POSITION PAPER

Individual Learning Based on AI

The Origins and Profitable Applications of AI on Learning Platforms for Personalized Learning

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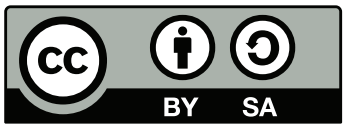

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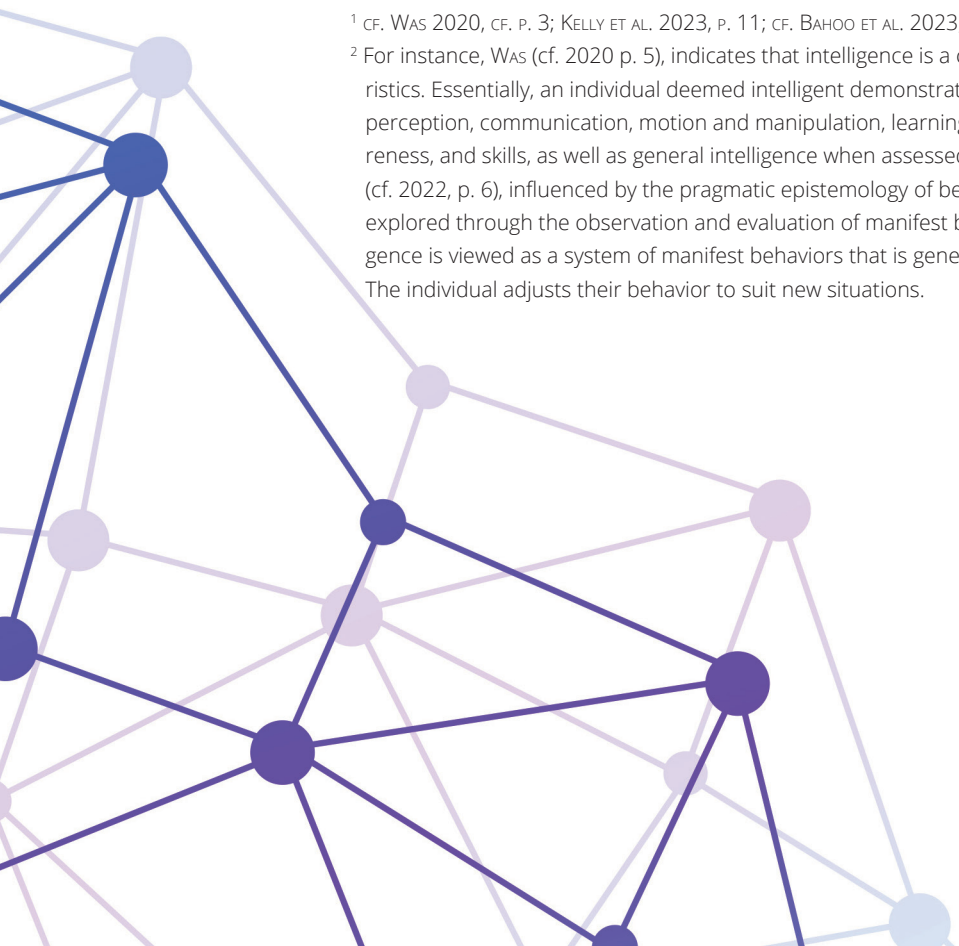
Introduction

This paper addresses a significant milestone in the field of Artificial Intelligence (AI) and its role in continuing education. One of the main challenges in understanding AI today is the lack of consensus on its definition.[1,2] In this paper, the concept of Artificial Intelligence (AI) is first considered from a pragmatic perspective. This should help to better understand the application of AI in industry and in companies, in order to improve efficiency and performance in the workplace through the use of AI on learning platforms. Newly generated AI is being used on social media platforms like *Facebook* or streaming platforms like *Netflix* to tailor user preferences based on their interaction history. In this sense, the use of algorithms has greatly benefited the information organization to determine preferences. This knowledge can be leveraged to address learning needs more effectively in employee training within an enterprise or industry. This approach both considers user preferences and efficiently manages the company's requirements. For example, an employee is looking for the right learning opportunity but does not know what to look for and browses through the wide range of available options. In the end, they may choose a training course that fails to challenge them because it does not offer anything new. The learning process can also be monitored and directed more effectively by the responsible party overseeing staff development. Motivational aspects play a crucial role in designing individualized training programs. Effective time management is also a key factor in developing strategies to optimize training time. Currently, there is a lack of AI tools based on open-source learning platforms. It is crucial to design these tools as open-source solutions to ensure accessibility, not only for large enterprises but also for small and medium-sized enterprises (SMEs). Understanding these resources and their potential applications is essential for uncovering the true nature and potential of artificial intelligence, a field that continues to reshape and redefine the boundaries of individual learning platforms in the current context.



[1] cf. Was 2020, cf. p. 3; Kelly et al. 2023, p. 11; cf. Bahoo et al. 2023, p. 14

[2] For instance, Was (cf. 2020 p. 5), indicates that intelligence is a construct encompassing a range of characteristics. Essentially, an individual deemed intelligent demonstrates above-average abilities in problem-solving, perception, communication, motion and manipulation, learning, representing knowledge, planning, social awareness, and skills, as well as general intelligence when assessed through tests. On the other hand, Coelho Mollo (cf. 2022, p. 6), influenced by the pragmatic epistemology of behaviorism, asserts that intelligence can only be explored through the observation and evaluation of manifest behavior. According to this perspective, intelligence is viewed as a system of manifest behaviors that is general, flexible, goal-directed, and adaptive. The individual adjusts their behavior to suit new situations.

1 Intelligence

This paper begins with an exploration of two fundamental components central to the underlying theme: the meaning of intelligence and the meaning of artificial intelligence. First, we provide a nuanced understanding of „Intelligence“, examining its multifaceted dimensions and implications. Following this, this paper turns its attention to the concept of intelligence within the concept of AI, exploring its connotations and implications.

From a psychological perspective, intelligence has generally had the particularity of being treated either as something that designates a specific and even ostensible fact or phenomenon - not directly, but through tests - for example, Spearman's g factor. [3] This factor is a theoretical construct in psychology, which remit to the combination of executive functions like memory, language, or perception. Alternatively, it is considered a construct that encompasses other categories that may be equally or more problematic, such as the integration of executive functions like memory, attention, skills, and abilities - enabling adaptation to environmental demands. In other words, intelligence can be seen as a unitary integral phenomenon that exists ontologically (like factor g) or as a logical category. This category accounts for various psychological functions, for example attention, memory, logical reasoning, verbal aptitude, etc. These types of facts can be analysed independently of each other. Intelligence is the integration or interaction of these functions.[4] Therefore, intelligence "is a highly contextual term that can vary widely in meaning".[5]

The concept of intelligence can be traced back to Galton, who proposed that it is a psychological phenomenon that accounts for differences between individuals.[6] It has also been strongly associated with heritable biological factors, especially genetic ones. In addition, it has been strongly linked to a structuralist tradition that suggests the possibility of understanding certain standards for the thought processes that we call intelligence.[7] Sternberg[8], a leading researcher in this field, provides a comprehensive overview of how the issue has been addressed, which can be summarized in the following table:

The contemporary concept of intelligence is closely linked to cognitive science, neuroscience, neuropsychology, and mathematical logic. The general idea behind this interdisciplinary approach is that cognitive processes, such as intelligence, can be modelled. This analytical view assumes that the elements of the process can be organized into a series of small steps that interact with each other.[9] At this point, it is useful to introduce the concept of a neural network, which is one of the most remarkable models applied across other disciplines. The neuron is the unit responsible for transmitting information through electric and biochemical interactions at multiple levels. This model has inspired studies of psychological processes that analyze intelligence as a unit and develop models to explain how it works. In this case, there is a multitude of information inputs related to sensory and perceptual processes that involve various Information reception channels. Due

Intelligence Localization	Level of Interaction
Individual	Biological Level
	Molar Level (Cognition, Metacognition)
	Behavioral Level
Environment	Cultural/ Social Level
	Intracultural Position Level
	Interconnection Level Sublevel

Image 1:
Summary of Sternberg's framework on the genesis or location of intelligence and its various combinations (own representation based on Sternberg 2004, pp. 325–338).

[3] cf. Piaget 1967/2009, p. 18
[4] cf. Woodley of Menie et al. 2011 p. 3358; cf. Buckhalt 2002, p. 110
[5] Was 2003, p. 3
[6] cf. Garret 1967
[7] cf. Piaget 1967/2009, p. 53; cf. Baltes et al. 2006, p. 39
[8] 2004
[9] Coelho Mollo 2022/2024, p. 11

to this complexity, intelligence is usually explained through a molar analysis rather than molecular one.[10]

For instance, one of the most commonly used theories to explain intelligence is the categories theory, which involves the formation of categories and logical structures through formal logic or mathematics.[11] Although neuroscience explains the biological foundations of the language process, there is a tendency to focus more on abstraction than on physical facts while explaining intelligence.[12] It may seem obvious that humans can develop a language based on fundamental categories such as cat, mouse, or dog. The common characteristics of these species are summarized in a general category. These categories appear straightforward because they represent familiar particularities. However, they form the foundation of the philosophy of science, which raises the classical question about the origin of knowledge; namely, whether knowledge arises from experience or from abstract rationality. The category theory arising from this perspective could elucidate intelligence through the construction of multiple interconnected categories and their relationships with each other.[13] From such relationships, more complex categories like ‚causality,' or even higher abstractions such as geometry or arithmetic emerge, as well as the ability to judge or employ inductive reasoning.[14]

Artificial Intelligence

Defining the term ‚intelligence' is a complex task that extends beyond the realm of knowledge and includes psychological aspects such as emotions, sensations, and perceptions. Therefore, the use of the term combined with the adjective ‚artificial' is a pragmatic approach to guide research towards a possible modelling of the naturalization of human thought processes. When dealing with AI, our minds frequently gravitate toward the vivid imagery portrayed in science fiction movies. This often includes visions of robots or computer entities reminiscent of Arthur C. Clarke's iconic novel, 2001: A Space Odyssey' or, more contemporarily, the thought-provoking series ‚Black Mirror,' which captivated audiences between 2017 and 2023 and explored the intersections of technology and society. This type of AI is called "superintelligence", which means that it can surpass human intelligence. The question arises whether it is possible to simulate or to replicate human capabilities and intelligence. This leads to two hypotheses about AI, one strong and one weak.[15]

The strong hypothesis proposes that an AI system has the potential to possess actual cognitive abilities similar to human thought and consciousness. In other words, it suggests that an AI could think and have a mind like humans.[16] The weak hypothesis suggests, that although an AI system may exhibit behavior that mimics thinking and having a mind, it does not mean that the AI possesses consciousness or true cognitive processes. According to this perspective, the actions of AI are merely simulations of thought and reason that lack true understanding or consciousness.[17] It is important to note that these are only theoretical positions that have been discussed and debated by various researchers, philosophers, and thinkers in the field of AI. The weak form of the AI hypothesis is often associated with the concept of „behaviorism" in AI, which focuses on observable behavior rather than internal mental processes. The strong form, on the other hand, is more in line with theories that assume that AI could potentially achieve true cognitive understanding.[18]

In this context, there are two basic concepts of intelligence in the field of artificial Intelligence (AI): General Intelligence (GI) and Narrow Intelligence (NI). General Intelligence (GI) pertains to the complexity of human intelligence, encompassing capabilities such as critical thinking, emotional understanding, and higher-level complex phenomena like

[10] cf. Gardner 1987; cf. Parkin 1999; Rathi et al. 2023

[11] cf. Phillips 2022, p. 3

[12] cf. Phillips 2022, p.5

[13] cf. Phillips 2022, p.14

[14] cf. Haking 1983, pp. 46-48

[15] Berberich & Hölzer 2019; Was, 2023

[16] cf. Buzato 2023, p. 5; cf. Was, 2023, p. 15; cf. Massmann & Hofstetter 2020, p. 180

[17] cf. Was 2023, p. 14

[18] cf. Was 2023, p. 3

consciousness. In contrast, Narrow Intelligence (NI) involves the development of processes or models that aim to process information on a large scale through systems and machines that mimic human-like functions, including learning, decision-making, operational tasks, and predictive analysis.[19] For instance, the concept of neuronal networks in AI does not replicate the intricate processes of the the human brain. The transmission and decoding of information do not occur through identical processes such as electric or chemical synapses. In fact, the speed of performance differs significantly between these cases. The concept of neuronal networks serves as a useful analogy to create models that are more effective in decoding information, as seen in algorithms that incorporate this neural network idea.[20] The development of artificial intelligence leans more towards the development of Narrow Intelligence rather than striving for the creation of a superintelligent entity.[21]

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[19] cf. Wo 2022, p. 130; cf. Massmann & Hofstetter 2020, p. 180

[20] cf. Rathi et al. 2023, p. 2

[21] cf. Berberich & Hölzer 2019, p. 215; cf. Massmann & Hofstetter 2020, p. 180

2 Algorithms and Machine Learning (ML)

The advent of artificial intelligence has made learning platforms an area of interest for AI and ML, as well as related terms such as 'algorithms' and 'deep learning'. Algorithms are formal or mathematical tools used to formalize and systematize a particular process in order to mimic certain aspects of human information processing. Processes such as reasoning, decision-making, pattern recognition, concept mapping, judgment, and prediction can be formalized and modeled in computer programs or mathematical frameworks. An algorithm can be described as a set of clear, step-by-step instructions for a process. It takes an input and converts it into an output through a series of defined operations.[22]

Algorithms have existed since formal logic came into being. However, in the case of AI, the machine is expected to process information and select parameters for self-learning (one of the multiple methods to describe an action of an algorithm).[23] For instance, a first-semester computer engineering student requires a laptop for programming and other semi-complex tasks related to their classes. Given a budget of no more than 500 €, the student might find it challenging to choose the best option from the many available online. Relying solely on price as the determining factor may not lead to the best decision. In this scenario, the student needs to consider more than just price to make an informed decision. Factors such as brand reputation, size, processing power, size of random access memory (RAM), design, and battery life should be considered. While design and battery life may be of less concern for the student's specific needs, RAM and processing power are critical considerations. An algorithm can streamline the decision-making process by narrowing down the options based on price, while also optimizing the selection based on the prioritized criteria. Machine learning refers to a computer's ability to learn and make predictions using algorithms based on data, enabling it to make well-founded decisions. This capability is developed without the need for manual programming of the learning process. In this case, a certain type of laptop could be categorized for customers (computational engineer student/best laptop option/budget).

For example, AI-based systems may be capable of understanding and processing natural language, recognizing faces in images, making personalized recommendations, or making complex decisions based on data. It is important to note that ‚AI-based' is a broad term that can encompass many different technologies and approaches. Therefore, AI-based systems can be implemented in various ways and used in different application areas.[24] An example of an AI-based platform is the development of an algorithm or system designed for curate audiovisual content on an ARD streaming platform. This algorithm enables and streamlines the selection process based on both the audiovisual elements and the content itself. Consequently, this resource establishes a robust metadata foundation, resulting in a more efficient, individualized, and precise content search. This encompasses not only textual information but also includes audio and visual components.[25] Maroni et. al. also affirm that "New contributions are immediately complemented by searchable metadata, making topics and content more quickly discoverable. Journalists can promptly find quotes and keywords in the contributions because the mining system functions like a search engine for audiovisual content, making the audio track searchable as text, recognizing speakers, and in the future, also identifying faces"[26]. An imaginable application could be the adaptation of such technology to learning platforms, to suggest tailor-made content to learners.

[22] cf. Berberich 2019, p. 14; cf. Ribeiro et. al. 2021

[23] cf. Berberich 2019, p. 27; cf. Was 2020, p. 38

[24] cf. Maroni et al. 2020, p. 20

[25] cf. Maroni et al. 2020, p. 22

[26] cf. Maroni et al. 2020, p. 24

3 Learning Platforms

However, the use of AI does not only offer benefits for journalists[27]. AI can also be used profitably on learning platforms.[28] The use of AI on learning platforms in companies has many benefits. One benefit for learners is that the learning process is faster, more accessible, and personalized. AI supports learning technology through methods such as machine learning, educational data mining, and learning analytics. On an organizational level, processes such as evaluation and planning can be improved through data analysis. In the learning environment, new methods for assessment, grading, and tutoring become available. ‚Smart' learning tools in the learning process itself offer numerous possibilities, including personalized learning, support systems, automated assessments, recommendations, and predictions.[29]

One of the most important challenges at all stages of education, and especially with regard to lifelong learning within companies, is the imperative task of seamlessly integrating technology into curricula and pedagogical strategies. There are many factors, such as resources, government policies, and the teaching staff, that help to ensure that they can be implemented easily, practically, and in a way that meets the needs of all stakeholders. Nevertheless, such changes may not be possible without the development of programs that improve pedagogical skills, for example. Furthermore, the interaction with the learning platform needs to be intuitive and familiar. The use of AI in setting up individualized learning support should then take the form of in-depth resources or pedagogical tools. In this case, the AI-based learning platform can categorize the learning goals through data analysis. So, the feedback from the interaction between the user and the learning platform provides data that can be used to align the path for the individual to determine their preferences, skills, areas for improvement, disposition towards learning, and the relevance of the instruction for specific work in the organization.[30]

The learning process can be better oriented and tailored to the individual by using an algorithm to filter the necessary skills for the learner. Specific feedback can be offered to each participant and optimize the learning process. Whether the online course is useful depends on whether it can „meet the learning needs", help learners to „achieve learning goals", address the balance between engineering and learning, and enhance their learning experience.[31]

For instance, when working with big data it is necessary to select relevant information combined with categories, such as the use of data mining, audio mining, etc. Based on this information the system creates a user profile, offering a complete mapping and structure of their learning process. This means that the feedback and the content of the learning material are personalized and tailored to the user's interaction and their relationship with the organization. The learning platform becomes more competitive in selecting the relevant skills to teach and meeting the needs of each employee. This optimizes training time and prevents participants from wasting time on irrelevant information.[32]

Optimizing employees' time efficiently is crucial in today's workplaces. With the help of AI, crafting personalized learning plans tailored to each employee becomes not just a possibility but a strategic advantage. By using AI algorithms, it is possible to analyze an employee's learning patterns, strengths, and areas needing improvement, allowing the creation of a learning roadmap. This approach not only optimizes the use of employees' time but also ensures that learning initiatives align precisely with everyone's professional development needs.[33]

3.1 Trends in the Use of the Individual Learning Platforms for Lifelong Learning in Germany

In 2021, the mmb Institut – Gesellschaft für Medien- und Kompetenzforschung mbH conducted a study on AI adoption trends in the education sector. The study surveyed 99 companies worldwide that provide educational resources based on AI, with 13 institutions in Germany, 33 in China, and 30 in the USA. The companies primarily focused on individual and adaptive learning. The study indicates that the integration of AI in education not only addresses technological advancements but also plays a vital role in enhancing the skills and competencies of the workforce. The emphasis on supporting competence

[27] cf. Maroni et al. 2020, p. 26

[28] cf. Castro et al. 2023, p. 879; cf. Poestges 2020, p. 162; cf. Schneider et al. 2020, p. 554

[29] cf. Poestges 2020, p. 150; cf. Schneider et al. 2020. p. 537; cf. Todorovic & Steinert 2020, p. 582

[30] cf. Massmann & Hofstetter 2020, p. 198

[31] cf. Li 2021, p. 354

[32] cf. Was 2020, p. 26; cf. Li 2021, p. 354

[33] cf. Massmann & Hofstetter 2020, p. 204; cf. Poestges 2020, p. 145

in German companies through AI implementation signifies a broader objective of ensuring adaptability and competitiveness in the face of technological progress.[34]

Furthermore, the German *mmb Institut* conducts an annual ‚Learning Delphi' study with 95 experts from various vocational education-related domains, such as media representatives, emerging EdTech enterprises, traditional education sectors, and companies implementing new technologies for employee training. The latest study, conducted between late 2022 and 2023, revealed a noteworthy trend among organizations towards adopting adaptive learning. The results highlight a trend, especially in company-based vocational education training, to consider the integration of AI-based adaptive learning over the next three years. This trend is illustrated in the following figure, highlighting the anticipated importance of incorporating AI-driven adaptive learning methodologies:

Additionally, there is growing interest in individualized forms of learning, short (self-)learning units, and the increased use of virtual reality (VR) technologies. The importance of adaptive learning has gained recognition for its relevance in the learning landscape, but has also shown promising commercial potential, with reported revenues of 66 % compared to 45 % in the previous year. This suggests that it is highly likely that numerous commercially viable applications will integrate adaptive elements in the future, potentially leading to increased revenues derived from adaptive learning solutions.[35] Figure 3 (see p. 11) displays the results.

The study's conclusion highlights a substantial shift in the perception regarding the utilization of learning platforms within the workforce (lifelong learning), potentially impacting market dynamics and the business models of service providers in this field.[36]

One of the most debated topics in relation to the use of AI revolves around the future of the workforce. In 2018, the World Economic Forum predicted that around 75 million jobs would be replaced by AI. However, AI is expected to create around 133 million new jobs. In this scenario, it is essential for both employees and CEOs of companies to prepare for and anticipate this transformation.[37] To achieve this goal, individualized learning platforms will be essential in training new generations of workers and fostering new skills in today's employees. Consequently,

[34] cf. mmb Insitut 2021, p. 19

[35] cf. mmb Institut 2023, p 17

[36] cf. mmb Institut 2023, p. 12

[37] cf. Cann 2018; cf. Massmann & Hofstetter 2020, p. 171

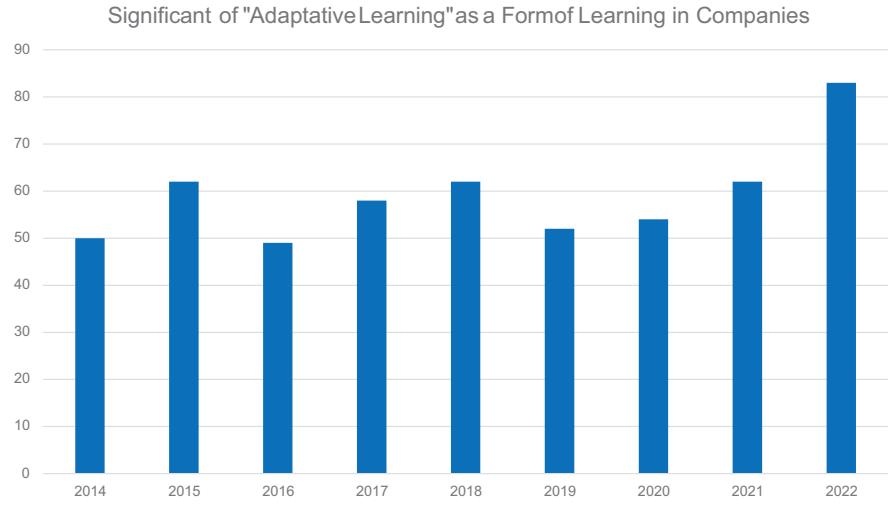

Image 2:
Results of the study on the significance of Adaptative Learning in the enterprise over the next three years (mmb Institut 2023, p. 5)

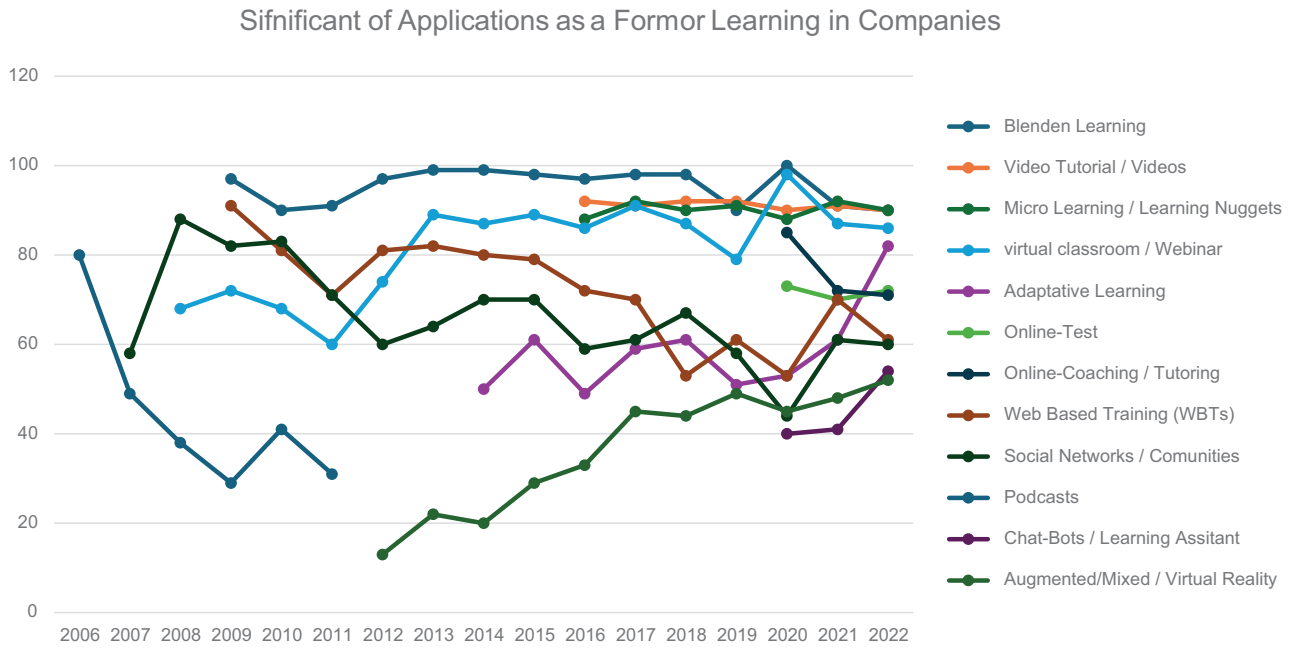

Image 3:
Results on the significance of different learning forms in enterprises, indicating an increase in the importance of adaptive Learning over the next three years (MMB Institut 2023, p 17).

ethical dilemmas, such as job displacement, could be anticipated, and strategies can be developed to mitigate the impact of this new technology on the labor market. Companies are responsible for adequately preparing their workforce. Corporate trainers should be ready to teach not only technical or cognitive knowledge, but also soft skills such as critical thinking and leadership.[38]

3.2 Recommendation and General Orientation for the Future of AI-Based Learning Platforms

A team of experts specializing in AI and learning from various fields came together to address current issues relating to the impact of the use of AI-based learning platforms in Germany. The experts are part of the joint project „Learning Journey. Individual. Informal. Mobile" (LIMo), which is funded by the *Bundesministerium für Bildung und Forschung (BMBF)* and supervised by the *Bundesinstitut für Berufsbildung (BIBB)*. In LIMo, instruments for user-oriented continuing vocational education and training are being developed, laying the foundations for informal and mobile learning. With experimental further development of the German open-source learning platform ILIAS, learning opportunities are set to become more personalized and seamlessly integrated into the daily working environment in the future. LIMo supports small and medium-sized companies in the modern organization and implementation of company training measures. This group of experts from LIMo was prepared through their prior joint project work. The project involved exploring the following key questions:

How would you currently describe further education and learning in your company?

What advantages and challenges do you see in the integration of AI in learning environments?

Why do you think it is important to further develop open-source learning platforms?

Based on the findings of the individual contributions and the subsequent discussion, they identified key points, made recommendations, and outlined possible future research topics for the integration of AI in vocational education and training in German companies. Thus, the discussion was organized in a common context and explored each topic or question from three dimensions. Firstly, at an individual level, secondly, from cognitive and emotional perspectives, considering social, political, ethical, and collective considerations. In addition, technical aspects were taken into account, relating

[38] cf. Massmann & Hofstetter 2020, p. 196

to the impact of the development of technical tools and algorithms.

3.3 Advantages of AI-Based Learning Platforms

The use of artificial Intelligence (AI) undeniably offers several benefits in developing more effective learning tools. As learning is a multifaceted human activity, continuous research is required to update content and strategies for optimal educational outcomes. The introduction of resources such as recommendation algorithms proves valuable in efficiently managing the time of trainers and learners. Furthermore, it represents a strategic approach to improve cognitive skills such as memory, attention, and logic.[39]

For example, an analysis of the discussion with the experts from the LIMo project reveals certain patterns. The AI algorithms can provide insights into when it is beneficial for learners to take breaks or switch learning topics. This adaptive capability enables the system to recognize patterns of behavior and to identify moments when concentration might decrease. In this way, AI significantly contributes to improving the learning experience by adapting to the individual's cognitive rhythm and optimizing the overall effectiveness of the training process. The following example illustrates this. Imagine the AI recognizes that ‚John is active on the learning platform.' If the AI observes, ‚John, you seem tired,' or ‚John, you have been switching between topics frequently,' it could dynamically adapt the learning experience to John's current state. This creates more personalized and effective learning environment.
One of the experts from the LIMo project drew attention to the topic of self-control with the following example: „This summer, in various discussions at the new conference, we explored the question of what tasks AI should be allowed to take on in the learning process. The main topic was metacognition. Psychologists emphasize the importance of individuals monitoring their own learning processes and reflecting on what is working and what is not. One expert from the LIMo Project said the following: It is crucial to constantly reflect on what is effective and what is not. If AI can help with this, especially for those who are not particularly good at it, it could be beneficial. But even if self-control is well mastered, it is important to maintain this autonomy. Therefore, it is of great importance to be cautious about how much AI should take over. Individuals should always be able to make their own decisions, and a recommendation system should never be mandatory. One should always have the freedom to say, ‚No, I don't want that.'"

The experts from the LIMo project highlight two dimensions of benefits from the use of IA recommender systems: 1) the ability to manage cognitive resources and employ self-control training tools for learning, and 2) optimizing learning platform usage time through an algorithm that recommends learning topics based on user information such as company needs, profile, interests, and knowledge gaps.

[39] cf. Massmann & Hofstetter 2020, p. 197; cf. Li 2021, p. 355

4 Ethics: Data Sovereignty and Open Source

In ongoing discussions concerning the ethical use of technologies, key issues such as security, data protection, and information sovereignty are of importance. The advent of the 4.0 revolution has spurred significant projects, such as GAIA-X, particularly in the European Union and Germany. This initiative addresses concerns regarding the transparent use of data across various topics and levels, including economic transactions and information regarding insurance, as well as information applicable to vocational and educational training. One of the most sensitive topics is information sovereignty, which includes the protection of data, privacy, and safeguarding trade secrets. To address these issues, it is necessary to establish robust collective regulations to encourage the generation and public sharing of data. This entails establishing and adhering to a code of conduct, especially for dominant online platforms.[40] On open-source learning platforms, these variables can be compromised due to the inherent nature of the resource. However, the free circulation of knowledge and data also ensures the decentralization of information control and underlines its public nature.[41]

Numerous elements need to be examined in the context of these debates. For instance, the extent to which the idea of offering a product for free is linked to the democratization of information raises important questions. In many cases, information can be tainted with false content.

A particular problem arises when developing algorithms for recommending content based on user profiles. This can lead to a repetitive pattern where individuals do not have access to alternative information to compare, which tends to lead to biased information consumption.[42] For instance, PLATFORMX suggests content or recommended connections that closely align with the user's existing beliefs. This lack of balance between user-driven investigative interests and engagement with alternative information can foster cognitive dependency and inflexibility.[43]

In the ongoing debate about the advantages of open-source[44] and open-access learning platforms[45], the concept of sustainability and universal access were once major themes. The argument was that users should not have to pay for access. However, economic factors inevitably have an impact on education and learning platforms and tie them to content, production, or platform maintenance, which must be financed. Public policy plays a central role when it comes to taking these economic aspects into account.[46]

[40] cf. Federal Ministry for Economic Affairs and Energy- BMWi 2019 p. 36; cf. Gaia-X 2021, p. 5

[41] cf. mmb Institut 2021, p. 38

[42] cf. Liu & Cong 2023, p. 788

[43] cf. Buzato 2023, p. 19; cf. Gligorea et al. 2023, p. 13

[44] cf. Behner & Arlinghaus 2023, p. 77

[45] cf. Castro et al. 2023, p. 881

[46] cf. mmb Institut 2021, p. 38; cf. mmb Institut 2023, p. 12

5 Summary and Implications

The study by the mmb Institute mentioned above found that participants showed a strong interest in the development of AI-based learning platforms. However, the study revealed a lack of application of such technologies in their companies. There are four mentions of participants taking courses and receiving information on the ILIAS and Moodle open-access learning platforms , which do not implement any AI based algorithms.[47]

Previous studies suggested that the focus of AI-related research appears to be in academia, particularly in universities and schools[48]. However, there is a clear gap in the application of AI in vocational education and training in companies.[49]

The discussions with experts from the LIMo project often revolve around crucial pedagogical and didactic aspects that are essential for effective learning. Yet, there seems to be a significant lack of research addressing the integration of AI in corporate vocational education and training. Therefore, it is important for companies to actively engage in research initiatives that focus on the pedagogical and didactic dimensions of AI-based vocational education and training. It is valuable to explore the implications and possible strategies for bridging this research gap. The dissemination of information on the use of this technology in companies, especially in small and medium-sized enterprises (SMEs), is crucial for its inclusion in research and the development of new tools. The research is multidisciplinary and involves various stakeholders such as universities, companies, software developers, and others. These stakeholders need an ecosystem in which the effectiveness and benefits of this technology can be tested and realized. However, there is also a gap between the technical possibilities and the actual implementation of this technology. Questions such as: "Can the use of recommender systems effectively increase motivation?" or "What feedback mechanisms are most effective in enhancing concentration or managing the cognitive resources of employees?" remain unanswered for now. These questions highlight the need for comprehensive exploration and understanding to bridge the existing gap and maximize the potential benefits of the technology.

Communication is one of the most crucial topics in multidisciplinary research. Software developers or programmers use a language that is precisely logical and coherent, but it is difficult to communicate with individuals who are not familiar with it.[50] For instance, an expert from the LIMo project shared an experience with open-source learning platforms: „I recently engaged in a discussion with a theoretical computer scientist during a course at the University designed for second-semester psychology students. These students were learning about AI from a pedagogical perspective and exploring how to integrate AI into teaching. The computer scientist gave a lecture on explainable AI. During the lecture, a psychology student asked, ‚What does 'explainable' mean to me as a psychologist?' The computer scientist replied, "Well, for us, it is quite simple. We extract a feature and reveal the code. In image processing, this can be done relatively easily using pixels." The added value for the end user is usually not assessed because there is a lack of expertise for a study, or it is simply not perceived as an issue for the computer scientist. The learner is not even consulted.' As mentioned earlier, the fact that the code is available does not mean it is understood. Hence, I think it is actually a very relevant problem."

The integration of artificial intelligence (AI) into vocational education and training in German companies has generated various insights and considerations. As we explore the complexities of this topic, it is evident that AI has the potential to revolutionize learning experiences by providing benefits in cognitive resource management, personalized learning recommendations, and improved concentration.[51] Moreover, it is essential to foster collaboration between universities, companies, and software developers. It is crucial to build an ecosystem where the effectiveness and benefits of AI technologies can be fully tested and implemented. Companies should actively participate in research initiatives and a balance must be struck between accessibility and ethical considerations.

In conclusion, the future of AI-based learning platforms depends on addressing ethical concerns, actively involving companies in research efforts, and promoting effective communication across different disciplines. Only through a concerted effort to close these gaps we can unlock the full potential of AI in revolutionizing vocational education and training.[52]

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[47] cf. Massmann & Hofstetter 2020, p. 160; cf. mmb Institut 2021, p. 6

[48] cf. mmb Institut 2019, p. 13; cf. Gligorea et al. 2023, p. 4

[49] cf. Massmann & Hofstetter 2020, p. 160

[50] cf. Dohm & Peter 2022, p. 10

[51] cf. Gligorea et al. 2023, p. 22

[52] cf. Gligorea et.al. 2023, p. 3; cf. Dohm & Peter 2022, p. 10; cf. Berberich & Kalder 2019, pp. 223-228

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