AI & Data Literacy for Non-Technical Students: A Hybrid-Augmented Learning Factory

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Artificial Intelligence (AI) has made a strong impact on business and private life. Nonetheless, understanding how AI works and which role data specifically plays in this context remain unclear for many people. We argue that especially students with non-technical backgrounds should build up AI & data literacy to understand the key concepts and leverage their potential in their field of study and research. For this purpose, we present the concept of a hybrid-augmented learning factory, where students can explore AI & data concepts with interactive and immersive technologies in a physical and virtual environment. In this workshop paper, we demonstrate our overarching idea of the hybrid-augmented learning factory as well as our current progress on implementing learning applications for the learning factory.

CCS Concepts: • **Human-centered computing → Mixed / augmented reality**.

Additional Key Words and Phrases: ai literacy, mixed reality, learning factory

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1 INTRODUCTION

Artificial intelligence (AI) plays an increasingly important role in our society but making sense of AI and the underlying data remains challenging [8]. This often leads to misconception and mistrust in AI for the public, as concerns on ethical issues have increased over the past decade [5]. Therefore, people need to be educated about AI and underlying concepts to overcome such challenges. Currently, In higher education, the advantages of AI & data have not been fully explored [15]. In particular, research has identified challenges of students with non-technical backgrounds in learning the underlying concepts. Yet, AI & data literacy is known to be of specific importance for non-technical audiences [11, 14].

Therefore, in this study we specifically focus on supporting students from non-technical backgrounds (e.g., business students) in improving their AI & data literacy. To reach this goal, we propose our concept of a hybrid-augmented learning factory. Learning factories by definition typically involve two aspects, the *learning* and *factory context* [13]. We aim to create a constructivist and action-oriented learning environment, in contrast to regular teaching. With regard to the factory context, we adopt a broader definition by Abele et al. [1]: learning factories create additional value by augmenting the competences of users. Instead of targeting concrete on-site factory settings and products, our concept focus on enabling hybrid learning experiences and enhancing competences of users with regard to data and AI literacy. In our hybrid learning factory, we provide preliminary learning content, structured according to the competences proposed by Long and Magerko [5], and used immersive technologies such as Augmented Reality (AR) and Mixed Reality (MR) to create engaging learning experiences.

Here we aim to contribute to the field of HCI by suggesting a novel user experience in learning AI concepts and testing it with university students with non-technical backgrounds. Later, we aim to provide design guidelines to support researchers and practitioners teaching AI with AR and MR.

2 A FRAMEWORK FOR A HYBRID-AUGMENTED LEARNING FACTORY

Aiming to create a hybrid-augmented learning factory for improving AI and data literacy, we follow the conceptual framework and design considerations of [5] and determined initial design goals. During the design process, we considered existing studies on teaching machine learning to non-majors and prioritized two design guidelines for our artifacts [11]: a) explainability; b) embodied interactions. Apart from AI-literacy, we also emphasize the importance of understanding the underlying data in AI-related contexts. Thus, we also adopt the data literacy framework proposed by Gummer and Mandinach [4] and integrated existing evaluation tools such as [12] in our concept.

The focus of our hybrid-augmented learning factory is to create an immersive learning experience with AR and MR technology, supporting students from non-technical backgrounds in improving their AI and data literacy. Aiming to support students in achieving their learning goals, we investigated the significant learning taxonomy proposed by Fink [3], which provides guidelines for creating the structure of learning content. In the process of creating significant learning experiences, we focused on two dimensions of the taxonomy. First, we contribute in fostering "foundational knowledge", which addresses the significance of understanding basic concepts and promotes the explainability of AI artifacts. Secondly, we integrate embodied learning in the "application" dimension, allowing students to develop their understanding of the topics with active engagement with the learning content and artifacts we provide. Thereby, based on our design guidelines derived from [5] and the significant learning taxonomy [3], we propose a framework for a hybrid-augmented learning factory.

The term *hybrid-augmented* covers two perspectives: a) creating highly immersive on-site learning experiences using AR head-mounted displays such as Microsoft HoloLens; b) offering hybrid learning experiences in a remote-setting with mobile applications on smartphones and tablets. As prior research reveals, the potential of AR and VR technology in educational contexts have been explored in various areas, such as medical education [2], K-12 education [6], pair programming [10], etc. Such research indicates the potential of AR in promoting students' motivation, improving learning outcome by making abstract concepts more tangible, and potentially reducing cognitive workload [2, 9]. For the on-site experience, we are currently working with AR/MR devices including HoloLens 2 and Varjo XR-3 to create immersive experiences. For the hybrid experience, we are designing mobile AR experiences to offer students the flexibility of learning AI-related content without visiting the learning factory.

Regarding the learning content, we currently focus on the following competences defined in [5] and implemented AR/MR based applications for the hybrid-augmented learning factory: a) AI's strengths & weaknesses; b) decision-making. We plan to deliver learning content covering more competences after conducting field studies with students.

The learning journey of students is also considered in the framework. Currently, we plan to offer three types of learning experience: a) exploratory; b) guided; c) lecture-based. In the exploratory experiences, students can select any learning content as their starting point and explore the content at their own pace, following the instructions provided in each learning application. This approach allows maximum flexibility and freedom in the learning process. However, existing studies have pointed out the limitations of a solely exploratory learning approach [7]. Therefore, we propose also a guided learning approach, aiming to provide necessary guidance and promote self-regulated learning for students. In a guided learning journey, students first assess their AI & data literacy with the help of a chatbot. By answering the questions asked by the chatbot, students are encouraged to reflect on their previous knowledge and experience. Upon finishing the self-assessment, the chatbot presents a personalized AI & data literacy report to students and recommend content to start with. Lastly, we designed lecture-based learning experiences to integrate our learning factory into the existing teaching activities of the Karlsruhe Institute of Technology (KIT).

3 CURRENT PROGRESS AND OUTLOOK

The hybrid-augmented learning factory has been established in a co-learning space at KIT. Figure 1 shows the current status of the space design. The learning factory currently includes the following hardware and infrastructure:

- Structured wall shelves with learning content arranged in boxes
- Two tables used as working areas for AR and MR applications
- TV and tablets for displaying relevant information (e.g., instructions) for students
- AR and MR devices such as HoloLens

Fig. 1. Current status of the learning factory

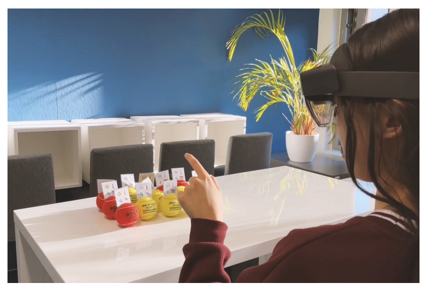

Fig. 2. A student completing a learning module

We have implemented two applications in our learning factory so far, covering two basic AI algorithms (ID3, K-means). Figure 2 shows one learning application we implemented on HoloLens, teaching decision tree and the ID3 algorithm on HoloLens. The other application is a mobile AR application, allowing students to explore clustering and the k-means algorithm in an embodied learning experience. For the guided learning experience, we implemented a self-assessment chatbot. Currently, we are evaluating the first applications in a field study to explore further research directions of the concept, as well as seeking inspirations for the upcoming learning applications.

4 CONCLUSION

In this paper, we present our concept of a hybrid-augmented learning factory, focusing on creating engaging learning experience of AI-related topics and improve AI & data literacy of students with non-technical backgrounds. In the workshop, we would like to share our knowledge in creating hybrid learning experience and systems. We would also like to discuss integrating new pedagogic methods, learning tools and curricula in our existing concept with fellow researchers.

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