Increasing Teacher Efficiency with AI: An Overview

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Abstract – Artificial intelligence (AI) research aims to model the way human thinking works, in an attempt to reproduce abilities such as learning, decision-making and problem-solving. The concept of artificial intelligence is not a new one, research on it began in the 1950s when Alan Turing formulated the Turing test, a test to measure the intelligence of a machine. Major milestones in AI research include the creation of the first artificial neural networks in the 1950s and the first game programs in the 1960s. In the 1970s, the algorithms and techniques that still form the basis of AI today, such as machine learning and symbolic AI, began to emerge. The real breakthrough came with the integration of AI into everyday use in the 1990s and early 2000s. With the rise of the internet and the digitalization of data, AI has spread to a wide range of areas, including internet search engines, recommendation systems, online shopping algorithms and virtual assistants in smartphones. In the 2010s, AI continued to make significant progress in areas such as autonomous vehicles, medicine and robotics. AI-based language models, such as the GPT-3.5 used by ChatGPT, later upgraded to GPT-4 base models, published in November 2022, are increasingly becoming part of our daily lives and across industries are being used in a growing number of fields to facilitate intelligent communication and human-machine interaction. In this paper, we are focusing on AI-based support for teachers. We will explore areas where AI can be effectively used to increase the efficiency of teachers' work, enumerating some AI-based solutions that can greatly contribute to relieving teachers of their daily routine tasks.

Keywords: artificial intelligence (AI); AI tools; ChatGPT; LLM; prompt engineering.

I. INTRODUCTION

The emergence and development of AI is the result of the combined impact of many scientific and technological factors. Research into AI began in the 1940s and 50s, as computing technology began to develop and machines became capable of simulating aspects of human thought (see Fig. 1). Alan Turing's work "Computing machinery and intelligence" (1950) [1] was of particular importance in the early stages of AI, as it articulated the essence of AI and the possibilities for measuring machine intelligence.

Symbolic AI dominated AI research in the 1950s and 60s, an era led by Alan Turing and John McCarthy. This fundamental approach used logic rules and symbols to model intelligent behaviour. Researchers created systems such as "ELIZA" or "General Problem Solver" that mimicked human-like interactions. McCarthy was one of the founders of AI as a discipline and developed several fundamental concepts, such as the LISP programming language [2].

In the 1970s, AI research focused on mathematical foundations and formal modelling. Judea Pearl and Richard E. Neapolitan played an important role in the further development of MI research. Pearl's work was key to developing the theoretical foundations of causality and Bayesian networks [3], while Neapolitan was one of the first to apply Bayesian networks to decision trees. The emergence of Bayesian networks and decision trees enabled problem solving and decision making in uncertain environments.

In the 1980s, Geoffrey Hinton, Yann LeCun and Terry Sejnowski were the leading figures in AI research. Hinton and LeCun revolutionized AI with their breakthroughs in neural networks and the advance of so-called deep learning.
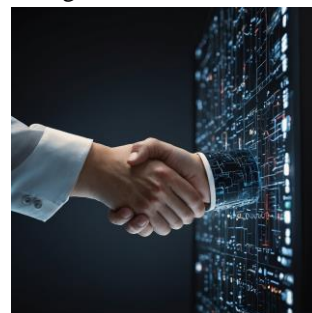

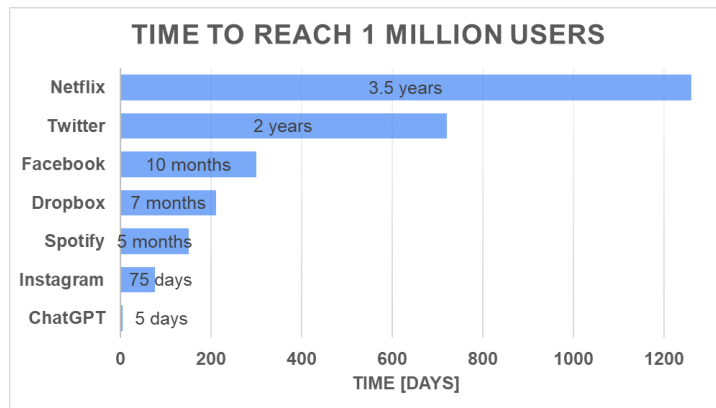Fig. 1. A teacher shaking hands with the AI. Generated with Leonardo AI.

Fig. 2. Number of days to reach one million registered users. Source: https://www.statista.com.

Sejnowski's research in adaptive systems and neural coding played a key role in the development of AI [4]. The use of such techniques has enabled machines to learn and adapt from data, increasing the level of intelligence.

In the 1990s, the rapid development of information and communication technologies offered new opportunities for AI. The availability of vast amounts of data and information created an era of data-driven machine learning. Prominent researchers of this era include Judea Pearl, Yoshua Bengio and Fei-Fei Li [5].

The 2000s saw further advances in AI, which enabled more efficient processing and analysis of large data sets. Big Data, cloud computing and the proliferation of GPUs have given a new impetus to the development of AI. Andrew Ng has had a significant impact on the field of AI as the leader of the Google Brain project and through his work at Stanford University. Ng has also contributed to the wider uptake of AI through his breakthroughs in online learning and the popularization of MOOCs (Massive Open Online Courses) [6].

In the 2010s, deep learning revolutionized AI. Techniques such as convolutional neural networks and recurrent neural networks [7] have made it possible to solve highly complex tasks, such as object recognition or machine translation, more efficiently. This period has seen major advances in self-driving cars [8], robotics, healthcare and personalized services.

Many exciting developments in AI are currently underway. Applications of AI in autonomous vehicles, medical diagnostics and personalized services are expanding. However, ethical and societal issues, as well as privacy and responsible AI development remain important challenges.

II. ARTIFICIAL INTELLIGENCE TODAY

One of the most significant events in the proliferation of AI (artificial intelligence) was the public release of ChatGPT (Generative Pre-trained Transformer), a product of OpenAI, an artificial intelligence research laboratory (see Fig. 2). ChatGPT uses interpretive models to automate continuous communication with users, allowing it to interactively and instantaneously process input data. The development of this technology has gone through several iterations, prominently including the GPT-1, GPT-2, GPT-3, and GPT-4 models [9].

A. The Evolution of GPT Models

The first model, GPT-1, was introduced in June 2018 and consisted of 117 million parameters. This model demonstrated the power of unsupervised learning in language understanding tasks. It was followed by GPT-2 in February 2019, which had 1.5 billion parameters, marking a significant advancement in language models. GPT-3 debuted in June 2020, representing a substantial leap with 175 billion parameters and enhanced performance. The prototype of ChatGPT was released on November 30, 2022, based on GPT-3, and quickly garnered significant interest. GPT-4 was launched on March 14, 2023, and became available as a paid chatbot product. On May 13, 2024, the GPT-4o (omni) [9] version was made available in the free version of ChatGPT, representing a major advancement in both knowledge and performance compared to ChatGPT 3.5.

B. The Proliferation of AI Among High-Tech Companies

The spread of AI is also evident in the technology industry. In the spring of 2024, Samsung introduced AI tools in its flagship phones and tablets (see Fig. 3) [10]. Initially, AI features were available in the Galaxy S24 series, and later, through updates, the S23 series also received them. These new AI features include Google search with circling, live translation of phone calls, AI-based generative editing of photos, and instant translation of chats and dialogues. Samsung's example inspired other manufacturers as well. AI services are now available on Google Pixel phones [11], Microsoft has also integrated its own Copilot into Skype, Bing and plans to integrate it into MS Teams [12]. Although Apple has not yet integrated AI functions into iOS, it is likely that competition will drive them to introduce these features soon.

Fig. 3. Samsung's slogan for 2024: Galaxy AI is here. Source: https://www.sammobile.com.

Fig. 4. Bíró Ada - AI-based TV co-host of the Hungarian National Television (21 April 2024). Source: https://cdn.cms.mtv.hu.

C. AI in Television Hosting

Another significant application area for AI is television hosting. AI-based hosts are not a new phenomenon, as they have been used for news broadcasting in several countries in East Asia for nearly two years [13]. In Europe and Hungary, the first AI-based host appeared in April 2024 on the Duna Television show "Delta". Bíró Ada (see Fig. 4), the first Hungarian-speaking AI-based host [14], not only fulfills her role on television but also engages with her fan base on Facebook.

The rapid development and proliferation of AI technologies have brought revolutionary changes to various industries. The GPT models developed by OpenAI, the AI integrations by Samsung and other high-tech companies, and the emergence of AI-based television hosts all indicate that AI is becoming a crucial technology for the future. Continuous developments and the increasingly widespread applications suggest that the role of AI in everyday life and industry will continue to grow (see e.g. [15]).

III. AI SOLUTIONS FOR ROUTINE EDUCATIONAL TASKS

This paper reviews common routine tasks performed by educators that are time-consuming and can be significantly alleviated through AI-based solutions. The AI tools we have tested and proposed are summarized in Table I. The use of these tools can relieve teachers from their routine responsibilities, saving them time and energy that can be redirected towards higher- level intellectual activities, relationship-building, or personal rejuvenation.

A. Daily Planning and Lesson Planning

In today's fast-paced world, it is crucial for teachers to manage their time and plan their daily and future tasks. This planning can be done using traditional paper-based methods, which are not very effective. In contrast, modern technological tools such as smartphones and Google Calendar synchronization offer significant improvements. In addition, AI-based solutions that intelligently optimize teachers' schedules can even be used for timetabling, according to various predefined needs. These tools were originally designed for the business sector, but can also be effectively used to schedule teachers' activities.

The preparation of lesson plans requires a significant investment of time from teachers and is often seen as an undesirable routine task. AI tools based on Large Language Models (LLMs) can greatly assist in this process. Given the right prompts, these tools can generate text on the requested topic in a short time. Well-designed lesson plans allow for a logical and coherent structure of the learning material, ensuring that all students progress at the right pace towards the learning objectives.

B. Information Retrieval

Information retrieval is vital for teachers, as it allows them to find up-to-date and relevant material for their teaching, thus enriching and updating their teaching methods. By searching for information, teachers can quickly and efficiently access the latest research, professional articles, textbooks and other educational resources to help them develop their curriculum and make lessons more interesting. This facility is particularly important in fast-changing disciplines where rapid incorporation of new knowledge is essential. In the classic case, the search for information is limited to either Google or some other search engine. AI-based search allows, for example, searching in different video content without viewing it, with possible content extraction. This can save teachers a lot of time, focusing on relevant tasks.

C. Translation

Translation is an essential function for teachers, as it allows them to access teaching materials in different languages and thus enrich their knowledge. Through translation, teachers are able to integrate the latest research, textbooks and pedagogical methods from international sources into their own teaching materials, thus increasing the quality and diversity of teaching.

Fig. 5. Guitarist astronaut on the Moon - Image generated with Leonardo AI.

Fig. 6. Guitarist astronaut on the Moon - Image generated with Freepik AI image generator.

Accurate translations ensure that the meaning and intent of the original materials remain intact, so that students receive authentic and understandable information. In the past, for example, Google's translator proved ineffective for certain languages. More recently, the emergence and integration of AI-based translators has led to a significant improvement in quality, allowing for a choice of multiple translation options.

D. Text Generation

Text generation tools allow teachers to quickly and efficiently create different types of teaching materials, such as lesson plans, worksheets, tests and notes, adapted to the individual needs of students. In addition, text generation gives teachers the ability to quickly and efficiently provide students with feedback on written assignments, make corrections and give assessments, thus supporting the learning process and progress. Also with AI-based text generation tools, it is important that teachers write detailed, context rich prompts to produce relevant content.

E. Text Summarization

Text extraction (summarization) allows teachers to effectively review and summarize complex or long texts and extract the most important information that may be relevant to the learning objectives. Teachers are often confronted with long studies, literature and other educational resources from which they need to extract relevant content for effective integration into teaching materials, e.g. for the purpose of making slides, notes. Text extraction can therefore help teachers to prepare lessons and teaching materials efficiently, saving time for teaching and other pedagogical tasks.

F. Transcription

Transcription, or text extraction from audio and video recordings, is an important way for teachers to convert speech or audiovisual material into written format. This helps teachers to more easily review and interpret information from audio and video recordings and to use it effectively in their teaching. With transcription, teachers can accurately record the content of the speech and easily access key information for use in lesson preparation, supplementing teaching materials and creating student assignments.

G. Code Generation

Generating program code is an important opportunity for teachers, especially in the field of teaching computer science and programming. It allows them to create different types of programs, exercises and examples to help students learn basic programming concepts and skills. The generation of program code also helps teachers to guide students step by step into the world of programming and to foster the development of computational thinking and algorithmic reasoning.

H. Plagiarism Detection

Plagiarism screening allows teachers to effectively check written work and projects submitted by students for possible plagiarism. This helps teachers to detect plagiarism immediately and take appropriate action to deal with it, such as warning students or applying appropriate sanctions. In addition, plagiarism screening gives teachers the opportunity to clearly communicate their teaching goals and expectations to students, thus promoting conscious and ethical academic work. There are plagiarism filtering applications that can also detect AI-based text generation.

I. Image Generation and Editing

Image generation allows teachers to create their own graphics, charts, diagrams and other visual elements for teaching materials, which help students to understand the material and its context more easily. This opens up a new world for teachers, as they do not have to browse the Internet for visual content, the use of which could have legal consequences. Image generation tools can

also help teachers to provide visual tools for students' independent learning, for example for presentations, posters or other projects. (see e.g. Fig. 5 and Fig. 6).

Image editing allows teachers to customize and enhance existing images to better suit their teaching objectives and the needs of their students. With image editing, teachers may be able to add backgrounds, text, arrows or other elements to images in educational materials that can help students process and understand information. Image editing can also help teachers to make teaching materials more meaningful and thus make the learning process more engaging and interesting for students.

J.   Music Composition

Music composition offers teachers the opportunity to create their own music, which can help students to develop musical creativity and understanding of music theory. Teacher- composed music can be, for example, instructional songs, orchestrations, or musical compositions that help students better understand musical concepts and techniques. Composing music can also help teachers to introduce different styles and genres to students, giving them a broader musical knowledge and experience. In addition to orchestral composition, these AI tools allow the extraction of melody samples of instruments played on a recording, either in a melody sheet or sound file format.

IV. THE APPLICATION OF AI TOOLS TO FACILITATE TEACHING WORK

In this section, we have collected and presented AI tools that can significantly ease teachers' work (see Table 1). Although these applications are not specifically designed for teachers but for a broader audience, they can still be effectively utilized in teachers' daily routine tasks. The AI tools listed in Table 1 were selected from the applications we have tested, but many similar alternative solutions exist in the market. After trying these tools, each teacher must decide which solution is the most suitable for them. This article aims to provide guidance, focusing on the applicability of AI tools for teachers..

III. CONCLUSIONS

After a brief introduction, we reviewed the main possible routine tasks of teachers and explored the AI-based toolset available to optimize these tasks and make teachers' work easier and more efficient. Most of the AI tools presented can be tried and tested for free, but professional solutions based on advanced AI models require payment. In almost all cases, the communication interface is the prompt, making "prompt engineering" a crucial profession today. It is essential to communicate with AI tools in a detailed, contextually appropriate manner with clear instructions to ensure they provide results that meet our expectations effectively. Although the target audience of the presented AI tools is not specifically teachers, these tools can also be applied in teaching work. By utilising these tools, teachers can save a significant amount of time and energy, allowing them to devote more attention to more meaningful activities, focusing on the human aspect of teaching, and last but not least on their own professional development

As AI transforms industries and job markets, educators must stay up-to-date with technological advances. Teachers who adapt and learn to use AI effectively can maintain their relevance in an evolving educational landscape, enhancing their professional development. Equally important becomes for students to be familiar with AI technologies to be prepared for future careers. Teachers equipped with AI knowledge can introduce students to the ethical, social, and technical aspects of AI, fostering critical thinking and problem-solving skills essential in the modern world. In the future, we aim to examine the effectiveness of AI tools on teachers' work using empirical methods (see e.g. [16]).

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APPENDIX

TABLE 1. AI tools to support teachers' activities.

Teacher's activity	AI-based tool	Official website
Daily planning	Reclaim AI Trevor AI	https://reclaim.ai https://www.trevorai.com
Lessons planning	LessonPlans	https://www.lessonplans.ai
Translation	DeepL Translator Google Translator Microsoft Translator	https://www.deepl.com/translator https://translate.google.com https://translator.microsoft.com
Searching	Google Lens Perplexity AI	https://lens.google/#cta-section https://www.perplexity.ai
Text generation	ChatGPT Claude Gemini Microsoft Copilot Perplexity AI	https://chat.openai.com https://claude.ai https://gemini.google.com https://copilot.microsoft.com https://www.perplexity.ai
Grammar check	Grammarly	https://www.grammarly.com/
Generating test questions	ChatGPT Claude Gemini Microsoft Copilot Perplexity AI	https://chat.openai.com https://claude.ai https://gemini.google.com https://copilot.microsoft.com https://www.perplexity.ai
Text extraction	MonkeyLearn Text Extraction Tool Claude ChatGPT Scibbr Summarizer	https://monkeylearn.com/blog/text-extractor https://claude.ai https://chat.openai.com https://www.scribbr.com/text-summarizer https://www.summarizer.org
Presentation design	Gamma	https://gamma.app
Transcription (voice or video to text)	AssemblyAI Claude Gistly: YouTube AI Summary with ChatGPT Google Cloude Speech to Text	https://www.assemblyai.com https://claude.ai https://chromewebstore.google.com https://cloud.google.com/speech-to-text
Program script generation	ChatGPT Claude Gemini GitHub Copilot Microsoft Copilot	https://chat.openai.com https://claude.ai https://gemini.google.com https://github.com/features/copilot https://copilot.microsoft.com
Plagiarism check	Copyleaks Grammarly Turnitin ZeroGPT	https://copyleaks.com https://www.grammarly.com https://www.turnitin.com https://www.zerogpt.com
Image generation	DALL-E 3 Freepik Leonardo Ai Microsoft Copilot Midjourney Perplexity AI Playground AI Stable Diffusion XL Tengr.ai	https://openai.com/index/dall-e-3 https://www.freepik.com/ai/image-generator https://leonardo.ai https://copilot.microsoft.com https://www.midjourney.com https://www.perplexity.ai https://playground.ai https://stablediffusionxl.com https://tengr.ai
Image editing	Adobe Photoshop Google Magic Editor Samsung Generative Edit	https://www.adobe.com https://store.google.com https://www.samsung.com
Music composition	Beatoven AI MuseNet Song AI Music Generator	https://www.beatoven.ai https://openai.com/index/musenet https://ilovesong.ai