Introducing a Smart Learning Assistant on a MOOC Platform: Enhancing Personalized Learning Experiences

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***Abstract*—This paper presents the Smart Learning Assistant on the German MOOC platform AI-Campus. It is an AI-powered, dialog-based system that provides learners with personalized learning support and features for enhanced learning. The paper presents the original motivation and planned features of the Smart Learning Assistant as well as its technical implementation, architecture, and status quo. An initial evaluation was conducted using event logs from the dialog system and an integrated feedback loop. It shows that learners start to use the learning assistant and are also engaged in long conversations. Frequent topics of conversation are related to the user's profile, more information about AI-Campus, information about AI, or reporting an error. However, the initial analysis has also shown that users are not yet satisfied with the first assistant and that the list of topics and functions as well as the conversation guidance need to be expanded. The paper concludes with a discussion of future directions for AI development and integration in MOOC platforms, including the need for continued evaluation and refinement of AI-enabled educational technologies. In addition, an overview of future functionalities and opportunities for improvement is provided. Overall, this paper contributes to the understanding of the potential benefits and challenges of AI in education and sheds light on the role of a Smart Learning Assistant in enhancing personalized learning experiences on MOOC platforms.**

I. Introduction

Massive Open Online Courses (MOOCs) are online courses designed to provide access to quality education to a global audience. They have become a promising alternative to traditional classroom learning, offering learners flexibility and convenience in their drive for knowledge. In addition, MOOCs are the only format that can scale to thousands of learners at a time, which is a positive and desired alternative in light of the growing skills shortage. MOOC platforms have seen massive growth in recent years [1], with millions of learners signing up for courses from leading universities and organizations around the world.

Artificial intelligence (AI) is increasingly being integrated into MOOC platforms [15], providing learners with personalized learning experiences and new ways to engage with course content. AI-powered features such as intelligent tutoring systems, chatbots, and machine learning algorithms are being used to enhance the learning experience and provide personalized guidance and learning materials to learners [11], [13]. AI-powered MOOC platforms can help learners identify knowledge gaps, suggest personalized learning paths, and provide real-time feedback on their progress. They can also analyze data on learner behavior to improve course design and pedagogy [7].

The AI-Camppus is an online education platform supported by a German federal ministry that offers MOOCs and resources related to artificial intelligence and machine learning. In addition to prioritizing the practical application of AI and promoting an AI-competent society, the platform also actively employs AI functionalities. Among these functionalities, the Smart Learning Assistant is a notable feature that aims to enhance the learning experience of students. The Smart Learning Assistant is an AI-powered tool that provides personalized information about students' learning journeys, answers questions and offers support whenever needed. It is accessible 24/7, enabling students to learn at their own pace and on their own schedule. To analyze student interactions and provide the necessary data, the Smart Learning Assistant utilizes natural language processing and machine learning algorithms.

As the use of AI in education continues to evolve, it is important to understand its potential benefits and limitations. This paper focuses on the Smart Learning Assistant on AI-Campus, which provides learners with personalized learning support in the form of a dialogue-based system. The paper explores the features and technical aspects of the Smart Learning Assistant and evaluates its effectiveness in enhancing the learning experience for MOOC learners. Finally, an outlook is given on further functionalities that will be integrated into the Smart Learning Assistant to further improve the user's learning experience.

II. Related Work

Intelligent learning assistants are becoming increasingly popular in Massive Open Online Courses (MOOCs) because they can provide individualized support to learners. Research in this area has explored various aspects of designing and implementing smart learning assistants, including their effectiveness, and their impact on the user's learning behavior.

Carolyn Rosé, a professor at Carnegie Mellon University, has conducted extensive research in the area of intelligent learning assistants [3], [14]. One of her notable contributions is the development of the Co-Intelligent Tutoring System (Co-ITS) [3], which provides adaptive support to students in online discussion forums. A study published in the International Journal of Computer-Supported Collaborative Learning, Rosé, and her colleagues found that students who received support from Co-ITS showed higher levels of engagement and critical thinking than those who did not. [5]

Another key researcher in this area is Ken Koedinger, also from Carnegie Mellon University. Koedinger has conducted numerous research efforts in the area of intelligent tutoring systems, including Cognitive Tutors in the area of mathematics [9], computer programming, or chemistry [6]. In a study, [10] published in The Cambridge Handbook of the Learning Science, Koedinger, and his colleague found that students who received support from Cognitive Tutor had higher learning levels than those who did not.

Moreover, another tutoring system is AutoTutor [2] which is designed to provide personalized and adaptive instruction to students. It uses natural language processing and discourse analysis to engage in a dialogue with students, assess their knowledge and understanding, and provide feedback and explanations. AutoTutor has been applied to a variety of domains, including science, mathematics, and language learning, and has been shown to be effective in improving learning outcomes.

Several studies have also examined the use of smart learning assistants in MOOCs more broadly. For example, MOOCBuddy [4], a web-based platform designed to enhance the learning experience of MOOCs, has been shown to increase engagement and motivation among MOOC participants and improve their learning outcomes. Furthermore, a study investigated whether the use of emoticons by chatbots had a significant impact on user satisfaction. The study found that users were more satisfied and perceived chatbots as friendlier and more human-like when they used emoticons in their messages [12].

In recent months, there has been a lot of coverage of "ChatGPT", a chatbot developed by OpenAI. ChatGPT and the intelligent assistant for MOOC platforms have similarities in their ability to provide information and answer user queries in the context of online courses. However, there are significant differences between the two in terms of their capabilities and limitations. Both can provide information and answer user queries, but their focus and capabilities differ. ChatGPT has a broad scope and can handle general conversations [8], while the intelligent assistant is specific to MOOCs and focuses on answering FAQs and providing information about courses, user progress, and certificates. ChatGPT has general knowledge but may misinterpret MOOC-related questions, while the intelligent assistant has specific knowledge about MOOCs but may struggle with ambiguous questions in other knowledge domains. ChatGPT engages in interactive conversations, while the intelligent assistant follows a structured interaction style. In summary, the intelligent assistant has domain-specific expertise, while ChatGPT has a much broader range of topics and conversational skills [8].

In summary, research on smart learning assistants in MOOCs has shown promising results in terms of their effectiveness in providing personalized support to learners. The work of researchers such as Carolyn Penstein Rosé and Ken Koedinger has contributed significantly to the development and evaluation of these systems, and further research is needed to explore their potential in different learning contexts.

III. AI-Campus

AI-Campus is a MOOC platform offering online courses and resources on artificial intelligence and machine learning (ML). It was launched in 2020 and is funded as a research and development project by a German federal ministry. The platform features a wide range of courses, from introductory courses on AI and ML to more specialized topics such as deep learning, natural language processing, and digital health. Courses are developed by experts in the field and are mainly available in German and occasionally also in English. The vision of AI-Campus is to create an AI-competent society. The MOOC-Platform aims to create greater awareness of AI and educate people about the subject. It also encourages users to use AI and educates them on how to handle these emerging technologies.

One of the unique features of AI-Campus is its focus on practical application. The platform provides learners with access to virtual labs where they can practice creating and using AI models in a hands-on environment. In addition, the platform hosts hackathons and other events where learners can apply their knowledge to real-world problems. AI-Campus also offers certification programs for learners who complete specific courses or series of courses. These certifications can be used to demonstrate knowledge in specific areas of AI and ML to employers or other stakeholders.

Compared to other MOOC platforms, AI-Campus has a more targeted content offering as it focuses exclusively on AI and ML. In addition, this MOOC platform also implements many AI features directly, for example, through the Smart Learning Assistant or a course recommendation system.

AI-Campus strives to provide personalized learning experiences, which are achieved through AI-powered features, including a chatbot. Chatbots are computer programs that simulate a human conversation and allow learners to ask questions, get answers, and receive personalized guidance for their learning journey. The chatbot on AI-Campus uses natural language processing (NLP) algorithms to understand learners' questions and respond with accurate, relevant information in real-time. However, since the chatbot not only answers frequently asked questions (FAQs) for learners but also engages and support them directly in their learning in MOOCs, the chatbot has been re-purposed as "Smart Learning Assistant." The next section will explain in more detail the vision behind the learning assistant, which functionalities are planned or already implemented, and how it is technically designed.

IV. Smart Learning Assistant

This section will explore the motivation behind the development of a Smart Learning Assistant for AI-Campus, introduce the features that enhance the learning experience for students, and give an overview of the implementation and architecture of the currently deployed assistant.

A. Motivation and Features

The introduction of a Smart Learning Assistant on AI-Campus has several motivations: (1) Personalized learning experience, (2) Learners Engagement, (3) Convenience, (4) Scalability, and (5) Cost-effectiveness.

The personalized learning experience is an important element of an AI-powered MOOC platform. The Smart Learning Assistant can provide personalized support and guidance to learners based on their individual needs and preferences. By analyzing learner data, the assistant can make appropriate recommendations, answer questions, and provide needed information - all in real-time.

The Smart Learning Assistant can help keep learners engaged and motivated throughout the learning process. Through timely feedback and suggestions, the assistant can encourage learners to stay on task and achieve their learning goals. This can also be promoted with the help of certain functionalities built into the Smart Learning Assistant, such as reminder functions, a quiz, or the ability to query information directly through the assistant. In addition, learners are encouraged to continue learning, discover new courses, and improve their AI knowledge. This also further promotes the vision of lifelong learning.

By being available around the clock, the Smart Learning Assistant can provide learners with on-demand help, eliminating the need to wait for a human teacher or tutor. This convenient and accessible learning experience empowers students from all over the globe to learn at any time and receive support whenever needed.

Automating routine tasks that would typically require human intervention can reduce the cost of supporting and guiding learners on a MOOC platform with the aid of a Smart Learning Assistant. The assistant's capacity to handle a large volume of learner interactions can also help reduce the workload of MOOC instructors and tutors, enabling them to concentrate on more complex tasks. As a result, the implementation of a Smart Learning Assistant can lead to an improved learning experience and delivery of MOOCs while simultaneously decreasing the associated costs [17].

B. Implementation and Architecture

The Smart Learning Assistant on AI-Campus is based on the open-source conversational AI framework RASA, as shown in Figure 1. The framework consists of two main components: Rasa NLU and Rasa Core.

Rasa NLU is responsible for extracting intents and entities from user input. Intents refer to the subject or purpose of the user's statement or question, while entities refer to specific details or parameters related to the intention. Rasa NLU uses machine learning techniques such as natural language processing (NLP) and entity recognition to accurately identify the user's intent and entities.

Rasa Core, on the other hand, handles dialog management and response generation based on the user's intent and entities. It uses a machine learning-based approach to learn from past conversations and predict the most appropriate response for a given input. The response can be, for example, a predefined utterance, an API request to retrieve more information or a series of buttons that provide the user with different options to choose from.

The conversational user interface (CUI) serves as the user interface for the Smart Learning Assistant. It is integrated into AI-Campus behind a "Help" button and allows users to interact with the assistant via natural language. The CUI is designed to be user-friendly and engaging, using the design and language of the MOOC platform. The assistant is also programmed to respond in a polite and friendly manner to encourage users to use it more often.

Overall, the architecture of the Smart Learning Assistant on AI-Campus is designed to provide an efficient and user-friendly AI conversation experience. By leveraging RASA's open-source framework, the assistant tries to accurately understand and respond to user inputs, while the CUI provides a responsive and intuitive user interface for interacting with the assistant.

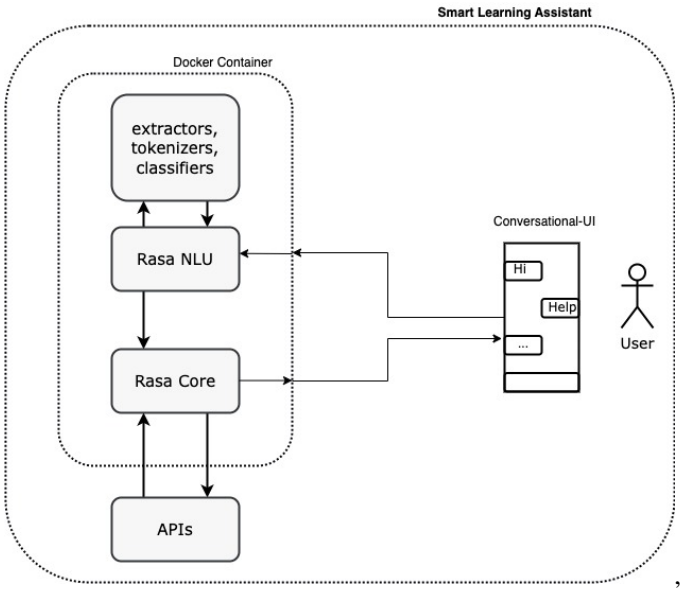

Fig. 1. The architecture of the assistant consists of the Conversational UI and the Rasa framework, which runs in a Docker container and can query various APIs.

C. Status Quo

The Smart Learning Assistant on AI-Campus has been up and running for about half a year and has proven to be quite successful in providing quick and accurate answers to a variety of frequently asked questions about the campus and its courses. It is able to answer questions about the basics of the

campus, such as what a MOOC is, what AI-Campus is, how much it costs, and how to change personal information such as language and name. The assistant can also answer more specific questions about the courses offered on campus, such as the topics covered and whether prior knowledge is required. Moreover, the assistant responds to inappropriate user behavior in a humorous way to lighten the mood. The out-of-scope questions are continuously analyzed to further improve the assistant and add new knowledge to its database. This ensures that the learning assistant is constantly evolving and expanding its knowledge base to meet the needs of its users. Additionally, users can give feedback on the effectiveness of the assistant's responses. The assistant also has a general search function that can help users find topic-specific courses. If requested, the assistant can redirect the user to the contact form to get in touch with a real human employee. Additionally, users can provide feedback on the help received, which is helpful to improve the quality of the help provided in the future.

The Smart Learning Assistant has also added personalized FAQs that can access user data to provide more targeted answers. This is a great addition as the assistant can provide tailored information based on a user's past activities on campus.

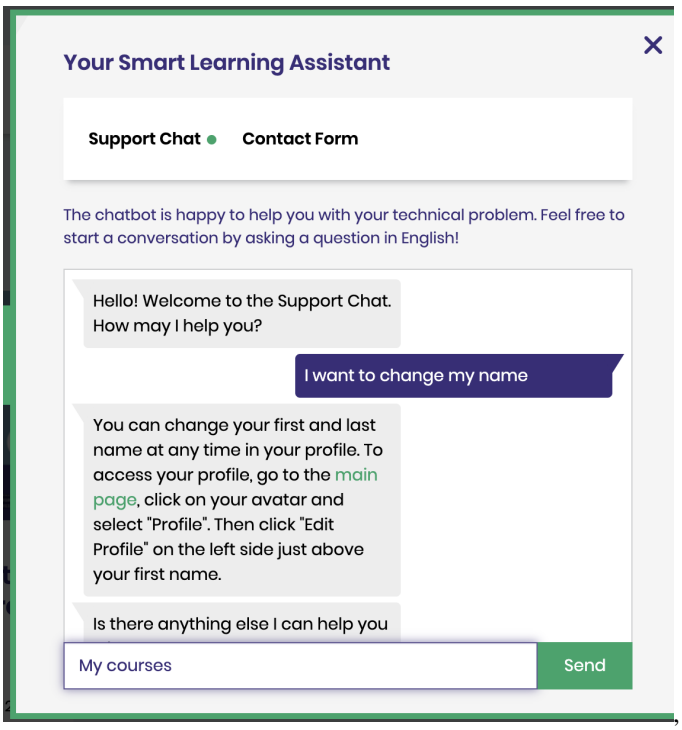

Fig. 2. A conversation with the Smart Learning Assistant answering FAQs

V. First Analysis

The following chapter evaluates the initial analysis of the Smart Learning Assistant. It is important to note that some functions (feedback, etc.) were introduced only in the middle of the analysis, so it has rather little resonance or relevance.

A. Evaluation

The assistant was active from October 2022 to April 2023 and had 128 users. During this period, there were 542 conversations with a total of 1066 messages exchanged between the users and the assistant. It was able to handle 28 tickets, 13 of which had a prior conversation and 15 of which had no prior conversation.

The most common topics discussed were related to the user's profile (179 conversations), more information about AI-Campus (84 conversations), and information about AI (57 conversations). Other topics were related to technical issues (38 conversations), such as video problems and reporting bugs. The chatbot received eleven questions about its identity ("Who are you?", "Are you a bot?"). The chatbot reacted calmly to the four insults received but admonished the user to be friendly with each other. There was no request to be redirected to get help from a human assistant.

Of the feedback received, only 2 users were positive about the conversation, while 17 users reported that the assistant was unable to provide satisfactory support. The Smart Learning Assistant was deployed on multiple platforms, with the majority of users using Windows or macOS, as shown in Figure 3.

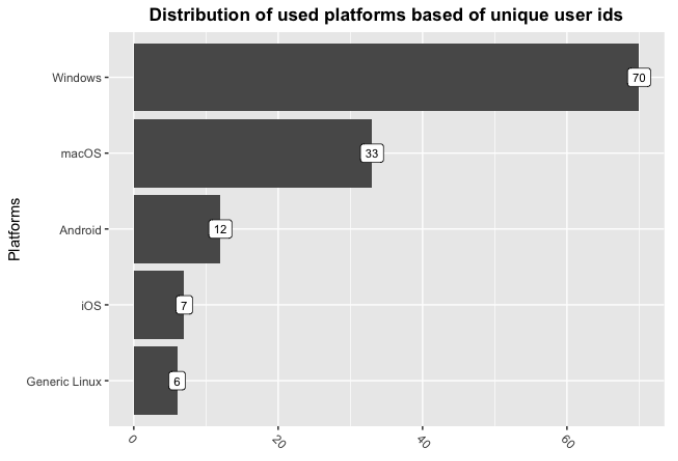

Fig. 3. The distribution of platforms from which users have used the assistant. Some users did not send platform information.

B. Discussion

The assistant was able to handle a reasonable number of conversations and tickets within the given time frame, totaling 542 conversations and 28 tickets. The topics discussed were well defined, with most conversations revolving around the user's profile, AI-Campus, AI, or reporting an error. Questions about the current course progress were also asked several times.

However, the feedback was not very positive: only 2 out of 19 users had a positive experience. This suggests that the chatbot needs to be improved to better meet user needs. The reasons for this negative feedback could be the limited skills of the chatbot or the lack of customization. Also, the

varying length of the conversations and the resulting difficulty in interpreting them could also explain the negative feedback. It should be added here that the feedback at the time of evaluation only allowed a "yes/no" response to the question about satisfaction with the answer provided by the assistant. Thus, there is no further information as to why a user was/was not satisfied with the conversation. Furthermore, it should be noted that apparently, many users did not answer this question. It is possible that they closed the assistant after receiving an answer.

A positive aspect is that the assistant got only insulted four times during the period. It is unclear here whether the reaction of the assistant was tested or whether a user insulted the assistant out of frustration within the conversation. It is noticeable that no user asked for a real human assistant. It is possible that the users did not know about this possibility.

The use of the Smart Learning Assistant on multiple platforms, with the majority of users using Windows and macOS, shows that it can be integrated with different systems. However, the cross-platform performance of the assistant should be evaluated to ensure that it is optimized for all platforms.

In general, some questions were not understood correctly. On the one hand, the questions were not part of the topic domain of the assistant. On the other hand, the question was often too long and complex, so the assistant did not understand it. The next section explains the possibilities of improving the conversation and feedback function.

VI. Conclusion and Future Work

AI-Campus is a digital learning platform that aims to provide personalized learning experiences to its users. The Smart Learning Assistant is an AI-powered chatbot integrated into AI-Campus to help users with their learning experiences. The vision of the assistant goes beyond simply answering FAQs. Important here are the five key motivations: (1) Personalized learning Experience, (2) Learner Engagement, (3) Convenience, (4) Scalability, and (5) Cost-effectiveness. From these, the key features and corresponding behaviors of the assistant can be derived.

The current assistant was created with the open-source AI framework RASA. Besides FAQs, the first personalized questions are already answered and insults as well as questions that go beyond the scope are detected.

The evaluation and discussion provided valuable insights into the chatbot's performance on AI-Campus. While the chatbot was able to handle a reasonable number of conversations and tickets, the feedback received pointed to areas for improvement, such as better personalization and handling of insults.

Future work focuses on implementing new features, such as a recommendation module that suggests resources based on the user's interests and needs, but also an integrated search for courses and course content. An existing analysis [16] describes other functionalities that should be integrated into a MOOC platform assistant to satisfy users and further close the gap between traditional learning and online teaching.

Better conversational capabilities could be achieved by expanding the assistant's knowledge base and improving its natural language processing algorithms. In the process, conversations will continue to be analyzed and potential topics will be identified to be added to the assistant. In addition, an improved feedback function will be implemented that allows users to give direct feedback to the chatbot. A detailed questionnaire consisting of several evaluation criteria, such as the course of the conversation in general, the answering of the question, the appearance of the chatbot, and the possibility to express further suggestions and wishes, will contribute to improving the performance of the assistant. In order to better support the users at the start of the conversation and to point out question possibilities, some suggestions will be made to the user in the future. Hopefully in this way, the function "forward to a human assistant" will also be used if necessary.

In summary, the Smart Learning Assistant is an essential part of AI-Campus, and continues development and evaluation will help provide better learning experiences to users. The evaluation and discussion provide valuable insights that can be used for future work to improve the performance of the chatbot and better meet user needs.

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