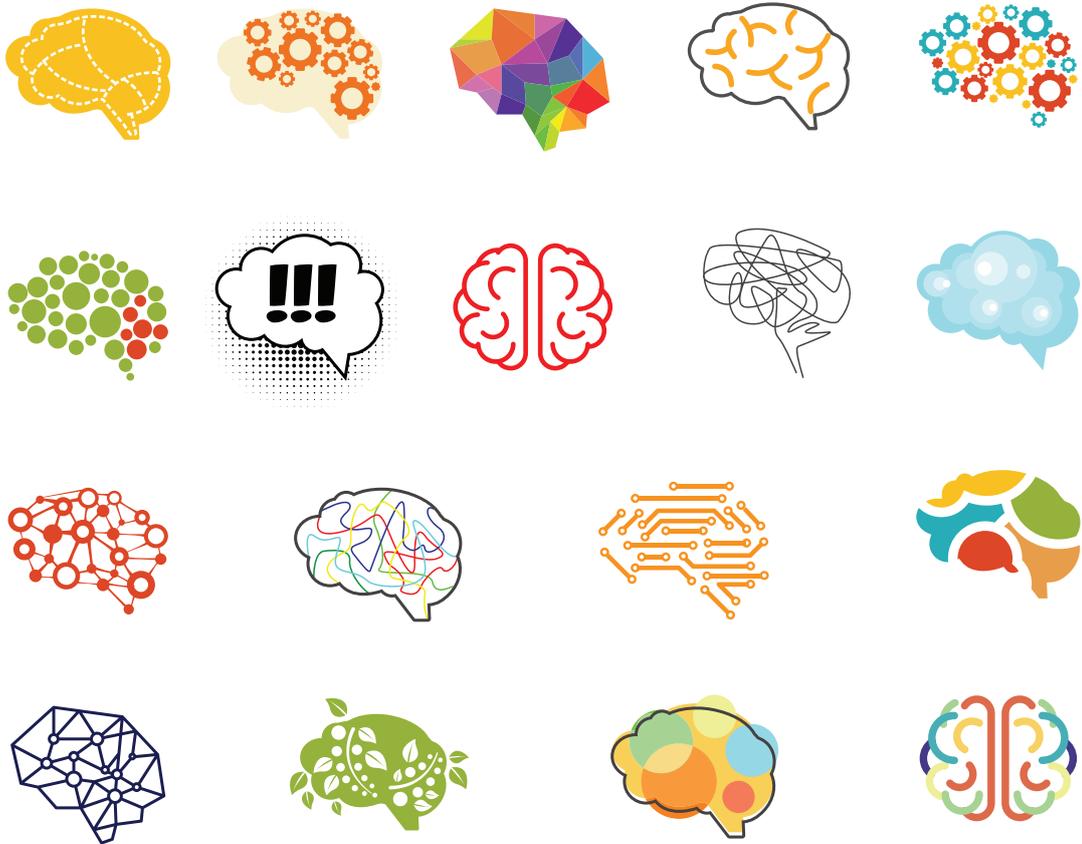


# TRANSFORMING EDUCATION WITH ARTIFICIAL INTELLIGENCE



Why Artificial Intelligence is the key to  
modernising education

**{AI-Edu.io}**

London | Dubai | Sao Paulo

It's increasingly hard to find an aspect of modern life that isn't touched, or has the potential to be touched, by Artificial Intelligence (AI). Manufacturing, transportation, food production, climate modelling, law enforcement, retail, media, telco, security and defence - the list of areas that AI is making inroads into covers a vast spectrum of human activity.

AI is increasingly behind decisions that directly affect our health, job prospects, and personal finances. It has the potential to be our most powerful tool for making efficient, effective and bias-free decisions, but only if we understand it.

Most people view AI as complex and inaccessible but in reality, AI can be understood by all. In fact, AI *must* be understood by all so everyone can participate in the workforce, democracy and society. AI in education can make the curriculum more relevant and engaging; help make learning and teaching more effective; and help people develop complex problem-solving skills.

This paper aims to help education decision makers and teachers understand AI, and how AI can offer new learning opportunities and experiences, prepare people for the future workforce, and make learning more effective.

## Education for the Age of Intelligence

The most profound shift in the evolution of technology yet has only just begun - cognitive tasks normally performed by people are now being carried out by machines. AI is significantly different from previous technologies in that it can take the place of human cognition and exceed human performance in a growing number of areas. As AI ushers in the Age of Intelligence, it also raises concerns about jobs, ethics and security.

Today's students should be developing the confidence to question digital media, Big Tech, and government policy, and create an increasingly democratic and socially useful Internet. This involves mastering the basic mechanics of AI to be able to frame AI problems, and understanding concepts such as bias, weightings, and XAI ('Explainable AI').

## AI Opportunities for Education

The two main opportunities for AI in education are for students to **learn** about AI, and for AI to **augment** teaching, learning and operations.

AI is already being used in education. For example, any organisation that uses computers will be running anti-virus, spam filters and search engines

– all of which use AI. Increasingly we are seeing AI-driven online tutoring systems, personal assistants for students, and drop-out prediction. In fact, the use of AI in education is predicted to grow six-fold in the next four years<sup>i</sup>. As AI is increasingly applied in education, it's increasingly important that both students and teachers understand AI.

The growing use of AI in education comes at a time when, according to the World Economic Forum, there's a global learning crisis which is leaving millions without basic skills<sup>ii</sup>.

In 2018, over one-fifth of all young individuals worldwide were neither acquiring skills through education or work experience and 617 million children and adolescents are not proficient in either reading or mathematics<sup>iii</sup>. Across the world students' return on investment in Higher Education is falling. Yet at the same time employers have difficulty in finding people with the right kind of skills.

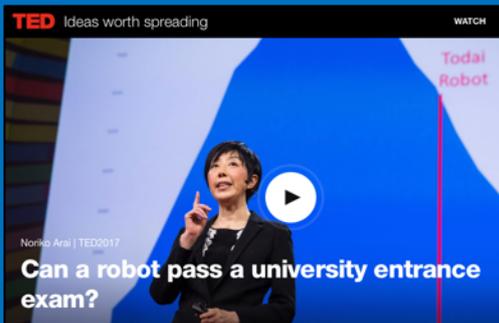
**Until it is part of everyone's education AI will be done to those who don't understand it by those who do.**

## So how can AI help?

### 1. Making the Curriculum More Relevant and Engaging

#### Implications of AI for Learning and Assessment

In 2017 a robot beat 80% of the students taking the entrance exam for Tokyo University. The exam included Maths, English, Science, and a 600-word essay.



Picture C/O TED

More recently, in 2019, researchers at Shanghai Jiao Tong University in China trained an AI to take English proficiency exams and achieved overall score of 74%.



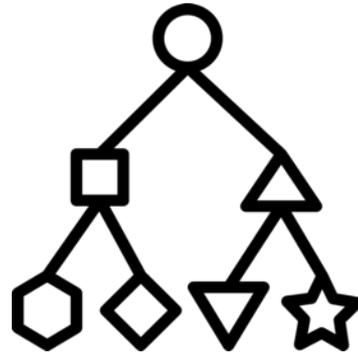
Picture C/O New Scientist

AI's capabilities raise significant questions about what people now need to learn and how learning should be assessed.

There are three key reasons why AI is now an essential ingredient in the curriculum. Firstly, "all occupations could be transformed by AI to some extent"<sup>iv</sup>. Secondly, there's a need to prepare for AI in everyday living, particularly with the rise in the abundance and use of data. Thirdly, there is the widely acknowledged need to develop complex problem solving and algorithmic thinking skills.

Together with automation and climate change, the march of AI is accelerating the need for children to acquire problem-solving, creative thinking, algorithmic thinking and team-working skills. Projects based on AI themes can be a catalyst for developing these skills, and don't need to be complex – e.g. a simple project to help students understand the concept of classification can go a long way to developing an understanding of key AI

principles, whilst also developing algorithmic thinking skills at the same time.



AI offers a way-in to a world of fascinating topics and attention-grabbing questions. What does it mean to be intelligent? How does your brain work? Where does your phone data go? Topics such as metacognition, statistics and probability, data representation and interpretation can be brought to life through an AI lens.

Let's now look at how AI can make the curriculum more relevant and engaging in different subject areas<sup>v</sup>.



#### Mathematics

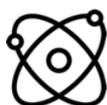
At the heart of AI is Mathematics, and AI systems use algebra, statistics, probability, logic, matrices and calculus. AI in the Mathematics curriculum offers a vehicle for learning these subject areas through solving real-world problems with algorithmic thinking skills.

#### AI Curriculum Idea – Probability

How did an AI algorithm called AlphaGo use probability to beat the greatest Go player in the world? Simulate AlphaGo using a board game.



Introducing aspects of AI into Mathematics through simple computing tasks also prepares students for a world of work where complex maths is no longer done by hand.



**Science**

Across the span of science, the ability to collect data and make sense of it through AI has exploded. For example, the expanding use of Big Data for genomes and protein research in biology; Big Data flowing from sky surveys in physics<sup>vi</sup>, and in chemistry with the use of machine learning to discover new drugs. AI in the Science curriculum offers engaging ways to make sense of a broad range of science topics.

**AI Curriculum Idea – Pattern Recognition**  
 How can computers be used to recognise patterns? Use data and statistical models to distinguish between different varieties of a plant.



**Technology**

The focus in technology needs to shift from how to use technology to how to *create* technology. In other words, from IT to Computer Science.

AI in the Technology curriculum should help students see what is going on inside the AI ‘black box’; help them build models of what is happening ‘under the hood’ of AI applications; and allow them to develop AI applications. These activities build practical computer science and algorithmic thinking skills and knowledge.

**AI Curriculum Idea – Natural Language**  
 What is the Turing Test and why is it so difficult to pass? Build a chatbot to ‘guess the animal’.



**Humanities, Arts and Languages**

AI has deep relevance across a wide range of non-STEM subjects. Critical thinking skills, deeper understanding of the world around us, philosophy, ethics, communication, and creativity are all needed to solve the complex problems and address the opportunities presented by AI.

Fascinating questions about the nature of intelligence, consciousness and creativity can engage students’ attention. Can machines be more creative than humans? Should algorithms be used for sentencing criminals? Is automation good?

**AI Curriculum Idea – Intelligence**  
 What is intelligence? Stack-rank a given set of objects, plants and animals in order of their intelligence and explain your decisions.



**University Undergraduates**

Students are increasingly making sure that they graduate ready to bring computing-intensive approaches to fields as diverse as molecular biology, economics and urban planning.

With AI having such significant impact across all areas of study at undergraduate level, it makes sense for all undergraduates to at least have an appreciation of where AI is relevant to what they are studying.

**AI Idea – AI Foundations**  
 All undergraduates, regardless of area of study, should learn what AI is and how it works. They should be able to apply and evaluate machine learning methodologies in their studies and research, appreciate how AI is relevant to other subject areas, and be fluent in the values and ethics that should govern the use of AI.

“Institutions must equip tomorrow’s leaders to be ‘AI bilingual’. Students in every field will need to be fluent in AI strategies to advance their own work”.  
*L. Rafael Reif, President of the Massachusetts Institute of Technology vii*

“Children need to be adequately prepared for working with, and using, AI. For a proportion, this will mean a thorough education in AI-related subjects, requiring adequate resourcing of the computing curriculum and support for teachers. For all children, the basic knowledge and understanding necessary to navigate an AI driven world will be essential. In particular, we recommend that the ethical design and use of technology becomes an integral part of the curriculum”.

*UK House of Lords Select Committee on Artificial Intelligence<sup>viii</sup>*

## 2. Making Learning More Effective

The main application of AI in education is in learning-facing tools which respond to an individual student’s needs. These are often referred to as ‘intelligent tutoring systems’, or ‘adaptive’, ‘personalised’ or ‘differentiated’ learning platforms, and have capabilities like:

- Curating and sequencing learning content based on a student’s needs
- Diagnosing strengths, weaknesses or gaps in a student’s knowledge
- Providing automated feedback
- Facilitating collaboration between learners

Rather than having students follow one of a static set of pathways designed by a human, Machine learning algorithms pick up strengths, gaps in knowledge to build on and scaffold learning

appropriately, with the aim of providing a greatly increased level of ‘personalisation’. The vast majority of these tools cover single subject areas, such as mathematics.

These tools benefit students by offering a move away from a ‘one-size-fits-all’ approach to learning, enabling students to learn at their own pace or tailor learning materials to their own interests.

Such tools are used by learners in the classroom, particularly in large mixed-ability classes, where teaching through a single teacher offering direct instruction may be more difficult. Where quality teacher resources are scarce, this approach relieves time-burdens from teachers, and school leaders and policymakers can worry less about decreasing class sizes in order to get better learning outcomes.

### Key Point

The skills and knowledge possessed by good teachers **greatly exceed** what any AI can be taught. A key role of AI in education therefore is to **augment**, not replace, teachers.

## 3. Making Teaching More Effective

Teacher-facing AI can help teachers to reduce their workload, gain insights about students and innovate in their classroom. It supports teachers through a combination of capabilities including:

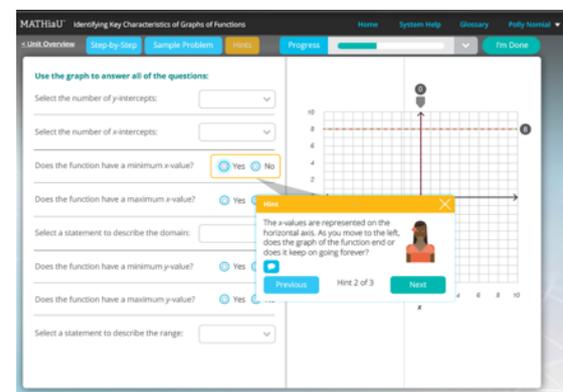
- Automating tasks (such as assessment, plagiarism detection, administration or feedback)
- Providing insights about the progress of a student or class
- Helping with classroom management, and optimally organising students into groups
- Teaching assistance with frequently-asked-questions

Time saved through the automation of some low-value tasks could free up a teacher’s time to invest in other aspects of teaching. Insights gained about students’ progress could help teachers to target their attention more effectively.

Although AI is often seen as seeking to replace teachers, research suggests that this is neither possible nor desirable.

### AI Case Study –MathiaU

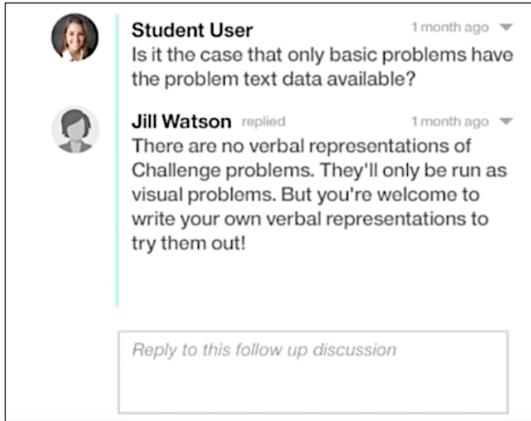
Carnegie Learning’s MATHiaU re-phrases questions, re-directs the student, and zooms-in on the parts of the problem that are proving most difficult.



Picture C/O Carnegie Learning

**AI Case Study – Jill Watson**

Jill, an AI agent, lives in Piazza, the online Q&A platform used by Georgia Tech. Jill assists students in both physical class, which has about 50 students, and the more heavily attended online version. Jill’s answers to students rose to 97% accurate, and most students who interacted with Jill online didn’t know ‘she’ was an AI agent.



Picture C/O Georgia Tech

**AI Case Study – Ofsted (Office for Standards in Education)**

Following a trial run by the Behavioural Insights Team in 2017, Ofsted has been using supervised machine learning to identify which schools should be prioritised for a full school inspection since the Summer of 2018. This involves training an algorithm which uses datasets from across many schools. Using progress and attainment data from the Department for Education, school workforce census data, and parental view responses, the AI is able to make predictions about a schools’ performance in an inspection. This prediction is not used to inform full inspections, but Ofsted claim that AI will ‘ensure that our approach to inspection is proportionate, and to focus our efforts where they can have the greatest impact.’



**AI Case Study – Hubert**

A new AI tool called Hubert is changing the way university students evaluate their professors. Instead of filling out a form, students use a chat window to give feedback on the course and their professor. Afterwards, Hubert categorizes the students’ comments for the professor to review.



Photo by Mikael Kristenson on Unsplash

**4. Making Operations More Efficient**

AI is already being used to make some parts of education operations more efficient and effective.

**Decision Making**

Machine learning can help present options for aiding decision making. For example, machine learning-driven analytics is increasingly used in deciding how to prevent dropout.



Machine learning combined with Robotic Process Automation (RPA) can even go a step further by helping to automate some interventions.

**Management**

Machine learning with RPA can combine different data sources while applying rules, processes, and calculations to give managers custom reporting and dashboards, while eliminating manual activities. AI can be used to handle increasingly complex staffing plans that support personalized and competency-based learning. In other areas, machine learning is widely used in corporate recruiting and onboarding and increasingly specialised AI-based management solutions are coming to education.

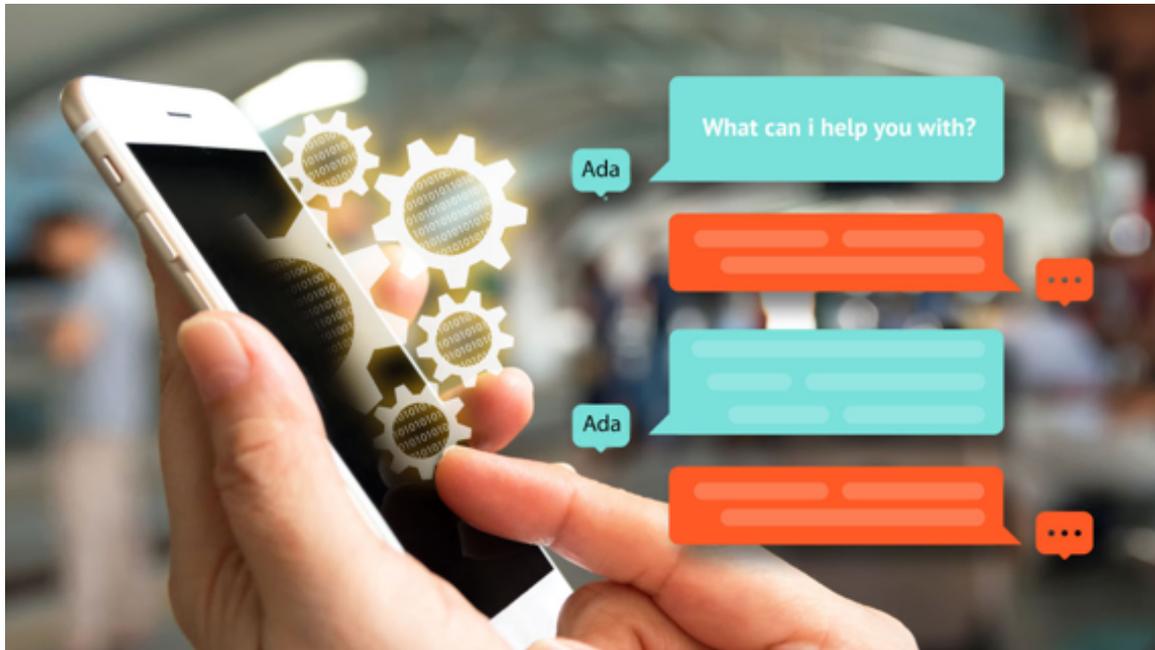
**Processes**

Registration of students, enrolment and admission, collaboration and communication, managing classrooms can be made more efficient with machine learning and RPA.

Students and staff at all levels ask hundreds of questions every week regarding the ins-and-outs of their studies and life in school or on campus. Many of these questions are process, procedural or policy-related, and where they are frequently repeated and require no human judgement, they can be answered well using chatbots.

**AI Case study - Ada**

Bolton College’s AI-driven virtual assistant, ‘Ada’, helps deliver on-demand requests for information, advice and guidance to their 11,000+ students. As of February 2019, Ada is able to respond to 2,500+ questions on general college enquiries as well as specific questions about students (e.g. attendance) and curriculum content across different IT systems. Addressing student individual needs at scale in this way has saved staff many hours on administration activities and out-of-hours teaching, whilst continuing to deliver quality content to students.



Picture C/O JISC

**Student Recruitment**

Where institutions need to recruit students and develop a relationship with their customers, there is much that AI can do to help. The goal of marketing is to reach ‘segments of one’, so much of the sophisticated use of AI in marketing is about targeting the right outbound message to exactly the right recipient. For inbound communications, chatbots are turning out to be a very useful tool.

**Case Study – Student Recruitment Chatbot**

Bella Converse by AI Networks enables institutions to improve the conversion rate amongst students and parents considering a school or college. At Britannia, implementation of Bella Converse lead to a 10% increase in student recruitment opportunities.



Picture C/O Britannia English Academy

## HOW CAN WE HELP YOU?

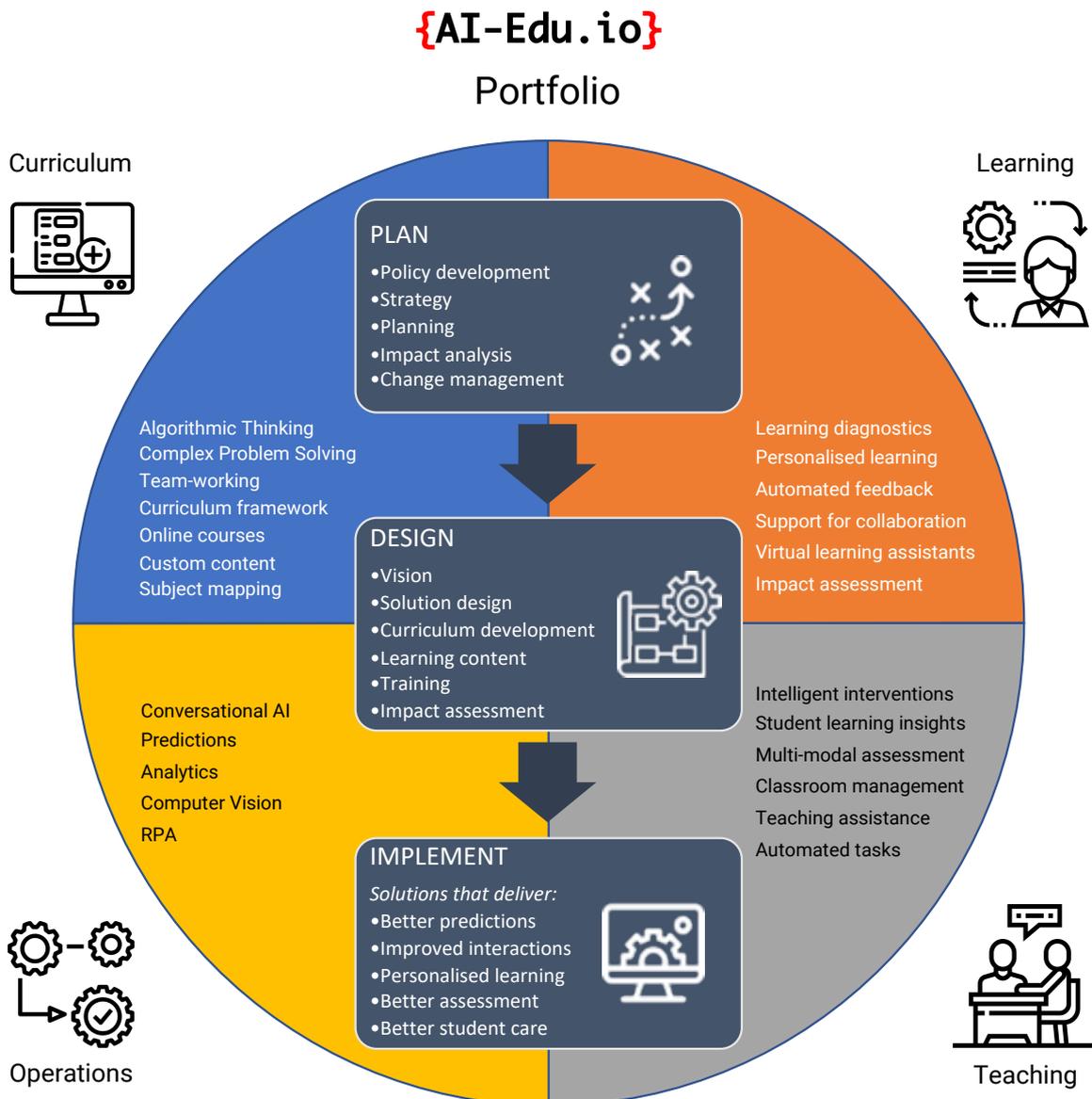
{AI-Edu.io} is a partnership between {learn-tech.io}, AI Networks, and Weatherby Education Studies focussed on bringing the benefits of AI to all aspects of education.

### Our Vision for AI in Education

Our goal is to enable all kinds of education organisations to harness the full power of AI for the benefits of all their students, stakeholders and communities. We see AI as a holistic and integrated fabric in a modern education organisation, used to prepare young people for the AI-driven world ahead of them; empower students to learn better; enable their teachers to teach more effectively; and help their institutions be more effective.

Together with our global network of education and Deep Tech experts we deliver AI-focussed strategy, planning, policy, solution design, AI project implementation, products, training and evaluation to education establishments worldwide.

We have the capabilities to take a project from inception to implementation at all levels – from nations or states to individual schools.



## PLAN



WEATHERBY  
EDUCATION  
STUDIES



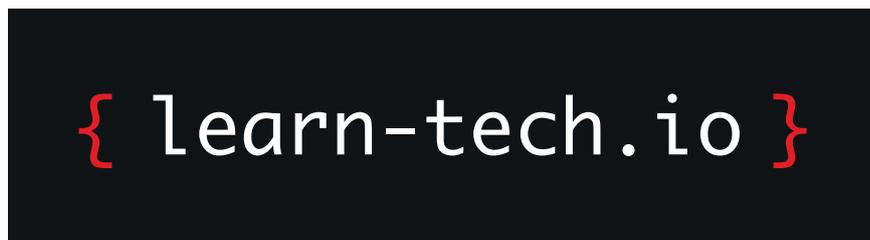
Headed by Dr Kristen Weatherby of Weatherby Education Studies, our planning and policy services include:

- Strategy development
- Research and evaluation design and implementation
- Training to build research and evaluation capacity in educators
- Workshops for practitioners or decision-makers to summarise and understand relevant policy or research
- Literature reviews, policy reviews, white papers grounded in academic research

Kristen's diverse career has taken her from the classroom to running global education programmes at Microsoft, to leading the world's largest survey of teachers for the OECD and to academia as a researcher in education technology.

Clients of WEATHERBY EDUCATION STUDIES include the OECD, Lumiar Education, Tmrw Digital, Real Training and EdTech start-up companies in and beyond London.

## DESIGN



Headed by Mike Lloyd of learn-tech.io, our solution design services include:

- Envisioning
- Technical strategy development
- Curriculum development
- Project scoping
- Concept development
- Architecture and product planning

Author of *Schooling at the Speed of Thought*, Mike is an Education Technology industry veteran with 10 years in education, 13 years international experience at Microsoft, and 6 years running his own business.

{learn-tech.io}'s clients and partners include – Nord Anglia Education; Queen Mary University of London; Intel; Pearson; Box Hill Institute; Bankers Lab; Burges Salmon LLP

## IMPLEMENT



ARTIFICIAL  
INTELLIGENCE  
NETWORKS



Headed by Amintas Neto Founder of Artificial Intelligence Networks, our implementation offerings include:

- Bespoke AI systems
- Software development
- AI knowledge transfer
- System integration
- Support
- Products - Microsoft preferred Education AI Suite:
  - Bella Converse - Enhance interactions between students, parents and the faculty
  - Bella Predicts - Actionable insights; drop-out & late payment prediction
  - Bella Sapiens – adaptive courses, content and programs
  - Bella Care - Surveillance & Security - monitor the wellbeing of students

Amintas is a software engineer with thirty years' experience in the IT industry including at Microsoft and HSBC.

ARTIFICIAL INTELLIGENCE NETWORKS' education customers include FAEL; SENAI; Britannia; and Colegio Educare.

## Find out more

<https://www.kristenweatherby.com>

<https://learn-tech.io>

<http://ainetw.com>

## Glossary of Common Terms

### Machine learning

Machine learning is the 'engine room' of AI, the algorithms that learn to make predictions

### Neural networks

Neural networks are a form of AI inspired by the structure of the human brain. They are made up of processing nodes (artificial neurons) which are connected in layers. Each node receives data from nodes above it and passes this down to nodes below it. Data has 'weight' attached to it by the nodes, which attribute value to the data. If the data doesn't pass a certain threshold, it is not passed on.

### Big data

Big data refers to data sets that are too large and complicated to be analysed using simple algorithms and require more complex data analytics or Machine learning to understand.

### Narrow AI

An AI system that can do one human task.

### General AI

An AI system that can do many tasks as well as a human. General AI does not yet exist.

<sup>i</sup> Artificial Intelligence (AI) in Education Market worth over \$6bn by 2024, Global Market Insights, Inc. June 5, 2018

<sup>ii</sup> <https://www.weforum.org/agenda/2018/08/global-learning-crisis-millions-without-basic-skills-unesco/>

<sup>iii</sup> <https://www.un.org/development/desa/dpad/publication/world-economic-situation-and-prospects-april-2019-briefing-no-125/>

<sup>iv</sup> The Impact of Artificial Intelligence on Work, Royal Society, 2018

<sup>v</sup> World Economic Forum - <https://www.weforum.org/agenda/2018/09/why-schools-should-teach-the-curriculum-of-the-future-not-the-past/>

<sup>vi</sup> <https://www.sciencemag.org/news/2017/07/ai-revolution-science>

<sup>vii</sup> <https://www.ft.com/content/24f18c28-2a39-11e9-9222-7024d72222bc>

<sup>viii</sup> <https://publications.parliament.uk/pa/ld201719/ldselect/ldai/100/100.pdf>