DESIGNING A GAMIFIED WEB APPLICATION FOR TRAINING ACADEMIC READING SKILLS

Ella Dovhaniuk and Tobias Thelen
Osnabrück University, Germany

ABSTRACT

In this paper, we present didactical, technical, and interaction design aspects of a learning environment for training academic text reading skills in higher education that is currently being developed. The concept is built on experience gained from a gamified learning environment for academic abilities in the domain of German orthography standards. It uses spaced repetition for skill training instead of just memorizing facts and maintains user models that allow for adaptive task selection using expert-designed skill lists and task-skill allocations. Gamification components such as levels and ranks have been incorporated to boost motivation. Only 19% of users (n=121) ceased using the application when they reached the minimum obligatory goal in homework assignments, indicating that the motivational effects work for the target group. The foundation for transferring these experiences to a new domain is laid by analyzing academic reading skills and competencies to be trained. In the design phase, task categories, interface mockups, and gamification mechanisms for the envisioned web application have been sketched, and it will now be implemented as an open-source application.

KEYWORDS

Academic Skills, Gamification, Higher Education

1. INTRODUCTION

In times of excessive growth of information flow, reading is one of the means of learning in the case of the correct psychological and pedagogical approach, as it is estimated that eighty to eighty-five percent of our perception, learning, cognition, and activities are mediated through vision (Ripley et al. 2010). According to the advisory group of the Programme for International Student Assessment, reading literacy is defined as understanding, using, and reflecting on written texts in order to achieve one's goals, develop one's knowledge, and participate in society (OECD 2003). Reading literacy plays an important role among the fundamental academic competencies propagating knowledge for the current information society.

In higher education, skills have to be trained intensively up to a certain level of mastery. These skills include subject-specific skills but also subject-independent skills like the confident use of scientific language and the ability to read academic texts. Often, these skills are addressed in introductory courses, but further development happens implicitly in the further course of study. For students struggling with these skills, long-term and motivating training opportunities might be helpful.

For efficient memorization and repetitive learning, spaced repetition techniques are often applied, either in analog settings such as the "Leitner System" for flashcards (Leitner 1974) or various digital adaptations (Settles & Meeder 2016). Implementations of spaced repetition keep track of the last time a user has been presented a task and the mastery level shown for that task. Tasks with lower mastery levels will be repeated earlier and thus presented more often than tasks with higher levels. For motivation, gamification is a well-known concept of using design elements from games in non-game contexts. It has successfully been used in many different higher education contexts and is usually considered as an additional element in educational settings that are supposed to increase motivation and lead to more prolonged and more intensive engagement with tasks (for an overview, cf. Wiggins 2016). Typical gamification elements are level systems that make progress perceptible and rewards like badges or titles that act as externally motivating goals.

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2. EXPERIENCE WITH GAMIFIED ACADEMIC SKILLS TRAINING

The system we are designing for improving academic reading skills follows a model that has already been successfully applied to an academic training scenario. Prospective teachers of German were given a tool to practice the German comma rules coded in the official orthography rules (Rat für Rechtscheibung 2018). This "Kommatrainig" application comprises spaced repetition and gamification elements and has been used by over 2,600 students. It is based on subject-specific skills corresponding to the official rules and subrules, resulting in 30 different skills/rules. Subject experts from teacher education and German linguistics have grouped these skills into a linear order of increasing complexity within each category. As a result, each level (see below) corresponds to one official rule, and as the rules are ordered in increasing difficulty, the levels are also assumed to have increasing difficulty in a general, non-individual way. A comma task always includes a German sentence and requests the user to either set the commas in a sentence, correct a sentence with some commas already set, or select the proper rule for a fixed comma. To be usable for training, sentences have to be labeled with rules for comma positions. Every sentence can have multiple labels corresponding to multiple rules (figure 1).

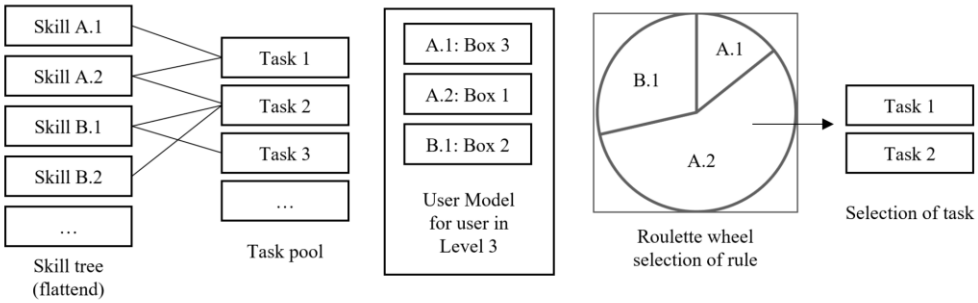

Figure 1. Skills (rules) and tasks as the basis for rule and task selection

The rules are introduced and activated one after another, so the user starts with only one rule and practices it until tasks for that rule have been solved correctly sufficiently often. For introducing a new rule, the last one has to meet two conditions: At least four tasks concerning that rule have been presented, and the majority of tasks for that rule have been solved correctly. For each user, a list of rule proficiency levels is maintained that puts each skill in a box corresponding to Leitner boxes. When selecting the next task to present to the user, first a skill is selected in a roulette wheel selection that assigns higher probabilities to boxes with lower numbers. When applied correctly in tasks, rules start in low boxes and end up in higher boxes. For the selected rule, the concrete task to present is then selected from all tasks for the rule that do not require skills not introduced yet (see user model, roulette wheel selection, and task selection in figure 1).

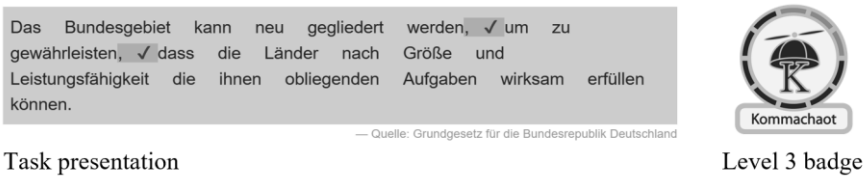

Figure 2. Task presentation and level badge: Here, the user had to set proper commas in a German sentence and now received positive feedback indicating that both comma positions were correct

Tasks are presented in an interactive environment where users can set and erase commas or choose rules from a selection list. After submitting their solution, feedback indicating correct positions and explaining errors is given (see task presentation in figure 2). Simultaneously, the user model is updated, and, if appropriate, new rules are introduced. The rule introduction is associated with the main gamification element used in the "Kommatraining," the level system. Each rule corresponds to a level, so level 30 is the highest level to reach when mastering all 30 rules. Every ten levels, a new rank is reached, beginning with "Kommachaot" ("comma slob") and ending as "comma king" (level 21 and higher). Thus, a level represents the most challenging rule the user has been presented with. A higher level will only be reached when

mastering enough tasks involving that rule, i.e., at least four tasks with at least 75% correct solutions. This approach has been chosen to motivate users to not only practice rules they already know but also to feel rewarded when a new, more challenging rule is introduced. The application also uses other gamification elements that are not specific game design elements but are often used in games to increase motivation. These include immediate feedback, a high pace of tasks, a lack of long explanations, and the introduction of the environment as part of the game. Tasks presented to the user can be solved in a very short time, usually less than 30 seconds, and immediately afterward, feedback is provided. Users can have a detailed look at error explanations but don't have to. The first task is presented just two clicks after starting the games, and instructions are if needed, but never block the user experience. The three task types are not introduced simultaneously. The first two levels only give comma-setting tasks, then comma-correcting tasks, and eventually, comma-explaining tasks are introduced. This gives the users time to adapt to both the task types and the increasing complexity of rules.

There is evidence that the gamification elements succeed in creating a high motivation for using the environment. The "Kommatraining" has been used in three linguistics classes for students training to be teachers of German as mandatory homework. To pass the homework, students had to reach the "comma king" rank (level 21). Of n=121 students, only 19% stopped after getting to that level. 46% of the students even continued until they reached the highest level.

3. ACADEMIC READING SKILLS AND COMPETENCES

The general skills of working with text include the ability to predict the content of the text by title, keywords, fragments of text, illustrations, and other non-textual elements that accompany the text; the ability to make simple and complex plans of the text; the ability to present its content (concise, complete, selective); the ability to understand in detail lengthy, complex texts, whether or not they relate to one's own area of speciality, provided he/she can reread difficult sections; the ability to comprehend and critically interpret virtually all forms of written language, including abstract, structurally complex, or highly colloquial literary and non-literary writings; the ability to comprehend a wide range of long and complex texts, appreciating subtle differences in style and implicit as well as explicit meaning; ability to practically distinguish literary and scientific-cognitive texts; the ability to understand the "task" of the work, i.e. to find out to whom it is addressed and for what purpose; the ability to determine the idea of the text, establish the sequence of actions in the text and comprehend the relationships between the events described in it; and determine the author's and own attitude to the presented information.

The formation of reading skills and competences involves the ability to read an unfamiliar text at the appropriate speed and, after one reading, to understand the actual content and structure of the text; divide the text into parts; establish cause-and-effect relationships between sentences and paragraphs; the ability to highlight the main points and details; determine the theme and main idea of the text; choose titles for the text and its parts, etc. Our aim is to gain the appropriate level of reading competences including the ability to use reading as a means of acquiring new knowledge for further study, and the ability to read texts of different genres in different situations, which may also use various forms of information presented (charts, figures, tables, graphs, and diagrams). To help students develop and improve their skills and competences, we offer a set of tasks such as filling in the gaps, matching headings, punctuating a text, sequencing, using linking words, comprehension questions, matching features, matching paragraphs, paragraph completion, text completion, etc. All tasks are tailor-made according to the proficiency levels B1-C1.

We intend to expose students to different types of texts and build their capacity to comprehend the wide range of reading material they will encounter during their studies. To achieve this, we (1) select texts of multiple genres and high quality; (2) ensure that a chosen text contains appropriate vocabulary and has a relevant level of complexity; and (3) align the tasks with the claimed competences. We get articles for appropriate-length, academic-level readings from a variety of sources, including but not limited to those found in academic research databases. Before assigning each reading, we pass it through the text analyzer to check if it contains vocabulary from the Key Academic Word List. Thus, we enable students to master their skills to work independently and productively with the help of our application.

Additionally, we create tasks to work on specific grammar concepts that students struggle with the most (the topics were carefully selected together with the teachers from the linguistic center of the university based on the analysis of the students' tests and written assignments as well as studying research in the field of teaching academic English). We also provide extra activities in various formats that will aid students in expanding their vocabulary and solidifying the lexical units most frequently encountered in academic texts.

4. SKETCH OF THE APPLICATION

The application is currently being developed after the design phase has been concluded. The two main user experience approaches taken are motivation and consistency. For the motivation part, the adaptive learning environment is designed to use mechanisms that have proven effective in higher education scenarios as part of the "Kommatraining". It addresses consistency by using additional elements for rewarding constant everyday use and by stressing out long-term learning success. In the beginning, the application will only cover general aspects of academic texts, but by its concepts, it can easily be extended to cover subject-specific aspects as well. We will use a simple, yet versatile task type: each task presents a paragraph of academic text and prompts the user with one or very few questions about this text (see figure 3). After finishing the reading assignment, students are then given the opportunity to complete a grammar exercise on one of the carefully selected topics. Typically, grammar tasks are organized according to complexity level and taken directly from the text. The learner has the opportunity to choose an extension section after completing this assignment, where additional tasks are offered to practice the specified grammar structure.

As an example, tasks for practicing the use of the passive voice can be in the first level of complexity and in the third one, and if a certain number of tasks of an easier level are successfully completed, the student will be redirected to a more complex level. The grammar tasks contain keywords that connect related tasks on the same grammar topic from various levels. Also, using our application, students have the opportunity to master up to 1,000 lexical units, which are the most important and valuable for academic English. Working with the context increases chances of understanding new vocabulary because it enables students to infer the meaning of numerous words. Regular repetition of lexical units is one of the key strategies for learning vocabulary. If a student has not yet memorized a new word, it should be repeated as frequently as possible so that they have the chance to do so. In our application, this vocabulary practice is scheduled on a regular basis, and students deal with a significant academic vocabulary word list that has been carefully chosen and recurs frequently in contexts and tasks that aid in its memorization.

Sticking to one single general type of task allows for a simple user interface and a gentle start to learning. The variety of question types and the variety of different skills and competences addressed maintains tension during use.

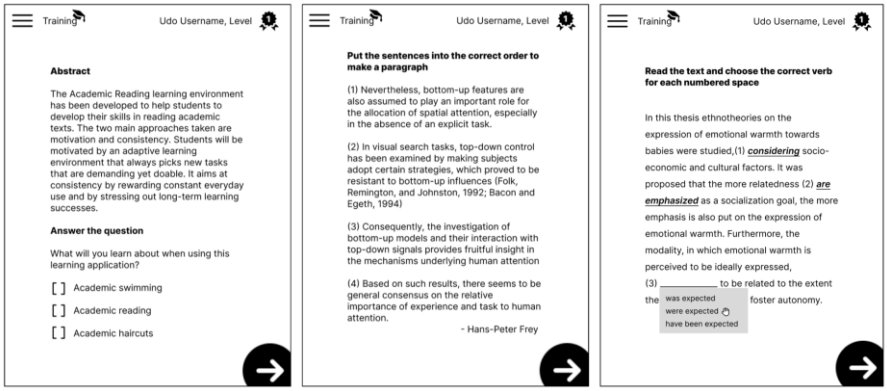

Figure 3. Screen mockup designs of task types and the user interface

Motivation should be increased by a level system like in the "Kommatraining" and various feedback elements. All choices are commented on, especially mistakes, as they bring up a short explanation of why they were wrong. The student can view the original text, verify that the response is accurate, and, if necessary, obtain more information (links to online dictionaries, grammar guides, and methodological

instructions are accessible) (optional). Gamification elements like points, usage streaks, and achievements will give users a good sense of their progress and always present goals that can be reached with a bit of extra effort. Being an academic tool, the program will not try to hide these mechanisms from the user but will explain them openly. Users will have the choice to activate or deactivate many of these elements.

5. CONCLUSION

We have presented design considerations of an application for training academic reading skills. The implementation is currently work in progress and will involve students to develop a wide variety of engaging tasks. We assume that by using concepts from spaced repetition learning and gamification elements, the app encourages students to use it as an everyday companion to practice reading academic texts in frequent but short episodes. The key challenge will be to provide a rich pool of tasks covering all the necessary skills, balance the parameters for skill repetition, gain rewards, provide incentives and maintain user interest in the app. We expect the learning environment to be an interesting addition to introductory courses in academic reading and writing and will actively seek cooperation with teachers and students to evaluate its usefulness. Future directions of development include transferring the app to other languages, widening the scope for more non-linguistic aspects of critically reading academic texts, or the inclusion of academic writing tasks. The application and the tasks will use open-access texts only and will be released under an open-source license.

Thus, the proposed approach to the organization of teaching academic reading using the application not only upholds the long-standing customs of teaching foreign languages through technological means but also expands them by making use of essentially new prospects. Experience with the suggested instructional tools has demonstrated their viability and efficacy in contemporary, realizable educational practice. A successful user experience is facilitated by the use of independent and gamified activities which is crucial for the successful acquisition of a foreign language.

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