Show me the numbers! - Student-facing Interventions in Adaptive Learning Environments for German Spelling

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Abstract: Our work presents the result of an experiment conducted on an online platform for the acquisition of German spelling skills. We compared the traditional online learning platform to three different adaptive versions of the platform that implement machine learning-based student-facing interventions that show the personalized solution probability. We evaluate the different interventions with regards to the error rate, the number of early dropouts, and the users’ competency. Our results show that the number of mistakes decreased in comparison to the control group. Additionally, an increasing number of dropouts was found. We did not find any significant effects on the users’ competency. We conclude that student-facing adaptive learning environments are effective in improving a person’s error rate and should be chosen wisely to have a motivating impact.

Keywords: Adaptive Learning, Adaptive Intervention, Learning Analytics.

1 A Large Scale Online-Controlled Experiment

Since adaptive learning comes in many shapes and sizes, it is crucial to find out which adaptations can be meaningful for which areas of learning. One possibility to implement an intervention in an adaptive learning environment may be to show the student his or her performance data [WL18]. In their review, Bodily and Verbert review student-facing learning analytics reporting systems, that directly show students’ performance data [BV17]. In their review, they found 14 articles that measured the effects of student-facing reports on student achievements. Of these, eight articles showed significant improvement in student achievements while five had no significant results.

In this contribution, we specifically investigate adaptive learning interventions for acquisition of spelling skills in German. For this purpose, we transformed a learning platform (Orthografietrainer.net) into an adaptive learning platform and implemented a machine learning-based prediction model on which the interventions are based. Our interventions are all student-facing interventions, i.e., information is displayed to the user in the user interface. The online-controlled experiment was carried out from the 21st of June to the 31st of October in 2022. During this time, all users in the student user group who performed

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capitalization tasks were randomly assigned to the control group or one of three intervention groups. All three intervention groups adapt to the user based on the prediction of the users’ performance. The experiment was pre-registered at the OSF and its setup is extensively described in [Rz22]. A more detailed version can be found online. In total, 8,121 users took part in the experiment answering 687,386 exercise sentences. We compared the control group to three intervention groups and calculate the error rate, number of dropouts and user competency. Interventions 1 and 2 are student-facing interventions where users are shown their prediction results. In Intervention 1, the prediction result is shown verbally, in intervention 2 it is shown as a percentage. Intervention 3 does not show the prediction results. Instead, for users whose prediction result is below 50%, the suitable spelling rule is displayed.

2 Results & Conclusion

Our results showed that all three interventions led to a decreasing error rate for the users in comparison to the control group. Here, interventions 1 and 2 result in an effect size of 0.11 and 0.12, while intervention 3 produces an effect size of 0.09 and is therefore negligible. An analysis of the number of dropouts showed significantly higher dropouts in comparison to the control group in all intervention groups, however, the effect sizes are negligible. The calculation of the users’ competencies with the Rasch model did not show significant results. In summary, we found that student-facing machine learning-based interventions lead to fewer errors in German spelling learning environments. However, it can also demotivate users leading to more dropouts.

Bibliography


4 https://doi.org/10.17605/OSF.IO/3R5Y7
5 https://doi.org/10.48550/arXiv.2306.07853