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THE DIAS PROJECT – DEVELOPMENT OF AN INTELLIGENT DIGITAL ASSISTANT IN HIGHER EDUCATION ENVIRONMENTS

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ABSTRACT: The following paper will introduce the DIAS project (Digital Intelligent Assistant for Studying and Teaching) hosted at the University of Applied Sciences Ansbach, Germany. In this research project, a digital study assistant based on conversational Artificial Intelligence will be developed. To meet the multi-faceted needs of students in their day-to-day studies, the assistant will have four components: communicator, for answering questions, for conversation, and for mentoring; a planner, for performing time management and course planning; a motivator, for actively managing learning success; and an analyzer, for providing the necessary information about the student's study progress.

Keywords: *Digital study assistant; Digital education; Chatbot; Conversational AI*

1. PURPOSE OF THE PAPER

An efficient study organization serves as a basis for a successful study. However, during the Covid-19 pandemic, the procurement of information and support becomes more difficult for students. Moreover, most universities lack appropriate digital offers to continue to provide students without face-to-face teaching a full educational experience with the individual support they need.

A growing research interest in the field of digital assistants in recent years (Maedche et al., 2019), especially concerning the usage of conversational Artificial

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Intelligence (AI), opens up new possibilities to apply in the educational domain. Building on the promising opportunities, the DIAS project aims to develop a digital intelligent assistant for studying and teaching based on conversational AI. In this current German university research project, the digital assistant will have four main application areas: communicator, for answering questions, conducting conversations, and mentoring; a planner, for performing time management and course planning; a motivator, for actively managing learning success; and an analyzer, for providing the required information about the student's progress in the program. Overall, the AI-based assistant will accompany students, inform them, motivate them and enable them to better organize and successfully complete their studies. The open source-based development will be available for other universities and educational institutions.

The purpose of this paper is to summarize the DIAS project including its different components and to shed light on the planned integration into the existing university system. The rest of the paper is organized as follows. Section 2 reviews related work, whereas section 3 outlines the rationale for developing such a digital student assistant. Afterwards, the DIAS itself and its four components as well as the architecture are presented in detail in section 4. Finally, approaches for future work are illustrated in section 5.

2. RELATED WORK

Digital assistants are increasingly being used in educational contexts (Maedche et al., 2019). Universities expect the offer of such systems, especially due to the growing use of distance learning settings, to improve communication and the general learning experience between lecturers and students as well as to provide administrative support (Song et al., 2019). In general, an intelligent assistant can be understood as an AI system that is capable of conversing with users in natural language (Windiatmoko et al., 2020). They can respond to instructions and complete certain tasks or answer queries by finding and providing information (Chandraa & Suyanto, 2019).

Recent developments in the education domain have produced innovative digital assistants with different components and purposes. The majority of assistants focus on the communication components, which means that there are numerous chatbots that only focus on providing information by answering questions about various topics like application deadlines, exam results or general information about the university [e.g. Windiatmoko et al., 2020; Chandraa & Suyanto, 2019; Ranoliya et al., 2017). These systems require large amounts of data, which are available e.g. by connecting to a domain-specific database (e.g. collected FAQs of the university) (Galko et al., 2018) or by connection to the university website (Ait-Mlouk & Jiang, 2020). The creation of a

knowledge graph (a network that represents relationships between real-world entities) is also conceivable (Tamayo et al., 2020). Moreover, assistants exist to support the execution of selected processes, e.g. in the application process or in the registration of courses (Chandraa & Suyanto, 2019; Hien et al. 2018). Another project investigates how students can be supported in achieving individual educational goals by processing data from e.g. learning management systems and data on individual learning and work behavior (Weber et al., 2021). In the future, the data-driven environment will be able to provide situation-appropriate hints, reminders, and recommendations, including local as well as externally offered courses and Open Educational Resources (OER) (Weber et al., 2021). In addition, there are also systems that support teaching. These include, for example, intelligent tutoring systems that impart knowledge through peer support modules and content quizzes (Song et al., 2019; Lai, 2011).

3. REASONS FOR A DIGITAL STUDY ASSISTANT

The reason for developing and implementing a digital student assistant at the university is conditioned by the following circumstances.

More than a quarter of all Bachelor students in Germany do not successfully complete their studies (Autorengruppe Bildungsberichterstattung, 2020). According to a recent study by the DZHW, students with a lack of motivation to study and a wait-and-see attitude are particularly at risk of dropping out (Heublein et al., 2017). This group of people in particular, but also other students, would benefit from assistance that supports and motivates them to actively self-manage and organize their studies.

In addition, the situation is changing due to the growing proportion of digital courses, such as in blended learning courses (a combination of personal instruction and computer-based learning), or currently due to the pandemic. Students have fewer opportunities to exchange ideas with each other and with their professors. In a study conducted in 2020 by the university's own Service Center for Digital Teaching and Didactics (SDL) on digital teaching at HS Ansbach, many professors complained that they can no longer address and motivate students in this setting as individually as before. It is to be feared that individual problems will be recognized later than before and that students are more likely to drop out.

Furthermore, students do not always clearly recognize which information can be found where. Sources that can be accessed around the clock are e.g. the student portal, learning platforms like Moodle and Ilias as well as the IT service portal and the university's homepage. For further questions or in case of individual difficulties, there is the possibility of counseling - in person, by e-mail or by telephone. An evaluation of the

2020 enrolment and application process at the HS Ansbach shows that students already have difficulties in obtaining information at the beginning of their studies (Hochschule Ansbach Studierendenservice, 2020). Specifically, a low level of comprehensibility and coordination of the various communication channels was criticized.

The Assistant is also intended to relieve advisors by answering routine questions with easy-to-find information that are frustrating for advisors and cost valuable consulting time. These questions should be answered more quickly by the Assistant in the future. Students have such questions around the clock, but until now it has often taken days to receive a mail response or professorial advice.

Against this background, Ansbach University of Applied Sciences would like to use an innovative, digitally-supported approach to better integrate its information and counseling services for students, make them clearly available, and further expand them.

4. INTRODUCTION TO DIAS

The assistant will be built in the form of a virtual assistant. It is generally designed to be open, so that different output channels ("frontends") can be integrated and users can access it on a website or through an app, for example. The back-end is equally open, so that the institution providing the service can integrate its individual information sources and channels. Although the service is initially designed for use in universities, it can in principle also be used by other education providers and in other scenarios.

The assistant is being developed in close cooperation with all stakeholders and tested as a model in two degree courses at the University of Applied Sciences Ansbach. An app and an information terminal which is intended to be installed on the campus are to be implemented as exemplary output channels After the project has been successfully completed, it is planned to implement it throughout the entire university.

The four key components of the DIAS (planner, communicator, analyzer and motivator) will help students as well as teachers and the administration in their daily study and working life.

Following shows supporting factors for the students:

- interactive and intelligent information assistance on the course of studies and teaching content
- identification of learning content, creation of learning plans, learning progress forecasts and evaluations
- guidance system for course and exam registration
- learning motivation with reminder and reward functions (success-coins)

- answers to individual questions, if necessary connection to the right advice/application office
- study progress forecast and early warning system

Further the supporting factors for the teacher and the administration:

- interactive and intelligent information assistance on study process, administrative procedures and documents.
- anonymous evaluation of learning progress and learning behavior
- efficient medium of information transfer by stored standard answers and content
- support of learning motivation through anchoring of learning objectives
- relief of email traffic and more time for individual support

By providing these various functions, DIAS will assist students in successfully completing their studies. It gives support for the key factors of information availability and interaction and tackles the too many barely coordinated communication channels. Implemented within different touchpoints (f.e. app or the university website) an additional implementation throughout a hologram is planned. Therefore an interactive construction will be placed at the university itself to increase the awareness at first and the active usage at second.

4.1. Components of DIAS

a) Communicator

The communicator component of DIAS basically refers to the function of a chatbot (see fig. 1). A chatbot should provide students with quick answers to routine questions at any time. For this purpose, teachers and administrators store quality-assured standard answers in advance. Therefore, a rule-based answer generation approach will be followed in the beginning. In a second expansion stage, the chatbot will be expanded to include AI-based answer generation in order to provide answers to individual questions. For this purpose, the bot makes use of various frameworks and methods from conversational AI, including Spacy, a library for programming tasks in Natural Language Processing (NLP) using Python and the RASA framework that is used to develop the assistant's infrastructure. If necessary, students will be connected to the relevant advice or application center. The chatbot is the communication hub between students, teachers, administration and the four modules of DIAS. In principle, the chatbot can be integrated into various communication channels in order to pick up the participants at familiar communication points. For example, it can be implemented on campus in a hologram or an info terminal to provide information on the spot. To create a personal connection, two- or three-dimensional avatars are envisaged as chat partners. An integration of the chatbot into WhatsApp,

telegram or university websites is also conceivable. Regardless of this, the information procurement is always based on the same, uniform and quality-checked information pool.

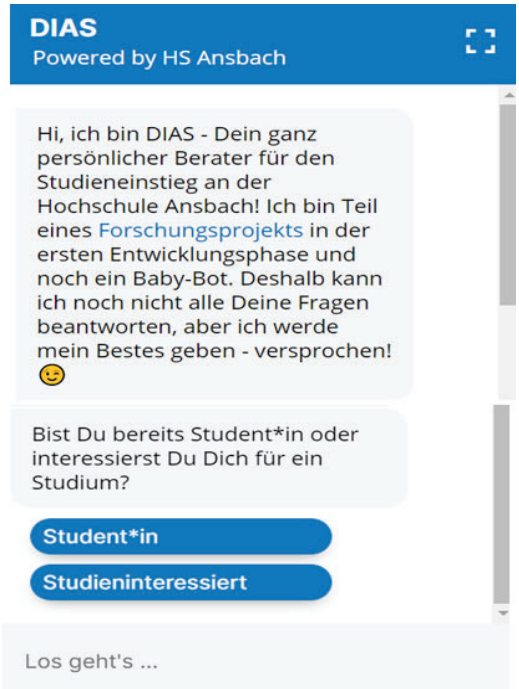

Figure 1. Communicator component

b) Planner

DIAS as a Planner will actively support students in their study planning and serve them as a versatile, interactive, and intelligent information assistant on the study process and course content. Students will be using the Planner to identify course content, create learning plans and register for courses and exams with the help of a guidance system. It is also planned to provide the student with a to-do list, a learning journal, and a goal tracker. Teachers and administrators will use the service to streamline processes, actively "feed" it with information and make documents available. On this basis, DIAS reminds students individually, for example, of the need to apply for a disadvantage compensation or of re-registration deadlines or of own defined goals and tasks. In its function as a planner and study organizer, DIAS also provides an AI-based question and answer system. With the help of intelligent search algorithms, students can ask DIAS content-related questions about the lecture, the course schedule, and their own status in the course.

c) Motivator

DIAS will be equipped with a motivating function based on gamification elements. Gamification elements are already known from various application contexts. Self-motivation apps are for example being used successfully in the areas of sports and health, but they are also increasingly used in education, for example in the form of platforms like Kahoot or in apps like Bubble or Duolingo. “Gamification of education is a developing approach for increasing learners’ motivation and engagement by incorporating game design elements in educational environments.” (Dichev & Dicheva, 2017). DIAS will provide the students with reward and success points that illustrate the achievement of learning objectives. If teachers anchor such learning objectives in the DIAS motivator, they can be treated like levels in games to encourage students to learn in a playful way. Push messages can be used to remind students to complete a unit, and success coins are credited when the unit is activated, or the goal is reached. Rank names similar to online communities, can also be introduced by marking progress with awards such as Ambassador, Super User, Special Matter Expert, etc.

d) Analyzer

Learning Analytics is an educational technology which can be used by students and by teachers. It collects the information of the learner and uses them to improve the learning by either helping the student to reflect on the learning progress or offering the teacher an actionable feedback function towards their students (Wollny et al., 2021).

Therefore, the DIAS is intended to enable as well a voluntary, AI-based determination of study and subject progress forecasts. The forecast should realistically show students risks in their study progress and act as an early warning system if necessary. For example, the usage for the students could be the receiving of an early warning if they are unlikely to achieve the required ECTS by the end of the semester if their performance remains unchanged. Such developmental analyses could help to reduce failure rates in the short term. However, the analyzer should also support teachers directly. The usage for the teacher can be, for example, to have an anonymous evaluation of the learning progress of the course participants to track the current learning status, optimize their courses or offer supplementary learning paths and materials in the sense of constructive alignment. The AI can also give them recommendations for this. In the future, support for agile forms of teaching is also conceivable.

To implement these functions a connection towards different databases will be made. In order to obtain the information about each student's progress and grades, it is necessary to connect to a university database that contains the relevant data about each student. Collecting this information can reveal, for example, missing ECTS and missing courses.

In addition, the connection to the learning platform "Moodle" is made in order to connect the different courses and the existing course content. Moodle offers a platform which is used by students and teachers equally to provide and access course material and course tasks. It can be used as a learning environment and to offer different tasks and learning objectives (Moodle, 2022). Using this function data can be received about the learning progress and therefore the probability of success within the course. Therefore further functions are already existing, e.g. tasks with a grading system can be included to monitor the study progress as well as additional plugins are available which includes softwares that provide tools like flashcards or a documentation tool (H5P, 2022). Which tools and plugins are the most relevant to use still needs to be determined but promising options seem to be available.

4.2 ARCHITECTURE

The following figure (fig. 2) shows the planned architecture of DIAS. The data collection is based on the connection to existing systems such as the grading system Primuss, a student eFile, module handbooks as well as the existing administration system. The architecture is based on Data Privacy by Design which means data protection by technical design. The idea behind this is that data protection is best observed in data processing operations if it is already technically integrated when they are designed (Cavoukian, 2022). As mentioned, DIAS will have the four components communicator, planner, motivator and analyzer which will mainly offer services as a digital assistant for study process and execution, for learning content and motivation, for an early warning system and study progress forecast, for study management and for provision of information. The underlying technologies of these services will be Machine Learning and Artificial Intelligence including a question answering system, a knowledge-based rule system, Natural Language Processing and Understanding as well as Blockchain as an incentive system. The recipients of these services will be students as well as lecturers and study program directors. But it also reduces the workload of academic advisors, for example through the communicator who handles routine questions of students. Possible communication channels include messenger services such as Telegram and WhatsApp, a degree program or university app, teaching and learning systems such as Moodle, and the university website.

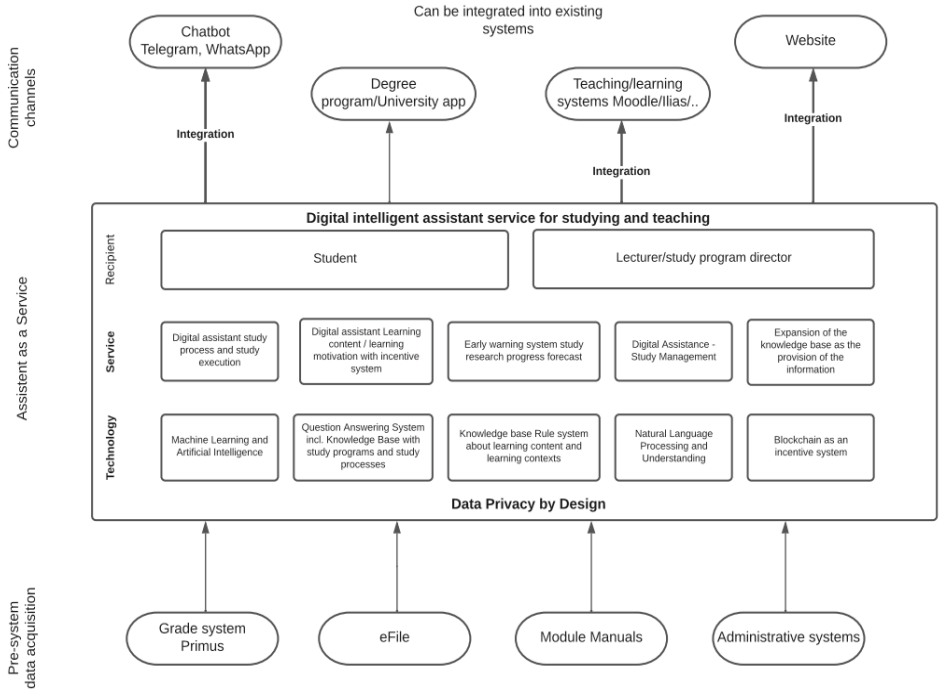

Figure 2. Architecture of DIAS

5. FUTURE WORK

The project is guided by the CRISP-DM process model with its six phases/work packages. Within the individual work packages, an agile approach based on SCRUM is used. The goal is to create a minimum value product in each of the defined SCRUM sprints (time-defined work phases). The approach of developing such a minimum usable product for the stakeholders per iteration cycle ensures rapid usability and evaluation.

At this stage several work packages are simultaneously in process to ensure constant development and improvement. Therefore, the work packages which include business understanding, data understanding, data preparation and modeling are not finished yet and will be developed further in future.

This is connected to the evaluation phase of the constructed models which is processed hand in hand with the modeling, for the effectiveness and accuracy. The evaluation of the AI methods is based on effectiveness indicators such as the accuracy of forecasts and the error rate of the results based on historical data. It contains the core of the DIAS system and its artificial intelligence.

The future will be the deployment, where an exemplary implementation of a frontend by an iOS or Android app, an exemplary integration into a chatbot of the student service or into a teaching or learning system such as Moodle is created. Furthermore, processes will be developed for the creation of a service and a support environment as well as the establishment and definition of further development and adaptation activities. The deployment approach is step-by-step as well as agile and iterative. The effectiveness of the overall system will be evaluated during the three-semester trial phase. Feedback will be collected in a biannual survey and various key figures will be defined and evaluated, such as the dropout rate, the failure rate, and the student satisfaction scale.

At last a preparation for the university-wide implementation and transfer will be intended. For this purpose, a guideline for the implementation of DIAS in different environments will be developed. Project results will be presented at appropriate events, e.g. scientific congresses and working meetings of Bavarian universities.

REFERENCES

Ait-Mlouk, A.; Jiang, L. (2020). KBot: A Knowledge Graph Based Chat Bot for Natural Language Understanding Over Linked Data. *IEEE Access*, *8*.

Cavoukian, A. (2022, April 20). Privacy By Design. https://privacysecurityacademy.com/wp-content/uploads/2020/08/PbD-Principles-and-Mapping.pdf.

Chandraa, Y.; Suyanto, S. (2019). Indonesian Chatbot of University Admission Using a Question Answering System based on Sequence-to-Sequence Model. *4th International Conference on Computer Science and Computational Intelligence, Procedia Computer Science*, *157*.

Dichev, C., & Dicheva, D. (2017). Gamifying education: what is known, what is believed and what remains uncertain: a critical review. *International Journal of Educational Technology in Higher Education*, *14*(9).

Galko, L.; Porubän, J.; Senko, J. (2018). Improving the User Experience of Electronic University Enrollment. *2018 16th International Conference on Emerging eLearning Technologies and Applications (ICETA)*.

H5P. (2022, April 20). Examples and Downloads. https://h5p.org/content-types-and-applications

Heublein U.; Ebert, J.; Hutzsch, C.; Isleib, S.; König, R.; Richter, J.; Woisch, A. (2017). Zwischen Studienerwartung und Studienwirklichkeit. *DZHW Forum Hochschule*.

Hien, H.; Cuong, P.; Nam, L.; Nhung, H.; Thang, L. (2018). Intelligent Assistants in Higher- Education Environments: The FIT-EBot, a Chatbot for Administrative and Learning Support. *Ninth International Symposium on Information and Communication Technology*.

Hochschule Ansbach Studierendenservice Abt. 1-Imma (2020). Immatrikulation und Bewerbung 20202-BA.

Hrsg. Autorengruppe Bildungsberichterstattung (2020). Bildung in Deutschland 2020. wbv Media, Bielefeld 2020.

Lai, K.-W. (2011). Digital technology and the culture of teaching and learning in higher education. *Australasian Journal of Educational Technology*, *27*(8).

Maedche, A.; Legner, C.; Benlian, A.; Berger, B.; Gimpel, H.; Hess, T.; Hinz, O.;

Morana, S.; Söllner, M. (2019). AI-Based Digital Assistants: Opportunities, Threats, and Research Perspectives. *Business & Information Systems Engineering*, *61*.

Moodle. (2022, April 20). Lernerfolg mit Moodle. https://moodle.de

Ranoliya, B. R.; Raghuwanshi, N.; Singh, S. (2017). Chatbot for university related FAQs. *International Conference on Advances in Computing, Communications and Informatics (ICACCI)*.

Song, D.; Rice, M.; Oh, E. (2019). Participation in Online Courses and Interaction with a Virtual Agent. *International Review of Research in Open and Distributed Learning*, *20*(1).

Tamayo, P.; Herrero, A.; Martin, J.; Navarro, C.; Tránchez, J. (2020). Design of a chatbot as a distance learning assistant. *Open Praxis*, *12*(1).

Weber, F.; Schrumpf, J.; Thelen, T. (2021). Development of a Digital Goal Setting Companion for Higher Education. In: Kienle, A., Harrer, A., Haake, J. M. & Lingnau, A. (Hrsg.). *DELFI 2021*. Bonn: Gesellschaft für Informatik e.V., (109-114).

Windiatmoko, Y.; Hidayatullah, A.; Ahmadi, R. (2020). Developing FB Chatbot Based on Deep Learning Using RASA Framework for University Enquiries. *ICITDA Conference Batch 3*.

Wollny, S., Schneider, J., Di Mitri, D., Weidlich, J., Rittberger, M., & Drachsler, H. (2021). Are We There Yet? - A Systematic Literature Review on Chatbots in Education. *Frontiers In Artificial Intelligence*, *4*.