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WHAT TYPES OF AI APPLICATIONS IN EDUCATION

Among the possible classifications of AI scientific domains, the following table presents an AI taxonomy¹ according to the family functions possibly performed by AI.

	Al taxonomy		
	Al domain	Al subdomain	
Core	Reasoning	Knowledge representation	
		Automated reasoning	
		Common sense reasoning	
	Planning	Planning and Scheduling	
		Searching	
		Optimisation	
	Learning	Machine learning	
	Communication	Natural language processing	
	Perception	Computer vision	
		Audio processing	
Transversal	Integration and Interaction	Multi-agent systems	
		Robotics and Automation	
		Connected and Automated vehicles	
	Services	AI Services	
	Ethics and Philosophy	AI Ethics	
		Philosophy of AI	



Figure: AI taxonomy - AI scientific domains and subdomains (from Samoili & al., 2021 JRC report¹).

Let's see which AI techniques are used in the AI-based education-oriented applications proposed by Holmes & al. in 2019².

Student teaching	Student supporting	Teacher supporting	System supporting
Intelligent Tutoring Systems (ITS) (inc. automatic question generators)	Exploratory learning environments	ITS & learning diagnostics	
	Formative writing evaluation	Summative writing evaluation, essay scoring	Educational data mining for resource allocation
	Learning network orchestrators	Student forum monitoring	
Dialogue-based tutoring systems	Language learning applications	Al teaching assistants	Diagnosing learning difficulties
	Al collaborative learning	Automatic test generation	
	Al continuous assessment	Automatic test scoring	
	Al learning companions	Open Education Resources (OER) content recommendation	Synthetic teachers
Language learning applications (inc. pronunciation detection)	Course recommendation	Plagiarism detection	
	Self-reflection support (learning analytics, meta-cognitive dashboards)	Student attention and emotion detection	Al as a learning research tool
	Learning by teaching chatbots		

Figure: Different types of current AI-based systems for Education (from Holmes & al. 2019²).

Each Al-based educational tool or resource has its own specific techniques. However, it is sometimes possible to guess which ones are likely to be used for a given resource.

Let's take some examples:

- **Dialogue-based tutoring system**, as a student teaching service Such systems are likely to use: **communication** techniques such as natural language processing for speech and language understanding and generation and **reasoning** techniques for tutoring purposes
- Course recommendation, as a student supporting service As for personalised marketing offers and recommendations functions that can be found on the Internet, course recommendation systems are probably based on machine learning techniques by analysing relevant current data related to the student learning path and identifying similarities to previous generalised student learning paths.
- Student attention and emotion detection, as a teacher supporting service Such a system is likely to use perception techniques (computer vision for facial recognition for example) and machine learning techniques to analyse the student's facial expressions or behaviour if such information are collected and analysed.



- 1. Al Watch Defining Artificial Intelligence 2.0. Towards an operational definition and taxonomy for the Al landscape Samoili, S., López Cobo, M., Delipetrev, B., Martínez-Plumed, F., Gómez, E., and De Prato, G. EUR 30873 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-42648-6, doi:10.2760/019901, JRC126426. ← ←
- 2. Artificial Intelligence In Education: Promises and Implications for Teaching and Learning Wayne Holmes, Maya Bialik, Charles Fadel Boston, MA, Center for Curriculum Redesign, 2019. ← ←