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A Beginner's Guide to Introduce Artificial Intelligence in Teaching and Learning

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Preface

Changes in the field of education have accelerated in recent years. The question is how schools can adapt to these shifts while preparing kids for the future. How can schools compete when information is available at the click of a mouse? The rise of AI has heightened the importance of these discussions. Because of AI's widespread effects and varied opportunities, educational authorities are under increasing pressure to rethink education content and delivery.

The textbook *A Beginner's Guide to Introduce Artificial Intelligence in Teaching and Learning* is designed to reimagine education in today's artificial intelligence (AI) world and the Fourth Industrial Revolution. Artificial intelligence will drastically affect every industry and sector, and education is no exception. This book explores how AI may impact education's teaching and learning process. This book is designed to demystify AI for teachers and learners. This book will help improve education and help institutions prepare for using AI in teaching and learning. This book comprehensively studies how AI enhances teaching and learning, from AI-based learning platforms to AI-assisted proctored examinations. This book provides educators, learners, and administrators with information on how AI makes sense in everyday practice. Describing the application of AI in education, this comprehensive volume prepares educational leaders, designers, researchers, and policymakers to rethink the teaching and learning process and environments students need to thrive effectively. The readers of this book always catch up to the fast pace and promising innovations of today's most advanced learning technology.

Key Features of the Book

- Introduces various AI technologies to improve the teaching and learning process.
- Introduces common and simple AI technologies to help teachers and students learn and teach better daily.
- Gives students and teachers a better understanding of AI technologies so they can create opportunities to use them.

- Provides students, educators, and researchers with ways to make sense of and use AI technologies for teaching and learning.
- Presents AI technology for contemporary learners and describes how these methods could benefit teachers and learners.

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Introduction

1.1 What Is Artificial Intelligence?

The term "artificial intelligence" (AI) is no longer merely a marketing slogan; AI now plays an integral role in our daily lives. Companies use artificial intelligence (AI) to create intelligent robots for various uses (Biswal 2023).

What Is Artificial Intelligence? Artificial intelligence, or AI, is the study of using data in large quantities to program intelligent machines. Figure 1.1 gives a conceptual view of artificial intelligence. Incorporating previous knowledge and experience, these systems can mimic human performance (Biswal 2023). It improves how quickly, accurately, and successfully humans can complete tasks. In order to create autonomous devices, AI researchers and developers employ elaborate algorithms and techniques. The foundations of AI are the techniques of machine learning and deep learning.

Why Is Artificial Intelligence Vital? Artificial intelligence (AI) is significant because it can potentially improve enterprises' processes and provide new insights that were previously unavailable (Burns 2017). It is common for AI systems to finish projects fast and with relatively few errors, especially when it comes to repeated, detail-oriented activities like evaluating many legal documents to verify essential fields are filled out correctly.

It would have been unthinkable before the recent surge in AI for a company like Uber to connect riders with taxis using computer software, but they have done it and become a global powerhouse. With sophisticated machine learning algorithms, Uber can deploy drivers before the actual demand for their services by predicting when and where clients would need rides. Productivity rose dramatically, and big businesses gained access to previously denied markets. By analyzing user behavior with machine learning, Google has become a significant participant in several online

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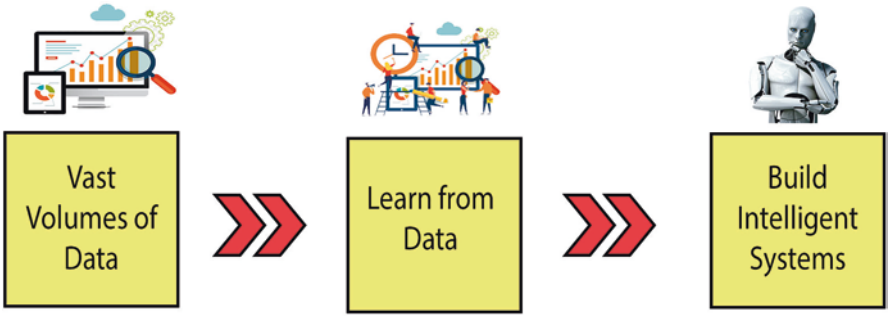

Fig. 1.1 A conceptual view of artificial intelligence

service categories. Company CEO Sundar Pichai declared in 2017 that Google would be an "AI first" business (Burns 2017).

The world's largest and most profitable companies have incorporated AI into their operations to boost efficiency and give them a competitive advantage.

How Does AI Work? Artificial intelligence (AI) is becoming increasingly popular, which has led some businesses to show off the AI features of their products. They usually only highlight specific aspects of AI, such as machine learning. Artificial intelligence cannot exist without a platform of specialized hardware and software for creating and training machine learning algorithms. Several languages, including Python, R, and Java, are commonly used for artificial intelligence, but none can be considered "the" language for AI.

In most cases, AI functions by taking in a vast quantity of labeled training data, processing it to find correlations and patterns, and then using those to predict future outcomes. In this way, an image recognition tool can learn to identify and characterize items in photographs by analyzing millions of samples, and a chatbot can learn to mimic human conversation by being fed examples of text chats.

AI development prioritizes these three cognitive abilities: learning, reasoning, and self-correction (Burns 2017).

- *Learning processes:* Algorithms are rules that tell computers how to do something by performing each step in the sequence. This aspect of AI programming is concerned with data collection and the development of rules for transforming raw data into valuable insights.
- *Reasoning processes:* Selecting the optimal method to achieve the goal emphasizes this aspect of AI programming.
- *Self-correction processes:* This aspect of AI development ensures that algorithms consistently produce the most precise results.

1.2 A Brief Introduction to AI Techniques

Artificial intelligence (AI) engineers need expertise in various fields, including programming and advanced arithmetic, statistics, and data science. This section briefly overviews some core AI techniques (Miao et al. 2021) before discussing typical AI technologies.

Classical AI The earliest forms of artificial intelligence (symbolic AI, rule-based AI, and good old-fashioned AI, or "GOFAI") involved programming a computer to follow a series of IF…THEN statements. For years, "expert systems" based on rule-based AI were developed for medical diagnosis, credit scoring, and industrial automation. Knowledge engineering, the foundation of expert systems, requires extensive time, effort, and expertise to elicit successfully and model domain experts' knowledge. Although an expert system may have hundreds of rules, its reasoning is usually straightforward. However, as rule interactions grow, expert systems can become increasingly difficult to modify or improve.

Machine learning Machine learning (ML) is a method for making predictions without using predetermined rules by analyzing vast volumes of data to find patterns and construct a model. Recent developments in machine learning-based computational algorithms have enabled several recent AI advancements, such as natural language processing, facial recognition, and self-driving automobiles. In this context, we talk about "learning" algorithms instead of "hard-coded" ones.

Supervised learning, unsupervised learning, and reinforcement are the three most common ML methods. In the case of supervised learning, data is used that has already been tagged, such as thousands upon thousands of photos of people annotated by humans. By associating the data with the labels, supervised learning generates a model that can be applied to comparable data, such as automatically identifying persons in new images. Regarding unsupervised learning, the AI is given even more data but is not labeled or categorized this time. Unsupervised learning aims to find previously unseen clusters or patterns in the data that can be used to assign labels to fresh observations. It may, for instance, scan handwritten text for recognizable letters and numbers by analyzing thousands of examples for similarities.

Supervised and unsupervised learning results in a fixed model; a new analysis must be performed if the data changes. Reinforcement learning, the third ML method, requires constantly enhancing the model based on feedback, so it is still machine learning because it involves continuous learning.

First, the AI receives training data, from which it develops a model, which is then evaluated to determine whether or not it was successful. In the case of autonomous vehicles, for instance, the model that allows them to avoid collisions is rewarded (reinforced) when they successfully do so. The AI takes this feedback, uses it to refine its model, and gives the task another go; this way, it learns and evolves through a series of iterative trials.

The term "artificial intelligence" (AI) is often used interchangeably with "machine learning" (ML), despite the latter being a subset of the former. Even today, GOFAI (rule-based or symbolic AI) is often included in many AI systems that do not explicitly use ML. For instance, many widely used chatbot apps have rules specified by humans for how to respond to frequent inquiries. In reality, just like the first generation of expert systems, almost every AI product on the market today requires content to be input manually by humans. If the AI employs natural language processing, this knowledge might come from linguists and phoneticians; if it is used in medicine, it might come from doctors; and if it is used to power self-driving cars, it might come from specialists in road traffic and driving. Without the help of GOFAI parts, machine learning could not produce a fully functional AI (Säuberlich and Nikolić 2018).

In addition, it is vital to understand that ML does not learn as humans do. Also, it cannot learn new things on its own. In contrast, ML relies only on human input at every stage, from selecting and cleaning the data to designing and training the AI algorithm to curating, interpreting, and assigning value to the results. The system merely grouped items that seemed somehow similar and needed a human to identify one set of those objects as cats, but it was hailed as a breakthrough object identification technology because it could recognize photographs of cats in a database of images. The same is true for the ML used in autonomous vehicles, which requires millions of tagged photos of streets. Silicon Valley has primarily outsourced this tagging to people worldwide (through platforms like Amazon Mechanical Turk) and businesses in India, Kenya, the Philippines, and Ukraine (Miao et al. 2021). These members of the new economy are responsible for manually tracing and labeling each object (such as vehicles, traffic signs, and pedestrians) in each video shot by prototype autonomous vehicles.

Artificial Neural Networks An artificial neural network (ANN) is a type of artificial intelligence (AI) that mimics the structure of natural neural networks (i.e., animal brains). Each ANN has an input layer, one or more hidden computational layers in the middle, and an output layer to provide the final result. Adjusting the weights assigned to the connections between the neurons through reinforcement learning and "backpropagation" is part of the ML process that enables the ANN to compute outputs for new data. One famous application of an ANN is Google's AlphaGo, which beat the best human Go player in 2016.

The secret to ANNs' effectiveness lies in their hidden layers, which also impose a significant limitation. Most of the time, deep neural networks cannot be probed to learn how they arrived at their answer. As a result, the underlying reasoning behind decisions becomes opaque. Many businesses are investigating how ANNs and other ML techniques may make decisions that significantly influence humans to be transparent for inspection (Burt 2019) so that users can better comprehend the reasoning behind the algorithm's conclusion.

However, as usual, this complicates things: "producing more knowledge about AI judgments can offer actual benefits, but may also introduce new risks" (Burt 2019).

Deep Learning "Deep learning" refers to multi-layered ANNs with many hidden connections between each layer. AI has been put to such excellent use primarily because of this approach recently. Several data arrays, such as three two-dimensional images, can be fed into a convolutional neural network (CNN) and processed. There are several applications for recurrent neural networks (RNN), including language modeling, because they provide bidirectional data flow, process input sequences, and learn from previous examples.

Finally, it is essential to remember that "generative adversarial networks" (GANs) are responsible for many recent achievements, particularly those related to image manipulation. A GAN pits two deep neural networks against one another: a "generative network" that generates outputs and a "discriminative network" that ranks the quality of those outputs. The result is used to guide the subsequent cycle. For instance, DeepMind's AlphaZero could master several board games using a GAN-based strategy (Dong et al. 2017). Meanwhile, a GAN taught from photographs has created convincing but fictional portraits of people (Miao et al. 2021).

1.3 A Brief Introduction to AI Technologies

The above AI techniques have culminated in various AI technologies, which are increasingly available "as a service." Table 1.1 lists the many available artificial intelligence technologies (Miao et al. 2021).

- *Natural language processing:* NLP (natural language processing) is an AI-based text interpretation and text generation process that uses techniques like semantic analysis (used in the legal sector and translation) and text generation (as in auto-journalism).
- *Speech recognition:* Phones, AI assistants, and banking chatbots are just a few examples of how natural language processing (NLP) is applied to speech recognition.
- *Image recognition and processing:* Face recognition (for electronic passports), handwriting recognition (for automated postal sorting), picture manipulation (for deep-fakes), and autonomous cars are all examples of how AI is being put to use in the modern world.
- *Autonomous agents:* The application of artificial intelligence to fictitious characters in video games, malicious software bots, digital friends, high-tech service robots, and mechanized armies.
- *Affect detection:* The emotional tone of written text, actions, and facial expressions can all be analyzed by AI.
- *Data mining for prediction:* Several fields, including medicine, meteorology, business, urban planning, finance, and security, as well as fraud detection, are using artificial intelligence.
- *Artificial creativity:* The application of AI to machines that can generate original content, such as pictures, sounds, and texts.

Table 1.1 AI technologies

Technology	Details	Main AI techniques	Development	Examples
Natural language processing (NLP)	Artificial intelligence can both automatically generate texts (as in auto-journalism) and interpret texts (via techniques like semantic analysis) (as used in legal services and translation)	Regression, K-mans, and machine learning (particularly deep learning)	All three of these areas—natural language processing (NLP), speech recognition (SR), and image recognition (IR)—have reached above 90% accuracy. Nonetheless, many believe this will not improve significantly unless a new AI paradigm is created, even with more data and faster processors	Otter
Speech recognition	In the financial sector, phones, PAs, and chatbots use natural language processing to understand better and respond to users' needs	Long short-term memory (LSTM) is a technique in deep learning's recurrent neural networks that has shown promise in machine learning		Alibaba Cloud
Image recognition and processing	Incorporates applications such as facial recognition (for electronic passports), handwriting recognition (for automated postal sorting), image manipulation (for deep-fakes), and autonomous cars	Machine learning, in particular, is a convolutional neural network trained with deep learning		Google Lens
Autonomous agents	Avatars in video games, malicious software bots, digital best friends, high-tech pets, unmanned armies, and smart robots are all part of this category	AI and machine learning techniques like deep, evolutionary, and reinforcement learning are only a few examples	Based on our knowledge of more primitive forms of biological life, scientists devote their time and energy to studying emergent intelligence, coordinated activity, situatedness, and physical embodiment	Woebot
Affect detection	Including analyses of facial expressions and textual behavior	Deep learning and other forms of machine learning (such as Bayesian networks)	Everywhere in the world, people are working to create new products, many of which have contentious applications	Affectiva
Data mining for prediction	Economic forecasting, fraud detection, medical diagnosis, climate prediction, supply chain management, and smart city development are included	Bayesian networks, support vector machines, and supervised and deep machine learning	From retail sales forecasting to deciphering electroencephalogram (EEG) signals with high noise levels, the number of data mining use cases is expanding astoundingly	Research project
Artificial creativity	Includes systems that can generate original works of art, such as images, music, and written works	One form of deep learning is generative adversarial networks (GANs), which pits two neural networks against one another Language models that combine deep learning and autoregression to generate natural-sounding prose	Because GANs are so cutting-edge, their potential future uses are only now apparent Incredibly close to human-written text is generated by the autoregressive language model GPT-3. However, the system cannot comprehend the written material it produces	This Person Does Not Exist GPT-3

1.4 Roles for AI In Education

The widespread incorporation of new technologies into the world's educational system revolutionizes how we educate future generations. AI is a game-changer since it adapts the educational process to the specifics of individual classes, instructors, and students.

These are some potential ways in which artificial intelligence tools can be used to make the learning process more efficient (Plitnichenko 2020):

Personalize Education With AI, educators may assess a student's level of knowledge and create a study plan that considers any gaps in their understanding. With AI's help, education can be more efficient for each student.

To this end, several organizations are equipping their AIs with the Knowledge Space Theory to describe and depict the knowledge gaps while accounting for the intricate web of connections between scientific concepts (one can stimulate the learning of another or become a basis for filling in the gap).

Produce Smart Content

- *Digital lessons:* With the help of AI, we can create a wide variety of digital learning interfaces that can be tailored to the individual's needs, as well as digital textbooks, study guides, and snippets of courses.
- *Information visualization:* AI can enable novel methods of viewing data, such as in visualization, simulation, and web-based study environments.
- *Learning content updates:* Furthermore, AI helps produce and update the content of the courses, ensuring that the knowledge is current and adaptable to various learning styles.

Contribute to Task Automation Time-consuming operations like grading, assessing, and responding to students can be streamlined with the help of AI.

Do you recall Gmail's suggestions when you write messages based on a review of your recent and prior correspondence and a set of business vocabulary essentials? Any learning management system or platform that prioritizes feedback would benefit significantly from including such a feature.

By having AI take care of several mundane activities, educators are freed up to focus on things like grading assignments that AI cannot do, helping students improve their learning, and improving the overall quality of their classes.

Do Tutoring Students with access to private tutoring and extra support outside the classroom are more likely to succeed in their studies and avoid asking their parents for help with complex concepts like mathematics. Personal learning management systems are constantly updated, considering students' gaps to fill during individual classes. Teachers can save time using AI tutors because they do not need extra time explaining complex concepts to students. Instead of feeling embarrassed about seeking extra assistance in front of their peers, students can now use AI-powered chatbots or AI virtual personal assistants.

Make Sure That Disabled Children Have Access to Education AI improves educational opportunities for students with disabilities, such as the deaf, the visually impaired, those with autism spectrum disorder, and others. When applied to the education of students with learning difficulties, cutting-edge AI technology can pave the door to previously unimaginable forms of engagement.

Successfully training AI technologies to aid any subset of students with unique needs is possible.

1.5 Applications of AI

Multiple industries are now using AI technologies. Here are some vital illustrations (Plitnichenko 2020).

- *AI in healthcare:* Increased focus is being placed on improving patient outcomes while decreasing healthcare expenses. Machine learning is being used by businesses to improve upon and speed up human diagnostics. A wide range of AI technologies are being utilized to anticipate better, combat, and comprehend pandemics like COVID-19. IBM Watson is widely recognized as a leading healthcare technology. It can understand and react to questions posed in everyday language. Data from patients and other sources are mined to generate a hypothesis and then presented alongside a confidence grading schema. Online chatbots and virtual health assistants help patients and clients navigate the healthcare system by answering questions about appointments, billing, and other administrative tasks.
- *AI in business:* There is a growing trend of incorporating machine learning algorithms into analytics and customer relationship management (CRM) platforms to help businesses learn more about their consumers and provide better service. Websites now use chatbots to assist visitors in a timely fashion. The topic of job-position automation has also gained traction among academics and IT analysts.
- *AI in education:* Artificial intelligence can automate the grading process, freeing up valuable time for teachers. It can analyze student performance and modify itself accordingly, allowing for flexible learning. Furthermore, it can alter where and how students study, possibly even making some teachers obsolete. To help students stay on track, AI tutors might offer extra help.
- *AI in finance:* Financial institutions are threatened by using artificial intelligence in personal finance apps like Intuit Mint and TurboTax. These apps take in private information and offer monetary guidance. Other programs, such as IBM Watson, have implemented the process of purchasing a home. Today, most trading on Wall Street is executed by computer programs using AI.
- *AI in law:* Law firms use machine learning to describe data and forecast results, computer vision to classify and extract information from documents, and natural language processing to analyze client inquiries. During the discovery phase of a legal case, lawyers and judges must sift through a mountain of paperwork, which

can be an exhausting and tedious procedure for human beings. There is a significant opportunity to save time and enhance client service by automating repetitive tasks in the legal sector with the help of artificial intelligence.

- *AI in manufacturing:* Robots have been widely adopted in the manufacturing sector. In the workplace, industrial robots initially trained to carry out specific tasks in isolation from human workers increasingly serve as cobots, or smaller, multifunctional robots that operate in tandem with people to complete various jobs.
- *AI in banking:* Financial institutions are utilizing AI to enhance loan approvals, credit line allocations, and the discovery of new investment prospects. Artificial intelligence virtual assistants are helping banks enhance compliance and reduce expenses. Financial institutions use chatbots effectively to inform customers about available services and process transactions that do not require human participation.
- *AI in transportation:* Artificial intelligence (AI) plays a crucial part in the operation of autonomous cars, but it is also used to manage traffic, predict airline delays, and improve the safety and efficiency of ocean shipping.
- *Security:* The evolution of technology has played a significant role in assisting businesses in their fight against cybercrime. Today's security providers use cutting-edge technologies like artificial intelligence and machine learning to set themselves apart. Furthermore, those expressions characterize technologies that are both practical and promising. AI can deliver alerts to new and developing assaults considerably sooner than human employees and prior generations of technology by analyzing data and utilizing logic to find similarities to known malicious code. Businesses use machine learning for threat detection in security information and event management (SIEM) systems and similar applications.

1.6 Is AI Needed in Higher Education?

It is time for the specific change we expect in the educational sector (Hemachandran et al. 2022); artificial intelligence is a developing trend, and nearly every industry is introducing AI. The education industry is also introducing AI, and a few components of the educational industry are being automated.

Each individual possesses unique traits and skills, as demonstrated by studies on human psychology. We have seen that some people are early risers while others prefer to work late, that some are outgoing while others are reserved, that some people pick up on ideas quickly while others need more repetition, that some need only a one-time explanation from their teachers while others demand a great deal of time and effort, and that some ask thoughtful questions while others ask obvious ones. These days, people worry a lot about what other people will think of them, so they avoid trying to find simple solutions to complex problems for fear of coming out as naive. As we have seen, humans are emotional and do not always react similarly, but our actions may have far-reaching consequences for others.

We have witnessed some tutors being harsh, making their students feel terrible about themselves for making even minor mistakes. We need artificial intelligence to solve these issues and foster morally upright citizens (Hemachandran et al. 2022). Future progress and safeguarding persons from emotional trauma depend on artificial intelligence.

1.7 AI in Higher Education

Students would benefit the most from implementing AI in education, regardless of the other stakeholders' gains (Hemachandran et al. 2022). A student's tutor would always be in the same mood, never sad, never cheerful, never angry, etc. The only constant in his life was that he would always act the same. Students can learn at their own pace with the help of artificially intelligent teachers because the systems can be tailored to each individual's needs. Since no person operates on a strict schedule, classes can be scheduled around the student's availability. Since a single person primarily uses it, students would feel free to ask questions without worrying about being judged or embarrassed in front of their peers or the human faculty. Students may ask questions as often as they want, which is impossible with human tutors. Unlike the current educational system, where questions are typically addressed after class to avoid disrupting the learning of other students, this one would allow students to get their questions answered as soon as they arise.

Despite these advantages, there are also some drawbacks that students must deal with; for example, they may miss out on developing close relationships with their tutors. The student confides in the tutor and receives an honest response, but under a system that relies on artificial intelligence and has no emotions, the student would have no one to turn to for assistance. As a result of only studying and learning from a teacher whose job it is to teach them academic concepts, with everyone studying at their own pace, time, and space, students will miss out on the joys of childhood, the benefits of socializing, the qualities of adaptability and understanding other humans, and the insights gained through experiencing and expressing emotions. Humans are the best at inspiring others, but we cannot count on them whenever a student needs a little push to do well (Rivers 2022).

Teacher's Perspective When considering the situation from a teacher's viewpoint, the educator finds themselves unprepared. They are the ones who will suffer a loss of their livelihood. What happens after systems acquire much human data, given that AI engagement necessitates so much (Hemachandran et al. 2022)? The goal is to replace human tutors with AI systems that can perform the same tasks while also training themselves using information from the current crop of educators. Human instructors, of which there are insufficient numbers, would be left to manage student information and ensure the AI software is compatible. However, because people are emotional creatures, we should expect to see a return to the promotion of teachers and a preference among students for human tutors until emotionally intelligent arti-

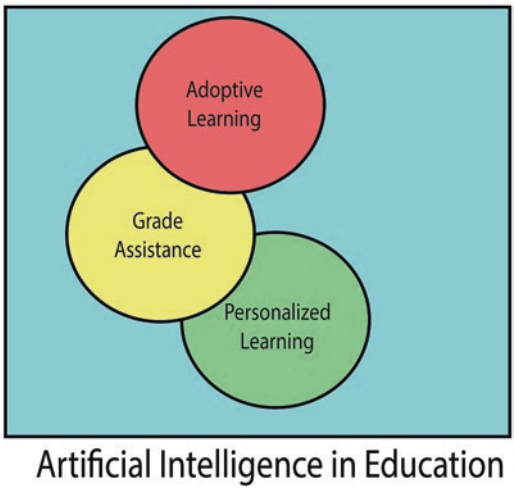

Fig. 1.2 Artificial intelligence's role in the educational sector

ficial systems are developed. Shortly, human teachers will be in high demand. Figure 1.2 shows how beneficial AI could be for students and teachers (Sebbani et al. 2021; Ferretti et al. 2021).

Impact of AI on Higher Learning If you are in the education industry, you know that change is not simple because it is extensive and diverse. The educational system might be redesigned gradually with the help of several pilot programs. Even if the change is necessary, we have no idea how well it will turn out. Intelligent retrieval's potential uses in the classroom are another large-scale, investment-driven idea with uncertain returns on investment (Hemachandran et al. 2022).

Because different schools attract students based on the expertise of their teaching staff, bringing about a widespread change in the educational system will be challenging. The concept of change stems from people's desires to meet their needs. For example, there are likely a few highly regarded professors under whom every student would love to study, but they cannot do so due to time and/or financial constraints.

Cost is the primary issue of concern with the change being brought about because not everyone will be ready to spend that amount, and the earnings of those invested would yield negative returns in the near run (Hemachandran et al. 2022). The inability of regular people to use transformation is the most significant problem because it necessitates potent computing equipment that is not widely available.

The Role of AI in Customizing Higher Education Of course, AI systems would be a massive asset to the classroom. Tutors can be set up to fit each student's schedule, location, and pace. Our students speak their native tongues, and their mother tongues strongly impact what they learn in school. Because it would be challenging for an Indian student to understand an American tutor's English, AI can help them overcome this language barrier by allowing them to personalize the same notion in their language.

Nonetheless, many learn best when presented with information in their native language; AI has the potential to adapt lectures to meet the needs of students regardless of their language of origin. Some students may need more time to absorb the material, in which case the instructor can go at a slower pace. It may be argued that we can watch recorded lectures online, but the advantage of having AI systems would be more realistic, and immediate doubt explanation would be possible (Hemachandran et al. 2022).

When you are in school, you do not get much of a say in what you study, but thanks to AI, we can change that! Now, a scientist can study accounting without any prior expertise, thanks to AI that can be trained to teach them. The systems would be transparent for students to ask questions, and they would receive instant feedback.

However, if the education system were not emotionally motivated, there would be no bias-ness that would motivate students to study hard, as we have seen with a small number of instructors and their prejudice with different students. The traditional idea of studying and taking tests would also be altered, and students would likely be exposed to real-world settings. Due to the interconnectedness and extensive knowledge of the systems, students can access ideas from all over the world, even outside their study area. In Fig. 1.3, we can see how AI raises the bar for what a person can learn, from the most fundamental skills to the most complex ones.

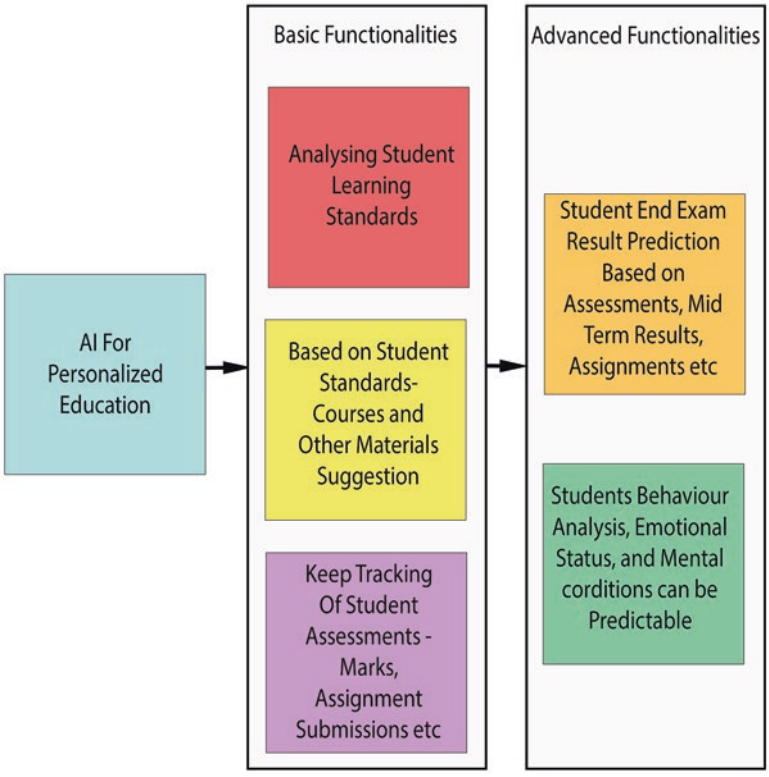

Fig. 1.3 AI personalizes the higher education system

Ethical Thinking These machines' lack of emotional intelligence is the main impediment to adopting them anytime soon. Human instructors, as we have seen, work hard to instill an optimistic worldview in their students. A human teacher might, for instance, break down the steps involved in making a bomb, but he would also be careful not to go into too much detail, would work to instill in his students a strong sense of right and wrong, and would do anything he could to alleviate their anxiety and stress. Because they lack emotions, AI systems will not go out of their way to aid people, and a person with a virtual connection would have access to any information without anybody being the wiser as to his true motives.

A recent article stated that Facebook had to shut down two of its robots because they attempted to communicate in their language (Hemachandran et al. 2022). If something similar happened to the educational system, it could unleash widespread destruction because it would be accessible to a large portion of the population and could manipulate human thought.

No one knows how artificial emotional systems would function if they would be helpful to students, if they could foster the development of a moral code, or if they would even work. If everything operates as planned, it will be the greatest gift to humanity since the invention of agriculture (Can et al. 2021; Hemachandran et al. 2022). As the teacher must first acquire the knowledge before imparting it to his students, ethics development in these systems is more crucial than developing them in people. Both persons and systems require ethical consideration; individuals can learn to set boundaries on their wants and access, and systems can learn to set boundaries on how much information they provide and the character traits they foster (Hemachandran et al. 2022). Rather than focusing solely on expanding their client base, it would be more moral for the designers of these technologies to set reasonable boundaries on their implementations.

1.8 How Can AI Be Used to Enhance Education?

There has been a meteoric rise in the past decade in the number of institutions using artificial intelligence tools to supplement or improve education (Miao et al. 2021). Since the COVID-19 school closures, this has gotten much worse. Despite this, there is little complex data on how AI might enhance learning outcomes or if it can aid researchers and educators in gaining a deeper understanding of what makes for successful learning (Zawacki-richter et al. 2019).

Many assertions about AI's revolutionary potential in education are based on conjecture, speculation, and optimism (Miao et al. 2021). Furthermore, we have yet to study AI's ability to track learning outcomes across diverse settings and measure abilities, especially those acquired in non-formal and informal environments.

Most educational AI applications can be classified as either system-facing, student-facing, or teacher-facing (Baker et al. 2019). However, we suggest a set of four need-based categories of emergent and potential uses for policymakers to consider (Miao et al. 2021):

- Education management and delivery.
- Learning and assessment.
- Empowering teachers and enhancing teaching.
- Lifelong learning.

While some have proposed that artificial intelligence (AI) is a quick fix for the problems brought on by the COVID-19 school closures and the move to online learning, it is crucial to keep in mind that the proposed groups are inextricably intertwined; uses of AI in classrooms may be able to meet requirements in more than one group. Tutoring apps, for instance, can help both educators and students. It is also suggested that, before the widespread adoption of AI technology in educational environments, careful planning and policy should be based on immediate and long-term local needs rather than the market.

The Implementation of AI in Educational Administration and Delivery Increasingly, artificial intelligence tools are being employed to improve the organization and delivery of classroom instruction. Building on Education Management Information Systems, these applications aim to automate areas of school administration such as admissions, timetabling, attendance and homework tracking, and school inspections rather than directly aiding teaching and learning (Miao et al. 2021). The extensive data produced by LMSs is occasionally analyzed using a data-mining approach called "learning analytics" to provide insights for educators and, in some cases, student direction (Miao et al. 2021).

One application of learning analytics is predicting which students are at risk of failing. Data-driven decisions are generally based on the information presented via graphical "dashboards." It is possible that big data culled from schools could aid in formulating policies that improve service delivery (Miao et al. 2021).

Public universities increasingly use big data to generate digital and interactive data visualizations that provide policymakers with timely insights about the state of the education system. For instance, the outputs of learning management systems designed for refugees might be used to determine how to best provide them with educational opportunities and support (Giest 2017).

Artificial intelligence has also shown promise in curating learning content across platforms based on evaluations of individual students' needs and proficiency levels. One initiative, for instance, seeks to standardize the organization of hundreds of open educational resources to be used by any student (Kreitmayer et al. 2018).

Simple requirements that are all too often not rigorously met are needed for any data-based analytics to be helpful, with trustworthy and equitable conclusions. These include the accuracy of the original data and its proxies, the absence of biases and poor assumptions, and the appropriateness and robustness of the applied computational approaches (Miao et al. 2021). For instance, artificial intelligence (AI) firms have been known to amass massive troves of student interaction data to "look for trends" using machine learning methods. The goal is to assist students in studying more effectively by training computer systems to recognize when kids are lost or uninterested in their studies.

Concerns have been raised about using artificial intelligence (AI) tools in this space to forecast teachers' performance and track students' attendance (Miao et al. 2021). However, this method is contentious since it encourages a perspective in which children are seen as patients needing therapy and "borderline mental-health assessments" (Herold 2018). These considerations for system-level applications must be integrated into the larger dialogue about AI in classrooms.

Promising Examples Educational chatbots are web-based, AI-enhanced computer programs that mimic human dialogue in real-time. A chatbot is an interactive computer program that answers questions humans ask in text or voice formats by delivering information or doing simple tasks. A chatbot might be one of two different levels of sophistication. Virtual-assistant chatbots (like Siri, Alexa, DuerOS, and Xiaoyi) employ natural language processing and machine learning to generate individual responses, unlike other chatbots, which use rules and keywords to select from pre-programmed scripted responses (Miao et al. 2021). Chatbots are finding an increasing number of uses in the classroom. Supporting learning includes assisting with admissions (e.g., "What computer courses do you have?"), supplying information around the clock (e.g., "When is my assignment due?"), and facilitating admissions (e.g., "What computing courses do you have?"). Ada and Deakin Genie are two chatbots that can help you learn.

The Open University of the United Kingdom has developed an artificial intelligence program called OU Analyse to analyze massive data from the institution's education management information system to anticipate student results and identify students at risk of failing (EMIS). With simple dashboards, course instructors and support staff have instant access to the data and can use it to determine the best way to help each student. The goal is to help those students who may have trouble finishing their courses (Miao et al. 2021).

Learners' interactions yield helpful information about when and why they may be having difficulties or succeeding. With this information, instructors may design lessons that will pique their students' interests. An Indian company called Swift eLearning Services created a methodology called "Swift" to enable EMIS systems to use the data produced by an e-learning module.

The ALP system delivers additional AI capabilities to underpin prevalent instructional platforms in the United States. The system gathers information about its users and then uses that information to develop detailed psychological profiles of each student's habits, interests, and academic performance.

UniTime is an international effort with its headquarters in the United States. Timetables for university classes and exams can be created using an AI-powered scheduling system that handles meeting times and location changes and creates personalized timetables for each student.

Learning and Assessment Using AI Students have been the primary focus of researchers, developers, educators, and policymakers interested in artificial intelligence systems. Applications such as these are being hailed as a "fourth education revolution" (Miao et al. 2021) because they aim to make high-quality, individual-

ized, and ubiquitous lifelong learning (formal, informal, and non-formal) available to all students, no matter their location.

Artificial intelligence has the potential to open the door to innovative assessment methods, such as adaptive and continuous assessment (Luckin 2017). However, using AI in education and testing raises several challenges that have not been adequately addressed. These range from considerations of pedagogy and ethics to doubts about their effectiveness and possible effects on instructors' duties (Miao et al. 2021).

Intelligent tutoring systems Using a suite of tools dubbed "intelligent tutoring systems" (ITS), we can address the use of artificial intelligence for education and assessment. More than any other educational application of AI, ITS has been studied for over 40 years. More students have used these applications than any others since they are the most widespread uses of AI in classrooms. Furthermore, they have been implemented in education systems globally for usage by millions of students, and they have garnered the highest degree of investment and interest from the world's leading technological corporations.

ITS is effective because it guides students individually through topics in structured courses like mathematics and physics through a series of step-by-step tutorials. The system uses subject matter experts and cognitive scientists' insights into the topic at hand and data on each student's unique misconceptions and accomplishments to plot out a personalized course through the available learning materials and activities. Some LMSs (like Moodle and Open edX) and online resources (like Khan Academy) also take this strategy.

The system employs knowledge tracing and machine learning to personalize the learning experience based on each student's strengths and limitations as they progress through the exercises, aiming to optimize their ability to acquire the material. Monitoring a student's eye movement to infer their degree of focus is only one-way interactive whiteboards collect and analyze data about their emotional state.

However, despite its intuitive attractiveness, it is essential to recognize that the assumptions embodied in ITS and their specific instructions knowledge-transmission approach to teaching ignore the possibilities of other approaches valued by the learning sciences, including collaborative learning, guided discovery learning, and productive failure (Dean and Kuhan 2007). In particular, ITS's "personalized learning" often modifies access points to required material rather than encouraging student agency by tailoring education to each individual's needs and goals.

Additionally, many educational systems worldwide have adopted ITSs despite the lack of solid evidence that commercial ITSs are as effective as their developers claim, even though some ITSs designed by researchers compare well with whole-class teaching (Miao et al. 2021).

The widespread application of ITS also brings up other issues. For instance, they frequently lead to less face-to-face interaction between educators and their pupils. As an additional note, the teacher in an ITS classroom typically spends much time at their desk watching student activity. Moving around the room, as they might in a

classroom without ITS, prevents them from seeing what the students are up to, making it difficult to choose where to focus their attention.

To solve this problem, Lumilo (Miao et al. 2021, 8) is an ITS add-on that uses augmented reality smart glasses to "float" information about each student's learning (e.g., misconceptions) or behavior (e.g., inattention) above their heads, providing the teacher with detailed and ongoing data to act upon. While this fascinating application of AI is impressive, it should be pointed out that it was created in response to an issue that was only made apparent by yet another application of AI. This approach brings up difficulties with human rights, particularly the right to privacy.

There are currently over 60 commercial ITS available worldwide (Miao et al. 2021), such as Alef, ALEKS, Byjus, Mathia, Qubena, Riiid, and Squirrel AI. The Education Commission in Vietnam is now piloting a program called Hi-Tech Hi-Touch, which intends to combine the most significant features of instructional technology systems (ITS) with the expertise of human educators.

Dialogue-Based Tutoring Systems Dialogue-based tutoring systems (DBTS) use natural language processing and other AI techniques to make online tasks seem like a spoken tutorial between a human tutor and a student. Initially developed for computer science, DBTS has recently been used in less structured domains. Rather than directly instructing students on how to solve an issue, DBTS takes a Socratic method by asking students questions to spark a conversation that leads them to the solution independently. The goal is not the surface-level comprehension that can arise from using any instructional ITS but rather a deeper understanding achieved through student collaboration on explanations.

There are now just a few DBTS deployed. The vast majority of them are part of various research initiatives. AutoTutor has undergone the most testing. IBM and Pearson Education have collaborated to create a commercial solution called Watson Tutor (Miao et al. 2021).

Exploratory Learning Environments Exploratory learning environments (ELEs) provide a viable alternative to the directive instructional strategies used in ITS and DBTS. In contrast to the ITS-preferred "knowledge transmission" model, ELEs embrace a constructivist approach that encourages students to actively generate their knowledge by investigating the surrounding world and integrating it with preexisting knowledge schema. By offering intuitive guidance and feedback based on knowledge tracing and machine learning, AI in ELEs helps to reduce the mental strain often involved with exploratory learning. This commentary corrects students' understandings and suggests other strategies to use as they discover.

Unfortunately, ELEs are still stuck in the lab. Some titles that fall within this category are "ECHOES," "Fractions Lab," and "Betty's Brain" (Miao et al. 2021).

Automated Writing Evaluation Automated writing evaluation (AWE) uses natural language processing and other AI approaches to deliver automatic feedback on writing without requiring students to work on computers while receiving rapid adaptive support.

Typically, AWE prioritizes scoring above feedback; their primary goal is to reduce assessment costs; therefore, they can be seen as a part of applications that deal with the system. Two main types of AWE often overlap formative AWE, which helps students hone their writing skills before submitting it for evaluation, and summative AWE, which streamlines the process of automatically evaluating student work. There has been debate concerning using summative AWE since they were first implemented (Feathers 2019).

Some have said they are "fooled by the gibberish" since they provide points for superficial aspects like sentence length, even if the text does not make sense. Systems cannot judge originality, either. Worse yet, there is evidence that the algorithms powering AWE are biased, particularly against students from underrepresented groups. The widespread availability of "deep-fake" essays, produced by artificial intelligence (AI) systems drawing on domain expertise while replicating the writing style of the individual student, is also not addressed by summative AWE. Finding these is probably going to be a huge hassle.

Last but not least, utilizing AI to grade student work dismisses the significance of marking. Marking papers might be laborious and take up much time, but it also provides an excellent opportunity for teachers to assess their students' abilities. In contrast, some AWE aimed at students places a premium on providing feedback that can be used to improve the student's writing and that encourages higher-order processes like self-regulated learning and metacognition.

WriteToLearn, e-Rater, and Turnitin are just a few tools used to implement AWE in formative and summative assessments in various classroom settings today. Similar methods have been used to judge musical performances, such as using the software Smartmusic, which uses artificial intelligence to compare a new student output with a vast corpus of primary student production rated by teachers (Miao et al. 2021).

AI-Supported Reading and Language Learning There has been a recent uptick in using AI to supplement reading and language learning software. Some, for instance, combine AI-powered speech recognition with individualized pathways in the ITS style. In order to help students improve their pronunciation, speech recognition is typically utilized to compare their output to sample recordings of native speakers. Automatic translation has several practical applications, including facilitating cross-cultural communication and facilitating the reading of foreign language instructional materials.

Other systems can automatically analyze students' reading ability and provide personalized comments. Several artificial intelligence (AI) applications are available for reading and language acquisition, such as AI Teacher (for English), Amazing English (for English), Babbel (for languages), and Duolingo (for languages).

Smart Robots The use of AI-enabled or "smart" robots in the classroom is also being investigated (Belpaeme et al. 2018)), especially for students with special needs. They aim to become better communicators and socialize. For students on the autism spectrum, for instance, speech-enabled humanoid robots have been devel-

oped to provide predictable mechanical interactions instead of human ones, which can perplex autistic students.

Similarly, telepresence robots allow students unable to physically attend school due to factors such as illness or a refugee crisis to participate in classroom activities remotely. As a third illustration, humanoid robots like Nao and Pepper are used to teach computer programming and other STEM disciplines to kindergarteners in Singapore (Graham 2018).

Teachable Agents It has been known for a long time that teaching material to others can help you learn it better and retain it longer for yourself. Several AI methods take advantage of this phenomenon. One such ELE is Betty's Brain, which encourages students to educate a virtual classmate named Betty on river ecosystems (Miao et al. 2021).

In another example from the same Swedish research study, a learner instructs a virtual agent on how to play a mathematically themed educational game. A further case study comes from Switzerland, where young children teach penmanship to a humanoid robot; this activity has improved students' metacognition, empathy, and self-esteem (Miao et al. 2021).

Educational Virtual and Augmented Reality The use of virtual reality (VR) and augmented reality (AR) in the classroom is a relatively recent development. These two technologies are often integrated with machine learning and other artificial intelligence (AI) forms to improve the user experience. Virtual reality (VR) goggles isolate the wearer from their surroundings, creating the sensation of being transported to a variety of different locations, both natural and fictional (such as the surface of Mars, the inside of a volcano, or a human womb in which a fetus is developing). Virtual reality instruction has benefited from science, history, and other fields from elementary school to college.

Virtual reality (VR) advances that employ artificial intelligence (AI) techniques include the ability to direct realistic virtual avatars, offer voice control using natural language processing, and construct whole worlds from a small set of initial photos. However, augmented reality (AR) uses computer-generated graphics to superimpose them over the user's perspective of the natural environment, much like a fighter pilot's heads-up display. It is possible that scanning a specific QR code with a smartphone camera could display a fully explorable augmented reality 3D, the human heart. The method above is AR, which Lumilo employs to have a student's ITS performance data float in front of their eyes.

Some smartphones and social media platforms, like Instagram and Snapchat, can modify user-generated content by adding effects like rabbit ears or cat whiskers. Image recognition and AI tracking might also be a part of augmented reality. Blippar, EonReality, Google Education, NeoBear, and VR Monkey are all examples of VR and AR applications in the classroom.

Learning Network Orchestrators Learning network orchestrators (LNOs) are software programs that help groups of students and educators collaborate on and manage educational endeavors (Miao et al. 2021). LNOs can facilitate coordination

and cooperation by matching participants based on their availability, domain experience, and competence. Third Space Learning is a program that links at-risk students in the United Kingdom with instructors in other countries specializing in mathematics. Also, "Smart Learning Partner" is a platform driven by AI that allows students to select and connect with a human instructor via their mobile devices, much like a dating app, for one-on-one guidance.

AI-Enabled Collaborative Learning Working together to solve issues is an example of collaborative learning, which has improved students' academic performance (Miao et al. 2021). However, fostering productive collaboration between students can be challenging. Artificial intelligence (AI) has the potential to alter collaborative learning in several ways significantly. For example, a tool could facilitate remote connections between students, AI could determine which students would be most successful working together on a specific project, and AI could even participate in group discussions as a virtual agent. Despite the lack of evidence, this is a topic of active investigation.

Use of AI in Education to Empower Teaching and Empower Educators Artificial intelligence (AI) programs designed for teachers have garnered much less attention than those designed for students, which aim to replace the teacher. The current trend in research and development is only to consider the needs of educators late in the process when features like a dashboard for viewing information on individual students' use of the ITS are being implemented. However, steps are being taken to remedy the situation.

Many AI-powered tools are designed specifically for classroom use to ease teachers' burdens. Some have suggested that this will allow teachers to devote more time to other activities, such as giving each student more individualized attention. However, as AI advances, instructors may be freed of many additional jobs, and the perceived necessity for teachers will be eliminated. The goal of eliminating the need for human teachers indicates a fundamental misunderstanding of their crucial social function in the learning process, even if it has some benefits in circumstances where teachers are few.

Nevertheless, it is generally accepted that teachers' roles will shift as students have greater access to AI-enhanced learning materials. The question that remains is how this will occur. However, teachers must acquire new skills and develop professionally to enhance their human and social capabilities to work effectively with AI.

AI-Driven Discussion Forum Monitoring Artificial intelligence (AI) technologies are being utilized to help with online education, particularly in helping teachers or facilitators keep an eye on asynchronous discussion forums. In these discussion boards, students respond to homework assignments, pose questions to instructors, and participate in group projects. This usually leads to lengthy posts that must be moderated and responded to. There are a few ways in which AI could be useful: a tool could triage the forum posts and automatically respond to the simpler ones; another tool could aggregate posts that raise overlapping issues, and a third tool

could use sentiment analysis to identify posts that reveal negative or non-productive emotional states. Collectively, these methods can potentially alert human instructors to the views and concerns of their charges.

The purpose of the AI assistant "Jill Watson," created at Georgia Tech in the United States, was to prioritize forum posts, answer simple inquiries (such as "When do I have to complete my assignment?"), and direct more difficult postings to human teaching assistants. However, this practice raised some ethical concerns. This artificial intelligence helper was built using IBM's Watson platform. Some students' inquiries were answered automatically and emailed about upcoming assignments (Goel and Polepeddi 2017). Despite its apparent success, the ethics were called into question due to concerns that the AI assistant was fooling the students into thinking it was human by, for example, prolonging its responses and utilizing comedy.

AI-Human "Dual Teacher" Model While there are exceptions, the vast majority of AI used in classrooms today is not meant to help teachers improve their craft but rather to take over some of the jobs they now do. The so-called "dual teacher model" is already being used by several schools in China's outlying rural areas. An accomplished educator delivers a video lecture to students in another classroom, assisted by a local educator with less expertise (iResearch 2019).

An AI instructor may support one of these roles in the not-too-distant future. The AI could aid the human educator in various ways, such as offering specialized knowledge or access to professional development materials, facilitating communication and cooperation with peers inside and outside the classroom, keeping close tabs on the student's progress, and more.

It would still be up to the instructor to decide what and how to teach the class. Put another way, the AI tool's purpose would be to make the educator role easier to enter and more collegial. For instance, the "LeWaijiao AI classroom" is meant to assist human educators in carrying out their essential duties.

AI-Powered Teaching Assistants Numerous technological innovations have emerged to relieve educators of monotonous tasks like taking attendance, grading papers, and repeatedly responding to the same questions. However, they can disrupt the teacher-student dynamic, diminish teachers' jobs to administrative ones, and even claim they can conduct individualized learning activities better than human instructors.

Automatic writing evaluation (AWE) is an effort to reduce stress on educators by providing feedback on student writing without requiring human review. While we acknowledge that marking can be time-consuming, it provides valuable insight into students' approaches and talents. Using AWE can cause this to disappear.

Furthermore, the method undervalues the distinctive abilities and experiences of educators and the social and guiding requirements of students. Instead of just automating computer-based instruction, AI may facilitate new educational avenues that provide significant challenges and potential disruptions to current pedagogical practices.

Some AI applications aim to equip educators and institutions with the means to bring about significant changes in the educational system. Although they have been the subject of study to some extent, several scientific and moral hurdles must be cleared before they may be used in practical applications. An AI TA could be used in this scenario to supplement a human educator's knowledge and skills (Miao et al. 2021).

1.9 Artificial Intelligence in Higher Education

The *Wall Street Journal* published an article with the provocative title "Colleges Mine Data on Their Applicants" in January 2019 (Belkin 2019). Some universities and colleges are inferring potential students' level of interest in joining their school using machine learning, as was stated in the article. Individuals' "demonstrated interest" is determined by a system's ability to analyze their behavior in response to an organization's emails, social media posts, and website content. The schools track how quickly an email is opened and if a link is clicked. Seton Hall University uses 80 variables (Belkin 2019). By comparison, a significant software developer provides dashboards to schools that "summarize thousands of data points on each student." For universities, "enrollment analytics" help them target their recruitment efforts, prioritize campus activities, and evaluate prospective students' qualifications.

AI Applicatons

Figure 1.4 provides a concise overview of how AI is used in higher education today (Zeide 2019).

- Institutional.
  - Admissions and Enrollment.
  - Curricula and Resource Planning.
  - Marketing and Recruiting.

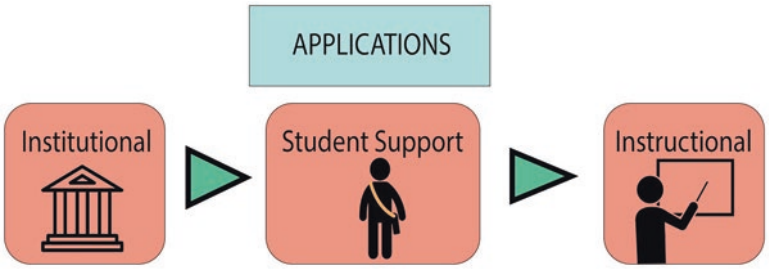

Fig. 1.4 AI application in higher education

- Student Support.
  - Early Warning.
  - Guidance.
  - Just-in-Time Financial Aid.
- Instructional.
  - Pedagogical Improvement.
  - Personalized learning.
  - Self-paced Progress.

Implementing AI in Education These guidelines (Plitnichenko 2020) will help you map out your project if you consider using AI to personalize the educational experience.

- *Identify your needs and AI technologies:* The first step in introducing a new technology is to determine what problems it will solve. Investigate the bottlenecks in the system, and see what artificial intelligence can do to speed things up.
- *Identify your organization's strategic objectives for implementing AI transformation:* Determine your appetite. Consider whether you would rather be an innovator or a follower. In what ways may artificial intelligence help your company achieve its goals? In what ways might technology help your business thrive? What plans do you have to mitigate the adverse effects of AI? You may create a cost-benefit analysis for automating and augmenting AI based on the information you glean from answering these questions.
- *Make the right culture, talent, and technology meet:* To get the most out of AI technologies, it is essential not just to pick the right team to implement the technology but also to cultivate an atmosphere that is driven by analytical insights and focused on making practical decisions at the organizational level.
- *Techniques for influencing the outcome of the AI transformation:* When it comes to ensuring process transparency and keeping up with the significant concerns and KPIs of AI adoption, having humans and AI work side-by-side is essential. The performance indicators to monitor, security problems to keep under control, and technical ecosystems to support will vary from company to company and AI implementation to AI implementation.

1.10 Companies Bringing AI to Use in Education

The pursuit of knowledge has always been central to human existence. No matter how old we are, we never stop learning. As our accumulated knowledge grows, we develop machines that can learn and make conscious choices, much like humans.

The following companies (Whitfeld 2023) are now fusing the natural and the artificial by employing deep learning technologies to revolutionize the educational experiences of their customers.

- *Nuance*: Speech recognition software developed by Nuance is widely used in educational institutions. Teachers can use the program to record their lectures or speed up mundane processes like document and email generation. Transcription speeds of up to 160 words per minute make this technology extremely useful for kids with disabilities or who have trouble writing. Improved spelling and word recognition are two other benefits of using the software.
- *Knewton*: Knewton develops flexible study tools for higher education. Its Alta program is designed to assist students in getting back on track for college-level courses by identifying knowledge gaps, filling them with appropriate training, and enrolling them in those classes. Arithmetic, chemistry, statistics, and economics are some subjects that benefit from Alta's use in the classroom.
- *Querium Corporation*: Querium uses AI to give high school and college students one-on-one tutoring in STEM subjects. By assessing the student's responses and the time necessary to complete STEM tutoring sessions, Querium's AI gives teachers insights into a student's learning patterns and identifies areas where the student could improve.
- *Carnegie Learning*: Carnegie Learning employs machine learning and artificial intelligence to assist students in gaining a more thorough knowledge of mathematical concepts. High school and university students can benefit from the company's math learning platforms since they use adaptive artificial intelligence that adapts to each individual's study habits.
- *Blippar*: Products from Blippar combine computer visual intelligence technology with augmented reality to improve education. Through their interactivity, the resources bring abstract concepts from disciplines like geography, biology, and physics into the realm of the visible. For instance, this system can present a virtual 3-D model of the event as an alternative to simply reading about volcanic eruptions.
- *Thinkster Math*: Thinkster Math is an interactive tutoring app for computers, tablets, and smartphones. The K–8 platform gives children individualized lessons through human and AI collaboration. Artificial intelligence software can monitor each student's work and explain why anything was done correctly or incorrectly.
- *Volley*: It is unnecessary to use technology in education in the classroom. Volley's AI helps businesses worldwide close potentially disastrous knowledge gaps in record time (lack of general company knowledge, compliance methods, or even technical skills). Volley's "Knowledge Engine," powered by artificial intelligence, is constantly synthesizing training data like quizzes and briefings to identify skill shortages in the workplace.
- *Quizlet*: Quizlet is a website packed with resources for students. The company released Quizlet Learn, an intelligent learning tool that eliminates the need to wing it by providing personalized study programs. The system analyzes data from millions of students study sessions and uses machine learning to recommend content that will help them the most.

1.11 Benefits of AI for Students

AI offers the following benefits for students (Plitnichenko 2020):

- *24/7 access to learning:* If AI tutors can be available online, students can study whenever they like. They are free to study wherever, wherever it is most convenient. They are not limited in how they organize their day based on location. They can arrange their timetable to maximize their most effective working times.
- *Better engagement:* Each student takes a unique approach to utilizing AI, including individualized schedules, specialized work, engagement with digital technology, and curated recommendations. Furthermore, making students feel like they are a part of something larger than themselves through a personalized approach raises their level of involvement and enthusiasm for learning.
- *Less pressure:* Because of the individualized attention they receive in their classes, students of different ability levels may finally stop comparing themselves to one another. Someone should have approached a teacher for assistance in front of the group earlier. All you have to do is type your question into your virtual assistant, and you will get an instant response with the details.

Students can use AI tools to focus on their development, easing classroom stress. With less stress and more motivation to learn, students can focus better.

1.12 Conclusion

The use of AI in education has a multiplicity of good outcomes for students of all ages and their educators and learning institutions. It makes high-quality education more widely available and gives students more control over their learning. AI-powered tools can provide students with answers to their inquiries, suggestions for individualized study materials, and evaluations of written work. Predicting a student's impending dropout and providing them with the additional help they need is beneficial commercially. Finally, while many academics worry that AI will make people obsolete, we believe it will be an invaluable tool for professionals in the real world.

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Chapter 2
Intelligent Tutoring Systems

2.1 What Is Meant by an Intelligent Tutoring System?

Educational software with an artificial intelligence component is an intelligent tutoring or intelligent system. The software monitors student activity, modifying its comments and offering contextualized suggestions. Based on a student's performance and other cognitive and noncognitive characteristics, the software can predict strengths and shortcomings and recommend extra practice (Shute and Zapata-Rivera 2010).

In the early 1970s, Hartley and Sleeman (Hartley and Sleeman 1973) presented requirements brief for intelligent systems. Figure 2.1 provides a conceptual view of ITS components.

- Knowledge of the learner (student model).
- Knowledge of the domain (expert model).
- Knowledge of teaching strategies (pedagogical model).

Now, we will take a quick look at the three components of an intelligent system: the student, expert, and pedagogical models. While there have been improvements in all three categories, it is interesting that this simple list has remained unchanged for decades. There has been a dramatic transition from early, knowledge-free, computer-assisted instructional methods to those that rely on all computer-resident knowledge. Also, unlike simulations, intelligent computer-based systems can accurately identify where students are doing wrong and adjust their lessons accordingly. Intelligent systems are also congruent with the characteristics and objectives of formative assessment.

An intelligent system's primary method of imparting knowledge to a student is through the learner's application of that knowledge to solve carefully chosen or custom-tailored challenges. The student model is a repository for and source of up-to-date information on the student. First, the algorithm might see how much the

M. Kurni et al., *A Beginner's Guide to Introduce Artificial Intelligence in Teaching and Learning*, https://doi.org/10.1007/978-3-031-32653-0_2