefully thought through, considering various aspects. We rely on a mixture of storytelling, interactive H5P elements, and diverse learning materials and use an online SQL query tool that supports our approach. We have already tested the courses as an added value in university courses and evaluated and improved them. The feedback received from the students and the MOOC participants was overall positive. Nevertheless, the courses are designed for a broader target group and different usage scenarios to be suitable for our students as well as other universities interested school students, and teachers.

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