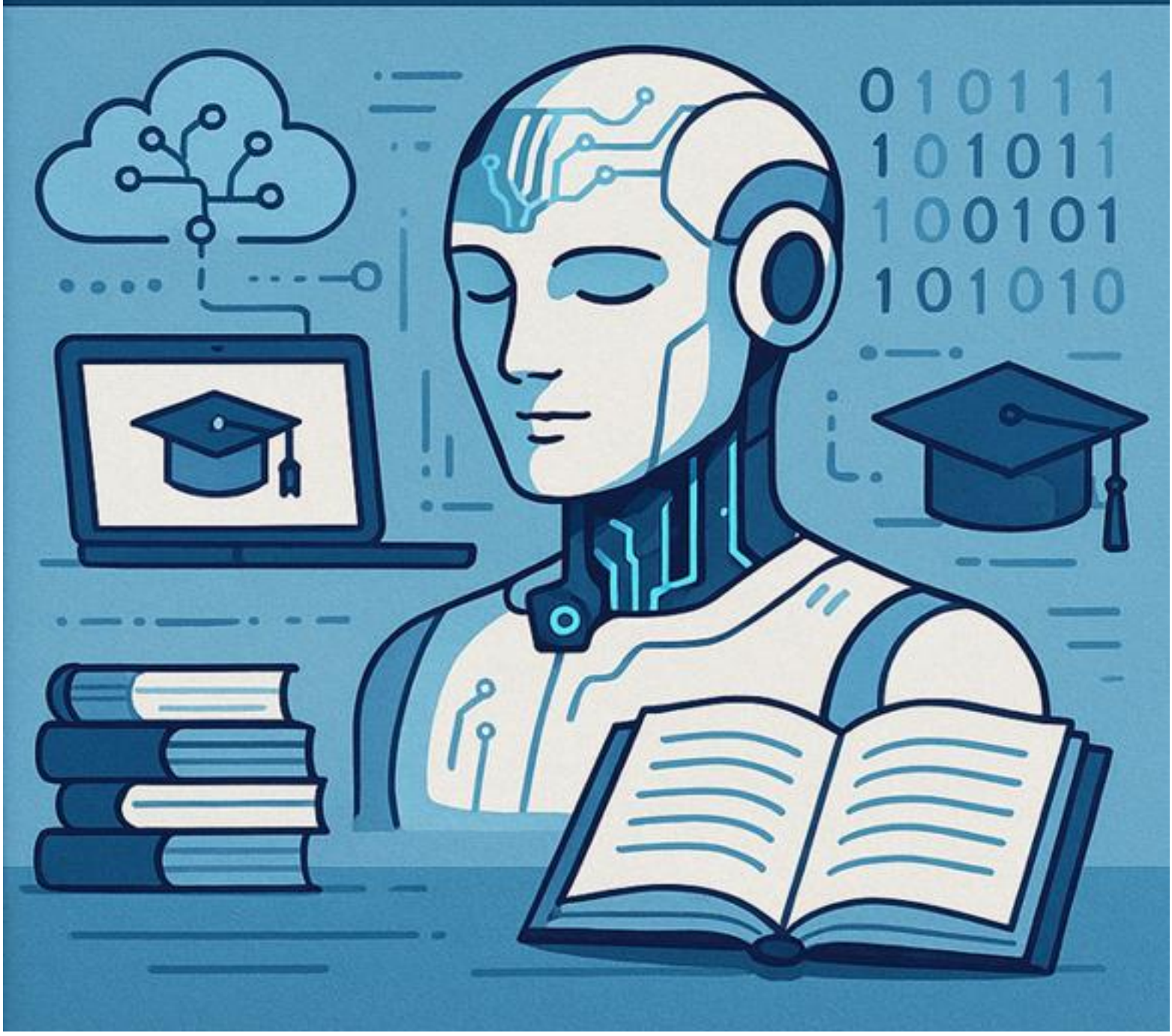
ARTIFICIAL INTELLIGENCE

SOLUTIONS FOR HIGHER EDUCATION



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Artificial Intelligence for Studies and Support in Higher Education,
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ARTIFICIAL INTELLIGENCE SOLUTIONS FOR HIGHER EDUCATION

Handbook for educators

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Content

Introduction

The rapid evolution of Artificial Intelligence (AI) is reshaping every aspect of modern life, with higher education standing at the forefront of this transformation. As educational institutions strive to adapt to a digitally interconnected and rapidly changing world, AI emerges not only as a tool but as a powerful partner in advancing teaching, learning, research, and development. This handbook, Artificial Intelligence Solutions for Higher Education, is designed to guide educators, researchers, policymakers, and students in understanding the vast potential of AI in transforming higher education practices.

This publication explores how AI technologies are being applied across a spectrum of academic functions. From assessment automation to skill development and innovative teaching methods, the book provides a comprehensive view of how higher education can evolve through intelligent systems. It draws from emerging research and practical cases described in this book.

Chapter 1 focuses on the application of AI in assessing and evaluating online education processes and conducting scientific research. With the growing reliance on digital platforms for learning, AI offers the potential to deliver real-time feedback, personalize assessments, and enhance the integrity and efficiency of evaluation processes.

Chapter 2 addresses the development of mathematical, technical skills, and creativity using AI tools. AI-powered platforms are revolutionizing how students engage with complex concepts by providing personalized learning pathways, adaptive problem-solving environments, and dynamic simulations.

Chapter 3 expands the view to using AI for the development of interpersonal skills and creativity. While technical proficiency is essential, today's global challenges also demand emotional intelligence, collaboration, and creativity. AI-driven platforms, including virtual mentors, language processing tools, and adaptive learning systems, are now being used to foster communication skills, empathy, and teamwork in increasingly personalized ways, bridging the gap between cognitive and emotional development.

Chapter 4 explores the advancement of new forms of education and upbringing through AI technologies. AI's impact goes beyond curriculum delivery—it enables entirely new educational models such as smart classrooms, AI tutors, hybrid learning environments, and immersive virtual experiences. These innovations are not only reshaping content delivery but also influencing how values, ethics, and cultural competencies are instilled in learners, contributing to the holistic development of future generations.

The goal of this handbook is not merely to present AI as a technological trend but to frame it as a transformative force for good in higher education. We hope that through this collection of knowledge and practice you will find important examples for your teaching practice.

Learners, i.e., teachers and trainers will be able to identify:

1. what AI tools support traditional and distance learning;
2. which tools to choose in specific teaching and upbringing situations;
3. the principles of working with AI tools;
4. how to deal with threats related to using AI tools;
5. adapting AI-utilizing classes to students' predispositions;
6. ethical rules and norms applicable in using AI tools;
7. increasing the attractiveness of teaching and upbringing materials.

Materials open version will be available at www.aissproject.eu

CHAPTER 1: Application of AI in Assessing and Evaluation Online Education Processes and Conducting Scientific Research

Case study 1.1: Digital Learning Assistance System (Chatbots)

1.1.1. Background of Digital Learning Assistance Systems

Digital Learning Assistance System (DLAS) represents a modern paradigm in the realm of education, utilising innovations in technology to enhance and personalize the learning experience. This innovative system leverages artificial intelligence and machine learning algorithms to provide tailored support to students across various educational levels. Unlike traditional learning platforms, a Digital Learning Assistance System goes beyond mere content delivery, actively adapting to individual learning styles, preferences, and pace. By analysing a student's performance, engagement, and interactions with educational materials, DLAS identifies areas of strength and weakness, offering targeted assistance and personalized feedback. This not only fosters a more efficient learning process but also empowers educators with valuable insights to refine their teaching strategies and address specific student needs.

Moreover, the Digital Learning Assistance System extends its impact beyond the student-teacher dynamic, fostering a collaborative and inclusive learning environment. With features like real-time analytics and interactive engagement tools, DLAS promotes active participation, communication, and knowledge-sharing among students. By fostering a sense of autonomy and personalization, this system aims to revolutionize the educational landscape, catering to diverse learning needs and maximizing the potential for academic success in the digital age. As the education sector continues to evolve, Digital Learning Assistance Systems stand at the forefront, ushering in a new era of adaptive, data-driven, and student-centric learning experiences. Today, due to Industry 4.0 and digitalization it has become a common practice for companies and institutions alike to seek for devices that would significantly increase. In addition to the financial benefits of raising output and quality, educational features present new opportunities (Oestreich et al., 2020). Employees can learn new skills, assembly procedures, and other things by using the systems. Assistance systems need to be adaptive in order to provide a positive user experience throughout the learning path. They should modify their degree of help based on the user's experience and present state. Recent studies suggest that digital learning assistance systems show promise, since study findings indicate that engaging in autonomous learning with a digital

assistance system yields performance curves comparable to those observed when learning the process through a personalized explanation (Oestreich et al., 2019). This in turn suggests that learners can achieve similar levels of proficiency and understanding whether they autonomously interact with a digital assistance system or receive guidance through a one-on-one explanation.

There are cases where it can be difficult for students to actively interact with the content and take care of their unique learning needs, which may impede their overall academic success. The integration of Conversational Agents (CAs) in e-Learning settings is becoming more and more popular as a means of addressing these limitations. CAs, now more often referred to as chatbots or virtual tutors, are AI-driven platforms intended to mimic human dialogue and offer learners interactive support. These intelligent agents can converse in regular language with students, respond to them individually, and provide focused help according to each student's needs and learning preferences (Ait Baha et al., 2023). In the sector of Higher Education, if technological advancements are applied appropriately within the institution, they can serve as a tool to enhance the quality of human resources in a number of ways. Online learning, or E-learning, is one of these development studies. The term "e-learning" refers to the process of creating learning experiences through the use of digital technologies. This allows for greater transparency in the learning process and greater freedom in the formulation, organization, and creation of learning experiences (Pradipta et al., 2020).

1.1.2. Digital Learning Assistance in Education

Throughout the recent years, there have been many initiatives to increase the efficiency and benefits of education. Numerous relevant studies are currently being conducted on topics including the use of recently created information and communication technology (ICT) for education, which has gained international attention. National efforts are being made to further this movement. But the tools available to support these initiatives are still insufficient. Study by Pérez et al. (Pérez et al., 2020) notice that Numerous teaching-focused chatbots have been developed and evaluated for several age groups, suggesting that they are adaptable educational resources. Furthermore, teaching-focused chatbots can take on many responsibilities such as an assistance to a teacher, a full-fledged educator, or a specialist trainer. It is not surprising that there are a lot of teaching-focused chatbots for language acquisition; conversing is a good way to learn a language, and using a chatbot to practice the language is reasonable.

Digital transformation (DT) has occurred at higher education institutions (HEIs) during the second decade of the twenty-first century. For institutions claiming to be leaders in their sector and to be highly competitive, it is an essential and necessary process. Numerous scholars have expounded about

the digital transformation from the viewpoint of the sector. Digital transformation can refer to the modifications that digital technologies can make to a business's business model, such as altered organizational structures, products, or process automation. Authors (Hess et al., 2016) while Gobble (Gobble, 2018) understands it as “the profound transformation of business and organizational activities, processes, competencies and models to fully leverage the changes and opportunities of a mix of digital technologies and their accelerating impact across society in a strategic and prioritized way”.

Today, it is evident that neither analysis of causation nor an analysis of students' learning behaviors have been frequently examined in current research. This demonstrates that even while academics studying education have started to focus on chatbot research, the majority of these studies still employ questionnaires and pre- and post-tests to gauge the efficacy of the technology (Hwang & Chang, 2023). Just a small number of research have started to focus on how students behave during the learning process. Fryer et al. (Fryer et al., 2017) conducted a 12-week study for students enrolled in foreign language classes using a chatbot system in addition to designing an experiment. They also watched and tracked the students' language learning habits. Fryer's study confirmed the advantages of chatbot systems in education and discovered that students' speaking performance was greatly enhanced when given a speaking task using chatbots.

Some currently developed prototypes (Jo et al., 2014) show promising yet imperfect results. The functionality, however, is highly relevant as the system brings a host of benefits to the instructor, learner, and their parents by offering a real-time monitoring system, an intelligent tutoring system, a collaborative education mechanism, an e-Portfolio system, and an efficient digital material production method. Additionally, these features can seamlessly come together through the implementation of a Structured Plug-in, enhancing the overall user experience.

1.1.3. Impact on Student Learning

Digital Learning Assistance Systems has made a major impact in the landscape of education, with a noticeable effect on student learning outcomes. These systems offer personalized learning experiences, catering to individual student needs and preferences. By adapting to each student's pace, style, and knowledge gaps, these tools provide a tailored approach that fosters a deeper understanding of the material. The real-time feedback and analytics embedded in these systems allow educators to identify areas of struggle promptly, enabling timely intervention and support. Therefore, students are better equipped to grasp challenging concepts, leading to improved academic performance.

Chatbots can be used to support the learning process by providing several key services facilitating learning. Research by Kooli (Kooli, 2023) investigates areas of the educational process that are affected

the most. These include integrity of assessments, transformation of academic research as well as potential ethical challenges associated with the use of AI within the framework of chatbots.

The integration of chatbots in education has significantly influenced language proficiency among students. Additionally, chatbots contribute to the development of practical language skills by simulating real-life communication scenarios. Students can engage in dialogues with chatbots that mimic everyday conversations, receive administrative assistance, or participate in academic discussions. This not only enhances their linguistic proficiency but also boosts their confidence in using the language in various contexts. Interactive AI-driven tools offer students a unique and immersive environment to practice and enhance their language skills (Ait Baha et al., 2023). In their study, the chatbot was utilized to provide an immersive language learning experience for participants in their first foreign language, which was French. It is important to recognize that, as our study showed, participants experienced some linguistic difficulties while using chatbots in a foreign language, which hindered their ability to fully understand the instructional material.

Collaboration and social contact were noted as further significant benefits of chatbot-based learning (Ait Baha et al., 2023). The study showed that chatbots have the ability to promote peer collaboration through group discussions and information sharing, even if students' primary interaction with them was with the chatbot. The integration of chatbots in education has significantly transformed social interaction and collaboration among students and educators. Chatbots can serve as virtual assistants, offering personalized support and instant responses to queries, creating a dynamic and engaging learning environment. Students can interact with chatbots to seek clarification on academic concepts, receive guidance on assignments, or even engage in interactive learning activities. This real-time interaction fosters a sense of collaboration, as students can share their experiences and insights with each other through the chatbot platform. Importantly, chatbots can facilitate group discussions and collaborative projects, enabling students to work together seamlessly, overcoming geographical barriers. This enhanced social interaction not only enriches the learning experience but also cultivates a collaborative mindset among students.

An open-ended conversation is facilitated by a collaborative learning strategy that can be used to encourage students to collaborate in pairs to produce solutions to a question. Prior to starting the synchronous collaborative task, the students were instructed to complete a specific unit's worth of assignments, tests, and videos. For example, a cloud-based CSCL called MentorChat is being offered as a conversational agent to assist educators in creating dialog-based cooperative learning activities (Kuhail et al., 2023).

It is not unusual that students lack experience finding credible academic materials when studying or attempting to learn something, especially those who are undergraduates or younger. Chatbots can serve as helpful tools that guide students through the process of locating academic materials and assist them in determining what is actually needed for their assignment or study (Ramandanis & Xinogalos, 2023). A conversational agent was used by (Peng et al., 2022) to assist students in processing academic papers more quickly. More specifically, after reading a document, students might consult the chatbot that targeted questions at them, allowing them to assess the text's suitability for their study needs. In this sense, it may be said that a conversational agent could help students with their research.

Systematic review by Okonkwo & Ade-Ibijola (Okonkwo & Ade-Ibijola, 2021) identifies 3 main findings related to chatbot integration into the educational process. The results show that the majority of chatbot system applications in education are concentrated in the areas of administration, advisory, assessment, research and development, and teaching and learning. This is feasible since chatbots may be applied in these possible educational domains. The teaching and learning component of education accounted for 66% of the examined studies on chatbot applications in education, while research and development comprised 19% and student assessments comprised 6%. 5% and 4% of the total percentage went toward administration and advisory research, respectively.

Furthermore, results show that using chatbots enables the collection of different types of information and its storage in an information unit for quick and simple access by authorized individuals. Moreover, chatbots provide instantaneous user support, personalized learning, and simultaneous access to the same material by different users (Okonkwo & Ade-Ibijola, 2021).

1.1.4. Case study description: Digital Learning Assistance System (Chatbot)

General context of the case study

- Country: Lithuania
- Type of organization: educational organization
- Course/subject/lesson: Master Degree
- Learning model: full-time

Teachers can apply artificial intelligence (AI) solutions in education for several reasons, i.e. the first one is personalization when AI can help personalize the learning experience for students by assessing their strengths, weaknesses, and learning styles. The use AI aims to provide tailored instruction that meets the individual needs of each student. The next point is related with efficiency and AI can automate routine tasks such as grading assignments, analyzing student performance data, and generating lesson

plans. By automating these tasks, teachers can save time and focus more on engaging with students and providing personalized instruction.

Data-driven decision-making is related with another important factor that AI can analyze large amounts of data to identify trends and patterns in student performance. Teachers can use this data to make informed decisions about instructional strategies, curriculum design, and intervention methods. Moreover, AI-powered tools can provide teachers with valuable resources such as adaptive learning platforms, intelligent tutoring systems, and virtual reality simulations. These tools can help teachers create interactive and engaging learning experiences for their students. However, AI can support teachers' professional development by providing personalized feedback and recommendations based on their teaching practices and student outcomes. Teachers can use AI-powered tools to reflect on their teaching strategies and continuously improve their instructional practices.

Moreover, another type of chatbots, i.e., Voice-based chatbots can provide personalized support and feedback to students based on their individual needs and learning preferences. By analyzing students' interactions and responses, chatbots can adapt their responses and recommendations to better support each student's learning journey.

Voice-based chatbots can also support teachers by automating routine tasks such as answering frequently asked questions, providing reminders and notifications, and facilitating communication.

Table 1. Pros and cons of using chatbots in education

Pros	**Cons:**
Voice-based chatbots can make educational resources and support more accessible to students with visual impairments or those who struggle with reading. Students can interact with the chatbot using spoken language, which can help remove barriers to learning. Personalized Learning: Voice-based chatbots can provide personalized support and feedback to students based on their individual needs and learning preferences. By analyzing students' interactions and responses, chatbots can adapt	Lack of Human Interaction: Chatbots lack the empathy, understanding, and emotional intelligence that human teachers possess, which can be essential for effective teaching and learning. Limitations in Understanding: Chatbots may struggle to understand complex questions, nuances in language, or context-specific queries, leading to inaccuracies or misunderstandings in their responses.

their responses and recommendations to better support each student's learning journey. 24/7 Support: Voice-based chatbots can provide students with access to support and resources outside of traditional classroom hours. Students can ask questions, review concepts, and receive assistance at any time, which can help promote independent learning and problem-solving skills. Engagement: Voice technology can make learning more engaging and interactive for students. By using natural language processing and voice recognition technology, chatbots can create conversational experiences that simulate real-life interactions, making learning more enjoyable and immersive. Teacher Support: Voice-based chatbots can also support teachers by automating routine tasks such as answering frequently asked questions, providing reminders and notifications, and facilitating communication	Overreliance on Technology: Relying too heavily on chatbots for learning and support may discourage students from seeking help from human teachers or peers, potentially hindering their social and emotional development. Privacy and Security Concerns: Chatbots may collect sensitive personal information from students, raising concerns about privacy, data security, and compliance with regulations such as GDPR and COPPA. Technical Issues: Chatbots may experience technical glitches, downtime, or compatibility issues with different devices or platforms, disrupting the learning experience and frustrating users. Cost and Maintenance: Developing, implementing, and maintaining chatbots can be costly and resource-intensive, requiring ongoing investment in technology infrastructure, software development, and technical support. Overall, while chatbots have the potential to enhance learning and support in education, it's important to carefully consider their limitations and drawbacks and ensure that they are used as complementary tools to human instruction rather than substitutes for human interaction and support.

There several cases already implemented in the practice at Kaunas University of Technology (KTU). Voice-based chatbots can make educational resources and support more accessible to students with visual impairments or those who struggle with reading. Students can interact with the chatbot using spoken language, which can help remove barriers to learning.

Overall, the motivation for teachers to apply AI in education stems from the desire to improve student learning outcomes, enhance teaching effectiveness, and streamline administrative tasks.

1.1.5. Conclusions and recommendations

Voice-based chatbots can provide students with access to support and resources outside of traditional classroom hours. Students can ask questions, review concepts, and receive assistance at any time, which can help promote independent learning and problem-solving skills. Voice technology can make learning more engaging and interactive for students. By using natural language processing and voice recognition technology, chatbots can create conversational experiences that simulate real-life interactions, making learning more enjoyable and immersive.

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Case Study 1.2: Plagiarism Avoidance Support

1.2.1. Introduction

Plagiarism is a serious offense that is encountered and has to be addressed in all levels of education. Plagiarism is a serious offense in higher education. It is defined as presenting someone else's work or ideas as one's own without proper citation. Plagiarism is a form of academic dishonesty that can lead to severe consequences, such as expulsion from the institution or loss of a job in the professional setting (Plagiarism and Avoiding It, 2024). Plagiarism is not only unethical but also defeats the purpose of education. It is essential to acknowledge others' work or ideas, whether in text, computer code, illustrations, graphs, or other media, to maintain academic integrity (Plagiarism, 2024).

Plagiarism avoidance is crucial in higher education because it helps students develop their academic skills and improve their writing. Avoiding plagiarism is not just about making sure references are correct or changing enough words to avoid detection. It is about deploying academic skills to make work as good as it can be (Plagiarism, 2024). Students who avoid plagiarism learn how to research, analyze, and synthesize information effectively. They learn how to use sources to support their arguments and ideas, which is an essential skill in higher education (Avoiding Plagiarism. Writing Centre Learning Guide, 2010).

Today, institutions have implemented several measures to counter plagiarism. One of the most common methods is to use plagiarism detection software such as Turnitin. This software checks submitted work against a vast database of academic papers, journals, and other sources to identify any instances of plagiarism. The software generates an originality report that highlights any matching text and provides a similarity score. Students can also access these reports to check their work before submission (How can I prevent plagiarism?, 2024).

Another way institutions counter plagiarism is by educating students on the importance of academic integrity and the consequences of plagiarism. Many universities provide writing tutorials, handbooks, and policies that warn students of the dire consequences of plagiarism. Some institutions also offer workshops and seminars on how to avoid plagiarism and how to cite sources correctly. In addition to these measures, some institutions scrutinize the writing styles of students to detect plagiarism. Professors can track the previously submitted papers of a particular student to produce a clear concept of that scholar's writing style. Any deviation from the student's writing style or the usage of unfamiliar phrases or words that are not compatible with their style can be a red flag for plagiarism (How do universities check for plagiarism?, 2020).

1.2.2. Problem areas

Study by Stander (Stander, 2020) shows that one effective and often used technique for preventing plagiarism is paraphrasing. The issue, however, lies in the fact that lecturers should take extra steps to help students overcome these obstacles as many find it difficult to apply the required paraphrasing abilities. While paraphrasing is one of the principals means by which writers capture the original words and ideas of other authors and, anecdotally speaking, appears to be commonly taught in academic writing courses for both native speakers and non-native speakers of English, it receives surprisingly little attention in both the pedagogical and research literature (Hirvela & Du, 2013).

Poor language proficiency in the second language (L2) significantly influences L2 literacy abilities, particularly in the realms of reading and writing, and plays a pivotal role in the occurrence of accidental plagiarism (Stander, 2020). Language proficiency is the foundation upon which effective communication and comprehension rest. When students struggle with the nuances of a second language, they often face challenges in understanding complex texts and articulating their thoughts coherently in writing. This deficiency in language skills can lead to unintentional misinterpretation of source material, resulting in accidental plagiarism. Inadequate command over the L2 vocabulary and grammar may cause students to inadvertently mimic or paraphrase source texts without fully comprehending the content, leading to unintentional breaches of academic integrity.

In practice, this results in failure to comprehend the sources they read and cite which, therefore, can lead students to resort to copying entire sentences or chunks of text without truly understanding the material (Howard et al., 2010). This lack of understanding poses a significant challenge to the educational process, as the essence of academic work lies not just in reproducing information but in comprehending, analyzing, and synthesizing it. When students merely mimic text without grasping its meaning, the educational purpose of citation is undermined. It becomes evident that students may resort to plagiarism as a shortcut to meet assignment requirements rather than engaging with the material critically. Therefore, emphasizing source comprehension is essential in preventing plagiarism, encouraging students to delve into the content, and fostering a culture of genuine understanding and original thought in the academic setting (Horning, 2009).

There are many different types of plagiarism tools available, ranging from free ones for educators, students, and editors to paid ones with more sophisticated features, algorithms, and capabilities. Beyond simply looking for stuff that is too similar, they can improve writing style, punctuation, and a host of other things. However, user's ability to use these programs is frequently restricted by the financial situation. For example, expensive plagiarism detection software is frequently available, however, subscribing to one can be too costly for an individual user or student or if you only inspecting

one output, therefore, such paid solutions are more popular among institutions. Alternatively, while limited in functionality, free and intuitive tools are available. Below is a list comprised by Bouchrika (Bouchrika, 2024):

Quetext

Quetext is one of the most effective online plagiarism detectors as it can identify copied passages fast and also help with citations. It allows quick and efficient review of thework with its free Instant Search feature. Quetext offers conditional scoring, fuzzy matching, and contextual analysis using their patented DeepSearch technology. Quetext is a very useful tool for writers who need to confirm the originality of their work. The plagiarism checker not only swiftly and precisely locates any and all instances of copied text, but it also instantly creates citations when needed. Quetext is designed to assist writers in staying on top of their sources without adding to their workload, as it might be simple to lose track of them.

Plagiarisma

Plagiarisma markets itself as a free platform with features similar to those of Turnitin and Copyscape (Plagiarisma, n.d.). Scholars had previously recommended using a 1:1 comparison strategy for plagiarism checking (Collberg & Kobourov, 2005), but plagiarism was now included in its program. Advanced algorithms are used by plagiarism detectors to analyze your work and compare it to a large collection of sources. This covers books as well as scholarly articles and online pieces. The use of plagiarism helps guarantee that your work will be carefully examined for any instances of plagiarism. Plagiarisma not only has an easy-to-use interface but also supports a number of languages and returns accurate results quickly.

Search Engine Reports

Search Engine Reports is a free plagiarism detector that academics and content creators can use. The restriction for the online search analyzer's plagiarism check is 2,000 words, which is quite generous. A file from Dropbox or your computer can be uploaded. Furthermore, its URL exclusion feature can run up to five URLs simultaneously and is free of cost. It is translated into 17 languages as well. Additionally, it provides three alternative views for your plagiarism search results: document view, matched sources, and sentence-wise results. Though more accurate, the rating methodology and interface resemble those of Small SEO Tools. It will provide you with a link to related information if it finds any instances of plagiarism. While not as precise as Plagiarisma or Quetext, its visually appealing and easy-to-use plagiarism check helps identify and fix problematic areas in a writer's work.

Plagium

Plagium is a user-friendly, free plagiarism detector that works similarly to Turnitin. It enables you to identify instances of copied text and URLs. It accomplishes this by breaking up the material into short passages and cross-referencing them with web resources. Compared to other search engines, Plagium claims that its approach provides users with cleaner, quieter search results. Furthermore, Plagium accurately pinpointed the original URL of a sample paragraph that had been plagiarized. Additionally, Plagium offers programs that charge you for each page you search. They also have a free Google Docs add-on that allows you to choose an unlimited amount of text as an alternative to these. Parts of the document where the software has identified duplicate content online are highlighted, which makes it convenient. You can also find links to the web source there. Its drawback, though, is that you are unable to compare your labor and the corresponding outcome side by side.

1.2.3. Case study description

The case presents the model of incorporation of a plagiarism avoidance chatbot into study course. This chatbot was chosen due to its impeccable availability and the assurance that students can receive instant plagiarism information whenever the need arises (24/7).

General context of the case study

- Country: Lithuania
- Type of organization: educational organization
- Course/subject/lesson: Bachelor's Degree Final Project
- Learning model: full-time

Initial situation

During this study course, students prepare a thesis, so it is very important that it is free of plagiarism. Although students are introduced to the university's plagiarism prevention procedures, the implementation of a chatbot in the educational environment is great for getting structured information about plagiarism, citation, etc. in real time. Such real-time feedback allows students to proactively address potential plagiarism issues, encouraging continuous improvement in their writing skills.

What motivation from the perspective of the teachers lead to the application of plagiarism avoidance chatbot? What were the concrete goals to be achieved with it?

The selection of the AI chatbot for educational use was grounded in its role as a supplementary learning tool, providing additional support and guidance. In the module, students' theses are assessed using the Turnitin plagiarism detection system. There have been cases where the detected text overlap exceeded the university limit, requiring correction. Thus, it is very important to maintain awareness of plagiarism at all stages of thesis writing. The integration of the virtual assistant was aimed at helping students understand the concepts of plagiarism more easily, help them avoid problems and guide them to the correct source citation. The overall goal was to improve students' ability to address plagiarism in their thesis.

Design: Learning and teaching strategy

Understanding the increasing challenges related to plagiarism and the need to equip students with effective tools, we have integrated a chatbot into the learning, teaching, and assessment processes.

Plagiarism avoidance chatbot usage scenario

Learning strategy. In preparation for the implementation of the chatbot tool in the study course, the first analysis of the use of this type of tool was carried out. The chatbot was then seamlessly integrated into the curriculum as an additional learning tool to introduce students to plagiarism. In the next phase, students were introduced to the features of the chatbot and given practical insights on how to use the tool to learn about plagiarism and interpret the feedback generated.

Teaching strategy. The use of the chatbot was included as an additional teaching tool, and students could check their thesis (or individual parts of it) against the recommendations of the chatbot. One-to-one support was also provided to deal with student queries, ensuring a clear understanding of plagiarism avoidance principles and effective use of the chatbot.

What technology was used?

Melibo software was used to create the chatbot. The chatbot was integrated into the educational platform Moodle (see Fig. 1.1).

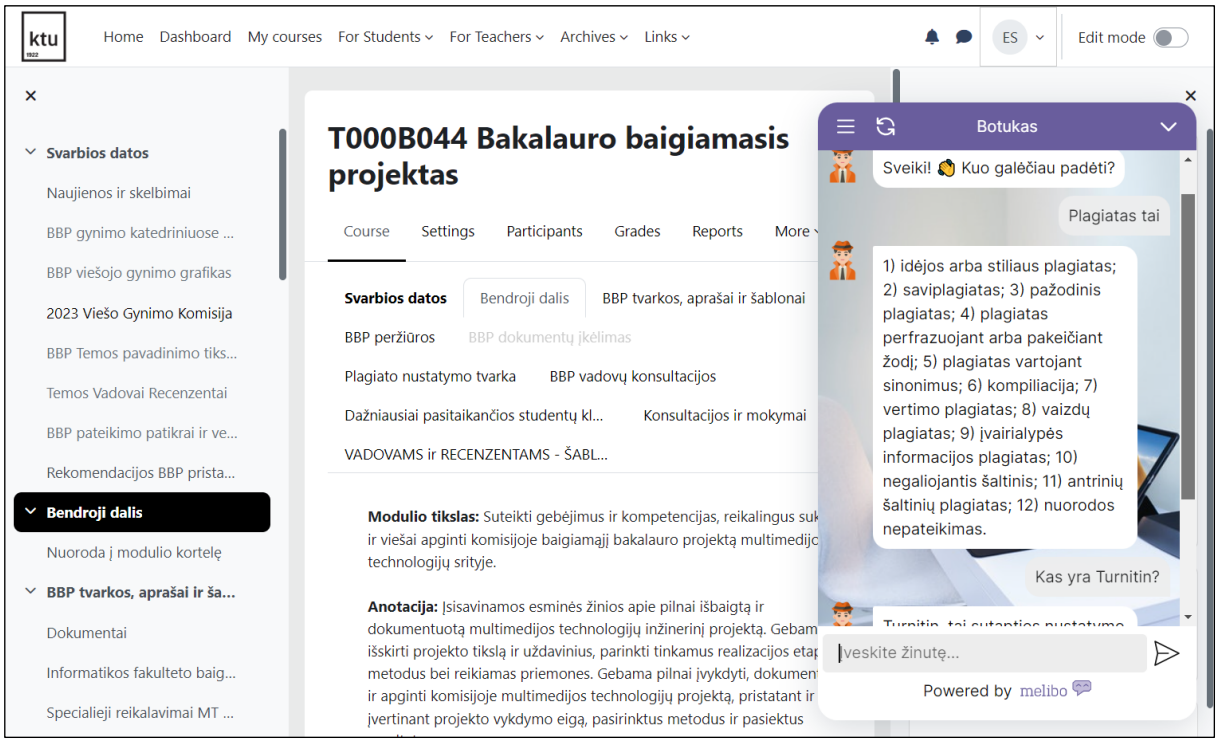

Figure 1.1. *The chatbot was integrated into Moodle*

How did teachers themselves evaluate the concept?

The module teacher gave positive feedback on the chatbot, acknowledging its effectiveness in providing clear guidance on how to properly cite sources and providing students with a general understanding of plagiarism. The ease of use and seamless integration with existing tools were also mentioned. In general, the teacher rated the chatbot as a valuable tool to promote academic integrity and improve the learning experience.

1.2.4. Conclusions and recommendations

This case study demonstrates the successful integration of a plagiarism avoidance chatbot into a course of study, demonstrating its role in raising awareness of plagiarism, guiding ethical writing practices, and contributing to a fair academic environment. Using a chatbot helped students better understand the nuances of plagiarism and ethical writing. From the teacher's point of view, the chatbot helped as an assistant to answer students' common questions related to plagiarism, citation, different citation styles, and similar issues.

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Case Study 1.3: Literature review Assistance

1.3.1. Introduction

Chatbots have emerged as innovative tools in the realm of higher education, offering a unique and efficient way to enhance the literature review process. In a higher education setting, students and researchers often have to deal with the vast volume of scholarly articles, books, and other academic resources relevant to their field of study. Chatbots designed for literature review purposes can streamline this otherwise daunting task by providing personalized assistance and guidance (Labadze et al., 2023).

One significant advantage of using chatbots in literature reviews is their ability to quickly sift through large databases, extracting relevant information based on user input. These chatbots can understand and process natural language queries, allowing students and researchers to articulate their information needs in a conversational manner. This conversational interface facilitates a more user-friendly experience, making the literature review process more accessible, especially for those who may not be familiar with complex search queries (Everything You Need To Know About Chatbot NLP, 2023).

Moreover, chatbots can offer tailored recommendations by analyzing the user's preferences, research objectives, and past interactions. By leveraging machine learning algorithms, these chatbots continuously improve their ability to suggest pertinent sources, ensuring that users receive the most up-to-date and relevant literature for their research. This personalized approach not only saves time but also enhances the quality of the literature review by exposing users to a diverse range of perspectives and scholarly contributions (The Benefits of Chatbots in Personalization Tactics, 2025).

Additionally, chatbots can assist in organizing and synthesizing the gathered information. They can help users create annotated bibliographies, summaries, or mind maps, fostering a more systematic and structured approach to literature review. This organization is crucial for scholars as they navigate through the extensive body of literature and strive to identify key themes, trends, and research gaps within their chosen field (Torch, 2023).

1.3.2. Case study description: Literature review assistance

General context of the case study

- Country: Lithuania

- Type of organization: educational organization
- Course/subject/lesson: Master Degree
- Learning model: full-time

Literature review assistance through chatbots can be a valuable resource for students and researchers, offering several benefits related with access to Information, Chatbots can help users access a wide range of academic literature, including research articles, journals, books, and conference papers, by providing relevant recommendations and search results based on users' queries and preferences. Moreover, chatbots can streamline the literature review process by helping users refine their search queries, filter search results, and identify relevant sources more efficiently, saving time and effort. However, Chatbots can provide personalized recommendations for literature based on users' research topics, interests, and previous reading history, helping users discover new and relevant sources that they may not have considered otherwise.

Assistance with Citation Management: Chatbots in education assist users with citation management tasks such as formatting citations, generating bibliographies, and citing sources correctly according to specific citation styles (e.g., APA, MLA, Chicago). Chatbots can provide language support for users who are non-native speakers or who are conducting research in languages other than their primary language, helping them navigate academic literature more effectively. Chatbots can offer guidance and tips on how to conduct a literature review, including strategies for identifying key concepts, evaluating sources, synthesizing information, and structuring the literature review section of a research paper or thesis.

Finally, chatbots can be a valuable tool for literature review assistance, it's important to recognize their limitations and use them as complementary resources alongside human expertise and guidance. Additionally, users should exercise critical thinking and judgment when evaluating the recommendations and information provided by chatbots (see Fig. 1.2).

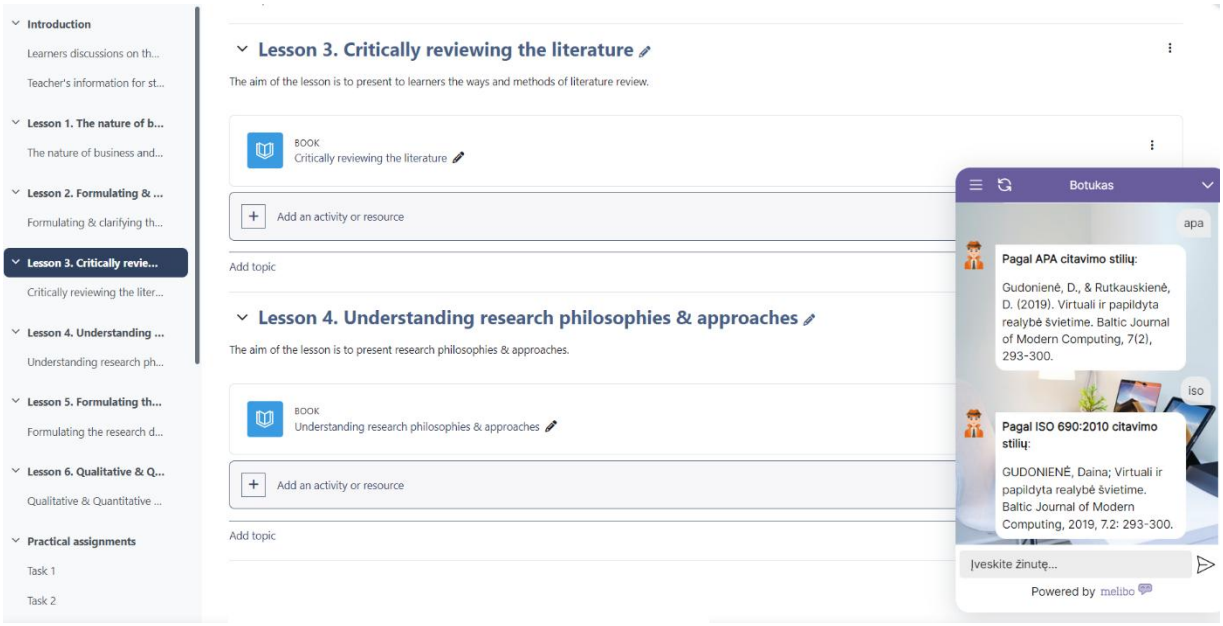

Figure 1.2. *Literature review assistance*

However, there are also limitations and considerations to keep in mind when using chatbots for literature review assistance when chatbots may struggle to understand complex queries, nuances in language, or context-specific research topics, leading to inaccuracies or misunderstandings in their responses.

1.3.3. Conclusions and recommendations

Learning process participants may have concerns about the privacy and security of their data when interacting with chatbots, particularly if sensitive information such as research topics or personal preferences is involved. However, there are many challenges related to technical issues and Chatbots may experience technical glitches, downtime, or compatibility issues with different devices or platforms, which can disrupt the user experience and impede users' ability to access literature review assistance.

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Case Study 1.4: Tutoring for Achieving Learning Outcomes

1.4.1. Introduction

General context of the case study

- Country: Lithuania
- Type of organization: educational organization
- Course/subject/lesson: Master Degree
- Learning model: full-time

Tutoring chatbots have emerged as innovative tools in higher education, revolutionizing the way students receive academic support. These intelligent virtual assistants leverage natural language processing and machine learning algorithms to engage with students in real-time, providing personalized tutoring experiences. One of the key applications of tutoring chatbots is their ability to offer instant assistance with a wide range of subjects, catering to the diverse needs of students pursuing higher education (Ashfaque et al., 2020). Whether it's clarifying concepts, solving problems, or offering guidance on assignments, these chatbots can enhance the learning process by providing immediate feedback and support. Lee et al. (Lee et al., 2020) claim that one of the most important aspects of learning in a university course is questioning, which increases learning effectiveness but also adds to the workload of the teaching team. This paper discusses the design of a chatbot that can respond to students' questions promptly on many popular social media platforms, such as Facebook Messenger, Telegram, and Line, thereby lessening their workload. The chatbot can respond to commands and queries in natural language. Hang (Hang, 2018) also mentions that chatbot can respond to inquiries about course materials and course logistics (such as the class schedule) whenever the professors submit the relevant course-related data to an online database.

According to Hobert (Hobert, 2019), intelligent programming tutors don't have a specific feature set, but the most popular ones are (1) the availability of learning materials (such as tutorials, concept explanations, and formative tests that use quiz questions to probe students' factual knowledge) and (2) automated assessment tools that grade students' homework automatically. The effort of teaching assistants may be decreased, and the degree of support provided by inexperienced programmers may be enhanced by the current e-learning systems. Hobert & Berens (Hobert & Berens, 2023) claim that the purpose of the digital instructor is to automatically assist students in chat conversations using natural language during lecture time. We develop a digital tutor using an iterative design process and

conduct a thorough field evaluation. The findings show that using digital tutors as middlemen in formal education is both applicable and helpful.

Besides their immediate function, tutoring chatbots contribute to the accessibility of education by breaking down geographical barriers (Roos, 2018; Kuisma & Takahashi, 2023). Students can access tutoring services from anywhere, at any time, fostering a flexible and inclusive learning environment. This is particularly beneficial for students who may face challenges attending physical tutoring sessions due to scheduling conflicts or other constraints. Additionally, chatbots can adapt to individual learning styles, tailoring their responses to the unique needs of each student, thus enhancing the efficacy of the learning experience (Kaiss et al., 2023).

Tutoring chatbots also play a pivotal role in promoting self-directed learning. Students that interact with chatbots have the potential to grow in self-awareness because they become more autonomous, self-regulated, and self-directed in their learning, which can enhance academic achievement and overall success. Additionally, by adding self-assessment prompts to instructional chatbots, students can participate in the self-assessment process and get prompt feedback and assistance. This can enhance their metacognitive abilities and encourage deeper learning (Chang, 2023). With so many adult learners enrolled in online courses, especially asynchronous ones that need a high degree of self-directed learning (SDL), artificial intelligence (AI) techniques may be used to improve adult learners' overall learning experiences. Chatbots are a type of artificial intelligence tool that has gained popularity recently. They are computer programs created to mimic human speech. Of all the different kinds of chatbots that are out there, ChatGPT is the newest and most sophisticated. It makes use of cutting-edge artificial intelligence (AI) and natural language processing (NLP) technologies (Lin, 2023).

Based on the study by (Chen et al., 2023), tutoring chatbots can assist students by provinding help with a number of services. Students primarily suggested the following features while discussing how chatbots could assist students with other responsibilities:

Personal tutor

Participants expressed a recurrent necessity to verify key information, encompassing course materials, textbook details, assignment deadlines, study recommendations, and office hour particulars. Additionally, there was a notable desire for chatbots to proffer guidance on course content. The constraint imposed by a low instructor-to-student ratio intermittently impeded participants from obtaining adequate support from their course instructors. Furthermore, instances where students were reticent or hesitant to engage directly with their instructors exacerbated the aforementioned challenge (Chen et al., 2023). It should be noted, however, these days, there are so many tools

accessible to create conversational agents that creating and implementing a chatbot may seem quite easy. Giving the chatbot the right data, though, so it can function as an instructional tutor, can be challenging. As of this writing, there is a dearth of material on designing the tutor, most of it buried in blog posts and papers that concentrate more on the implementation of chatbots than on knowledge modeling and design (Sánchez-Díaz et al., 2018).

Access resources anywhere

The chatbot can be accessed online and readily provides course information. It was discovered that chatbots used in educational settings could supply students with further reading and access to relevant resources when identifying problem areas (Kurni et al., 2023). This accessibility fosters a dynamic and flexible learning environment, catering to diverse student needs and promoting continuous engagement with educational content. As a result, students could study and comprehend the subject matter wherever they were after class (Chen et al., 2023; Hang, 2018).

Study aid

Chatbots in education are effective study aids because they offer instant access to information, providing students with immediate answers to their queries and facilitating on-the-spot learning. Additionally, their 24/7 availability allows learners to receive assistance at any time, promoting flexibility and accommodating different study schedules while also being able to adapt to individual learning styles, offering personalized guidance and targeted resources to enhance comprehension and retention. Chatbots benefit students with limited access to personal instruction and those hesitant to ask questions in class. While they can highlight course content, chatbots have limitations in replicating human interactions. Research suggests they are most effective as supplements to traditional classroom activities (Chen et al., 2023). Nguyen et al. (Nguyen et al., 2019) discuss the applicability of a chatbot to teach Math and state that it can assumes the role of an instructor, offering advice and teaching the student how to solve problems on their own. This application can interact with the student via a chatbot that answers questions. The way that our system tutors kids mimics how teachers actually tutor their pupils.

Chatbots are effective at estimating how often they will correctly answer a question about a service. The primary method by which these chatbots assess this is by counting the proportion of questions they correctly respond to. Conversely, while teaching-oriented chatbots are designed to facilitate learning, their effectiveness cannot be assessed in the same manner (Pérez et al., 2020). The success or failure of a chatbot that tries to encourage computer science learning depends on how well it encourages students to use these studies (Benotti et al., 2017). According to the study by Graesser et

al. (Graesser et al., 2005), AutoTutor produces improvements based on the measure of learning tested. It evaluates the effectiveness of its implementation using two methods: the quality of the dialog it maintains with students and the quality of the pedagogy used (Pérez et al., 2020).

Engage in activity-based learning

Study by (Chen et al., 2023) indicates that according to student respondents, more activity-based learning is needed so they may learn by doing rather than just reading or hearing about it. Some students find that this method of learning is more effective because it enables them to make connections between the stuff they study in textbooks and real-world instances.

Two key ideas in education are self-regulated learning (SRL) and active learning. Important pedagogical judgments are guided by these two notions when teachers organize their lesson plans and learning objectives. The term "active learning" describes student-centered tasks that demand knowledge analysis, synthesis, and evaluation in contrast to passive information consumption through texts or lectures (Lin & Chang, 2023).

By encouraging students to ask questions and seek help independently, these chatbots empower learners to take control of their academic journeys. This fosters a sense of autonomy and responsibility, skills that are crucial for success in higher education and beyond. As technology continues to evolve, the applications of tutoring chatbots in higher education are likely to expand, contributing to the ongoing transformation of the learning landscape.

Impact on learning outcomes

According to recent studies, ChatGPT and other AI-chatbots could significantly alter education, especially when it comes to assessment and evaluation procedures (Zhai, 2022). Numerous research testing ChatGPT demonstrate the potential advantages of AI chatbots for education, offering fresh perspectives and methods of instruction (Mollick, E. R., & Mollick, L., 2022; Nikolic et al., 2023). These results, however, indicate that more empirical study is needed to fully understand the implications, difficulties, and dangers of AI chatbots in educational environments.

Chatbots encourage students to complete the necessary learning tasks so they can acquire the desired knowledge or skill at the cognitive level by using the question-and-answer format. Along these lines, interacting with chatbots has the potential to affect how engaged students are in reading activities because they can act as human reading companions, offering guidance and emotional support to encourage students to reflect on the stories they are reading (Liu et al., 2022).

Study by Wu & Yu (Wu & Yu, 2023) indicates that research findings underscored a noteworthy distinction in the impact of AI chatbots on different educational levels, highlighting that college students emerged as the primary beneficiaries of this technology. The effectiveness of AI chatbot assistance appeared to taper off when applied to primary and secondary school children, casting doubt on the assumption that such interventions would lead to superior learning outcomes in comparison to students without such support. This nuanced observation prompts a reevaluation of the appropriateness of AI chatbots across diverse educational stages. Farazouli et al. (Farazouli et al., 2023) also make an observation that ChatGPT may affect how university instructors evaluate their students by making them more skeptical and critical of their writing and by casting doubt on their ability to read students' texts. Participants' views of the texts' quality are influenced by their mistrust of ChatGPT-generated material, as seen by the increased level of critical thinking. Downgrading reflects these shifts in how the text is viewed as lower quality. Researchers have found that because the participants were aware of the possible application of ChatGPT in the texts that were given to them, they were more likely to evaluate in a different way than they often would.

It should be noted, however, that international students are significantly impacted by the development of AI educational apps, therefore higher education institutions need to weigh the benefits and drawbacks of implementing them. It is critical to understand that AI is not a one-size-fits-all solution and that its application should take into account the particular requirements and cultural variances of overseas students. Regardless of the backgrounds or situations of students, this strategy enables universities to offer a more inclusive, accessible, and practical educational experience. In the end, educational institutions should see AI as a tool that complements the crucial role that human educators play in helping and mentoring overseas students as they pursue their academic goals (Wang et al., 2023).

1.4.2. Case study description: Tutoring for Achieving Learning Outcomes

Chatbots can offer instant feedback on students' responses, helping them understand their mistakes and learn from them in real-time. This immediate feedback fosters a dynamic learning environment and encourages active engagement with the material. Chatbots are used for tutoring more accessible to students who may have difficulty accessing traditional tutoring services due to geographical constraints, scheduling conflicts, or other barriers. With chatbots, students can receive tutoring support anytime and anywhere with an internet connection. Chatbots have the potential to scale tutoring services to reach a large number of students simultaneously. They can handle multiple interactions concurrently, making them an efficient and cost-effective solution for educational institutions with limited resources.

Chatbots can collect and analyze data on students' learning progress, performance trends, and areas of difficulty. This data can inform instructional decisions, help identify areas for improvement, and guide the development of targeted interventions to support student learning outcomes. Chatbots can also serve as engagement and motivation tools, i.e., Chatbots can engage students in interactive learning experiences through gamification, simulations, and conversational interfaces. By incorporating elements of fun and interactivity, chatbots can enhance student motivation and retention of key concepts and not only. We are providing tutoring example in the figure bellow.

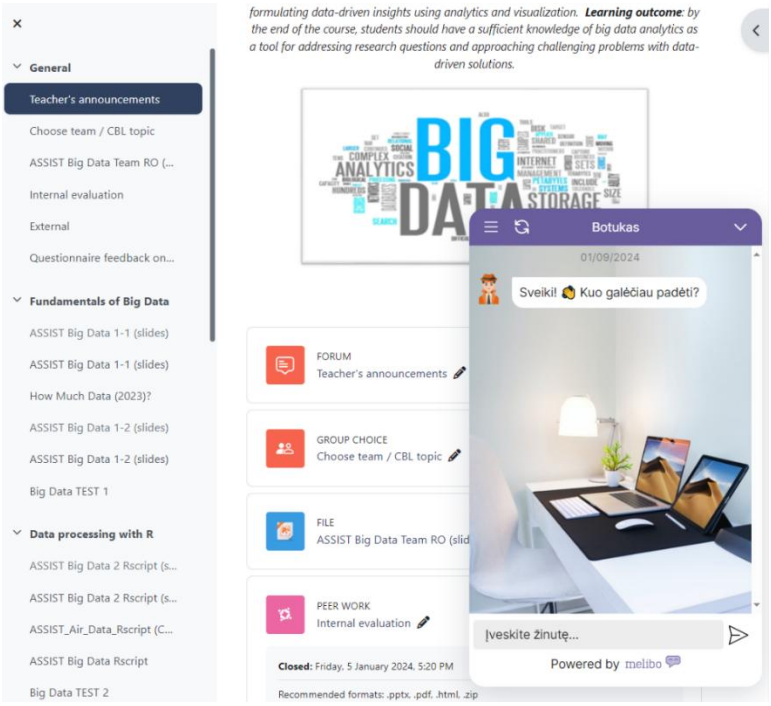

Figure 1.3. *Tutoring for Achieving Learning Outcomes*

1.4.3. Conclusions and recommendations

In summary, chatbots have the potential to enhance tutoring experiences and support student learning outcomes by providing personalized, scalable, and accessible support. However, it's crucial to address technical, ethical, and pedagogical considerations to maximize their effectiveness and ensure positive learning experiences for students.

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CHAPTER 2: Development of Mathematical, Technical Skills and Creativity Using AI Tools

Case study 2.1: Mathematics role in engineering

2.1.1. Introduction

Mathematics plays a crucial role in engineering, serving as the foundation upon which engineers build and apply their knowledge to solve real-world problems. Mathematics provides a framework for developing reasoning skills and enables engineers to break down complex problems into smaller, more manageable components.

However, math is one of the most complex and difficult subjects to study. Students face a number of challenges in learning mathematics. These challenges range from individual differences in learning styles to the need for individual attention to understand mathematical concepts.

2.1.2. Case study description

This case study describes some of the popular AI-based tools on the market for use in mathematics education in terms of their capabilities, availability and prospects for use.

Wolfram Alpha

Wolfram|Alpha a is an answering system developed by Wolfram Research. It is offered as an online service that answers actual questions by computing answers from external data. Wolfram|Alpha was released on May 18, 2009, and is based on Wolfram's earlier product Wolfram Mathematica, a technical computing platform.

Wolfram|Alpha uses natural language processing technology, part of the family of artificial intelligence, to provide students with an academic assistant that is faster than a teacher, more reliable than copying answers from friends, and much easier than finding a solution on your own. Users submit questions and requests for calculations via a text box. Wolfram|Alpha then computes answers and corresponding visualisations from a knowledge base of collected structured data from other websites and books. It can answer specifically formulated questions based on natural language facts. It displays its 'input interpretation' of such a question using standardised phrases. It can also analyse mathematical symbolism and respond with numerical and statistical results.

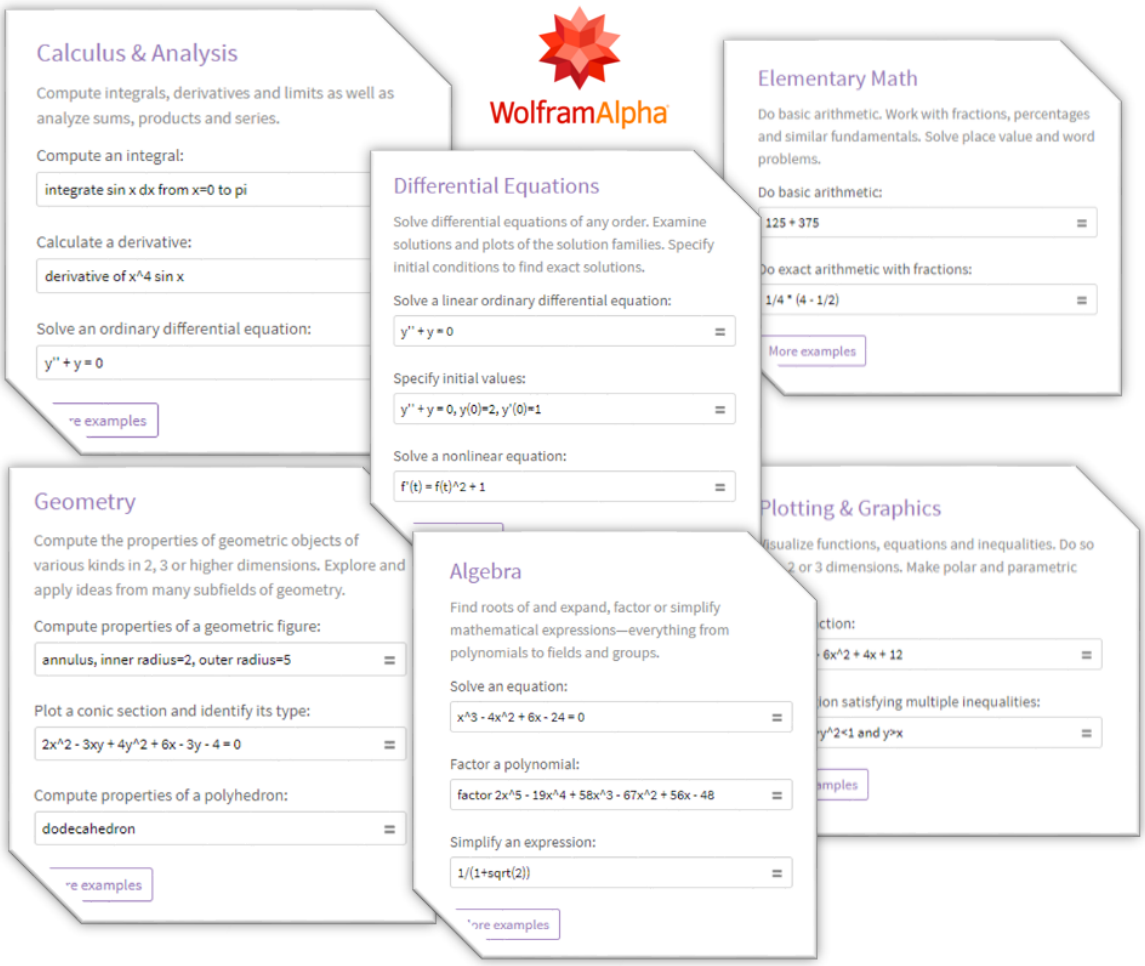

Figure 2.1. *Key features of Wolfram|Alpha*

Using Wolfram|Alpha is similar to doing a Google search, but Wolfram|Alpha provides specific answers rather than pages of potentially relevant results. Anyone can go to Wolfram|Alpha, type a question or equation into the dialogue box, press Enter, and get the answer (Wired, 2017). If you are trying to solve an equation, Wolfram|Alpha will provide the root of the equation, alternative forms and the solution. For step-by-step explanations, a professional version is available for $6.99 per month, with discounts for students and teachers (Wolfram Alpha, 2024; Wikipedia).

Khan Academy

Khan Academy is an American non-profit educational organization created in 2006 by Sal Khan. Its goal is to create a set of online tools that help educate students. The organization produces short video lessons. Its website also includes supplementary practice exercises and materials for educators. The videos enable students to acquire knowledge at their own learning speed according to the concept of mastery learning. They are therefore used by teachers to teach according to the principle of Flipped Classroom.

Figure 2.2. *Khan Academy and Khanmigo chatbot interface*

Created by Khan Academy, chatbot Khanmigo helps students with various subjects, and also lets them talk with famous historical figures. The chatbot offers individualized guidance to students on math, science and humanities problems; a debate tool with suggested topics like student debt cancellation and AI's impact on the job market; and a writing tutor that helps the student craft a story, among other features.

Employing adaptive learning technology, Khanmigo utilizes AI algorithms to tailor mathematical content based on individual student performance. By dynamically changing the difficulty of tasks and providing real-time feedback, the platform helps to ensure that each student receives a personalised learning experience, fostering a deeper understanding of mathematical concepts. Khanmigo's chatbot is actively used in many schools around the world.

First launched in March 2023 to an even smaller pilot program of around 800 educators and students, Khanmigo also allows students to chat with a growing list of AI-powered historical figures, from George Washington to Cleopatra and Martin Luther King Jr., as well as literary characters like Winnie the Pooh and Hamlet.

Khanmigo is at his best when teaching students about mathematics, specifically how to solve a problem, offering hints, encouragement and additional questions to help students think critically. At present, however, his own difficulties in performing calculations sometimes interfere with his attempts to help (Khanmigo, 2024; Wikipedia).

This is not a free bot, and costs $4 per month or $44 per year.

Symbolab

Symbolab is another example of supporting students in learning mathematical concepts. It is an educational software resource that supports intelligent didactics through Android mobile devices and a web-based system. It was published in 2011 by three Israelis - Michal Avni, Adam Arnon and Lev Alishaev - and is operated by EqsQuest Ltd. Symbolab uses artificial intelligence to interpret and simplify user queries, providing step-by-step solutions and detailed explanations in a variety of mathematical areas. Its interactive graphing and mathematical symbol recognition capabilities create an intuitive and engaging platform for learning and understanding complex mathematical concepts.

The application solves maths and science problems in areas such as pre-algebra, algebra, pre-calculus, trigonometry, statistics, physics, chemistry, finance and economics. It is also a huge database with over a billion maths problems and explanations. Symbolab offers a suite of educational resources including practice problems, quizzes, and tutorials. This integrated approach to learning helps students reinforce what they have learnt through a variety of exercises. Symbolab's adaptive learning paths cater to individual learning styles, allowing users to progress at their own pace and receive personalised guidance based on their interaction with the platform.

Symbolab Calculator provides automatic step-by-step answers to algebraic, trigonometric and calculus questions. It can be useful for solving conversions, simultaneous equations, equations, graphs, inequalities, integrals, derivatives, limits, and linear and quadratic equations.

One of the main components of the SymboLab manipulative is the Graph Utility package. The Graph Utility is designed to plot various types of graphs, including quadratic graphs. To access some of the more useful parts of SymboLab (practice questions, quizzes, unlimited notepad), a paid subscription is required (Symbolab, 2024; Wikipedia).

Photomath

Photomath is one of the most widely used apps for learning math, with over 220 million downloads and millions of problems solved every month. With its powerful features and easy-to-use interface, Photomath has become a popular tool for students of all ages looking for help with complex math problems. Harnessing the power of modern smartphones and artificial intelligence, Photomath allows users to solve mathematical equations by simply pointing their phone's camera at the problem. Using the smartphone camera, users can easily capture equations from textbooks, worksheets or even handwritten notes and instantly receive step-by-step solutions.

One of the most engaging features of Photomath is the comprehensive step-by-step explanations. When the software solves an equation, it doesn't just give the final answer, it breaks down the process into individual steps and shows the algorithm for solving the problem. This detailed approach allows students to understand the concepts and methods used, improving their problem solving skills and developing a deeper understanding of the subject matter. This approach enhances visual learning by providing immediate feedback and reinforcing understanding through practice and additional exercises.

Photomath supports a wide range of maths topics, from basic arithmetic and algebra to more complex calculus and trigonometry, making it a versatile tool for students at different levels. The easy-to-use, intuitive app is suitable for students of all ages, as well as parents and teachers, and helps make learning maths as accessible as possible (Photomath, 2024; Wikipedia).

The app provides enough support for users to ensure that they can get help with their maths problems. One of the main problems with Photomath is that students should use it as a study aid, not for quick problem solving. In practice, it is used for cheating, which can lead to dependency on the application and discourage independent thinking. In addition, Photomath does not provide comprehensive teaching of basic mathematical concepts, which require a balanced approach alongside regular classroom activities and study. When combined with traditional teaching methods and learning objectives, it can be used to check progress regularly. Teachers have a key role to play in explaining the ethical implications and creating a culture of active participation and understanding (Mastery, T. (n.d.)).

The basic Photomath app is free for download and offers solutions and step-by-step explanations to equations. Users can also purchase the upgraded Photomath Plus, which gives access to teacher-approved animated tutorials, exclusive math tips and definitions, custom visual aids and word problem solutions for $9.99 per month or $59.99 for the year.

Cognitive Tutor

Cognitive Tutor, an intelligent tutoring system developed by Carnegie Mellon University, has made significant strides in supporting students in grasping mathematical concepts. The name of Cognitive Tutor now usually refers to a particular type of intelligent tutoring system produced by Carnegie Learning for high school mathematics based on John Anderson's ACT-R theory of human cognition. However, cognitive tutors were originally developed to test ACT-R theory for research purposes since the early 1980s and they are developed also for other areas and subjects such as computer programming and science. The aim was to "...develop systems that provide individualized assistance to students as they work on challenging real-world problems in complex domains such as computer

programming, algebra and geometry". PACT's most successful product was the Cognitive Tutor Algebra course. Originally created in the early 1990s, this course was in use in 75 schools through the U.S. by 1999, and then its spin-off company, Carnegie Learning, now offers tutors to over 1400 schools in the U.S.

The Cognitive Tutor programs utilize cognitive model and are based on model tracing and knowledge tracing. Model tracing means that the cognitive tutor checks every action performed by students such as entering a value or clicking a button, while knowledge tracing is used to calculate the required skills students learned by measuring them on a bar chart called Skillometer.

Model tracing and knowledge tracing are essentially used to monitor students' learning progress, guide students to correct path to problem solving, and provide feedback. Cognitive Tutors can be implemented into classrooms as a part of blended learning that combines textbook and software activities (Cognitive Tutor, 2024; Wikipedia).

DreamBox

DreamBox, an adaptive maths software for elementary school learners, introduces gamification to the process of learning maths concepts. DreamBox Learning is an American online software provider specialising in primary and secondary school maths learning. Using artificial intelligence, DreamBox creates personalised learning paths embedded in immersive gaming environments. Through interactive scenarios and real-time feedback, DreamBox not only guides learners in solving mathematical problems, but also motivates them to explore and master new concepts.

The effectiveness of DreamBox is based on an adaptive learning system that tailors learning paths to the individual learner's progress. This adaptive approach provides a personalised approach to learners, taking into account their unique needs and challenges. For example, if a learner has difficulty understanding fractions, DreamBox will dynamically adjust the training process to provide targeted support in mastering that particular concept.

DreamBox is committed to making maths not only educational, but also fun. The platform includes interactive and gamified modules that turn abstract mathematical concepts into engaging challenges. Learners work their way through these modules by solving problems and completing tasks in a game-based way. This not only reinforces maths skills, but also promotes a sense of achievement and motivation (DreamBox, 2022; Wikipedia).

2.1.3. Conclusions and recommendations

Current methods of integrating AI into education are bringing tangible benefits and demonstrate the potential to improve traditional teaching methods, including in technical subjects. There are many innovative AI-based products on the market designed to improve understanding of mathematics.

The success stories of platforms such as Khan Academy, Wolfram Alpha and others demonstrate the effectiveness of AI in meeting individual learning needs, providing personalised guidance and deeper understanding of mathematical concepts. The products offer a variety of features, instantly scanning maths problems - from arithmetic to calculus - and using step-by-step explanations to help students understand and remember solution methods.

Recommendations for educators and institutions include developing collaborations with industry leaders to keep abreast of the latest advances in the application of AI in education. Developing the skills of educators to enhance teaching with AI tools will also ensure a smooth transition to technology-enhanced learning environments.

However, the integration of AI into the educational environment should not be seen as a replacement, but as a complement to traditional teaching methods, enhancing the overall learning process. It is important to raise educators' awareness of errors, unethical use of AI, effective methods of assessing students' competences and whether AI tools contribute to learning objectives. Educators should motivate students to see AI-based learning tools as complementary to other teaching methods, rather than as shortcuts to tasks and substitutes for student competence.

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Case study 2.2: Utilizing AI to Enhance Technical Skills and Creativity

2.2.1. Introduction

Artificial Intelligence has changed the way engineers and designers approach computer-aided design and modeling (not only automation but predictive modeling, generative design, etc.). AI can explore large design spaces, free designers from repetitive tasks, optimize designs, predict potential problems, and support faster iteration cycles.

2.2.2. Case study description

The dynamic interplay between technical skills and creative expression calls for a paradigm shift in education as well. This case study explores associated aspects.

Programming skills training and enhancement

Computer programming is the foundation of the digital world, which is expanding into more and more areas every day. Having strong programming skills is one of the most sought-after skills in today's labour market and an essential competency for many industries. As a result, programming training is being offered on a wide scale, from programming for young children to advanced training in the concept of lifelong learning. With computer programming skills, people can create new technologies and digital tools to drive innovation and economic growth.

Artificial intelligence-based programmes can greatly enhance the learning of programming students. AI-based code editors and integrated development environments (IDEs) analyse user-written code and provide useful suggestions, automated features and real-time error detection. AI can analyse patterns in student code to identify common errors and suggest improvements. Automated testing saves time and resources and ensures the delivery of high-quality software. In addition, the continuous improvement of AI-based debugging tools promises to significantly reduce development time and make programming more efficient.

AI-based platforms can also simulate real-world coding environments, allowing students to engage in hands-on projects. Such simulations can include interactive coding exercises, debugging scenarios and project-based learning modules that mirror professional programming challenges. By working on realistic problems, students gain valuable experience and confidence, better preparing them for their future careers (Gershgorn, 2021; Finnie-Ansley et al., 2022; OpenAI, 2023).

Some popular specialist products in this area include Amazon Code Whisperer, GitHub Copilot, Codex, TabNine.

- **Amazon Code Whisperer**, a new cloud-based feature provided by Amazon Web Services, is an AI-based programming tool that can generate both single-line and complete sentences of code in real time.

  CodeWhisperer runs within a developer's main integrated development environment (IDE). As developers write their code, they typically leave notes or comments in natural language, describing, for example, the purpose of the next block of code, or even the overall goal of the programme. The system looks not only at the code already written in the IDE, but also at the developer's comments, and then suggests in real time what it predicts the next piece of code will be useful for.

  CodeWhisperer can be used with Visual Studio 2022, and currently supports these languages: C, C++, and C#. It's available in two tiers, Professional and Individual (which is free to use). (Amazon CodeWhisperer, 2024).

- **GitHub Copilot** is a code completion tool developed by GitHub and OpenAI in 2021 to help users of Visual Studio Code, Visual Studio, Neovim, and JetBrains integrated development environments autocomplete code.

  According to the developer, GitHub Copilot offers implementations for many languages and a wide range of frameworks, but works particularly well for Python, JavaScript, TypeScript, Ruby, Go, C#, and C++. GitHub Copilot can also help create database queries or suggest APIs and frameworks to use. Copilot offers coding suggestions while typing: either completing the current line or a whole new block of code. The user can accept all or part of the suggestion, or ignore it and continue typing. Using the chat function, it is possible to ask Copilot how best to solve the problem. It is also possible to ask Copilot to explain existing code. Copilot can help find and fix bugs in the code.

  GitHub Copilot requires a monthly subscription costing $10 for individual use and $50 for commercial teams. Verified students, teachers, and maintainers of popular open source projects on GitHub are eligible to use Copilot Individual for free (Github, 2022).

- **OpenAI Codex** is an artificial intelligence model developed by OpenAI in 2021. It analyses natural language and generates code in response.

According to the OpenAI team, Codex is an enhanced version of GPT-3, which focuses mainly on coding. Compared to GPT-3, Codex has undergone additional training on 159GB of Python code from around 50 million publicly available GitHub repositories. OpenAI claims that while Codex is best suited for Python, it is also well adapted to work in other programming languages, including JavaScript, Perl, PHP, Ruby, Shell, Swift, TypeScript. OpenAI Codex can be used for a wide range of functions such as generating code, extending code, generating comments in an existing project base, refactoring code, translating code from one language to another.

Codex starts with a free version that covers the basic features. Paid packages with additional features start at $20 per month (OpenAI, 2023).

- **TabNine AI** is an artificial intelligence-based programming assistant developed by Tabnine, a company founded in 2013 in Tel Aviv, Israel.

  TabNine AI offers options such as local hosting, cloud integration in GCP or AWS, optional private code completion models, and AI-powered unit test generation. It is designed to improve the productivity, accuracy and efficiency of development teams. Starting in 2024, the company has announced new capabilities to provide personalised recommendations for each developer. According to the company's website, Tabnine can leverage the context of users and enterprise customers to provide more accurate and personalised recommendations for code generation, code explanations and guidelines, as well as test generation and documentation.

  TabNine AI offers three plans: Basic, Pro, and Enterprise. The Basic plan is free, while the Pro plan costs $12 per user per month with a 90-day free trial. The Enterprise plan is priced at $39 per user per month (TabNine, 2024).

CAD tools

Artificial intelligence is used in many fields, and modelling and design are no exception. Technology companies are harnessing the power of AI to improve the accuracy and speed of modelling, making the associated workflow both robust and easy to use.

Software products use AI algorithms to generate multiple variations of designs based on user-defined objectives. They then present the permutations in a single interface, allowing the user to visually evaluate them. In addition, some products have evaluation metrics that simplify the comparison process. This is known as generative design, and it uses automation to provide a better understanding of the design so that decisions can be made faster and better. Whereas traditional design relies on a

model based on the engineer's experience and knowledge, generative design is based on a set of parameters from which the artificial intelligence itself generates different models.

Generative design software is powerful and can be used in any manufacturing environment. It has a number of undeniable advantages, but CAD-embedded applications also look promising. With them, engineers working on projects can significantly enhance their solutions without going beyond their own modelling system.

Designers can reduce the weight of individual components, reduce production costs, create optimal scalability and increase productivity.

- **AutoCAD**, the flagship CAD software developed by Autodesk, uses AI to optimise design workflows.

  Available in Autodesk products and built for the Design and Make Platform, Autodesk AI provides intelligent assistance and generative capabilities that allow customers to imagine and explore freely, creating accurate, precise and innovative results. Through machine learning algorithms, it helps designers automate repetitive tasks, suggest design optimisations and even predict potential problems. Through AI, it extends the power of software to conceptualise and iterate designs faster.

  The Autodesk AI team is positioning these capabilities as a technology that unlocks creativity, helps solve problems, and eliminates unproductive work in industries that design and build the world around us. These can be used for a wide range of tasks [8]:

  Autodesk Forma provides rapid wind, noise, and operational energy analysis so you can make smart early-stage planning and design decisions that improve outcomes.

  In InfoDrainage, the Machine Learning Deluge Tool gives feedback on the best placement for retention ponds and swales to help prevent or reduce the impact of water disasters.

  AutoCAD leverages AI to help drafters iterate faster by reading handwritten and digital markups, and determining the intent of the user to recommend context-aware actions to easily incorporate changes.

  Construction IQ harnesses AI to predict, prevent, and manage construction risks that might impact quality, safety, cost, or schedule.

  In Autodesk Fusion, customers can automatically generate product designs that are optimized for manufacturing method, performance, cost, and more.

Generative scheduling in Autodesk Flow automates scheduling for media and entertainment productions by managing the constantly shifting variables between teams and budgets. Generative scheduling produces results in minutes for a process that has traditionally taken days, enabling teams to predict, plan, and right-size resources to ensure creative bandwidth where needed.

Autodesk Flame uses AI technology to automate manual tasks for artists like keying, sky replacement, beauty work, and camera tracking.

Through a collaboration with Wonder Dynamics, AI will power a Maya plug-in used to automatically animate, light, and compose computer-generated characters for live-action scenes (Autodesk, 2023).

- **SolidWorks**, another major player, is also using artificial intelligence to improve design quality.

  SolidWorks is a computer-aided design (CAD) software package designed to automate the work of industrial companies at the design and technological preparation stages of production. It enables the development of products of any complexity and purpose. Operates in the Microsoft Windows environment. Developed by SolidWorks Corporation, an independent division of Dassault Systemes (France) since 1997.

  SolidWorks software includes the basic configurations SolidWorks Standard, SolidWorks Professional, SolidWorks Premium, as well as various application modules, such as for engineering data management (SolidWorks Enterprise PDM), engineering calculations (SolidWorks Simulation) Professional, SolidWorks Simulation Premium, SolidWorks Flow Simulation), electrical design (SolidWorks Electrical), interactive documentation development (SolidWorks Composer), machining, CNC (CAMWorks), UE verification (CAMWorks Virtual Machine), quality control (SolidWorks Inspection), manufacturability analysis (SolidWorks Plastics, DFM, etc.), non-drawing technologies (SolidWorks MBD) and others.

  For example, SOLIDWORKS CAM has the ability to automatically generate a part's manufacturing toolpath after design. The CAM software uses the CAD models to generate the toolpaths that drive computer numerically controlled (CNC) manufacturing machines. These capabilities help engineers evaluate designs earlier in the design process to ensure they can be manufactured.

  AI and machine learning are also available in 3DEXPERIENCE Works browser-based design and engineering roles such as 3D Creator, in addition to some of the SIMULIA simulation roles.

There's even a procurement solution that uses AI to source product parts to make intelligent make-or-buy decisions and optimise supply chains (Solidworks, 2022).

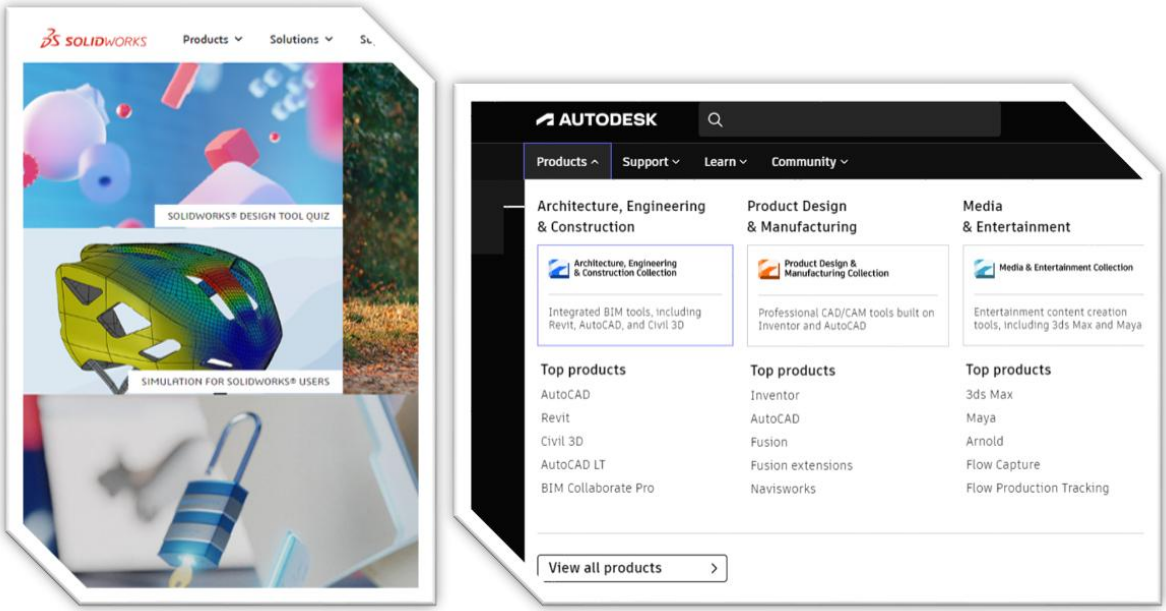

Figure 2.3. *SolidWorks and AutoCAD web pages*

2.2.3. Conclusions and recommendations

Artificial intelligence tools have huge potential in technological fields. This case study explores only a small part of the possible applications of AI.

AI-based programmes can significantly improve the efficiency of students' programming education by taking into account individual needs, developing targeted exercises or using explanatory mechanisms to fill in gaps. Software products on the market can predict the next line of code, suggest code snippets, complete partially written code and help with bug fixes. They can be combined with popular software development tools to automate repetitive activities, improve code, and create web and mobile applications. These tools can help developers, especially beginners, learn best practices and code standards, and optimise code for better performance. For almost all software products on the market, there are free versions with limited functionality and more feature-rich paid versions.

The benefits include time savings, increased productivity, improved code quality, ease of use and integration of different tools. As a result, students can spend less time debugging and more time developing the high-level skills they need to become effective programmers (Gershgorn, 2021).

However, almost all products have the disadvantage of supporting a small number of programming languages, introducing the possibility of bugs and providing incorrect code recommendations. Humans

therefore play a key role in the code review and testing phase to ensure that the code does what it is intended to do, and that it is used to help, rather than harm, society and its vulnerable groups.

CAD, modelling and design software developers are also recognising the power of AI to eliminate repetitive tasks, improve productivity and provide intelligent and useful suggestions. As a result, they are increasingly integrating AI-based solutions into their products (World Economic Forum, 2024).

In the transition to generative design and the construction of complex objects, the designer needs deep software skills and the ability to apply ML and AI to solve their problems. To unlock and maximise the potential of additive technologies, the education system must focus on the dynamic interplay between technical mastery and creative expression.

The AI-based software products on the market are designed to assist designers and engineers, not replace them. They are tools that users should use to free up time for imagination, research, problem solving and creativity.

Recommendations for educators and academic institutions include an emphasis on interdisciplinary approaches, encouraging students to explore the convergence of technical and creative fields by integrating AI-based tools into their courses.

Developing such interdisciplinary thinking will prepare students for the demands of a future in which technical and creative skills are increasingly intertwined.

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Case study 2.3: AI in the context of cybersecurity problems

2.3.1. Introduction

Responding to data security incidents has become more complex due to the massive shift to remote working and the rapid digitisation of business. Cybersecurity professionals are facing an unprecedented number of threats, a record number of attacks, and growing aggression from terrorist organisations and undemocratic governments. The COVID-19 pandemic has created additional cybersecurity challenges for European businesses, as many employees are moving online and digitising much of their work. In this context, the skills shortage is particularly acute.

Recent cybersecurity research shows that artificial intelligence and machine learning are effective in detecting and prioritising threats, detecting malware and, in some cases, performing automated actions to quickly remediate security issues. Artificial intelligence can add strength and provide greater protection, as the volume and complexity of cybersecurity data exceeds human analysis capabilities. Machine learning algorithms can detect early signs of compromise and identify potential threats that may evade traditional security measures.

As a result, effective cybersecurity systems based on artificial intelligence and machine learning technologies require people who can develop, maintain and adapt them as needed.

2.3.2. Case study description

This case study provides a brief description of current trends in AI-based solutions and discusses examples of cyber-attacks and AI-based countermeasures.

Predictive Analytics for Threat Detection

AI-based predictive analytics uses historical and real-time data to anticipate potential threats. Machine learning models analyse patterns and anomalies in network activity. For example, Darktrace's Enterprise Immune System utilizes unsupervised machine learning to detect deviations from normal behavior, identifying potential threats before they escalate. Darktrace's product uses unsupervised (in particular) machine learning techniques to build an intrinsic "pattern of life" for every network, device, and user within an organisation. From this evolving understanding of 'normal', it can then detect potential threats as they emerge in real time. It employs an autonomous response technology, Antigena, to take action against in-progress cyber-attacks. The product also visualises network activity

on a user interface, called the 'Threat Visualiser'. Since the company's inception in 2013, its technology has been deployed some 9,000 times (Darktrace, 2023; Wikipedia).

Darktrace Cyber AI Platform consists of two flagship products and four data analysis modules:

Enterprise Immune System which understands the DNA of a company at a granular level to detect threats and Cyber AI Analyst to automate higher level processes of investigating threats;

Antigena, the first autonomous response system for defending customers from machine-speed attacks, takes action with surgical precision and control either directly or through integration with firewalls or SOAR products; and Data analysis modules include Cloud/SaaS, Email (Office 365, G-Suite), Industrial/IoT (including legacy devices and smart sensors), and on-premise and virtualized networks.

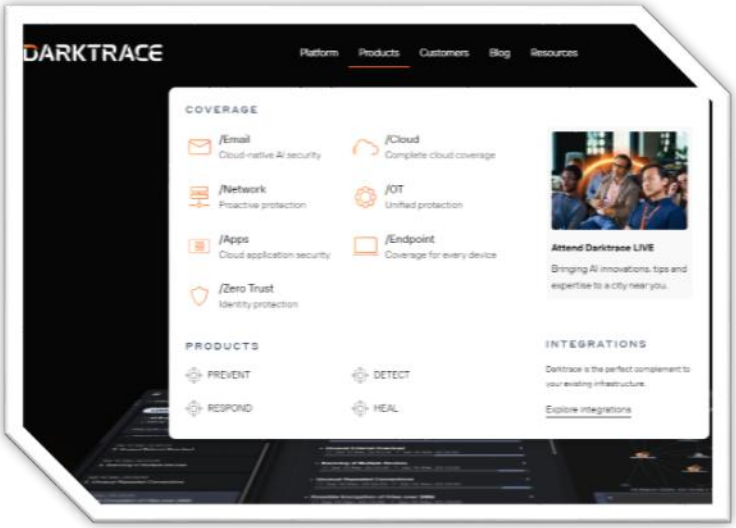

Figure 2.4. *Darktrace web page*

Practical Insight: *A notable example is the Stuxnet worm. It is the first known computer worm to intercept and modify the flow of information between programmable logic controllers and supervisory control and data acquisition (SCADA) systems workstations. The worm could be used as a means of unauthorised data collection (espionage) and sabotage in automated control systems of industrial companies, power plants, airports, etc. It was discovered in 2010. It was unique in that, for the first time in the history of cyber-attacks, the virus physically destroyed infrastructure. Its specific nature and targeting highlighted the potential for cyber-attacks to impact critical infrastructure. In this case, predictive analytics could have proactively detected the anomalous behavior of the malware, preventing its destructive impact on industrial systems (Wikipedia, 2024).*

By establishing a baseline of normal activity within an organization, Darktrace can identify deviations and anomalies, whether they are known or unknown threats. This adaptive approach enables the

detection of both common and sophisticated cyber-attacks. Darktrace's effectiveness extends to its autonomous response capabilities. The system not only identifies threats but can also take proactive measures to mitigate risks, contributing to a more robust cybersecurity posture. This emphasis on autonomy aligns with the company's commitment to staying ahead of evolving cyber threats.

Behavioral Analysis for Anomaly Detection

Behavioral analysis powered by AI scrutinizes user activities and system behavior, identifying deviations from established patterns. Solutions like Exabeam use machine learning to create baseline profiles, swiftly flagging abnormal activities that might indicate a security breach.

Exabeam stands as a comprehensive cybersecurity platform, seamlessly integrating Security Information and Event Management (SIEM), User and Entity Behavior Analytics (UEBA), and Security Orchestration, Automation, and Response (SOAR). Exabeam employs advanced behavioral analytics, powered by machine learning and data science, to establish baselines of normal behavior and detect subtle anomalies indicative of potential security threats (Exabeam, 2023).

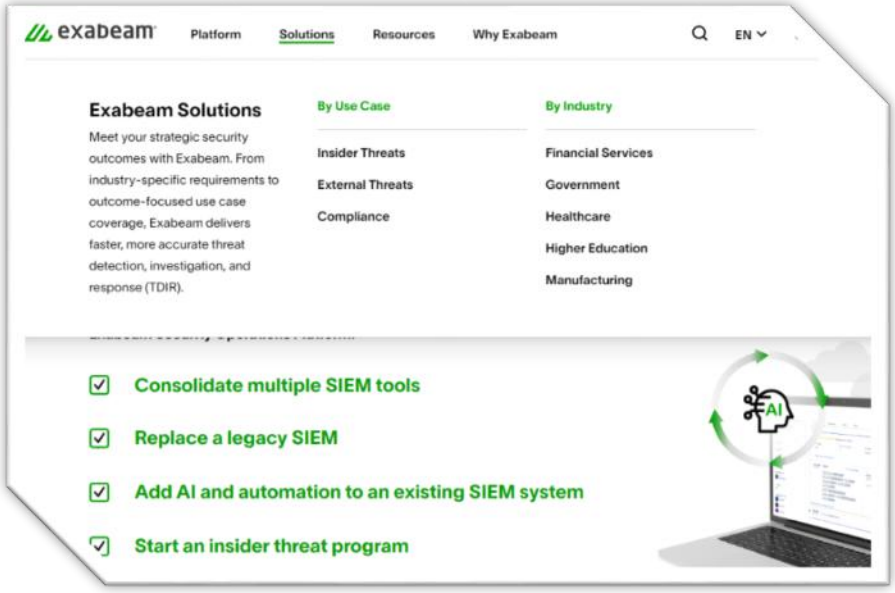

Figure 2.5. *Exabeam web page*

Practical Insight: *The Target data breach occurred in 2013, where attackers gained access to the retailer's network through a third-party HVAC vendor. The attackers installed malware on Target's point-of-sale systems, compromising credit card information and personal data of millions of customers. This incident underscored the significance of supply chain vulnerabilities in cybersecurity. In the case of the Target data breach, behavioral analysis could have identified unusual patterns in network access, preventing the compromise of sensitive customer data (Wikipedia, 2023).*

Exabeam SIEM extends the cloud-scale capabilities of Security Log Management with advanced features for threat detection, investigation and response (TDIR). In addition to its massively scalable ingestion, storage and intelligent search capabilities across petabytes of hot, warm or cold data in seconds, Exabeam SIEM includes Alert and Case Management over 100 pre-packaged correlation rules and the ability to write and test your own.

The platform's SIEM capabilities aggregate and analyze log data from diverse sources, providing security teams with a centralized, real-time view of their IT environment. Incorporating UEBA, Exabeam focuses on understanding user and entity behavior, enabling the identification of insider threats and malicious activities. The platform's adaptive learning ensures continuous refinement, enhancing its ability to detect evolving cybersecurity risks. Exabeam's SOAR features streamline incident response, automating routine tasks and allowing security teams to concentrate on strategic aspects of threat mitigation. The user-friendly interface and intuitive visualizations empower security analysts to quickly identify and respond to security incidents.

Adaptive Response Mechanisms

AI's adaptive response mechanisms ensure dynamic adjustments to cybersecurity defenses based on evolving threats. Security orchestration and automated response (SOAR) platforms like Palo Alto Networks Cortex XSOAR utilize AI to streamline incident response workflows, enabling faster and more effective reactions to security incidents.

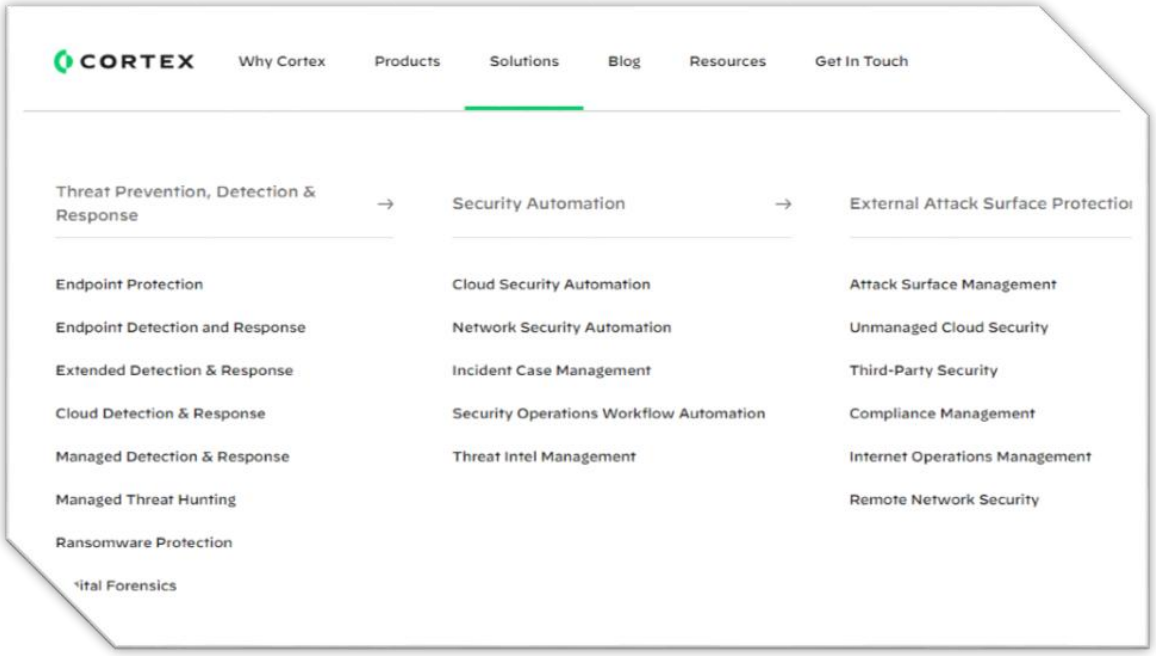

Figure 2.6. *Palo Alto Networks web page*

Practical Insight: *WannaCry Ransomware Attack, a global ransomware attack in 2017, exploited a vulnerability in Microsoft Windows systems. The malware propagated rapidly across networks, encrypting files and demanding ransom payments in Bitcoin for decryption keys. The attack impacted organizations worldwide, including healthcare systems and critical infrastructure, highlighting the widespread consequences of unpatched vulnerabilities. The WannaCry attack could have been mitigated more efficiently with AI-driven adaptive response, which could automatically identify and quarantine infected systems, minimizing the ransomware's impact.*

Palo Alto Networks Cortex XSOAR is a comprehensive security orchestration, automation and response (SOAR) platform designed to improve the efficiency and effectiveness of incident response processes. This unified platform architecture seamlessly integrates playbooks, workflows, threat intelligence and case management into a centralised hub, providing security teams with a holistic view of incidents (Palo Alto Networks, 2023).

Central to Cortex XSOAR are its adaptable playbooks. These predefined sequences of automated and semi-automated tasks guide security analysts through incident response workflows. Automation is a key element, enabling the platform to perform repetitive tasks, gather critical information and initiate response actions with precision.

To ensure that security teams have real-time, contextual information about emerging threats, Cortex XSOAR integrates with threat intelligence feeds. This integration enables analysts to correlate incidents with external intelligence, facilitating informed decision-making and enabling prioritised responses based on the latest threat landscape.

Cortex XSOAR includes robust case management capabilities to facilitate cooperation between investigators. Analysts can work together within the platform, sharing insights, assigning tasks and documenting the entire incident response process. This collaborative approach ensures a consistent and well-documented response to each incident. Cortex XSOAR's user-friendly interface improves accessibility and usability for security analysts. The intuitive design of the platform facilitates efficient navigation and utilisation of its powerful features.

Machine Learning for Intrusion Detection

Machine learning algorithms play a crucial role in identifying and preventing intrusions. Security solutions like Snort, enhanced with machine learning capabilities, analyze network traffic patterns to detect potential intrusion attempts in real-time. Snort, developed by Cisco, is a widely-used open-source intrusion detection and prevention system (IDPS). Renowned for its flexibility and robust capabilities, Snort is a crucial tool for network security professionals aiming to safeguard their networks from various cyber threats.

Snort operates as a packet sniffer and analysis tool. It monitors network traffic in real-time, scrutinizing packets for patterns and signatures indicative of known threats or malicious activities. Its versatility allows it to function as both a Network-Based Intrusion Detection System (NIDS) and a Network-Based Intrusion Prevention System (NIPS), offering options for passive monitoring or active prevention (Snort, 2023).

The strength of Snort lies in its signature-based detection approach, where predefined signatures or rulesets are employed to identify specific patterns associated with known attacks. Additionally, Snort supports the creation of custom rules, enabling organizations to tailor the system to their unique network environments and security requirements.

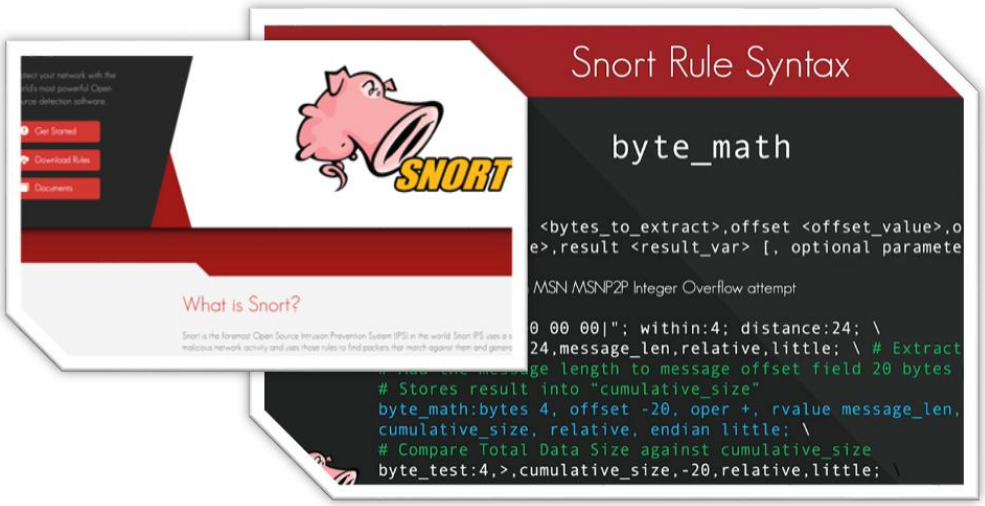

Figure 2.7. *Snort web page*

Practical Insight: *The Equifax data breach occurred in 2017, exposing sensitive personal information of nearly 147 million individuals. Attackers exploited a vulnerability in the Apache Struts web application framework to gain access to Equifax's systems. The breach raised concerns about the security of consumer data held by major credit reporting agencies. The Equifax data breach, could have been mitigated with machine learning intrusion detection, identifying and blocking malicious activities.*

Snort's modular architecture allows users to extend its functionality through the inclusion of preprocessors, detection plugins, and output plugins. This extensibility enhances its adaptability to evolving cybersecurity landscapes. Usage of Snort typically involves the installation and configuration of the software on a designated server or appliance within the network. Security professionals define rulesets or customize signatures based on their network's characteristics and potential threats. Snort can operate in different modes, such as sniffer mode, packet logger mode, or inline mode, depending on the desired level of intrusion detection and prevention. The generated alerts and logs by Snort provide valuable insights into potential security incidents, aiding analysts in identifying and responding to threats promptly. Integrations with security information and event management (SIEM) systems further enhance its efficacy, allowing for centralized monitoring and correlation of security events.

In essence, Snort's open-source nature, combined with its robust signature-based detection, extensibility, and real-time analysis, positions it as a versatile and powerful tool in the arsenal of network security professionals. Exploring Snort involves not only understanding its installation and configuration but also delving into the fine-tuning of rulesets to align with specific network security needs and staying abreast of the latest threat intelligence to continuously enhance its effectiveness.

Advanced Threat Intelligence Platforms

In the field of Advanced Threat Intelligence Platforms (ATIPs), several solutions offer diverse capabilities to help organizations enhance their cybersecurity posture. Each platform comes with unique features, integrations, and methodologies. Here are a few notable examples (Zcybersecurity; Journal of Cybersecurity Research).

- **ThreatConnect** is a widely-used threat intelligence platform that provides capabilities for aggregating, analyzing, and sharing threat intelligence. It offers features like customizable dashboards, playbooks, and orchestration to streamline workflows for security teams. Integration with various data feeds and security tools is a key strength.
- **MISP** (Malware Information Sharing Platform & Threat Sharing) is an open-source threat intelligence platform designed to improve the sharing of structured threat information. It allows organizations to collect, share, and collaborate on threat data, facilitating a collective defense approach. MISP supports the STIX (Structured Threat Information eXpression) and TAXI (Trusted Automated eXchange of Indicator Information) standards.
- **Anomali ThreatStream** is a threat intelligence platform that focuses on automating the collection, analysis, and dissemination of threat intelligence. It offers integrations with a wide range of security tools and data feeds, helping organizations operationalize threat intelligence for faster response and mitigation.
- **FireEye iSIGHT Intelligence** provides actionable intelligence to help organizations understand and respond to cyber threats. It combines machine-generated intelligence with human analysis, offering comprehensive threat insights. It is particularly known for its expertise in advanced persistent threats (APTs) and targeted attacks.
- **IBM X-Force Threat Intelligence** leverages the vast resources of IBM to deliver threat intelligence services. It includes real-time threat data, vulnerability information, and strategic insights. The platform provides a range of threat intelligence feeds and integrates with IBM's security products.
- **CrowdStrike Falcon X** is an extended detection and response (XDR) platform that includes threat intelligence capabilities. It offers features like threat hunting, malware analysis, and intelligence enrichment to provide context around threats. Integration with the CrowdStrike Falcon platform enhances its capabilities for endpoint protection.
- **Digital Shadows SearchLight** focuses on digital risk protection and threat intelligence. It helps organizations monitor and manage their digital risk by providing insights into external threats, data exposure, and potential vulnerabilities across the surface, deep, and dark web.
- **Recorded Future** is a platform in the realm of threat intelligence, offering predictive insights to empower organizations in bolstering their cybersecurity defenses. This product excels in

aggregating, analyzing, and interpreting vast amounts of data from diverse sources across the web to deliver actionable intelligence that aids security professionals in staying ahead of threats.

To use ATIPs effectively, organisations typically begin by configuring the platform to meet their specific needs and areas of focus. This involves defining parameters such as key issues, threat actors or industry-specific indicators of interest. Analysts can then use the platform to conduct in-depth research, perform threat assessments and gain insight into threat actor tactics.

ATIP's predictive analytics capability enables organisations to anticipate potential cyber threats and vulnerabilities. By staying ahead of the curve, security teams can proactively take action to mitigate risk and improve their overall cybersecurity posture.

2.3.3. Conclusions and recommendations

The strategic integration of AI-based solutions, from predictive analytics and behavioural analysis to adaptive response mechanisms, is becoming an increasingly important tool in the fight against cyber-attacks. AI's predictive analytics and behavioural analysis capabilities can enhance human understanding of dynamic threats. By identifying patterns and anomalies, AI enables potential threats to be identified and countered in advance.

AI automates routine tasks, allowing cybersecurity professionals to focus on the strategic and complex aspects of threat detection and response. AI-powered threat analysis platforms improve proactive detection of emerging threats. By analysing vast amounts of data and providing useful insights, AI-powered threat intelligence platforms enable organisations to strengthen their defences.

Organisations should prioritise the development of AI-related skills within cybersecurity teams to maximise the potential of AI to support cybersecurity. Encouraging the sharing of threat intelligence across industries and organisations strengthens collective cybersecurity defences. By improving the speed and accuracy of threat detection and incident response, the use of AI can help reduce the impact of cyberattacks and malicious acts, and improve the efficiency of cybersecurity operations.

However, there are also challenges and risks associated with the use of AI in cybersecurity. As cybercriminals refine their AI-based cyberattack techniques, this could lead to an 'arms race' between cybersecurity professionals and cybercriminals. There is a risk that large-scale language models will lead to an increase in social engineering and sophisticated phishing campaigns (IEEE, 2024; SANS Institute, 2024; Cybersecurity Intelligence Journal, 2024).

It is important to ensure that artificial intelligence systems are developed and used responsibly and ethically. To ensure that artificial intelligence is used responsibly and effectively in cybersecurity, companies and organisations should work with cybersecurity experts who have experience with artificial intelligence systems. They should also ensure that they have robust policies and procedures in place to manage the use of AI in cybersecurity. This could include guidelines and policies on how AI-based systems are trained, how decisions are made, and how bias is avoided.

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Case study 2.4: Coping with Inaccuracy and Deception in AI

2.4.1. Introduction

AI systems, driven by complex algorithms and large amounts of data, are prone to error and manipulation. Understanding the relationship between potentially inaccurate AI predictions and the risks associated with deliberate deception is necessary to create more robust and resilient AI applications. The adoption of AI in decision-making processes across industries stresses the importance of trust. Trust in AI is an indicator of its technological sophistication and a fundamental factor in ensuring that these systems are used responsibly and ethically.

2.4.2. Case study description

In the exploration of inaccuracy and deception in AI, this section delves into existing solutions and practical examples that highlight the intricacies of addressing these challenges. The focus is on real-world scenarios where inaccuracies have occurred, ethical problems have arisen, and how AI developers and researchers are working to mitigate these issues.

Addressing Bias and Fairness

In the pursuit of ethical AI development, addressing bias and ensuring fairness has become a critical focus. Real-world instances have revealed the inadvertent perpetuation of biases in AI systems, particularly within natural language processing and facial recognition domains. Several examples underscore the importance of addressing bias and fairness in AI:

- **Biased Language Models -** In the domain of natural language processing (NLP), biases in language models have been identified through instances where models inadvertently learned and perpetuated stereotypes present in training data. For example, large language models have demonstrated biases related to gender, race, and other sensitive attributes, leading to biased outputs in text generation.

  Efforts to address biased language models are reflected in research papers and guidelines from organizations such as OpenAI. OpenAI has acknowledged the challenges related to biases in their models and has actively sought external input to improve their systems.

- **Facial Recognition Disparities -** Facial recognition technology has shown disparities in accuracy across different demographic groups, with higher error rates for certain racial and gender

categories. Notable instances include cases where facial recognition systems exhibited inaccuracies, disproportionately affecting people of color and women.

The need to regulate facial recognition technology is the focus of European Union lawmakers and advocacy groups. For example, the EPRS publication "Regulating facial recognition in the EU" (Madiega & Mildebrath, 2021) explains the situation and highlights the concerns raised by the use and potential impact of facial recognition technologies on fundamental human rights.

In order to address the challenges posed by this technology, the European Data Protection Board (EDPB) published in May 2023 the Guidelines on the use of facial recognition technology in the context of law enforcement. The main objective of these guidelines is to provide guidance to both national and European Union lawmakers and law enforcement authorities on the application and use of facial recognition techniques. Although these guidelines focus primarily on the use of FRT systems in the framework of criminal investigations in accordance with Directive 2016/680 on the processing of personal data for the purposes of the prevention, investigation, detection or prosecution of criminal offences or the execution of criminal penalties, they also include general guidelines and clarifications (Osborne Clarke, 2023).

- **Fairness in Algorithmic Hiring -** AI-powered hiring tools have faced scrutiny for perpetuating gender biases in the recruitment process. Cases have emerged where algorithms, trained on historical biased data, led to discriminatory outcomes in hiring decisions, disadvantaging certain groups.

  Organisations must remain vigilant about the ethical and compliance implications of using AI technology in HR practices to reduce discrimination, despite the potential of generative artificial intelligence. Organizations such as the Institute of Electrical and Electronics Engineers (IEEE) and the Partnership on AI have developed guidelines and best practices for ensuring fairness in algorithmic systems.

Explainability and Transparency

Ensuring explainability and transparency in AI models is crucial for building trust and understanding how decisions are reached. Addressing the need for explainability and transparency involves developing methods and tools that allow users to understand and interpret AI decision-making processes. Instances where complex AI models produce results without clear explanations highlight the importance of transparency.

- **Automated Credit Decisions -** In the financial sector, AI algorithms are increasingly used for automated credit scoring. However, there have been cases where individuals receive credit

decisions without clear explanations. Lack of transparency in how these decisions are reached raises concerns about fairness and the potential impact on individuals' financial opportunities.

Example: A person is denied credit, and the automated decision-making process provides no clear reasons for the denial, making it challenging for the individual to understand or challenge the decision.

- **Healthcare Diagnostics -** AI plays a growing role in healthcare diagnostics, particularly in interpreting medical images. When AI systems make critical diagnostic decisions, the lack of transparency can lead to challenges in explaining to healthcare professionals, patients, and regulatory bodies how specific diagnoses were reached.

  Example: An AI system detects anomalies in medical images, but healthcare professionals struggle to understand the rationale behind the system's diagnosis due to limited transparency.

- **Automated Legal Decision-Making -** In legal applications, AI is used for tasks such as predicting case outcomes or providing legal advice. Lack of explainability in these systems can hinder the ability to understand the legal reasoning behind AI-generated recommendations.

  Example: An AI system provides legal advice on the potential outcome of a case, but the reasoning behind the advice is not transparent, making it challenging for lawyers and clients to fully grasp the basis for the recommendations.

- **Algorithmic Hiring Decisions** - In the context of recruitment, AI-driven tools are utilized for resume screening and hiring decisions. When these algorithms lack transparency, it can lead to concerns about potential biases and discrimination.

  Example: A job applicant is rejected by an AI-based hiring system, but the system provides no clear explanation for the decision, leaving the applicant uncertain about the factors that led to the rejection.

Adversarial Robustness

Adversarial robustness in AI is a critical aspect aimed at fortifying machine learning models against intentional manipulation and deceptive attacks. Instances of adversarial attacks have demonstrated the vulnerability of AI systems to subtle alterations in input data, leading to misclassifications or incorrect outputs. Efforts to enhance adversarial robustness include developing robust training techniques, incorporating adversarial training datasets, and designing models with built-in defenses against potential attacks. Ongoing research and collaboration within the AI community focus on creating models that are resilient to adversarial manipulation and can maintain reliable performance in the face of intentional deception. Here are some examples of adversarial robustness.

- **Image Recognition Adversarial Attacks - I**n the field of image recognition, adversarial attacks involve making imperceptible changes to input images to deceive AI models. These changes, often undetectable to the human eye, can cause the model to misclassify objects or produce incorrect results.

  Example: A stop sign is subtly altered in a way that is imperceptible to humans but leads an AI-based autonomous vehicle system to misinterpret it as a yield sign, highlighting the potential dangers of adversarial attacks in the context of safety-critical applications.

- **Voice Recognition Adversarial Attacks -** Voice recognition systems can be susceptible to adversarial attacks, where carefully crafted audio signals are introduced to deceive the system. These attacks aim to manipulate the system into recognizing the altered audio as a different voice or command.

  Example: Adversarial audio signals are used to manipulate a voice-activated virtual assistant, causing it to misinterpret commands or authenticate unauthorized users.

- **Text-Based Adversarial Attacks -** In natural language processing, adversarial attacks on text involve introducing subtle modifications to input text to deceive language models. These modifications can lead to misinterpretations, sentiment alterations, or biased language generation.

  Example: Adversarial modifications to a news article subtly change the sentiment, causing sentiment analysis models to provide inaccurate assessments of the article's tone.

- **Adversarial Attacks in Cybersecurity -** Cybersecurity applications, such as intrusion detection systems and malware classifiers, can be targeted with adversarial attacks. Attackers aim to manipulate input data to evade detection or mislead AI-based security measures.

  Example: Adversarial manipulations in network traffic patterns aim to deceive an intrusion detection system, allowing malicious activities to go undetected.

Continuous Monitoring and Updates

Establishing mechanisms for continuous monitoring and updates is crucial in addressing inaccuracies stemming from evolving data distributions. Continuous monitoring involves regularly assessing model performance, identifying instances of degradation, and updating models with new data or improved algorithms. Practical insights showcase instances where AI models trained on outdated data failed to adapt to new patterns, underlining the importance of continuous learning and adaptation in AI systems.

- **Evolving Data Distributions -** Real-world data is subject to change due to various factors, such as shifts in user behavior, emerging trends, or evolving environmental conditions. AI models trained on static datasets may become less effective over time as they encounter situations that were not adequately represented during the initial training.

  Example: A recommendation system for an e-commerce platform may become less accurate in suggesting relevant products if user preferences shift due to changing trends or seasonal influences.

- **Concept Drift in Financial Markets -** In financial applications, the concept of drift is evident as market conditions and factors influencing investment decisions evolve. Continuous monitoring is crucial to adapt trading algorithms to changing market dynamics and avoid reliance on outdated models.

  Example: A stock prediction model trained on historical data may struggle to predict market movements accurately during periods of financial instability or when faced with unforeseen economic events.

- **Dynamic Healthcare Diagnostics -** In healthcare diagnostics, continuous monitoring is essential to account for changes in disease prevalence, the emergence of new health risks, or advancements in medical knowledge. AI models must be updated to incorporate the latest information and maintain diagnostic accuracy.

  Example: An AI-driven diagnostic tool for a particular disease may require updates to account for new research findings or changes in the prevalence of the disease within a population.

- **User Behavior Changes in Recommender Systems -** Recommender systems, prevalent in platforms ranging from streaming services to e-commerce websites, rely on user behavior data. Continuous monitoring allows these systems to adapt to shifts in user preferences, ensuring recommendations remain relevant.

  Example: A music streaming service may need to update its recommendation algorithms to reflect changes in user taste, accommodating the introduction of new genres or artists.

Ethical Considerations in Design

Ethical considerations in the design of AI systems play a pivotal role in ensuring fairness, accountability, and transparency throughout the development and deployment lifecycle. Recognizing the potential societal impacts of AI, developers and researchers are increasingly emphasizing ethical guidelines to foster responsible AI practices. Here is a brief characterisation of the ethical considerations in designing and operating systems using AI.

- **Mitigating Bias in Algorithmic Decision-Making -** Ethical design involves addressing biases that may be present in training data or algorithms. Developers strive to identify and rectify biases to prevent discriminatory outcomes, especially in applications such as hiring, lending, and law enforcement where biased decisions could have significant societal implications.

  Example: An AI-based recruitment tool should have explicit measures to identify and mitigate gender and racial bias in the hiring process, ensuring fair and equal outcomes for all candidates.

- **Transparency and Explainability -** Ethical design emphasizes the importance of transparency and explainability in AI models. Ensuring that end-users, stakeholders, and affected individuals can understand how AI decisions are made enhances trust and accountability.

  Example: An AI-based credit scoring system should provide clear explanations of the factors that influence credit decisions, allowing people to understand and challenge decisions that may affect their financial capacity.

- **Privacy Preservation -** Respecting user privacy is a main factor of ethical AI design. Developers strive to implement privacy-preserving techniques, such as federated learning or differential privacy, to ensure that sensitive information is handled responsibly and that individuals retain control over their personal data.

  Example: An AI-powered healthcare application should ensure patient privacy without compromising patient data. It should enable accurate diagnosis while protecting sensitive medical information.

- **Fairness in Human-AI Collaboration -** In scenarios where AI systems collaborate with humans, ethical design ensures that human-AI interactions are fair, inclusive, and respectful. Developers work to prevent AI systems from amplifying existing biases or excluding certain groups.

  Example: An AI-powered education tool designed to provide a personalised learning experience that accommodates different learning styles should not reinforce stereotypes or favour certain groups over others.

- **Accessibility and Inclusivity -** Ethical AI design prioritizes accessibility and inclusivity, aiming to create systems that are usable by individuals with diverse abilities and backgrounds. This involves considering the needs of users with disabilities and ensuring that AI applications do not inadvertently exclude certain groups.

  Example: An AI-based language translation tool should be accessible to people with hearing impairments and include features such as text-based output or sign language interpretation support.

User Feedback Mechanisms

Incorporating user feedback mechanisms allows end-users to report inaccuracies or ethical concerns, facilitating continuous improvement. Establishing user feedback mechanisms requires an open and transparent communication channel between developers and users. By embracing user input as an integral part of the development lifecycle, AI systems can evolve to meet the diverse needs and expectations of their user base, fostering a collaborative and user-centric approach to continuous improvement. The AI community's ongoing efforts to solve problems in a responsible way are illustrated by the examples above.

- **Empowering Users as Co-Creators -** User feedback mechanisms position end-users as valuable contributors to the improvement of AI systems. By empowering users to share their experiences, preferences, and concerns, developers gain valuable insights that can inform iterative enhancements to the system.

  Example: A voice-activated virtual assistant encourages users to provide feedback on its responses, enabling developers to identify areas for improvement and enhance the system's natural language understanding.

- **Identifying and Addressing Bias -** User feedback becomes a powerful tool in identifying potential biases or unintended consequences in AI systems. Users can highlight instances where the system's outputs may be perceived as biased or where certain groups are disproportionately affected.

  Example: In a content recommendation system, users report instances where recommendations exhibit biases, prompting developers to investigate and address potential sources of bias in the underlying algorithms.

- **Detection of Ethical Concerns -** Users often play a key role in identifying ethical concerns related to AI applications. Their feedback can shed light on situations where ethical principles may be compromised or where the impact on individuals or communities raises ethical questions.

  Example: Users of an AI-driven financial advisory app may provide feedback if they perceive the system making recommendations that prioritize financial gain over ethical considerations, prompting developers to reassess their algorithms and decision-making processes.

- **Usability and Accessibility Improvements -** User feedback extends beyond identifying issues to suggesting improvements in usability and accessibility. This helps developers create AI systems that are more user-friendly and inclusive.

Example: Users with visual impairments provide feedback on the accessibility of an AI-driven navigation app, leading to the implementation of features such as voice-guided navigation and enhanced compatibility with screen readers.

2.4.3. Conclusions and recommendations

This case study highlights that the field of AI is not immune to inherent problems, both unintentional, such as bias and inaccuracy, and intentional, involving deceptive manipulation. Awareness of these problems is necessary to understand the intricacies of AI development and application.

Incidents of biased results, lack of transparency and potential breaches of confidentiality highlight the need to prioritise ethical principles throughout the AI lifecycle. The vulnerability of AI systems to adversarial attacks requires a robust security framework. The development of adversarial-resistant AI models becomes an integral part of the defence against deliberate manipulation that could compromise the integrity of AI-driven applications. In addition, AI systems must be equipped with tools that allow them to adapt to changing conditions to ensure continued relevance and effectiveness.

Therefore, investment in research and development to ensure counter resilience is critical. This includes protecting AI models from deliberate manipulation and ensuring that security measures are built into the core of AI systems. It is essential to take a collaborative approach and understand the impact of AI on society in order to promote holistic solutions that combine technological advances with ethical considerations.

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CHAPTER 3: Using AI for the Development of Interpersonal Skills and Creativity

Case study 3.1: Supporting Creativity

3.1.1. Introduction

When discussing creative or innovative thinking in the teaching process, it is worth starting with the question of what creative thinking actually is and what conditions it should meet to be recognized as such. According to one well-known approach (Simonton, 1988), creativity is an elite, exclusive trait, assuming that individuals possess a set of characteristics necessary for generating creative concepts. On the other hand, there is a more democratic approach (Guilford, 1978), assuming that creativity, innovation, and flexible thinking are accessible to everyone and can be further developed and trained. Nowadays, educational and scientific institutions lean towards the more egalitarian approach.

Features of creative thinking, such as flexibility, originality, abstraction, metaphorical thinking, association, and abstract construction, can now be enhanced using AI tools, making the training of creative thinking more accessible than ever before.

3.1.2. Case study description

AI integrated with a critical human approach and interpretation can be a valuable tool supporting creativity, which largely remains a unique human ability. AI can contribute to fostering creativity through various means, including:

1. **Generating Inspiring Ideas:** AI can generate inspiring suggestions, offer ideas for further development and implementation.
2. **Data Analysis:** AI can analyze data and provide insights, serving as a foundation for identifying new opportunities and finding inspiration.
3. **Data Visualization:** AI-generated visualizations can aid better understanding, inspiring creative thinking.
4. **Co-Creation in Art:** AI-powered generative models, such as text, image, or music generators, can be used by artists to create unexpected and creative works.

5. **Personalized Learning:** AI can tailor educational programs to support the development of students' creativity in a way that aligns with their learning styles.

6. **Simulations:** AI enables experimentation in virtual environments and testing new ideas without the risk of real-world consequences.

7. **Graphic Visualization:** AI allows the creation of advanced graphics based on prompts or verbal descriptions, supporting both creativity and the ability to articulate ideas verbally.

Among the AI tools gaining popularity for creativity training are text generators, copywriting tools, graphic generators, sound generators, video generators, and more. When working with students on exercises, it is important to strike a balance between using AI technology and preserving the human element of creativity. Exercises should provide opportunities for experimentation, sharing ideas, and their development. Here are examples of exercises for use in classes:

1. **Working with Text Generators:** Students create short texts and then use AI tools to obtain alternative versions. Comparison helps understand differences and sources of inspiration.

2. **Co-Creation of Graphics with Image Generators:** Students generate abstract descriptions of images and then collaborate with image generators to combine human creativity with AI capabilities.

3. **Creating Music Using Audio Generators:** Students describe their moods and emotions, then use audio generators to create compositions aligned with the description. This exercise, besides fostering creativity, can develop emotional intelligence.

4. **Creating Interactive Projects:** Students design interactive projects utilizing algorithms or other AI technologies, such as websites, games, or mobile applications.

The importance of maintaining a balance between AI technology and preserving the human element in creative exercises is emphasized, highlighting the need for exercises that encourage experimentation, idea-sharing, and development. The provided examples of exercises, showcase just few examples of practical approaches to integrating AI with the educational process. AI based exercises can not only stimulate creativity but also have the potential to foster emotional intelligence, making them valuable tools in modern education.

3.1.3. Conclusions and recommendations

Personalization of educational programs using AI can enhance the effectiveness of creativity training. Appropriately targeted and planned utilization of AI tools in the educational process, focused on educational goals, allows for the development of creative thinking among students. Monitoring the long-term impact of AI tools on creativity is a crucial element of modern education, and instructional support for teachers in this area is key to the development of contemporary education. The use of the discussed innovations in education is recommended, with an emphasis on critical thinking and the integration of human capabilities with the potential of AI.

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Case study 3.2: Creating Interactive Projects

3.2.1. Introduction

Interactive projects are modern tools creating an environment that allows users to intervene in a project. This type of project is used in education, entertainment, and business. The goal of such projects is to create a project system that ensures the optimal development of the project while maximizing user engagement. To ensure the effective operation of interactive projects, artificial intelligence is utilized, enabling fast and precise actions. This will provide users with an intuitive and responsive experience when interacting with the system. An invaluable benefit of applying artificial intelligence is the ability to evolve during interactions with the user.

3.2.2. Case study description

Creating interactive projects involves integrating several disciplines into a cohesive and user-friendly system with which users can interact. The design of such systems is supported by the AI based technologies, e.g.:

1. **ChatGPT** – Allows user interaction through chat, responding to user queries, assisting in educational tasks, or providing information about products and services in business.

2. **Google Assistant** – A voice assistant capable of processing user speech and engaging in realistic conversations, serving as a voice control tool.

3. **Tableau** - An advanced data visualization tool that can provide users with dynamic data analysis, create interactive dashboards, track trends, generate reports, and perform comparative analysis.

4. **OpenCV** - Used for image processing and computer vision, applied for motion detection, object and face recognition, or real-time image analysis.

Artificial intelligence supports interactive projects during the creation and management processes, functioning as a project manager coordinating various project tasks. AI can fulfill various project needs, including:

1. **Project Development** – AI can analyze project data and process information to contribute to project development.
2. **Optimization** – Effective and optimized operation of interactive projects ensures lower system resource requirements.

3. **Real-Time Operation** – AI can efficiently process information in real-time, creating content based on specific project assumptions.
4. **Interactivity** – Maintaining user interactivity with the project environment is crucial. When controlling a project through voice or gestures, AI can adapt to specific users during project work.

The combination of technologies like ChatGPT, Google Assistant, Tableau, and OpenCV, along with the application of artificial intelligence, enhances the creation and management of interactive projects across various domains.

3.2.3. Conclusions and recommendations

Interactive projects utilizing artificial intelligence represent a futuristic domain where technology meets creativity, offering innovative and engaging experiences to users. AI-driven interactive projects open up new possibilities for project management. The integration of artificial intelligence in interactive projects can contribute to optimizing the design and management of projects in the fields of education, entertainment, and business.

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Case study 3.3: Using artificial intelligence to develop and improve students' emotional competences

3.3.1. Introduction

Emotional competence is a key component of students' development, affecting not only their school success, but also their overall psychological well-being. Emotional education is becoming an increasingly important part of curricula, as it has numerous social, interpersonal and educational benefits. An important component of emotional competence is awareness of one's own emotions. This is because the ability to identify and name emotions allows for more effective communication, fosters positive relationships and avoids conflict. Self-regulation of emotions, on the other hand, makes students better able to cope with stress, more focused on tasks and more efficient in making decisions. Developing students' empathetic skills, on the other hand, makes it easier for them to establish positive relationships, which promotes cooperation and effective communication.

3.3.2. Case study description

Examples of the use of artificial intelligence in developing students' emotional competence may include:

1. **Emotional Development Supporting Chatbots:**

   Woebot is an AI-based chatbot that offers emotional support to help users develop skills to cope with stress, emotional difficulties and maintain well-being.

2. **Educational games with social elements:**

   Classcraft is an educational platform that uses game elements to motivate students and develop social skills. Students work together as part of a team, which fosters cooperation and builds healthy relationships.

3. **Natural language analysis in communication:**

   Kognito is a platform that uses natural language analysis to simulate conversations about mental health and interpersonal skills. Participants practice conversations with virtual characters, developing empathy and communication skills.

4. **Personalized emotional development plans:**

Replica is a chatbot that uses AI to interact with users to improve their communication skills and develop their ability to cope with stress.

5. **Apps using AI to support emotional competence:**

Wysa is a mobile app with a built-in chatbot that helps users cope with stress, anxiety and other emotional problems through conversations and exercises.

Youper is an app that uses artificial intelligence to talk to users, helping them understand and deal with their emotions and develop interpersonal skills.

Artificial intelligence can be used to help students manage their emotions by, tracking their emotional state and providing personalized strategies to cope with stress. Here are some examples:

1. **Biometrics data analysis:**

The Calm app uses data from built-in sensors to monitor the user's pulse. It tracks changes in heart rate in real time to assess stress levels. Based on this information, Calm offers the user personalized relaxation sessions, meditations or breathing exercises tailored to the current emotional state. In addition, Calm can collect data related to the user's activity, such as physical activity level or sleep quality, which helps to more fully understand the factors affecting stress levels. The app can also offer daily reports and analysis, showing trends in stress levels and suggestions for methods to reduce them. The app enables conscious monitoring and management of stress, which contributes to the user's overall mental health.

2. **Chatbots for emotional support:**

Woebot is a mobile application that was developed by a team of researchers at Stanford University. Woebot uses therapeutic techniques based on cognitive-behavioral therapy (CBT) and is programmed to chat with users to understand and help them cope with stress, feelings of anxiety or sadness. The bot offers interactive sessions in which it asks questions, listens to answers, provides support and delivers personalized stress management strategies. Woebot's features include monitoring mood, providing mental health information, and offering relaxation exercises and breathing techniques. The bot responds to the user's responses, tailoring the message to the user's current needs and emotions.

3. **Smart meditation and relaxation apps:**

Insight Timer is a platform that offers a wide selection of meditation, relaxation music and personal development content. The app uses artificial intelligence algorithms to personalize the meditation experience for each user. It collects data on preferences, level of proficiency, as well as

reactions to different types of meditation sessions. Based on this information, the algorithms suggest personalized sessions that may better suit the user's individual needs and goals.

3.3.3. Conclusions and recommendations

Emotional competencies are integral to the comprehensive development of students. Their development contributes not only to educational success, but also to the formation of positive social relationships and the ability to cope with life's challenges. Therefore, with special care, it is necessary to support the development of students in this area, providing them with the appropriate tools necessary to recognize and manage their emotions.

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Case study 3.4: Platforms for Improving Personal Skills

3.4.1. Introduction

The personal competencies of students are extremely important in their personal, social and educational development. They are an integral part of education, influencing a student's ability to cope with the challenges of life, relate to others, learn effectively, and succeed in various areas. Fostering these competencies in the educational process not only contributes to better student performance, but also shapes individuals who are ready to cope with the challenges of modern society (Elias M. J. et al. 2003). Many areas of personal intelligence can be distinguished (e.g., self-awareness, self-regulation, or motivation). Most of them refer primarily to self-regulatory skills, which are necessary for efficient self-management. Developing personal intelligence is therefore a prerequisite for being able to realize one's potential in all its fullness.

3.4.2. Case study description

One of the key skills in personal competence is undoubtedly the rational management of one's own time. Artificial intelligence can be used effectively to help students learn and improve this skill by providing personalized strategies, tracking progress, and identifying areas for improvement, e.g.:

4. **Focus@Will** is an application that uses music tailored to the user's preferences to help focus and increase productivity. While it doesn't provide adaptive advice in the strict sense, it can be a useful tool for improving focus and productivity.

5. **Clockify** is a time-tracking tool that allows users to analyze how they spend their time. Although it does not include artificial intelligence features, it provides useful time efficiency data that users can use to plan and optimize their time on their own.

6. **RescueTime** analyzes how users spend their time on various tasks on their computer or mobile devices. It helps understand time habits and provides reports that can be used as a basis for self-improvement of time management.

7. **Forest** is an app that uses gamification to help focus on work and avoid distracting activities. It helps build time efficiency habits by rewarding the user for staying focused.

Decision-making is a key life skill, the development of which is important both educationally and personally. This process requires not only analysis of the situation, but also evaluation of the available options and the consequences of the decisions made. Fostering decision-making skills among students

is not only beneficial to their personal development, but also contributes to the formation of independent, responsible individuals.

Artificial intelligence is used in many areas, including supporting learning and decision-making. Below are some platforms that use artificial intelligence to develop decision-making skills:

1. **AI-based decision-making simulations:**

   Educational platforms that offer interactive decision-making simulations based on artificial intelligence algorithms, allowing students to practice decision-making in various scenarios (e.g., Smart Sparrow, Labster, Articulate Storyline).

2. **AI-based advisory systems:**

   Chatbots or educational apps that use machine learning algorithms to provide personalized advice on educational, career or personal decision-making (e.g., IBM Watson Career Coatch, Kris).

3. **AI-based decision-making games:**

   Educational games that integrate elements of artificial intelligence, in which students make decisions and the system responds dynamically, providing feedback and consequences (e.g., Minecraft: Education Edition, Virtual Business - Personal Finance, Lure of the Labyrinth, Sandiego's Carmen: ACME's Most Wanted).

An important area of personal competence is negotiation and conflict resolution skills. To date, not many such initiatives have emerged in this area. However, it can be expected that in the future, the development of educational technologies will develop in the direction of increasing use of VR and AI in improving such skills. The following are general examples of areas where these technologies can be applied:

1. **VR Simulations for Soft Skills Training:** some learning platforms can integrate VR technology to create conflict simulations in which users can practice conflict resolution skills in a controlled virtual environment.

2. **E-learning Platforms with AI-driven Adaptation:** E-learning platforms can use AI to customize content in the area of conflict resolution, providing personalized content and scenarios.

3. **Chatbots for Interactive Learning:** AI-based chatbots can be used for interactive learning of conflict resolution skills, where users can participate in simulated dialogues and receive guidance.

4. **Professional Development VR Programs:** Some professional development programs can use VR technology to create realistic conflict scenarios where participants must make decisions and resolve situations.

3.4.3. Conclusions and recommendations

Artificial intelligence is becoming an integral part of today's world, and its potential for improving and teaching personal competencies is increasingly being recognized. The use of artificial intelligence in the development of personal competencies already offers unlimited possibilities. Activities aimed at creating and improving personalized strategies for improving personal competencies using artificial intelligence will probably contribute to increasing the quality of teaching offers.

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CHAPTER 4: Advancement of New Forms of Education and Upbringing through AI Technologies

Case study 4.1: AI tools as an aid in SERIOUS game design and development

4.1.1. Introduction

Artificial Intelligence (AI) is a newbie to the game development world. However, it is revolutionizing how games are created, enhancing efficiency and creativity. AI brings not only in-game features such as complex NPCs (non-player characters) behavior, scene design, storytelling, and procedural content generation, but behind-the-scenes development such as decision-making, balancing, and data gathering for a more engaging and challenging environment for players.

The capabilities of AI in game development enhance the developers' ability and creativity to create videogames. It can be applied in different fields of game development such as storytelling, intelligent NPC behavior, procedural generation, realistic animations, sound design, programming, art and design, and testing.

These advantages can be used to create serious games, which aim to educate, train and inform users through entertainment (Laamarti et al., 2014). Serious games, also known as gamification, provide an attractive digital environment for students in education. This enhances their learning experience, stimulates their motivation, increases their engagement and improves their knowledge in different areas. Serious games are used for training to develop important skills such as observation, motivation, criticism management, strategic thinking, and soft skills. They have been applied in various fields of education, including science (Ullah et al., 2022), history (Baxter et al., 2021), sustainable development (Katsaliaki & Mustafee, 2012), and engineering (Rajan, Raju & Sankar, 2013).

4.1.2. Case study description

Examples of AI-based tools in serious game development for educational purposes in different fields include Unity and Unreal.

- Unity is a cross-platform game engine that creates 2D and 3D games and interactive simulations. The Unity ML-Agents Toolkit is an open-source project within this platform that uses reinforcement learning to design NPCs that learn from user interactions.
- Unreal is a game development engine used to develop 3D games and simulations. The AI Toolkit within this platform enables the design of AI behaviours without the need for code.

4.1.3. Conclusions and recommendations

The benefits of the use of AI in the game development field are manifold:

- Efficiently: automating routine tasks can save time and resources during development
- Customization: AI can customize the gaming experience to individual player preferences
- Innovation: AI opens up new possibilities for gameplay mechanics and narratives
- Quality insurance: AI enhances the testing process, resulting in higher-quality game releases

AI automates the creation of game levels, characters, and dialogue, reducing the time and cost of game development while improving the user experience. This is especially useful in the development of Serious Games, which are entertaining tools designed for training and learning.

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Case study 4.2: Ethics and Regulations in the Use of AI in Education

4.2.1. Introduction

The technological evolution of recent years has had a positive and/or negative impact on our way of life, work, health, economy, and, of course, education and training (Alonso-de-Castro & García-Peñalvo). These emerging technologies offer new ways to enhance teaching and learning, personalized instruction, improve assessment, and increase access and equity. Sustainable Development Goal 4 (SDG4) of the 2023 Agenda (United Nations, 2019) aims to "ensure inclusive, equitable and quality education and promote lifelong learning opportunities for all" (UNESCO, 2019), and technologies play a fundamental role in achieving this goal. Moreover, SDG 4 emphasizes the use of Artificial Intelligence (AI) technologies to ensure equitable and inclusive access to education (UNESCO, 2019). However, AI also raises significant ethical challenges that need to be carefully considered and addressed by educators (OECD, 2021) related to (i) inclusiveness; (ii) transparency and explainability; (iii) human-centered values and fairness; (iv) Privacy and security; and (v) accountability and responsibility.

Inclusiveness: AI systems have the potential to perpetuate bias and discrimination, resulting in unfair outcomes for certain groups of users. This can occur when incomplete, inaccurate, or unrepresentative data is used, or when non-transparent and unaccountable algorithms are applied.

Transparency and explainability: AI systems may use black-box algorithms that do not reveal how they reach their conclusions or predictions, which could make it difficult for users to understand or question them. This can limit their ability to trust, verify, challenge, or appeal the actions or outcomes of AI systems.

Privacy and security: AI systems could collect, store, process, and share large amounts of personal and sensitive data from students and teachers, including academic performance, behavior, preferences, emotions, biometrics, and health information. This poses a risk to their privacy and data protection rights, particularly if the data is used for purposes other than education, such as commercialization, surveillance, or profiling.

Human-centered values and fairness: Autonomy and agency can be influenced or interfered with by AI systems, which can affect the ability of users to make informed choices, exercise control over their learning processes, express their creativity, or develop critical thinking skills. For instance, AI systems may provide recommendations or feedback that are not aligned with the learners' goals, interests, or values, or they may replace human interaction and guidance with automated responses.

Accountability and responsibility: AI systems may raise questions about accountability and responsibility for their design, development, use, or impact in education. For instance, AI systems may cause harm or errors that cannot be attributed to any specific human agent.

4.2.2. Case study description

The following are examples of AI-based tools that affirm to use of responsible AI:

- Google cloud: A suite of cloud computing services such as storage, networking, big data, etc. It is commited to Responsible AI Practices of Google [6], which highlighting the importance of addressing biases, ensuring privacy, and promoting accountability.
- Grammarly: An AI-based tool that helps poeple write and communicate with confidence across devices and platfroms. Grammarly claims to be committed to the responsible innovation and development of AI that puts our users first and encourages students to apply academic integrity that facilitates learning and education.
- Turnitin: An AI-based plagiarism detector, which affirms guiding principles for responsible AI integration into education technologies

4.2.3. Conclusions and recommendations

AI has the potential to enhance teaching and learning in education. However, its implementation raises significant ethical questions that must be considered. To address these concerns, ethical frameworks and guidelines should be developed and implemented, ethical practices and standards should be promoted, ethical education and awareness should be prioritized, and ethical governance and regulations should be strengthened. By doing so, AI in education can benefit educators, students, and society as a whole. Additionally, transparency of AI-tools is a key factor to determine whether an AI-based tool is safe, secure, and trustworthy.

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Case study 4.3: Personalization of Education Through AI

4.3.1. Introduction

The education sector is undergoing changes with the evolution and implementation of new technologies. Recently, virtual platforms for educational activities, collaborative e-learning software, and even mobile devices such as electronic tablets have become essential resources in the classroom. Although quality education requires active engagement from human teachers, the evolution of AI-based technology offers significant improvements for all levels of education. These AI-based tools provide learners with personalized experiences tailored to their requirements. This solves the challenge of integrating various forms of human interaction and face-to-face learning with new AI-supported technologies (Wang et al., 2023). AI-based tools can be used to personalize learning in the following ways:

- Adaptative learning pathways: AI can analyze student performance data to adjust learning pathways dynamically, delivering content and resources tailored to individual strengths and weaknesses (Raj & Renumol, 2024).
- Real-time feedback and assessment: AI-based systems can offer immediate feedback on assignments, quizzes, and assessments, aiding students' comprehension and progress (Chang et al., 2022).
- Personalized progress tracking: AI tools can monitor students' progress and generate performance reports for educators, enabling targeted support (Brusilovsky & Peylo, 1999).
- Peer collaboration and social learning: AI can enhance peer collaboration by suggesting study groups, pairing students based on their complementary strengths, and promoting cooperative learning (Dillenbourg, Baker & O'Malley, 1996).
- Automated tutoring and support: AI-based chatbots and virtual tutors can provide personalized assistance to learners by answering their questions and providing explanations (Woolf, 2008).

Among these tools are Intelligent Tutoring Systems (ITSs), which are AI-based tools designed to enhance learning both inside and outside the classroom. ITSs are computer programs that “provide (intelligent) tutors that have knowledge of what they teach, who they teach, and how to teach it (Nwana, 1990). ITSs can determine the learning path, recommend learning content to students, engage students in dialogue, and simulate one-to-one tutoring, among other functions (Zawacki-Richter et al., 2019). Intelligent Tutoring Systems (ITSs) have the potential to provide customized experiences for different students, teachers, and tutors (Churi et al., 2022). Therefore, they can greatly

support teaching and learning, particularly in large-scale distance teaching institutions where one-to-one human tutoring is challenging (Luckin et al., 2016).

4.3.2. Case study description

The following are examples of the use of AI-based tools for personalized learning:

- ChatGPT: a tool that enables user interaction through chat, answering user questions, assisting with educational tasks, or providing personalized feedback, resources, and learning materials to students.
- Fetchy: a communication platform that helps instructors to easily create custom-built content, and helps students learn in a personalized and engaging way.
- Consensus: a search engine to find insights in research papers.
- GradeScope: an online platform by Turnitin that assists educators in streamlining the grading process for exams, homework, and assignments, providing feedback to students, and gaining insights into student performance.
- Otter.ai: a transcirption tool to empower the student to fully engage in the learning process.
- Ivy.ai: a chatbor platform that helps students to answer their questions before they reach a human. Each bot is individually pre-trained with millions of questions and answers from your institution’s website to provide personalized results.
- Querium: an ITS to deliver personalized tutoring in math, science, and engineering subjects.
- Plaito: an online platform that analyzes student performance data, learning style, interests, and strengths to provide personalized recommendations for further study or areas of focus.

4.3.3. Conclusions and recommendations

The use of AI for personalized learning has the potential to revolutionize learning and development by tailoring training to the unique needs and preferences of learners. This promises improved outcomes, increased engagement, cost-effectiveness, and competitive advantage. Some of the key benefits of using AI for personalized learning include:

- AI can enhance learners' understanding and retention of the material, leading to improved learning outcomes.
- AI can automate certain aspects of the training process, such as assessment and feedback.
- AI can assist in making informed decisions about improving training programs by analyzing data on individual learning progress.

- AI can help organizations accommodate learners with disabilities and demonstrate their commitment to diversity and equity by making training materials more accessible and inclusive.
- AI fosters a culture of ongoing learning, enabling employees to upskill or reskill to adapt to a constantly evolving business environment.

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Case study 4.4: Transformation of Pedagogical Methods Through AI Technologies

4.4.1. Introduction

Artificial Intelligence (AI) has transformed the way we learn and teach. It enables personalized learning, improves feedback, and enhances efficiency in education. Although AI cannot replace instructors, it can help improve the quality of education and provide a more effective and efficient learning experience for students.

4.4.2. Case study description

Intelligent chatbots for instant support and guidance

Intelligent chatbots (Wong, 2023) are gaining popularity in education as they offer instant support and guidance to students inside, but outside of class hours. These AI-based assistants are available 24/7 to answer questions, clarify doubts, and provide personalized assistance. Using chatbots:

1. Students can receive immediate feedback on their homework or practice questions
2. Students have the option to request explanations for difficult concepts or access additional resources
3. Students can be guided step-by-step in problem-solving processes

Predictive analytics to identify at-risk students

Predictive analytics it is crucial identifying at-risk students who may require aditional support (Ouyang et al., 2023). By analyzing data from various sources, such as attendance, grades, or behavior, we can detect warning signs of academic problems. Predictive analysis enables teachers:

1. Identifying at-risk students at an early stage and provide targeted interventions to help them catch up.
2. Personalized learning: learning pathways can be recommended based on each student's strengths and weaknesses.
3. Resource allocation: it helps instructors to optimize resources allocation such as time and budget to improve the effectiveness of the course.

This measure helps instructors to reduce dropout rates and improving the overall students' outcomes.

4.4.3. Conclusions and recommendations

The appropriate and responsible use of artificial intelligence in higher education has the potential not only to improve the learning process, but also to improve institutional efficiency and open ways to develop more effective pedagogical methods and respond more quickly to current educational challenges.

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