Learning Analytics and Spelling Acquisition in German - A First Prototype

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Abstract. Data-driven learning in combination with emerging academic areas such as Learning Analytics (LA) has the potential to tailor students' education to their needs [1]. The aim of this article is to present a web-based training platform for primary school pupils who struggle with the acquisition of German orthography. Our objective is the improvement in their writing and spelling competences. The focus of this article is on the development of the platform and the details concerning the requirements and the design of the User Interface (UI). In combination with Learning Analytics, the platform is expected to provide deeper insight into the process of spelling acquisition. Furthermore, aspects of Learning Analytics will help to develop the platform, to improve the exercises and to provide better materials in the long run.

Keywords: German orthography · Technology-enhanced learning · Learning analytics · Educational media

1 Introduction

This article introduces the workflow and the interface design of a prototype development in the field of German orthography with a strong approach on LA. The platform, IDERBLOG[1], which is described in Sect. 3, aims to solve this issue by combining Technology Enhanced Learning (TEL) and LA with the acquisition of German orthography [2, 3]. The platform, which will be released in the course of 2016, will serve as a motivating innovation for children to acquire German orthography more easily. Teachers and researchers will benefit from the application which supports their decision-making process by providing them with possible educational interventions [3, 4].

The platform is based on Learning Analytics. The amount of data produced in the field of education is used by various kinds of institutions worldwide [5]. This kind of interaction leaves traces behind so that the learners' behavior can be analyzed [6].

[1] Platform IDERBLOG, available online: http://iderblog.eu/ (German language only, last visited December 7, 2015).

P. Zaphiris and A. Ioannou (Eds.): LCT 2016, LNCS 9753, pp. 405–416, 2016.
DOI: 10.1007/978-3-319-39483-1_37

The students' interactions with the learning platform are captured for analysis as well in order to gain further understanding, knowledge and insights about a learners' learning process [7]. This information can then be used for early detection of learning issues and enables teachers to actively intervene [8, 28]. The platform IDERBLOG will use this information in order to enhance the acquisition of German orthography, since problems in the field of German orthography affect primary school pupils' as well as university students' in everyday life situations [2].

1.1 Outline

The next section gives a short overview of the German orthography as well as LA. The subsequent sections are concerned with the planned workflow of the platform development, its prospects for self-learning and the process of interface designing. The last section will focus on the outlook and benefits of the platform.

2 Related Work

2.1 German Orthography

As the German orthography uses an alphabetic writing system, it is characterized by the fact that the phonemic structure of spoken language is mirrored in written language [9]. This leads to the assumption that words are spelled as they sound. Although the German orthography is much more transparent than the English one, where "the alphabet contains just 26 letters [which] correspond to 44 phonemes associated with 102 functional spelling units" [10], it is not as transparent as, for example, the Turkish one. The reason for unreliable correspondences lies in the missing 1:1 phoneme-grapheme-correspondences of the phonological principle, which is often caused by interfering principles of the semantic principle [2]. In contrast to the overall opinion, the majority of correct spellings can be systematically explained.

The co-existence of these principles has a huge impact on spelling instruction and acquisition [2]. One problem is, that the German orthography is often not taught systematically due to the missing knowledge of the orthographic system and its theoretical foundation. Consequently, many students experience spelling instructions as boring and formal, despite the fact that correct spelling is considered rather prestigious within the German-speaking world [11]. "In contrast to other areas of language learning, there is hardly space to argue about the correct or incorrect spelling of a word. This orthographical stiffness can probably serve as an explanation for its importance" [2]. Spelling competence is often reduced to a person´s knowledge of the correct spelling of given words and the rules of orthography. However, it is important to understand that it includes also being sensitive to misspelled words, knowing how to correct them, using spelling aids and applying strategies to prevent spelling errors in the long run [2, 13]. The consideration of this definition of spelling competence is fundamental for the applied approach in the project IDERBLOG.

2.2 Learning Analytics (LA)

LA focuses on "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" [31]. According to Campbell et al. [16], an analysis process has five steps: capture, report, predict, act and refine. Clow [17] used these five steps as a basis for his iterative learning analytics cycle which states that the loop should be closed. Khalil and Ebner [7] added stakeholders to the cycle according to their visions and missions. In addition, they spot the light on some of the ethical issues of LA and proposed an anonymization framework to preserve privacy of students [32]. The learners' data have to be processed in a specific mode in order to conduct scientific analysis and in order to support teachers and students with the adaption of their teaching and learning approach [26]. As a part of the previous frameworks, an adequate visualization has to be applied to present the feedback as simple and informative as possible to the stakeholders [14, 15]. Furthermore, analytical approaches to model a learner's profile based on their answering behavior and the analysis of different error types can lead to findings that help to enhance the whole learning process [18, 19].

3 The Platform

3.1 The Concept

The platform IDERBLOG tries to combine the development of writing skills, the acquisition of orthographic competence and the use of modern means of communication and digital instruments [2]. The aim is not to replace handwriting with the keyboard, but rather take advantage of the digital age: On the one hand, a text written on the platform can be published on a blog. Thereby, the platform is "providing relevant reasons and audiences for writing" [20]. On the other hand, the text is first analyzed automatically regarding spelling mistakes based on Learning Analytics and can consequently be edited several times. It is expected that the motivation to formulate a text and to revise it many times with the prospect of publishing it, is higher compared to typical essay writing in a classroom [2].

The analysis is conducted by the core of the platform, the *intelligent dictionary*, which also serves as the basis for training orthographic skills. By this, the children should be encouraged to reflect and think about the language to become aware of the structure of words [24]. It categorizes mistakes in order to offer specific feedback and hints for correcting the misspelled word. Based on the mistakes it also provides a qualitative analysis of orthographic problems for teachers. Additionally, these categories of mistakes are connected with a number of exercises in a training database [2].

The platform for the project is currently under development and not available for public presentation yet (rollout in 2016). However, the planned workflow and the general concept to ensure good age-appropriate usability and interface design [3] will be described briefly in the following sections.

3.2 Intelligent Dictionary and Feedback

The main idea behind the *intelligent dictionary* is that in case of a spelling mistake hints for corrections are provided. This stands in contrast to conventional autocorrection systems, which only give the information that something is wrong and/or immediately provide the correct word. The intelligent feedback system is based on the findings, that it is important to offer exercises and hints that allow the autonomous correction in a motivating context, in order to acquire correct spelling [30]. Therefore, the hint for correcting a mistake is given by a feedback that is formulated in a way that the learner has to think about the spelling [2].

For example, due to the morphological principle of the German orthography a word/morpheme is always spelled in the same way. Because of the phenomenon of terminal devoicing, there is a difference in the pronunciation, depending on the position of the obstruent (e.g. the written <g> is pronounced devoiced in /tak/ 'day' because it is at the end of the word, but voiced in /tage/ 'days' because it is at the beginning of the syllable). Therefore, children often spell /tak/ due to the phoneme-grapheme-correspondences incorrectly <*Tak> instead of <Tag>. In case these kinds of mistakes happen, the *intelligent dictionary* gives feedback that encourages the pupil to contemplate on a longer form of this word in order to decide which letter is the correct one.

The different categories for mistakes in the *intelligent dictionary* are based on the theory of German orthography e.g. [12]. Furthermore, various approaches as well as requirements for qualitative analysis of misspellings are considered [2, 29].

For teachers and parents, the platform will offer overall feedback of the student's performance. In combination with LA we plan to: (a) make in-depth analysis [26] of occurred misspellings for better understanding of the process of spelling acquisition; (b) predict the performance of students; (c) make recommendations for personalized exercises; (d) offer a reflection about recommended exercises and changing performance in the student's spelling acquisition; (e) benchmark possible weak points of the platform.

3.3 General Workflow for Text Creation and Correction

The students, as shown in Fig. 1, can write their texts on the provided platform (1). First, the text will be analyzed orthographically by the *intelligent dictionary* (2) [2]. Proper feedback, based on the error type and category, will be provided to the students. Then they have the choice to either try to correct the text (3) or submit directly (4). This intermediate step encourages pupils to correct misspelled words independently and self-reflexively [21]. After submission, the teacher gets a notification (5) and inspects the text for further correction and/or improvements as well as personal notes for the student (6). The result is then delivered back to the students for inspection (7). After this step, the text may be published in the provided class blog (8). Based on the recommendations made by the system, the student can choose between different exercises (9) and/or take the exercises suggested by the teacher (10).

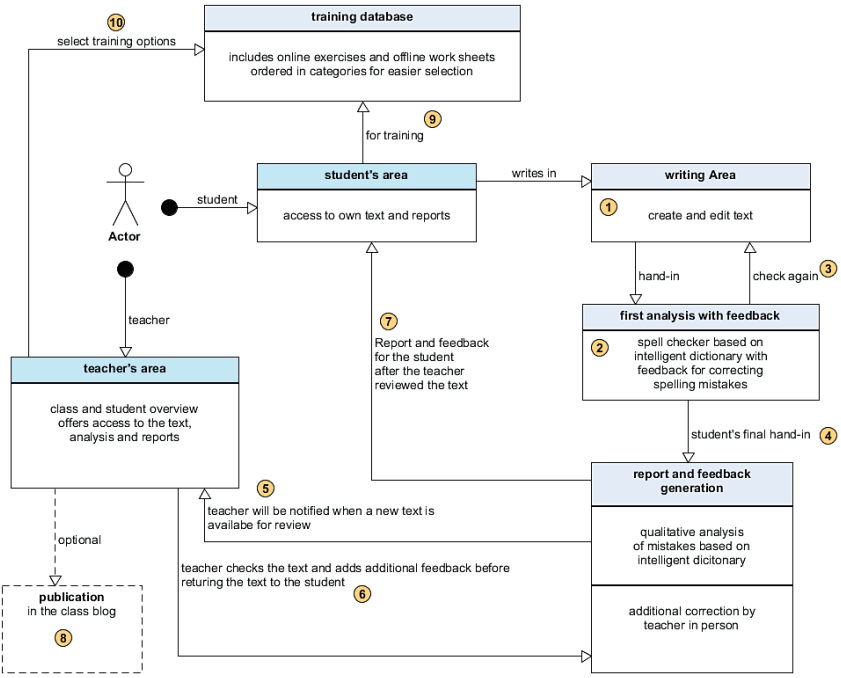

Fig. 1. General workflow of the text creation and correction [2]

3.4 Student's Workflow

Figure 2 shows the detailed workflow of a student. After the Login an overview over all submitted texts will be provided with the feedback given by the teacher as well as further information and hints for possible self-study exercises, provided by the training database. The process of text creation is outlined in Fig. 2 as well. The process is designed to be as simple as possible in order to ensure an easy usability and can be directly started with one click after the Login.

3.5 Teacher's Workflow

Figure 3 shows the workflow of the teacher. In order to offer schools, classes and students an easy registration a separate usermanager is provided. The system also allows the administration of the classes. In case a student loses his/her password it can be easily reset. The teacher area gives an overview over all texts of the classes in which the teacher is active. A separate area will inform the teacher if there are new texts available for correction. An overview of occurred mistakes and suggested exercises will be provided for the class as well as for the individual student. This information can then be used for early detection of learning issues and enables teachers to undertake a proper intervention [8, 28].

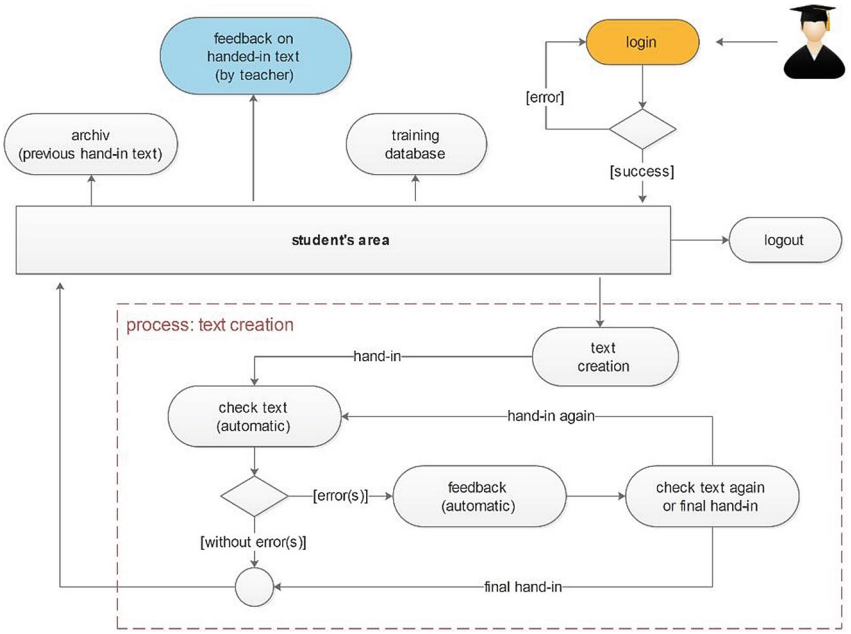

Fig. 2. Student's workflow

If there is a new text available, the teacher can further inspect the text and correct it if necessary. Additionally, errors which may not have been detected and categorized by the *intelligent dictionary* can be categorized. This ensures a qualitative analysis of all misspelled words of a given text by the teacher. Consequently, the system will recognize and categorize the error correctly in future submissions.

3.6 Training Database

A training database is provided by the platform. It contains selected existing online and offline exercises (currently 260). Online exercises that are exclusively developed for the project will also be added. The preselection of exercises helps teachers to support students with the improvement of the performance in problematic/challenging areas identified by LA. For a better overview, these exercises and worksheets are congruently ordered in categories and sub-categories of spelling mistakes [2]. All exercise types are available to teachers and students for free [25].

4 Interface Design

The platform is designed for primary school children, aged 8 to 12. The focus lies on a graphically appealing and age-appropriate web interface [22]. As suggested in the NMC Horizon Report [1], we reviewed the possibility to include the pupils as

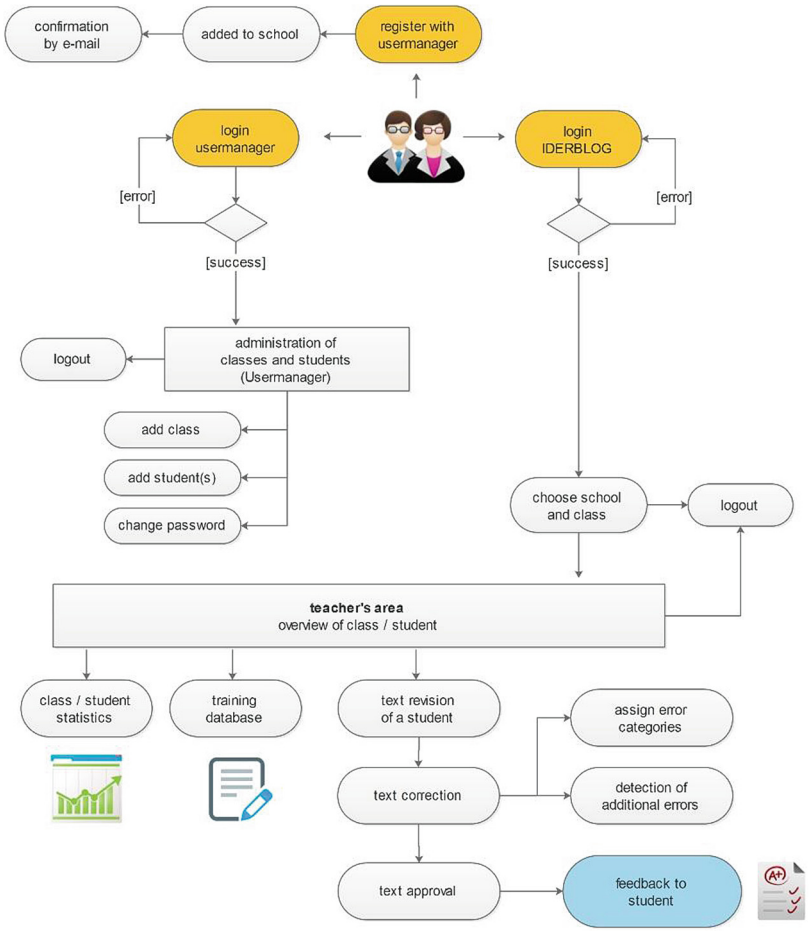

Fig. 3. Teacher's workflow

co-designers in the process. A graphic designer created drafts and color schemes for the project that have been examined and rated by students from different schools and classes. The favored design by the majority has then been developed further and integrated into the platform. The process is shown in Fig. 4.

To guarantee easy usability of the platform, we had to ensure that the students can reach the most important parts of the platform in less than five clicks. This convenient accessibility in combination with attractive figures should ensure high motivation in fulfilling the task of writing texts. In ongoing usability tests [23] we continue to improve the concept step by step [2].

In the next subsections, interesting areas are presented in form of mockups with a brief description.

Fig. 4. Figure creation: first prototypes (left) and final figures on the webpage (right)

4.1 Student's Writing Area

After the login, the student may start the writing process, as described in Fig. 2, with one click. Figure 5 shows the first review stage with information concerning wrong written words (in this case two). Further information on how to handle this error will be displayed by clicking on the marked word. With this information, it should be possible for the student to correct the word and submit the text for another check, if necessary. This intermediate step facilitates independent and self-reflexive corrections among pupils [21].

Fig. 5. Student's writing area

Fig. 6. Teacher's correction area

4.2 Teacher's Correction Area

After the students' final submission, the teacher will be informed about it. She or he has then the possibility to review the different steps of contributions by the student (if there has been more than one) in order to examine the independent correction abilities. Furthermore, as shown in Fig. 6, the teacher is able to correct the text, give notes and make it ready for the publication in the blog. Additionally, errors which may not have been detected and categorized by the *intelligent dictionary* can be categorized in this step. Once the teacher has finished the review, the student will be informed and can inspect the text and take further actions, e.g. look into online courses or exercises recommended by either the teacher or the system to improve her or his own abilities in writing.

5 Outlook

This article introduces a platform for children aged 8 to 12 with the goal to motivate them to improve their spelling skills via writing and publishing texts in a blog. During the text creation process, students benefit from automatic feedback provided by the *intelligent dictionary*. This feedback is based on categories with age-appropriate responses for mistakes. Furthermore, the platform provides a qualitative analysis for the teacher, who can use the results to help pupils with the improvement of word spelling. A training database provides teachers and students with proper exercises for supervised

and unsupervised learning. LA is used for in-depth analysis [26] of the occurred misspellings and will help to understand the process of spelling acquisition in detail. The results and an overview of possible systematically made mistakes will be presented to students, teachers and parents in an appropriate way. This allows the measurement of a student's performance in the long run [27]. It is expected that this unique combination in one platform has a positive impact on didactic approaches, education and science [2].

Acknowledgements. This research project is supported by the European Commission Erasmus+ program in the framework of the project IDERBLOG. For more information about the project IDERBLOG and its project partners: Hugo Adolph[2], Christian Aspalter[3], Susanne Biermeier[4], Sandra Ernst[5], Sonja Gabriel[6], Gabriele Goor (See footnote 5), Michael Gros (See footnote 2), Mike Cormann (See footnote 5), Anneliese Huppertz (See footnote 5), Kathrin Irma (See footnote 4), Susanne Martich (See footnote 3), Nina Steinhauer (See footnote 2), Behnam Taraghi[7] and Marianne Ullmann (See footnote 3), please visit our homepage http://iderblog.eu/ (German language only).

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