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An evaluation of the use of artificial intelligence applications in online education

Betül Tonbuloğlu [a] *

[a] Yildiz Technical University, Türkiye

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Highlights

- The potential of AI applications in enhancing the quality of online education and their contexts of use were explored.
- AI applications were found to be prominent in the following areas of online education: personalized learning, creating learning content, emphasizing the use of visual and audio content in teaching, learning assistance, use of teaching assistants and chatbots, strengthening the interaction between the instructor and students, grading and assessment.
- This research shows the potential for the development of the use of AI applications in the field of education and hints for combining AI technology with different modules in online education.
- It was suggested that further studies should be conducted on how AI applications should be integrated into online education programs and on the development of ethical principles and strategies for the use of AI in education.

Article Info: Research Article

Keywords: *Online Education, Artificial Intelligence, Personalized Learning, Learning Content, Learning Assistance*

Abstract

In online education, it is extremely important to achieve the targeted learning outcomes and to create an effective learning environment. This requires an interactive learning environment with a sense of learning community, personalised learning opportunities, well-designed instructional content that makes effective use of visuals, sounds and teaching assistans and instructors who can create and deliver them all effectively. Artificial Intelligence (AI) applications can be utilized for a wide range of purposes in addressing the indicators of effective online education and developing strategies to achieve them. This research aims to explore various applications of AI in online education and its impact on teaching and learning processes. In line with this purpose, the study used qualitative case study method to explore the potential of AI applications in improving the quality of online education and the extent to which such applications can be utilized in online education. Following the research, examples of artificial intelligence (AI) applications that can be used in online education for the purposes of providing personalized learning experiences, creating learning content, emphasizing the use of visual and audio content in teaching, providing learning assistance, improving student engagement through the use of teaching assistants and chatbots, strengthening the interaction between the instructor and students, and evaluation were presented and suggestions were made for the contexts in which these applications can be used. The potential and limitations of AI applications in the development of online education were emphasized. On the other hand, it was recommended that the ethical implications of using AI applications in online education should be considered through further research and critical evaluation.

1. Introduction

Due to the intrinsic advantages and limitations of online education, it is essential to choose the teaching materials used in online education environments and the learning processes designed for those

* Corresponding author: Betül Tonbuloğlu. Distance Education Application and Research Center, Yildiz Technical University, Türkiye.
e-mail address:betult@yildiz.edu.tr
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environments with a different approach than in face-to-face education. A comprehensive lesson plan design, audio and video content, as well as technology support teams play a significant role in the design of online teaching materials (Bao, 2020). However, problems such as the tendency of instructors without sufficient experience in this field to integrate the teaching materials and approaches used in face-to-face education directly into online education due to the sudden transition to online education with the COVID-19 pandemic, students' lack of self-discipline, and inappropriate learning environments may lead to a bias in the efficiency of online education. This is reinforced by the fact that 'emergency remote teaching' and the process of 'online education' are understood and evaluated differently (Avcı Akbel, 2021; Bozkurt vd., 2020; Hodges vd., 2020). At this point, understanding the indicators of effective online education helps instructional designers and instructors to develop strategies specific to the online environment (Arulkadacham et al., 2021).

There are numerous factors that have an impact on the effectiveness of online education. Well-designed course content, motivated interaction between the instructor and students, well-prepared instructors, and the creation of a sense of online learning community can be mentioned as some of the necessary factors for effective online teaching. Thorat et al. (2022) suggest building a quality curriculum, a learning community and a variety of active learning tools to improve the effectiveness of online education programs. In order to ensure a smooth transition to online learning and increase participation, Bao (2020) suggested making emergency preparation plans, dividing the teaching content into small units, emphasizing the use of audio content in teaching, using teaching assistants, strengthening students' learning skills outside the classroom, and combining online and offline learning. Various AI tools and applications can be used to facilitate the development of these factors.

AI applications today are rapidly transforming the way we teach and learn. There are a variety of AI applications that can be used to make online education more effective. By analyzing student data, AI-enabled applications can provide personalized learning experiences based on individual needs and learning styles, allowing instructors to identify areas for improvement and tailor their teaching strategies accordingly (Prinsloo et al., 2020). AI is able to provide questions customized to students' abilities and comprehension levels (Lukianets & Lukianets, 2023). In addition, AI-enabled intelligent virtual assistants and chatbots can provide instant support and guidance to students and answer questions, and AI applications can analyze student performance and predict those at risk of failure (Rui & Badarch, 2022). AI-enabled grading tools can enable fast and accurate grading, saving time for instructors to focus on other aspects of instruction (Yildirim & Celepcikay, 2021).

It is indicated that AI generally has the potential to transform online education and provide students with more personalized, engaging, and effective learning experiences (Majeed, 2023). Nevertheless, it is essential to consider ethical considerations when using AI-enabled tools in online education to ensure they are safe and to improve student outcomes (Uunona & Goosen, 2023). They also need to be regularly evaluated for their effectiveness in order to make sure that they actually improve the online learning experience (Li & Su, 2020).

This paper aims to explore various applications of AI in online education and its impact on teaching and learning processes. In this context, an analysis of how AI applications can be utilized to ensure the effectiveness of online education is presented and the role of AI in designing, delivering and evaluating the online learning experience is discussed. In line with the research objectives, answers to the following two research questions were sought:

1. What is the potential of AI applications in enhancing the quality of online education?
2. To what extent can AI applications be utilized in online education?

2. Literature

2.1. Evolution of Artificial Intelligence Applications

AI, commonly defined as the ability of a machine to mimic intelligent human behavior (Mintz & Brodie, 2019), is a computer science that focuses on developing intelligent machines capable of performing tasks that require human intelligence. Originally described by John McCarthy at the Dortmund conference in 1956 as "the science and engineering of making intelligent machines", the concept suggests that human intelligence can be defined in such a way that it can be simulated by a machine (Grewal, 2014). Wagar et al. (2023) noted that AI has the potential to adversely affect the economy by reducing human resource requirements in industries and may pose privacy-related problems. Nonetheless, they emphasized that, despite its negative aspects, AI is invaluable for the development of technology applications as a result of the increasing requirements for sustainability. The development of AI applications has been driven by advancements in computing power, data availability and algorithmic techniques. The advancements in deep learning, availability of big data and cloud computing infrastructure, natural language processing and computer vision have facilitated the training and deployment of AI models, enabling AI applications to understand and interact with human language and visual information (Hamal et al., 2022; Peltonen et al., 2022; Waqar et al., 2023).

The concept of AI, which has started to develop rapidly in various fields over time and continues to attract immense interest, holds the potential to revolutionize many different industries such as education, healthcare, finance and marketing. While it is noted that AI is useful in a variety of domains such as predictive diagnosis, clinical decision support, patient monitoring, healthcare management in the field of medicine (Panesar & Panesar, 2021), it is also emphasized that it has the potential to revolutionize marketing strategies and improve decision-making processes (Chen et al., 2021). AI has the potential to transform processes, improve decision-making and increase efficiency in many other industries. AI technologies can help minimize errors and increase productivity by executing repetitive tasks with precision and efficiency. Yet, there is a need to develop guidelines and regulations so as to ensure the responsible and ethical use of AI technologies. There is also a need for a structured network of research and collaboration between academics, industry and policy makers to address the challenges and maximize the benefits of AI applications.

2.2. Artificial Intelligence in Education

The use of artificial intelligence has an extensive historical background. Randhawa and Jackson (2020) summarized the use of AI in education as in Figure 1. It was mentioned that the earliest "teaching machines" promoted learning like a private tutor but could not be tailored to individual needs; Self Adaptive Keyboard Instructors (SAKI) were developed in the 1950s to adapt to student performance; computer- aided instruction systems, which were developed in the 1960s and 1970s but did not gain wide recognition due to cost and accessibility issues, were first applied to AI in 1970 and were referred to as Intelligent Tutoring Systems (ITS). (Holmes et al., 2019; Randhawa & Jackson, 2020). They represented an important example of the use of AI in education. ITS refers to the computer systems that provide students with personalized, effective and meaningful learning experiences (Goswami et al., 2019), allowing the application of active-participatory methodologies in the learning process (Castro-Schez et al., 2021). It is demonstrated that ITSs, driven by advances in AI technology, have a positive impact on computer-based instruction, making it more adaptive and interactive (Mahmoud et al., 2014). However, as these systems can be time-consuming to develop, with an estimated 200-300 hours per teaching hour (Aleven et al. 2006), authoring tools such as the Cognitive Tutor Authoring Tool (CTAT) (Goswami et al., 2019) and Dialogue Based Tutoring Systems (DBTS), a version of ITSs, have been developed to increase efficiency. DBTS is intended to simulate human-like teaching interactions by using natural language processing and dialogue management techniques to conduct interactive conversations with learners and provide them with personalized feedback and guidance (Castro-Schez et al., 2021). A more recent history of the use of AI in education involves Exploratory Learning Environments (ELE). Holmes

et al. (2019) emphasized that students in ELE "are able to actively construct their own knowledge by exploring and manipulating elements of the learning environment". ELE provides opportunities for students to actively engage with the learning material and develop their understanding through hands-on exploration (De Freitas & Neumann, 2009). Learning Apps and chatbots are also newly emerging tools in the field of education. Learning Apps provide students with instructional content and activities to support personalized and self-paced learning. Chatbots, on the other hand, are conversational agents that utilize natural language processing to interact with users and can be integrated into learning platforms to provide instant feedback, answer questions and assist learners in their learning process.

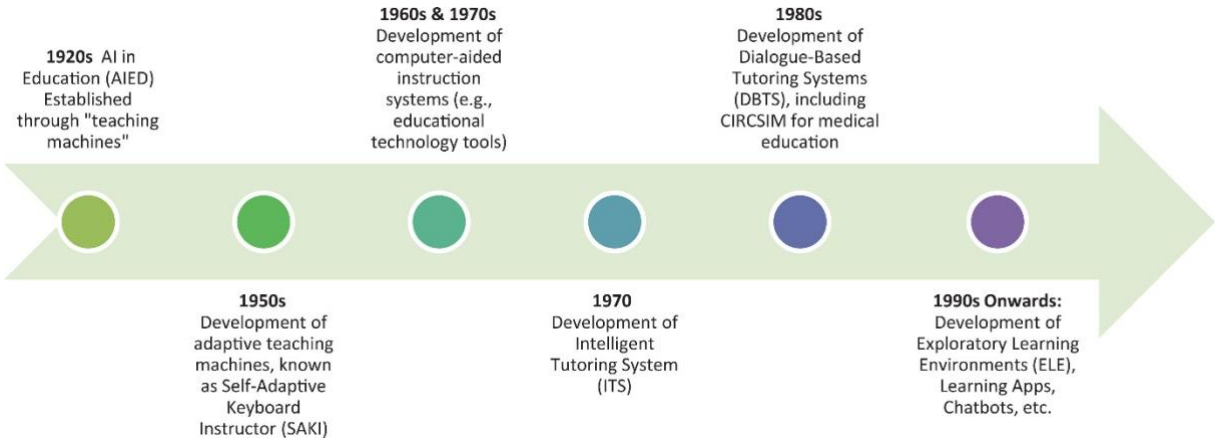

Fig. 1. Development of AI in education (Randhawa & Jackson, 2020).

Intelligent Tutoring Systems, conversational tutoring systems, discovery learning environments, learning apps and chatbots have been developed with the goal of enhancing the learning experience and providing students with personalized instruction. These technologies leverage advancements in AI to support active and effective learning experiences. These systems, however, can be time-consuming to develop, and efforts to improve efficiency in this field are ongoing.

2.3. The Role and Importance of Artificial Intelligence Applications in Education

The use of AI in education is of utmost importance as it reveals the potential of AI to transform teaching and learning processes. Some of the features that make the use of AI in educational processes different from other technologies are its ability to model the student's learning process, to determine the information needed through performance analysis and to make decisions, and to provide interaction by responding to student questions and directing questions to them. AI technologies have the potential to support student-centered pedagogical strategies and personalized learning to engage students in learning processes (Ouyang & Jiao, 2021). The use of AI in education can democratize education by helping students around the world access quality education, thereby enabling the development of more personalized curricula (Bulathwela et al., 2021). AI can also improve the teaching and learning process by transforming instructional design, assessment and learning environments (Xu & Ouyang, 2022). AI applications developed to support learning offer numerous advantages such as personalized learning experiences, facilitating the development of instructional content, and making interaction and assessment easier.

It is crucial to determine in which paradigm AI will be structured in education. AI can be positioned as a guiding, supporting or empowering tool in education. In a paradigm where AI is guiding, AI is used to represent knowledge models and guide cognitive learning, while in a paradigm where AI is supportive, learners work as collaborators with AI. Whereas, in a paradigm where AI is empowering, AI is used to

reinforce learning (Ouyang & Jiao, 2021). In all three cases where education is guided, supported and empowered by AI, it is observed that AI-based tools and applications are actively utilized in educational environments in different ways. Hamal et al. (2022) underlined the importance of developing AI-based tools to support learning and using them to understand how learning takes place.

It is possible to use AI for a variety of purposes in different fields of education. For example, it can be used to automatically predict learners' performance in physical education classes based on data collected regularly during teaching activities (Tang & Jiang, 2022). Similarly, the integration of AI into language teaching can improve the effectiveness of learning different languages by providing personalized and adaptive learning experiences (Yin, 2021). In the context of medical education, it can be used to simulate medical scenarios and provide virtual educational experiences for healthcare professionals (Randhawa & Jackson, 2020).

For the implementation of AI in education, instructors need to develop their digital competencies and acquire necessary skills to effectively integrate AI technologies into their teaching practices (Ng et al., 2023). Therefore, it is stated that AI will influence teachers' professional development and shape their teaching skills, educational thinking, teaching strategies and methods they use, and professional qualifications (Liu et al., 2021). Instructor support and training programs can play a crucial role in equipping teachers with the knowledge and skills needed to use AI effectively in the classroom (Wu & Yang, 2022).

2.4. AI Applications in Online Education

In the field of education, AI is of particular interest in online learning environments and is widely used to enhance teaching and learning experiences. AI is utilized in diverse aspects of online education, including management, teaching, and learning.

Zawacki-Richter et al. (2019) noted that AI in education can be actively used in four areas, which are as follows: 1. profiling and prediction, 2. assessment and evaluation, 3. adaptive systems and personalization, and 4. intelligent tutoring systems. In these ways, AI supports online education with content and feedback tailored to individual learners, and personalized learning experiences. AI-enabled systems play an important role in transforming educational practice into learning methods by identifying the most relevant information for the student and transforming educational practice into learning methods by monitoring the student's cognitive actions such as self-regulation and control to create intelligent tutor programs (Sun et al., 2021). This level of personalization increases the effectiveness of online education by catering to learners' specific needs and preferences. Additionally, AI-based platforms such as Classtime.com have proven to be effective tools for conducting assessments and providing immediate feedback to students (Ningsih, 2023). These platforms are used to analyze students' responses online using AI algorithms and provide personalized feedback, enabling students to improve their learning outcomes. AI-enabled systems can also assist instructors with administrative tasks such as grading assignments, allowing greater focus on teaching activities (Chen et al., 2020). Such automation of administrative tasks improves the effectiveness and quality of teaching activities.

There are a number of studies exploring the use of AI in online learning environments. For example, Li and Su (2020) designed an evaluation method for online teaching quality of basic education within the context of AI. Jia et al. (2022) reviewed 64 studies published from 2010 to 2021 in which AI was combined with online learning through bibliometric analysis, and provided an overview of the trends in this topic. Tang et al. (2023) conducted a systematic review on the application trend of AI in online learning. Fırat (2023) emphasized that AI technologies have the potential to greatly improve the organization of online learning and investigated how AI technologies can be integrated into learning management systems. It is also seen that AI has been used to determine the distribution of students' learning styles (García et al., 2007) and to develop learning systems (Kurilovas et al., 2015). While the application of AI in online education has great potential to provide personalized and effective educational

experiences for students and transform teaching and learning processes, there is a particular emphasis on reducing ethical and privacy concerns and introducing specific rules.

3. Methodology

3.1.Research Model/Design

This study was performed using the document analysis from qualitative research methods. The systematic inspection and assessment of printed and electronic (computer-based and Internet-transmitted) materials is done through document analysis (Bowen, 2009). Document analysis demands that data be reviewed and evaluated in order to elicit meaning, acquire understanding, and build empirical knowledge, just like other analytical approaches in qualitative research (Corbin & Strauss, 2008). Document analysis method was preferred in this study in parallel with the aim of determining the categories in which AI applications can be used in online education.

3.2.Data Collecting Tools

Two different checklists were used as data collecting tools to determine the AI applications to be included in the analysis and to specify the purpose, content, scope and context in which the determined AI applications can be used in online education. Checklists created by the researcher were edited and finalized through reviews by three experts.

3.3.Sampling or Study Group

The digital resources that provide instructional content in this study were included in the analysis. The recommended ai tool list was obtained from educational websites and professional development oriented social media platforms, which were the digital sources included in the analysis. "ai tool list, Generative AI, education" were used as search keywords. AI tool lists were obtained from 15 educational websites and 10 different posts on professional development orientated social media platforms. In at least three of these sources, artificial intelligence applications mentioned in terms of their contribution to education in different categories were selected.The selected AI applications were reviewed by 3 experts in terms of purpose, content, scope and the context in which they can be used in education. As a result of the reviews, categories were created regarding the advantages that AI applications offer to the educational environment and the contexts in which those applications can be utilized in online education. The experts were selected by purposive sampling method based on the criteria of having at least ten years of experience in distance education, having a degree in educational technologies and conducting academic studies in the related field.

3.4.Data Analysis

Qualitative document analysis was used in this study. Qualitative document analysis is an analysis method that systematically analyzes and evaluates the content of all printed and electronic documents (Kıral, 2020; Wach, 2013). This method, which involves searching, sorting, evaluating and synthesizing the data in documents, also allows the data in the research to be organized and classified into themes and categories (Labuschagne, 2003). According to this method, the first step is setting inclusion criteria for documents, followed by collecting documents, articulating key areas of analysis, document coding, verification, and analysis.

3.5.Validity and Reliability

Within the frame of the study, it was firstly aimed to ensure content validity of the document analysis tool. Content validity refers to how accurately the instrument measures the intended construct or content, and it can be achieved by involving experts in the field to decide on the relevance of the assessment (Wisnu Nugroho et al. 2022). The checklists prepared in this context were edited and finalized in line with

reviews by three experts. Furthermore, the criteria specified to ensure the internal validity of the research were again submitted to the experts for review at the end of the research, and participant confirmation was obtained.

4. Findings

As a result of the evaluation based on expert reviews on the contexts by which AI applications are used in online education, the contexts were determined in the following categories: "personalized learning, creating learning content, emphasizing the use of visuals in teaching, emphasizing the use of audio in teaching, learning assistance, use of teaching assistants and chatbots, strengthening the interaction between the instructor and students, grading and assessment". AI applications in the mentioned categories and their contexts of use are described in this section.

Theme-1: Personalized learning

AI-enabled tools can analyze student data and provide personalized learning experiences based on their individual needs and learning styles (Prinsloo et al., 2020). A good example of such tools is the EBA Academic Support platform for high school students (Figure 2). The *EBA Academic Support Platform* is intended to help students set goals, determine their current status through practice tests in the system, and provide personalized suggestions for problem subjects, so that students can identify their own learning needs and fulfill them without instructor guidance (Tonbuloğlu, 2021). AI algorithms also analyze student data to predict their performance and identify those at risk of failure, allowing instructors to intervene and provide further assistance (Rui & Badarch, 2022).

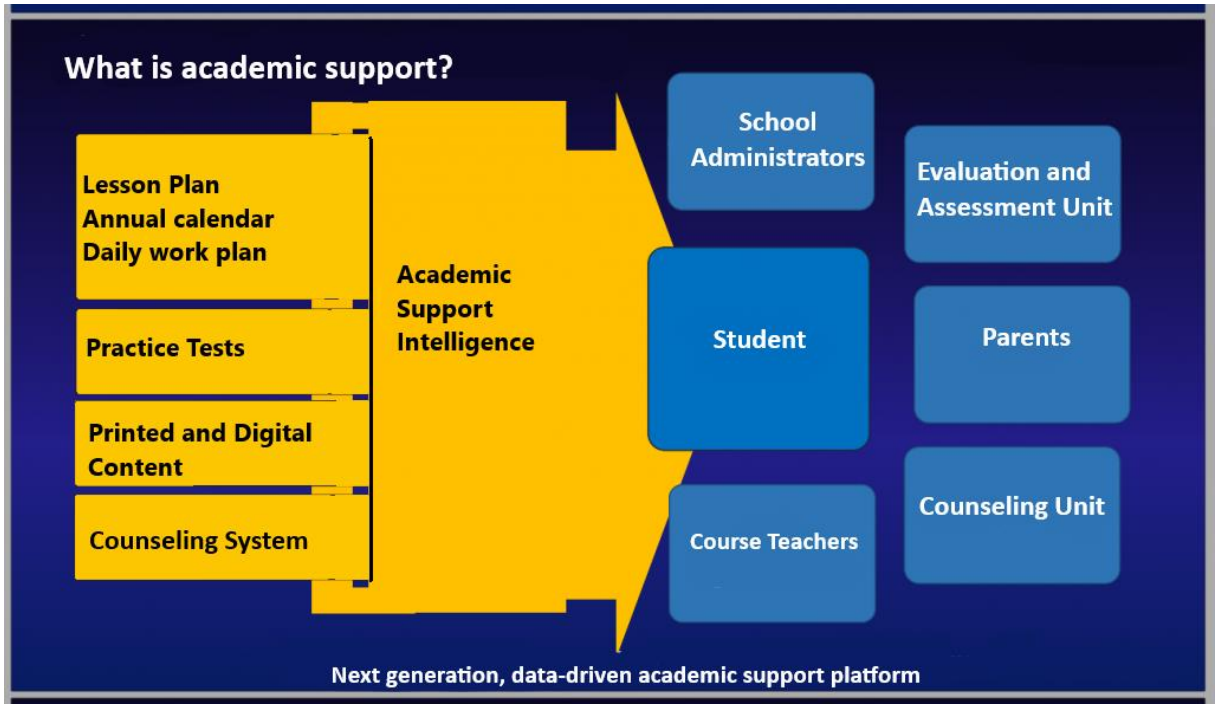

Fig. 2. EBA Academic Support Platform (Source: https://yegitek.meb.gov.tr/www/eba-akademik-destek/icerik/3014)

AI applications such as MyStudyLife can be used as planning and tracking applications designed for students. Such applications can help learners to create personalized learning plans, assign tasks and use reminders using AI features.

Online learning platforms such as *Duolingo, Khan Academy* and *Coursera* also use AI to provide students with personalized course recommendations and learning experiences tailored to their interests and goals.

Theme-2: Creating the learning content

Creating online learning materials requires long-term planned work of a professional team of instructional designers, curriculum experts, domain experts and content creators. This process involves some AI tools and applications that facilitate the creation and editing of pdf, image, video, text and files to be used in learning content. Using these tools and applications to create online learning content not only saves time but also provides great convenience to content creators.

ChatGPT, one of the leading generative AI tools, can be used to create learning content with answers on any topic. Using a language processing model that provides information based on available data, this productive AI application can create text or content that can be used as content in online education, summarize key points of a given text, analyze the overall tone, emotions or thoughts of people in social media posts, code in different programming languages, generate witty answers, and much more.

AI tools such as *ChatPDF* allow any question on any PDF document to be answered in any language. In this way, one can extract information from many different documents in a short time for any given purpose without the need to read the entire document, and the content can be compiled for use in online learning environments.

Tinywow allows users to easily create an article, paragraph, story, summarize content, correct grammar and enhance content in a text block, as well as performing some other tasks with AI such as image creation, pdf merging-splitting-editing-file type conversion, image editing, video downloading-video file type conversion. It is also possible to use this application to create a simple content plan, interpret the content, and have the AI respond to a question in professional, casual, enthusiastic, humorous, bold, sarcastic, dramatic tones.

Tools such as *Quillbot, Wordtune*, *Compose AI*, which are used to edit the text of the learning content, can be used to rewrite or paraphrase any sentence, paragraph or article, as well as to improve and edit the sentence structure.

Instead of PowerPoint presentations, which are very commonly used in online learning contents, different AI tools (such as *Gamma App, slidesai.io, tome.app*) can be used to create engaging and effective presentations, documents and web pages by simply specifying the subject of the presentation, without formatting and design work and without preparing text. AI can create your presentation or document in just two minutes by identifying the presentation titles, generating the content text, providing template options, and designing the content based on the template you have chosen.

For instructional content that needs to be organized in Excel, AI-powered tools such as *Excel Formula Bot* can convert textual instructions into Excel formulas.

Editing tools such as *Hemingway App* can be used to improve readability of the text in an instructional content. These tools highlight long, complex, dense and incomprehensible words and expressions, passive voices and adverbs with different colors and offer editing suggestions. In this way, the instructional content can be made more readable with suggestions for corrections to the wording of the text.

AI applications such as *Scribe How* can help create instructional content by converting on-screen actions into a step-by-step guide. Thanks to such applications, an automatic guide can be created and instructions on how to perform an action can be explained using screenshots, instructions and clicks. Moreover, these tools can be used to edit a document after it has been created, convert it to a pdf document and share it.

Theme-3: Emphasizing the use of visuals in teaching

The effective use of visuals in online education is one of the factors that have a positive impact on the effectiveness of the learning environment and learning efficiency. AI applications provide various advantages in creating and using visuals in a more effective and easy way.

Thanks to the applications (such as *AutoDraw*) that enable the automatic conversion of amateur sketches into professional drawings, the teaching content can be strengthened with illustrations created in a short time without the need for further Internet search or sorting out royalty-free images to be used in teaching.

AI applications that convert text to images (such as *Dall-e*, *tinywow*, *Runwayml*, *MidJourney*, *Adobe Firefly*) generate unique images with the descriptions of the desired image. Furthermore, *Stability AI*, the AI plugin of Photoshop, allows AI-generated images to be edited directly in Photoshop. This enables easy generation of royalty-free images suitable for the instructional content.

The instructional design can be made more effective by removing the backgrounds of the pictures to be used in the instructional content (with tools such as *removebg*, *tinywow*, *Remove Image Background*, *cleanup.pictures*). Applications such as *MagicEraser* and *Cleanup Pictures* enable easy removal of undesired details in the images to be used in the instructional content without the need for professional illustration software such as Photoshop, saving time and effort in the creation of the learning content. With tools such as *Pixlr*, tasks such as batch photo editing, generating images from text with AI, automatic background removal and photo design editing can be performed easily.

High-quality stock videos, music tracks, sound effects and video templates that can be downloaded for free with tools such as *Mixkit* can help visually enhance the instructional content and enrich it with different audio elements. AI applications such as *Synthesia* allow the generation of text-to-speech videos with support for over 120 languages and over 140 AI avatars. Thanks to these tools, professional videos can be created and used in course content without the need for equipment or video editing skills. Apps like *Descript* can also be used to record, edit, transcribe and share videos. Thanks to the AI applications such as *Uizard.io*, interface prototypes can be designed, new mobile applications or website projects can be designed, and ideas drawn on a paper can be transformed into a design with AI support. AI can be used to easily create materials that can be used in online education. Free and open source applications such as *rawgraphs.io* can be used to visualize data. This can help make the teaching content visually richer and more interesting.

Theme-4: Emphasizing the use of audio in teaching

Some AI applications that convert text to audio can easily emphasize the use of audio in content without processes such as recording the audio, synchronizing the image with the audio, or adding subtitles. *Narakeet*, a text to speech video maker, converts PowerPoint presentations into videos and automatically create narrations from speaker notes with different voice and language options. Offering 90 language options and 600 audio options, this tool can help create videos from images and sounds. *Elevenlabs.io* application converts text into speech with AI support, offering various voice options. These applications can be used to create educational video lessons in multiple languages or to produce audio books.

Applications (such as *VocalRemover*) that use AI to generate karaoke files by separating human voice from instrument sounds can be used in online music education, for various purposes such as supporting online course materials with background music, or deleting instrument sounds and retrieving only vocals. They can also help remove background noise behind human voice. This is a very useful feature for online learning materials.

There are AI applications such as *Krisp* that remove background noise and interference in online courses and meetings so that audio can be used more effectively in teaching. Furthermore, AI-enabled applications such as *Cleanvoice* that remove filler sounds, stuttering and mouth sounds, can also help use voice more accurately in online teaching content.

Instructional content can be customized and made more entertaining with AI applications (such as *beatoven.ai*, *soundraw.io*) that enable users to create and compose unique royalty-free music and songs.

AI applications such as *Podcastle.ai* enable studio-quality audio and video recording, editing, speech to text transcription and filler sound removal when creating and editing podcasts. These applications allow multiple tasks to be executed on a single platform.

Theme-5: Learning assistance

One of the steps to facilitate learning is to present learning content in small modules. In order to help learners better concentrate on the online learning content, it is crucial to present the content in small modules, with a duration of 20-25 minutes each, and to adopt a modular teaching approach. Shabadurai et al. (2022) drew attention to the need for effective presentation of content for online education. Voskobitova (2021) also suggested that online learning modules can be used as a complementary educational tool and as part of the main curriculum. One of the AI applications that can be used for this purpose is *vidyo.ai*, which allows the user to transform long videos into shorter clips. It can be used to assist tasks such as chunking the learning content and creating shareable clips of the content.
AI applications used to facilitate learners' understanding of complex topics can be considered as the means to provide learning assistance. Particularly in online courses that require mathematical calculation, the AI applications (such as *WolframAlpha*) that can provide step-by-step solutions of simple mathematical operations as well as complex and high-level problems and graph the equation can make a more effective visual representation of the course content.

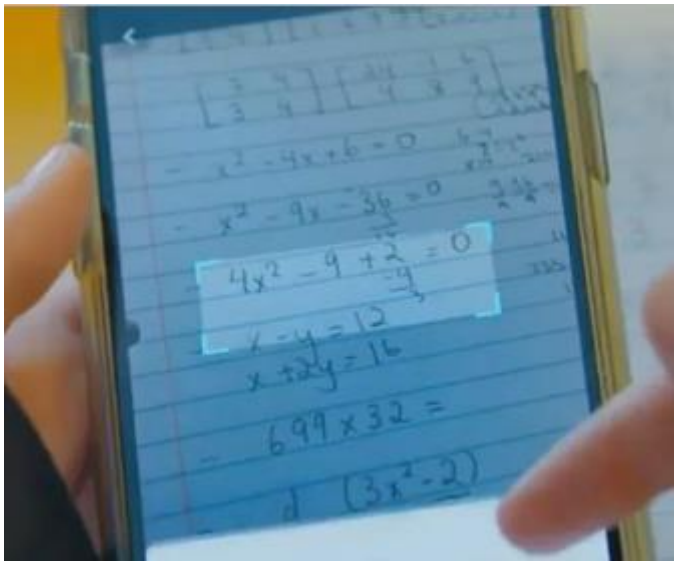

Fig. 3. AI Lab Microsoft Math Application (Source: https://www.v7labs.com/blog/ai-in-education#h1)

Applications such as *Microsoft Math* (Figure 3), with Optical Character Recognition feature, recognize mathematical equations from images and present the solution step by step with explanations and interactive graphs.

Theme-6: Use of teaching assistants and chatbots

AI-enabled virtual assistants and chatbots can provide instant support and guidance to students, answer their questions and provide feedbacks (Rui & Badarch, 2022). Thus, teaching assistants and chatbots stand out with their instant feedback feature, particularly in online learning environments where individual learning is more intense and students may feel more isolated than in face-to-face education.
Virtual learning assistants to be created with AI applications such as *Cognii* can provide formative assessment opportunities for the learning environment by providing instant feedbacks to student

questions. The fact that virtual learning assistants ask students questions related to the subject and provide feedback to the answers given promotes personalized learning.
With applications such as *studio.d-id*, you can have your own avatar created by the AI, upload your own picture as an avatar or choose one of the preset avatars. These avatars can speak the typed text in different languages and tones. This makes it easy to present the learning content with the help of different teaching assistants.
Drawings or created avatars can be animated with AI applications such as *Animated Drawings*. Thus, avatars that can be sketched as teaching assistants can be animated as desired (with movements such as running, jumping, waving, dancing, etc.) and integrated into the teaching content, making the learning process more enjoyable.
AI-enabled applications such as *Scroobly* allow characters to move in real time with camera access, allowing users to create fun animations without the need for design and coding knowledge. Such applications can be used in online courses to create avatars and make the lesson enjoyable.

Theme-7: Strengthening the interaction between the instructor and students

One of the biggest drawbacks inherent in online education is the problem of interaction. AI-enabled tools can be used in various ways to strengthen the interaction between the instructor and the student in online education.
The AI tools (such as *otter.ai, the live transcription feature included in Microsoft Teams*, *tldv.io*) that can attend all Zoom, Google Meet and Microsoft Teams meetings scheduled online, transcribe the conversation and take automatic notes to share with the selected audience have the potential to save a great amount of time and effort for both instructors and students in terms of providing instructional notes. This allows saving the time spent on taking lecture notes for instructor-student interaction. These applications can facilitate students with hearing impairments and limited writing skills to understand lectures and help them build interaction.
AI applications like *Taskade AI*, which are used to organize tasks of project teams, manage tasks and chat with the team, can help increase interaction in online education.

Theme-8: Rating and assessment

Supporting evaluation and assessment in online learning with AI tools can help the instructor to spend more time on learning activities as it will assist the instructor in their administrative tasks. Besides, it allows for quick and accurate results, enabling more effective implementation of formative assessments during the semester and bringing the learning outcomes closer to the objectives.
GradeScanner (Figure 4), which is an exemplary model for the use of AI for grading and assessment purposes, allows the user to scan and automatically assess answers to multiple-choice and multiple-answer questions. These AI applications, which also allow the creation of classes and the reporting of class statistics, can help assessments in online education to be made quickly and accurately.

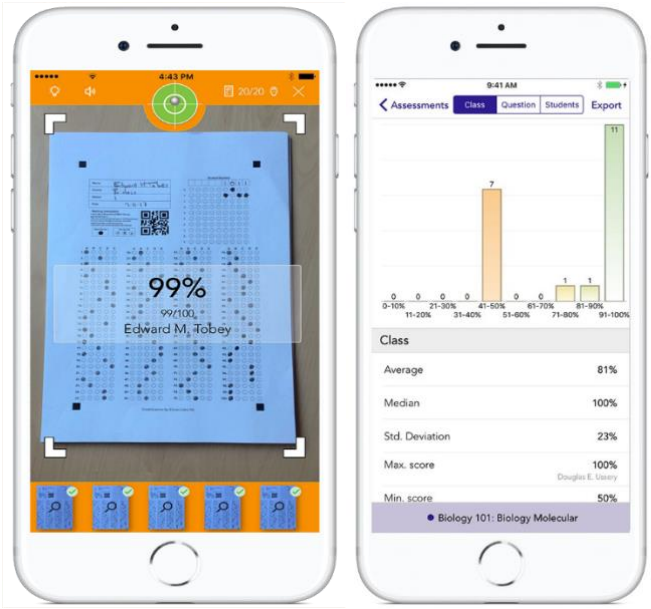

Fig.4. GradeScanner AI Application (Source: https://www.gradescanner.net)

In addition, AI-enabled applications such as *GradeScope* (Figure 5) can be used to assess assignments of variable length, such as problem sets and projects, as well as templated assignments such as worksheets, quizzes, and multiple-choice questions. With the features such as the ability to identify question types, distinguish between different written marks, and recognize handwriting, this application can automatically grade paper-based, digital, and code assignments, export grades, and generate detailed analytical reports. Integrating such AI-supported applications into the learning management systems of institutions can ensure that assessment processes in online education are carried out much more quickly and effectively.

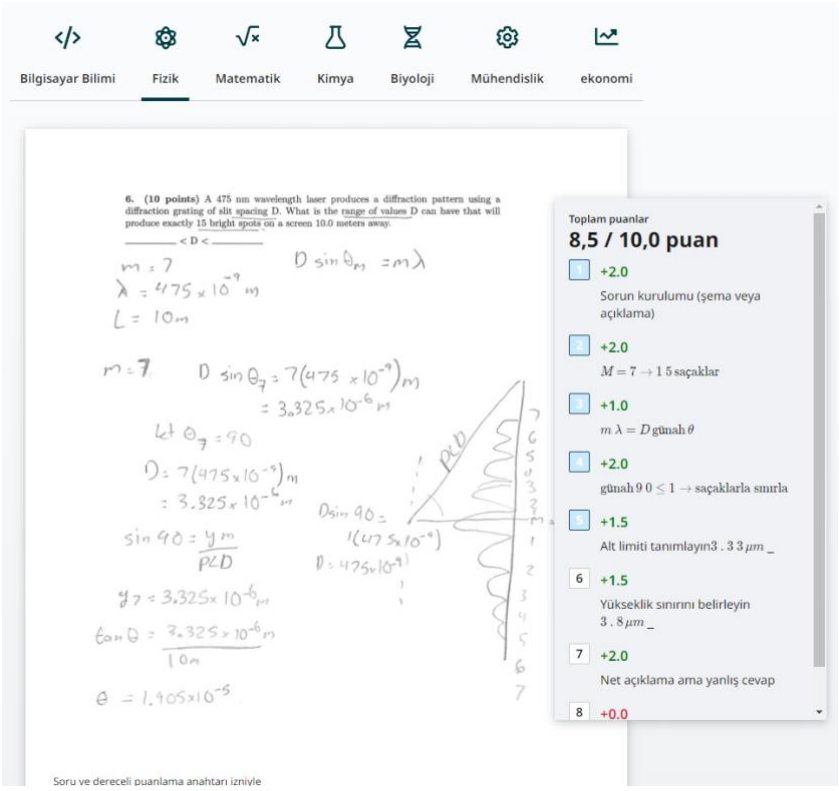

Fig. 5. GradeScope (Source: https://www.gradescope.com)

5. Discussion

AI-enabled applications have revolutionized education by providing students with personalized learning experiences based on their individual needs and learning styles. In addition to personalized learning experiences through AI algorithms, it has become possible for instructors to analyze learners' data to predict their performance and provide them with additional support. AI performance prediction models have been used in online higher education as an effective method to accurately predict students' learning performance using student learning data and AI algorithms and to take measures and steps of improvement accordingly (Aydogdu, 2021; Tomasevic et al., 2020). This allows instructors to identify students at risk of failure and provide interventions to help them succeed. This research discussed the potential of AI-enabled applications that can be used for this purpose and the contexts in which these applications can be used in online learning. Similarly, Fırat (2023) underlined that the integration of AI technologies into education has the potential to promote personalized learning experiences and the development of social skills. Harry (2023) also stated that AI plays a critical role in personalized learning through its use to identify patterns in students' learning behaviors, preferences and achievements. Moreover, it is claimed in the Educause Horizon Report (2019) that AI systems can personalize learning experiences, reduce instructors' workloads, and help analyze complex datasets.

AI applications can be leveraged to create learning content, which has a special importance in online learning, and elements such as visuals and audio that support the learning environment, and to enhance learning environments with audio and visuals. AI algorithms can analyze large volumes of data and generate content based on patterns and structures found in the data. It has been stated in this research that AI applications can be used in different ways in online education in the fields of content creation, supporting content with visuals and sounds, providing learning assistance, and supporting interaction and assessment. Likewise, Pears and Konstantinidis (2022) reported that deep learning algorithms allow the creation of high-quality custom learning content. It is also demonstrated by various studies that AI applications are used for purposes such as giving real-time feedbacks through automated grading systems or intelligent tutoring systems that provide students with instant feedback and guidance, monitoring student progress and making arrangements accordingly, providing personalized feedback by analyzing learner responses, helping students identify areas for improvement and reinforcing their learning (Pichert et al., 1994; Sottilare et al., 2018). Similarly, the use of AI in education is mostly focused on teaching, learning, assessment and collaboration in postgraduate theses in Turkey (Tonbuloğlu, 2023). The study by Alotaibi et al. (2020), who stated that chatbots can improve student performance and permanence of knowledge, supports the results of this research.

In conclusion, AI applications can be used to support online learning environments by producing high-quality custom materials, personalizing content for learners and providing real-time feedback. These applications have the potential to enhance the learning experience and improve learning outcomes. However, despite all its advantages, the use of AI in education also its own challenges and limitations. Concerns such as privacy and security issues, lack of trust, cost, and potential bias have been raised regarding the use of AI in education (Harry, 2023). For example, AI can also respond to harmful instructions such as giving the codes of a malicious software in education. For these and similar situations, ethical and privacy concerns regarding the use of AI technologies in education need to be carefully evaluated (Adiguzel et al., 2023). Mouta et al. (2019) noted that AI can create conditions that prevent expressing emotions, and Bozkurt et al. (2021) pointed out the need to develop ethical rules and policies regarding the use of data generated by AI. Therefore, Jobin et al. (2019) indicated that the ethical principles of transparency, justice and fairness, non-maleficence, responsibility, privacy, beneficence, freedom, fidelity, dignity, sustainability and solidarity should be considered for AI technologies. The ethical and societal disadvantages of AI systems can often be ignored in K-12 education contexts and it is important to identify these challenges (Akgun & Greenhow, 2021). Moreover, due to technical problems such as misclassifications in AI datasets, it is not always possible to obtain accurate results from AI

applications (Hatcher et al., 2020). These limitations highlight the need for complete and more accurate data so that AI can be used effectively in addressing educational needs and improving outcomes. It is also crucial to address the ethical implications and challenges associated with the use of AI in education.

6. Conclusion and Suggestions

Providing a common framework for consistency, design, pedagogy and content is seen to be important in meeting the rising demand for quality online education (Sapkota, 2016). To help build these elements, AI applications have been increasingly utilized in online education. Within the scope of this study, the potential of AI applications is discussed and the extent to which instructors and learners can benefit from these applications in online learning processes is addressed.

AI generally has the potential to transform online education and provide students with more personalized, engaging, and effective learning experiences (Majeed, 2023). The application of AI technologies, such as virtual tutoring systems and smart learning platforms, holds promise for improving learning outcomes and personalizing education (Naidu & Sevnarayan, 2023; Hinojo-Lucena et al., 2019; Yang, 2021). AI enables instructors to analyze student data to predict student performance and provide interventions to help at-risk students succeed, create high-quality custom learning materials, provide real-time feedback, and support interaction and assessment.

It is also important to evaluate these tools and applications for their effectiveness in order to make sure that they actually improve the online learning experience (Li & Su, 2020). Moreover, it is essential to consider ethical considerations when using AI-enabled tools in online education to ensure they are safe and to improve student outcomes (Uunona & Goosen, 2023). Addressing challenges such as privacy and security concerns, lack of trust, potential bias and technical issues with AI datasets, ethical implications and assessing the need for accurate data are all critical considerations for the effective use of AI in education. This research shows the potential for the development of the use of AI applications in the field of education and hints for combining AI technology with different modules in online education. It is recommended that further studies be conducted on how AI applications should be integrated into online education programs, as well as the development of ethical principles and strategies for the use of AI and how educational institutions can best prepare for the integration of AI technologies.

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