A DIGITAL STUDY ASSISTANT FOR HIERARCHICAL GOAL SETTING COMPANION FACES THE FIRST REAL USERS

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ABSTRACT

Digital Study Assistants (DSA) are an emerging type of software that combines web-based software architectures, various data sources, and algorithms from artificial intelligence (AI) to assist learners in improving their learning-related behaviors. In this paper, we summarize the implementation and results of a field study with a DSA for hierarchical goal-setting (HGS) at the Bremen, Hannover, and Osnabrück universities from November 2021 to April 2022. The results show that 70% of students in the sample chose to get digital assistance for educational goal-setting, which is the highest interest rate among the nine assistance functions available. Of the 290 students who chose to use the assistant, only 10 completed the full assistive intervention, which equals only 3.4%. We conclude that we should improve the usability and user experience and reduce the interaction costs of the intervention.

KEYWORDS

Digital Study Assistant, Hierarchical Goal Setting, AI in Higher Education

1. INTRODUCTION

The last few years have seen an increased interest in Digital study assistants (DSA), which combine modern, often web-based software development approaches, data from various sources and algorithms from artificial intelligence (AI) to assist students in learning-related activities. This increased interest is due to technological advances in processing capacities, accelerating digitalization of higher education infrastructure, and the central role of computers and mobile devices in learning scenarios.

There are a plethora of possible perspectives on human-computer interaction in the specific domain of DSAs. The SIDDATA[1] project, funded as part of the “Innovation Potentials of Digital Higher Education” funding line, the Federal Ministry of Education and Research since November 1, 2018, decided to place individual educational goals at the center and develop DSAs, which assist proactive learners in goal pursuit. Within annual agile software development cycles, we developed a series of assistant prototypes (Schurz, K. *et al.* 2021, Weber, F. *et al.* 2022), and we trained a Neural Network to match educational resources and learners (Schrumpf, J. et al. 2021), and published datasets from field experiments with prototypes (Schrumpf, J. et al. 2022, Weber, F. et al., 2022). A central feature of the digital study assistant prototype we published under MIT license[2], is the modular structure, which allows for the development of particular features with different functionalities that appear to the users alongside each other in a navigation bar.

In parallel, the second line of research has focused on developing a digital study assistant that focuses on university students’ educational goals. Within this line of research, we have collected educational goals in natural language (Weber, F., and Thelen, T. (2022), and we have developed methods to characterize educational goals (Weber, F., Osada, S. and Thelen, T.,2019; Weber, F. and Thelen, T. 2022; Weber, F. and Le Foll, E. 2020). From this line of research, a DSA centered around hierarchical goal systems has emerged (Weber, F. *et al.*, 2021; Weber, F. 2019), which we have published under an MIT license, too[3]. This paper summarizes the first attempt to integrate the two DSA systems and investigate real student users’ interactions with the resulting software.

1 Joint project for Individualization of Studies through Digital, Data-Driven Assistants
2 https://github.com/virtUOS/siddata_backend, https://github.com/virtUOS/siddata_studip_plugin
3 https://github.com/fweber/GoalTrees

2. METHODS

The SIDDATA study assistant has been integrated into the learning management system (LMS) Stud.IP, is frequently used by students at the universities of Bremen, Hannover, and Osnabrück. By default, the plugin is not visible, so students had to activate it by calling a URL, which has been made publicly available by invitation e-mails, the project website, flyers, university online news, and other advertising channels.

Once students open the SIDDATA study assistant (see Figure 1), all functionalities, which we call “recommender modules”, are shortly introduced as elements of a newsfeed, and students can choose to activate or deactivate the recommender module. The “Meine Studienziele” (*my study goals*) recommender module used an iframe Html element to embed the GoalTrees software from a different URL. On a practical level, this allows users to personalize their DSA, and from an empirical perspective, it yields valuable data about user preferences. Students could actively agree to donate their data in the data settings. We use the resulting statistics to infer how many students activated the *my study goals* recommender.

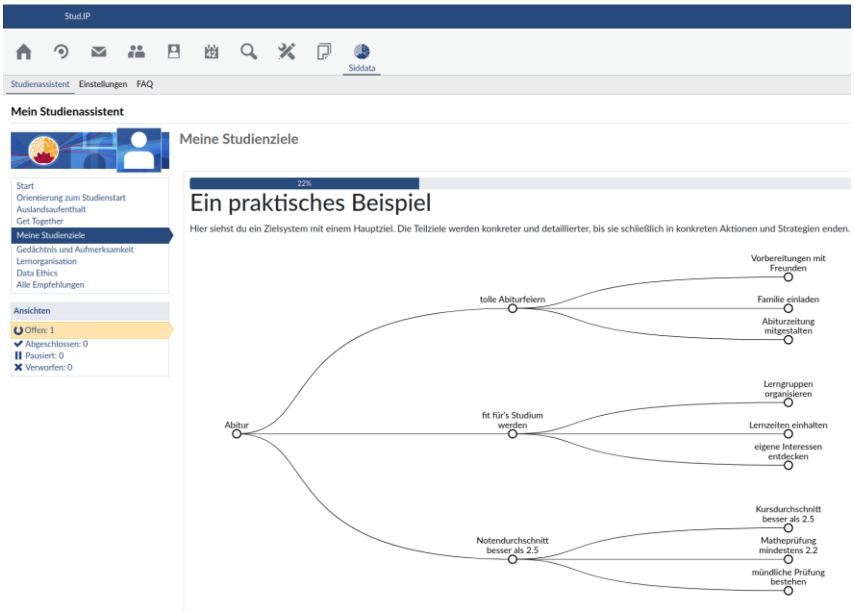

Figure 1. This screenshot of the SIDDATA DSA integrated into the LMS Stud.IP shows the navigation bar with all available recommender modules on the left side and the activated Hierarchical Goal-Setting module, which embeds the HGS-DSA on another server via iframe HTML 5 element

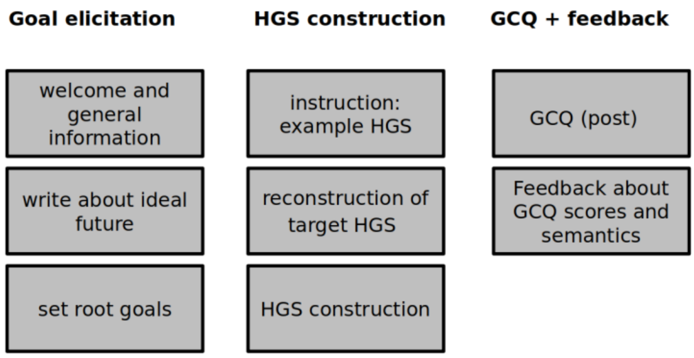

Figure 2. The procedure of the goal-setting intervention: Writing about an ideal future and ideal outcomes or studies stimulates personally meaningful root goals. Then participants derive subgoals and, step by step, an HGS. Then the GCQ questionnaire is answered for all goals. Finally, participants can see the GCQ scores of their goals and context information about why the goal characteristics are essential

The procedure of the *my study goals* intervention consists of three phases. In the first phase of goal elicitation, the user is welcomed and receives general information about the intervention. Writing about an ideal future and ideal university studies is intended to stimulate participants towards personally meaningful high-level goals, a list of which users type as the final part of the goal elicitation procedure. In the second phase, students get instructions and an example for HGS, reconstruct a given HGS, and finally choose one of their previously inserted root goals and build an HGS from it. In the third phase, participants answer the 32 items of the short GCQ version for all goals of the GCQ, and afterward, participants can explore the resulting scores for all goal characteristics and texts explaining their relevance. The whole procedure, starting from setting root goals, can optionally be repeated to create additional HGS.

3. RESULTS

In total, 1314 students used the SIDDATA DSA. From those, 22% (n=290) users donated their data for scientific purposes, and 78% (n=1024) did not. Of the 290 users who donated their data, 70% (n=203) activated the *my study goals* recommender, which is the highest activation rate among the available recommender modules (see Figure 3). Assuming that the activation rate of 70% in the population of data-donating students was representative of the total population, the total number of users for the *my study goals* recommender was 920.

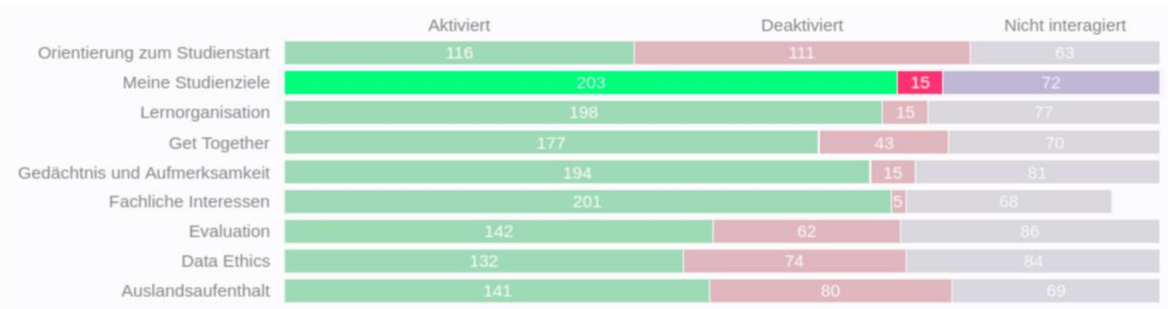

Figure 3. The plot shows users' choices to activate, deactivate, or not decide about making use of a module. With 203 users who activated the "Meine Studienziele" (my study goals) recommender module, it ranks first in terms of activation at first sight

Table 1. Ten participants completed the intervention and created at least one goal system

participant	high-level goals	sub-goals
1	2	5
2	6	37
3	3	19
4	4	8
5	4	15
6	6	6
7	4	48
8	5	23
9	1	59
10	3	9
total: 10	**38**	**258**

The statistics of the GoalTrees software server show that the number of students who completed the entire procedure was 10. Table 1 lists the numbers of high-level goals and derived sub-goals for those participants. In total, they created 38 goals and 258 sub-goals.

4. DISCUSSION

The high percentage of 70% of activations of the *my study goals* recommender, which ranks the module first among nine in total, shows a high interest in goal-oriented digital assistance. We interpret this as an encouraging signal for the future development and improvement of our DSA.

Only ten students completed the intervention, indicating that the interaction costs and the offered benefits seem to show a mismatch. Improvements in terms of usability and user experience seem to be necessary. Possible improvements could be adding color to the interface, which is currently still monochrome due to experimental requirements, and providing more gamification to reward interactions. A progress bar is present already to give participants an estimation of the duration.

A part of the intervention that can be aversive is answering the GCQ for all goals, which requires 32*n clicks for answering, where n is the number of goals in the HGS, and 32 clicks to submit the answers. Assuming an average goal system size of nine goals, 297 are required to complete the GCQ. These interaction costs could be reduced by using only a subset of the GCQ dimension, picking only a subset of the goals, or predicting goal characteristics with methods from AI, especially machine-learning methods from the goal wordings. Currently, we are adapting and fine-tuning the BERT (Bidirectional Encoder Representations from Transformers) language model for this purpose.

A field study is currently in progress to investigate the specific effects of Hierarchical Goal-Setting on goals. In a pretest-posttest design, the characteristics of root goals and changes in their characteristics through the intervention will be investigated. In the post-measurement, the characteristics of all goals in the HGS are assessed, which allows the investigation of correlations between depth and characteristics, and answers the question of whether characteristics are propagated through branches.

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