

A Game-based Learning App for Primary School Children with German as a Second Language

Thomas Deutsch^a, Stefan Hinterhölzl^b and Iris Groher^c

Institute of Business Informatics - Software Engineering, JKU Business School, Johannes Kepler University Linz, Altenbergerstrasse 69, Linz, Austria

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Abstract: The use of technology and multimedia is becoming increasingly important in today's classrooms. Digital games are often used by teachers to complement traditional methods of instruction, even for primary school children aged between 6 and 10 years. Studies show that these games have positive effects on learning outcomes and increase the motivation of children. In this paper, we present a game-based learning application we developed for children in primary school with German as a second language. The web-based learning application provides different learning games that can be customized by teachers based on children's needs. Reading and writing skills are not required to play the games. To increase the motivation of children, we integrated a reward system into the application, which can also be customized by teachers according to their needs. We have already used the learning application in two primary schools in Austria and the feedback we received was very positive.

1 INTRODUCTION

Software-assisted learning is becoming increasingly important. The use of technology and multimedia in classrooms supports teachers to complement traditional methods of instruction with innovative approaches that can change the way students learn. In particular, computer games have high potential as effective learning and teaching tools in modern classrooms (Husni et al., 2021), as they can engage a new generation of learners in a way that traditional education does not (Whitton, 2007). Students' motivation is also increased through digital game-based learning (Erhel and Jamet, 2013; Divjak and Tomić, 2011) and games have proven to be particularly effective when created by teachers (López-Fernández et al., 2021). Digital games are often used for learning foreign languages (Chiu et al., 2012; Chiu, 2013) but have also successfully been used for learning mathematics in primary school (Chen et al., 2015; Deng et al., 2020).

In Austrian schools, an increasing number of primary school children learn German as a foreign language. Knowledge of German as a language of in-

struction and the gradual development of educational language competencies form the basis for participation in all educational processes and are thus a prerequisite for success at school.

To better support primary school children in learning German, we developed *derdieDAZ*, a game-based learning application, in cooperation with Austrian school teachers. We implemented three types of learning games that can be customized by teachers as needed. An important feature of our application is that the games do not require reading and writing skills, as the content can be provided with images and audio files. To increase the motivation of children, we implemented a reward system with both digital and real-world rewards that can also be customized by the teacher. The implemented reward system is based on an analysis of widely used learning applications and expert interviews. We successfully tested *derdieDAZ* in two primary schools in Austria.

The remainder of this paper is structured as follows. In Section 2, we present the research method we followed to develop the learning application. In Section 3, we discuss existing learning applications and the results of the interviews with teachers. In Section 4, we present *derdieDAZ* and first results from using it in two primary schools in Austria. We conclude the paper with an outlook on future work in Section 5.

^a  <https://orcid.org/0000-0002-8536-983X>

^b  <https://orcid.org/0000-0001-6143-8776>

^c  <https://orcid.org/0000-0003-0905-6791>

2 METHODOLOGY

We developed the learning application in cooperation with primary school teachers in Austria. In the first meeting, the basic requirements for *derdieDAZ* were discussed. The teachers stressed the importance of supporting different roles (administrators, teachers, and students) as well as support for customizing the learning games. Support for audio output was also regarded as important. The application was developed over one semester following an agile development process and the teachers provided constant feedback.

To integrate rewards into *derdieDAZ*, literature on gamification and reward systems was studied and two existing learning applications were analyzed. Two semi-structured interviews with experts were also conducted online and recorded with consent for the analysis. The first interview was conducted with a female expert in the field of teaching with digital media and the second interview was conducted with a female expert in the field of didactic and language acquisition for German as a second language. We asked our interviewees about their experience with game-based learning applications and how they have used these applications in their classes. We further asked them about the elements of game-based apps that they consider to be important and whether customization is an important feature. We also wanted to know what reward systems (digital and non-digital) they have used in their classes and whether these systems have increased the motivation of students. During the interviews, we showed them *derdieDAZ* and discussed how reward systems could be integrated into the app.

3 EXISTING APPLICATIONS AND EXPERT OPINIONS

In this section, we present the results of our analysis of two existing game-based learning applications, Anton¹ and Scoyo², and the two focus interviews we performed. We selected Anton and Scoyo for our analysis as they are the most popular learning applications in Austria and Germany.

3.1 Analysis of Existing Learning Applications

Anton. The learning application Anton is a web-based learning app that provides over 100,000 tasks

¹<https://anton.app/de/>

²<https://www.scoyo.de/>

and over 200 types of exercises, explanations, and learning games. The application is designed for the 1st to 10th grades and it thus covers all years of compulsory education. It includes learning games and rewards in the form of stars and trophies as well as matches the content to both the Austrian and the German school curricula. Teachers can create groups that represent school classes and students can be invited to join these groups. For each group, the teacher can define weekly learning packages. In Anton, users can choose among different types of avatars, which can be customized by selecting different types of clothes, colors, and body parts. As noted above, when students complete tasks, they receive feedback in the form of stars and trophies, which are colored depending on the correctness of the answers in the learning game. In addition to the stars and trophies, users are presented with an avatar that performs a dance. They also immediately receive textual and audio feedback about their performance in the game. Users receive coins for solving tasks. For every six stars or trophies, they receive a coin. Coins can be spent on various digital rewards. For example, Anton offers games without learning objectives that can be played by spending one coin. Additionally, coins can be spent on individualizing the avatar.

Scoyo. The web-based learning application Scoyo provides learning material for children from the 1st to 7th grades. In addition to school content, it offers extracurricular content such as traffic education. Teachers create accounts for students, assign students to classes, and provide them with tasks. Similar to Anton, Scoyo supports the customization of avatars. In Scoyo, coins are earned for each correctly answered question in a learning game. These coins can be used to buy items in the reward shop. There are digital rewards in the form of additional avatars; however, physical rewards such as key rings and cinema vouchers can also be purchased. Scoyo implements a level system where experience points can be collected for correctly answered questions, which correspond to levels. The app also gives immediate feedback to students after each question. Trophies can be earned for challenges, such as five correctly answered questions in a row. Scoyo offers students a printable page on which their achievements are displayed. Teachers and parents can receive statistics about the results of students.

Both applications include a reward system. They support digital rewards in the form of coins that can be spent for customizing avatars or, in case of Anton, for playing games. Scoyo also includes a shop with physical rewards. Both provide a user management, where teachers can create groups for their students.

3.2 Interview Results

Our interviewees had considerable experience in using learning applications. One used learning applications daily in her class. The primary school children had fun with them and for her - as a teacher - it was important that the digital devices were perceived as working rather than playing tools. However, she also noted that learning applications are not a complete substitute for lessons, only a supplement. The data from the learning applications were never made public and only published on a privately run class blog on which the relatives of the children (parents, grandparents, etc.) could see the results of the games. Creativity and individualization were considered to be very important aspects of learning applications. In particular it was always important to obtain children's feedback and show the results of their work to their families and teachers. The interviewees agreed that teachers need comprehensive statistics to monitor the work of their students.

Reward systems were used both for groups and for individuals. There was a mixture of rewards from the application itself and from the teacher. The prize for reaching the group goal was a special lesson outdoors (e.g. on the sports field). Individual rewards usually amounted to small gifts such as erasers and pencils. One interviewee emphasized that to be effective, rewards must be clearly defined as rewards from the teacher. When the goal is achieved, it must also be clearly communicated that this reward now celebrates the children's work accordingly. The experts emphasized, however, that positive feedback is a very strong motivation for children and, under certain circumstances, should be given priority over rewards in the above-mentioned form.

4 THE LEARNING APPLICATION *derdieDAZ*

In this section, we present the learning application *derdieDAZ*, which is a web-based learning platform designed for children in primary school with German as a second language. We first present how children are supported by the app and how teachers can customize the learning games. We also show how rewards have been integrated into *derdieDAZ* to increase the learning motivation of children.

4.1 Game-based Learning

The learning application *derdieDAZ* provides three types of games covering entry-level skills of the Ger-

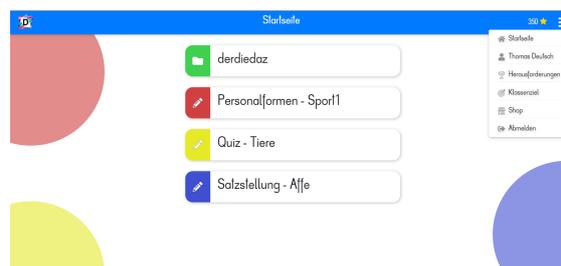


Figure 1: Main navigation screen for children.

man language: a quiz, a game for practicing personal pronouns, and a game for practicing the structure of sentences.

The application includes user management with three types of roles: administrators, teachers, and students. Each school using *derdieDAZ* has a dedicated administrator that can create teacher accounts. Teachers can create student accounts, with each student linked to one teacher. Teachers can create their own games to support their individual teaching methods. Additionally, a set of example games is provided by *derdieDAZ*.

In the next sections, we present how the different types of games support children in learning the German language and how teachers are supported in creating new games for their students.

4.1.1 Playing Games

One important challenge we face is that children in primary school can barely read during their first year in school. Our goal was thus to keep the navigation in the learning app as simple as possible, ideally without the need for reading skills to use the app. At least for the login and tasks that require skills beyond the children's capabilities, we assume that the children receive help from parents and teachers.

Figure 1 shows the screen presented to children after they login. The *derdieDAZ* folder at the top contains example games. The three blocks below represent the different types of learning games supported by *derdieDAZ*. The star on the top right is part of the rewards (see Section 4.2). The dropdown menu navigates users to their profile page and the reward shop.

Quiz. The first learning game *derdieDAZ* offers is the *Quiz* (see Figure 2). This game includes a question (in this example, "Which animal is this?"), an optional image to visualize or extend the question, and four possible answers ("a snake", "a cow", "a horse", and "a fox"), of which one is correct. The German articles of the nouns are visualized in different colors. Clicking on an answer selects and locks the student's choice. The student is then notified whether the answer is correct. If necessary, the student may switch

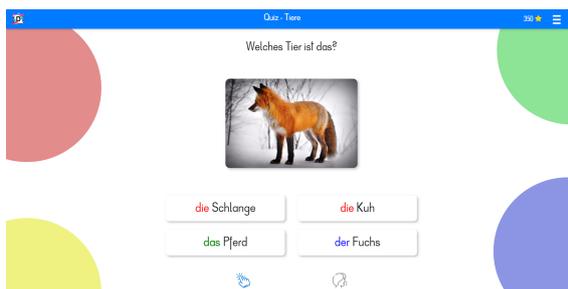


Figure 2: Learning game - Quiz.



Figure 4: Learning Game - Sentence Structure.



Figure 3: Learning Game - Personal Pronouns.



Figure 5: Creating a Learning Game - Quiz.

into audio mode by clicking on the bottom right button. In audio mode, clicking on an answer, question, or image plays the audio file provided by the teacher. Typically, the student hears the teacher’s voice reading the words and phrases. The goal of the Quiz is to help children build their basic German vocabulary. It can also be used to repeat other primary school subjects such as geography and biology.

Personal Pronouns. To help students learn conjugations of verbs, *derdieDAZ* provides a dedicated game (Figure 3 shows the conjugations of the verb “run”). In this game, students are asked to move the words in the third column to the appropriate place in the second column. Once completed, students can review their answer by clicking on the bottom middle button. Correctly placed words are colored in green and incorrectly placed words in red. The student can only move forward to the next question once all the words are in the correct order. Similar to the Quiz game, students can listen to the audio files provided by the teacher.

Sentence Structures. The third game provided by *derdieDAZ* helps children learn the correct sentence structures in the German language. In this game, students must reorder a twisted sentence (in the example of Figure 4, “the monkey”, “plays”, “the guitar”). Like in the other games, students can review their answer by clicking on the bottom middle button. Correctly placed words are colored in green and incorrectly placed words in red. Similar to the Personal Pronouns game, students can only advance to the next question once the sentence is correct. Additionally,

listening to provided audio files is again possible.

4.1.2 Creating Games

In this section, we describe how teachers can customize *derdieDAZ* by creating learning games for their students. Consequently, this part focuses primarily on the teacher’s perspective for arranging and providing content.

Teachers can create, edit, or delete games; students, however, can only play the games that their teacher has created. As some students may lack the necessary reading skills and therefore face challenges navigating through *derdieDAZ*, teachers can generate a direct link to each game or folder.

The general process of creating games is similarly designed for the three implemented game types. Figure 5 shows the teacher’s perspective for creating one task within a quiz game. The teacher is required to fill in the empty text boxes and optionally upload a picture or provide a link to it. For the quiz, the teacher aims to enter the correct answer in the green bordered box. The button with the colored circle enables or disables the article coloring in the task. Tool tips are presented to explain the additional settings within each game type. For all game types, *derdieDAZ* provides the possibility to record audio files for text and images.

4.2 Rewards

The application *derdieDAZ* is designed to motivate students in their learning activities through various

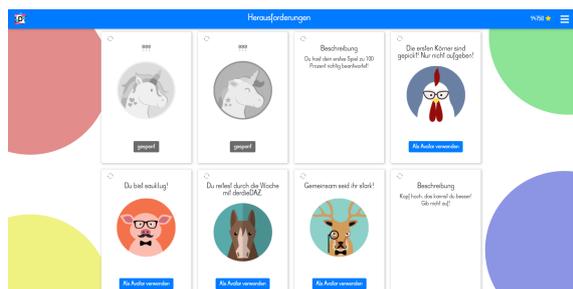


Figure 6: Individualization - Unlocking Avatars.

mechanisms. The analysis of the two existing learning applications and interviews suggest that individualization help motivate studying. Thus, *derdieDAZ* offers a range of avatars from which students and teachers can choose. Additional avatars can be unlocked by completing predefined challenges. Completing tasks in addition to regular learning/playing rewards students with points. These points contribute to both the class-wide goal defined by the teacher, and individual points that can be spent in the reward shop.

4.2.1 Individualization and Challenges

derdieDAZ provides individualization in the form of avatars. This allows users to personalize the user account and therefore increases the identification of students with their digital representation. This is further enhanced by the possibility of unlocking new avatars by completing special tasks (e.g., "complete a game without any incorrect answers", "play five days in a row"). Avatars that can be unlocked are presented in Figure 6. Locked avatars are colored in gray. By clicking on one of the cards, the user is presented with the necessary steps to unlock this avatar.

4.2.2 Points and Shop

Students in *derdieDAZ* receive points for playing games as well as for playing several days in a row. The points earned by completing one game are calculated based on the performance of the student. This prevents students from simply clicking through the games to quickly earn points. Teachers define the maximum amount of points that can be earned in a game.

These points are used as currency in the shop (see Figure 7). The items available in the shop are defined by the teacher. In the default setting, the shop only includes a downloadable homework voucher, allowing students to skip one piece of homework of their choice. The teacher defines the price of the voucher and decides whether students are allowed to buy them. The teachers receive a list of the purchases their students have made and are responsible for handing out

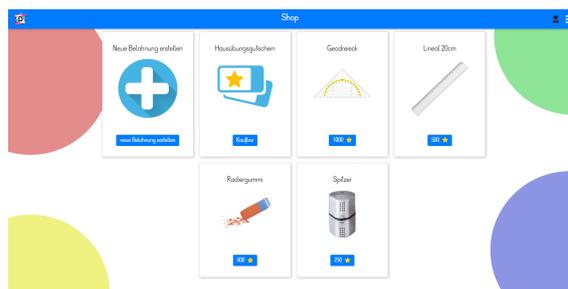


Figure 7: Shop - Teacher's perspective.



Figure 8: Class goal - Teacher's perspective.

the rewards. Rewards can only be bought again by students, if their teacher resets the reward for them.

4.2.3 Class Goal

To offer further motivation, *derdieDAZ* provides teachers and their students with the option of defining a class goal. All the acquired points are then double-counted: once for each student and once as a contribution to the class goal. Figure 8 shows an example of a completed class goal (e.g., "one outdoor lesson"). On this page, the progress of the class can be monitored and if the goal is accomplished, confetti covers the screen. Similar to the other aspects of the application, the teacher can fully customize the reward as well as the threshold and progress of the class.

4.3 Application in an Austrian School

derdieDAZ was continuously evaluated in two primary schools in Austria during the development process. The application was implemented in an agile way and thus feedback from teachers and students was constantly incorporated. It received mostly positive feedback from students; they had fun during the learning process and could navigate the application intuitively. Teachers generally liked *derdieDAZ*; however, they reported that it was time-consuming to prepare games with various difficulty levels for their classes. Therefore, teachers pushed the idea of predefined games that can be shared among teachers. In the

future, we plan to extend *derdieDAZ* by incorporating a community feature in which teachers can share the games they have developed.

5 CONCLUSIONS

The game-based learning application *derdieDAZ* helps primary school students with German as a second language improve their reading and writing skills using three game types. First, the quiz, a standard "pick the right answer out of four" game, aims to improve basic German vocabulary. The second, the pronouns game, helps students conjugate verbs correctly. Lastly, we provide a game to enhance sentence structuring skills.

The main input for the development of *derdieDAZ* came from teachers, the literature, the expert interviews, and an analysis of successful learning applications in the German market. After the first version of the application has been successfully tested in Austrian primary schools, gamification elements were added in a follow up project. The goal of this project was to enhance the learning motivation of students by supporting individualization, class goals, and a shop with rewards.

We have not yet evaluated the reward system of *derdieDAZ* in primary schools. However, the feedback we received from teachers during a demonstration was very positive. An evaluation in primary schools together with teachers and students is part of our future work.

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