



United Nations
Educational, Scientific and
Cultural Organization



Artificial Intelligence in Education

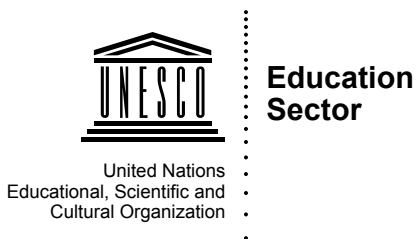
Compendium of Promising Initiatives

Mobile Learning Week 2019



UNESCO Education Sector

Education is UNESCO's top priority because it is a basic human right and the foundation on which to build peace and drive sustainable development. UNESCO is the United Nations' specialized agency for education and the Education Sector provides global and regional leadership in education, strengthens national education systems and responds to contemporary global challenges through education with a special focus on gender equality and Africa.



The Global Education 2030 Agenda

UNESCO, as the United Nations' specialized agency for education, is entrusted to lead and coordinate the Education 2030 Agenda, which is part of a global movement to eradicate poverty through 17 Sustainable Development Goals by 2030. Education, essential to achieve all of these goals, has its own dedicated Goal 4, which aims to *"ensure inclusive and equitable quality education and promote lifelong learning opportunities for all."* The Education 2030 Framework for Action provides guidance for the implementation of this ambitious goal and commitments.



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During the five-day MLW event, UNESCO gathered participants to share experiences and initiatives and plan joint actions with a view towards harnessing AI to achieve Sustainable Development Goal (SDG) 4. This report stems from a selection of the AI initiatives presented by speakers and the insights shared by participants at MLW 2019.

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Introduction

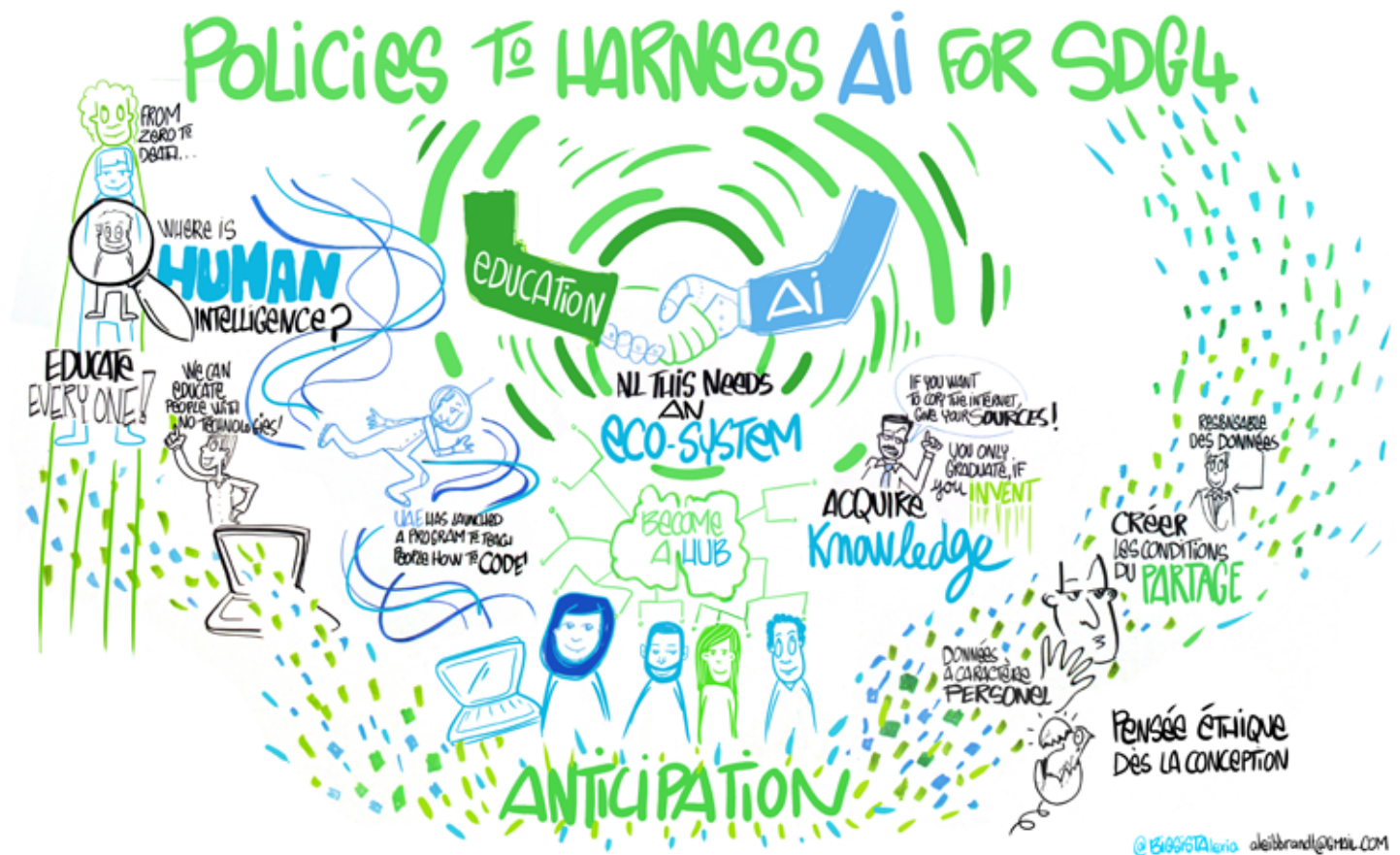


Figure 1 Policies to harness AI for SDG4

Source: Alexia Leibbrandt and UNESCO, 2019

Origin and purpose of this compendium

This compendium has been compiled as a product of Mobile Learning Week (MLW), the United Nations' flagship ICT in Education conference. The 2019 conference (#MLW2019) was organized in partnership with the International Telecommunication Union (ITU), ProFuturo Foundation and Skillogs. It was held from 4 to 8 March 2019 at UNESCO Headquarters in Paris, France.

Under the theme Artificial Intelligence (AI) for Sustainable Development, MLW 2019 examined the potential opportunities and challenges that AI technologies can pose, along with the many ways

governments and other organizations can leverage AI tools to accelerate the achievement of Sustainable Development Goal (SDG) 4.

As illustrated in Figure 1, the links between AI and education are multidimensional; many are still in nascent stages, while others seem to be challenging the very foundations of education internationally. This is undoubtedly impacting the principles of inclusivity and equity firmly entrenched in SDG 4. Through the gathering of delegates at MLW 2019, and more specifically the wide range of submissions received for the event, we see some important themes emerging. These range across the current and future job markets;

multiple forms of communication; technology hardware, software and strategies; and more. We need to look beyond systems to ecosystems. Above all, we see an emphasis on what it means to be human in the era of AI.

This compendium is an attempt to present a selection of some initiatives related to AI in Education in an organized and accessible manner for a wide audience, including policy-makers and policy-shapers in education; teachers and teacher trainers; leaders of education institutions, including voluntary and community organizations, social enterprises, and mutual and cooperative organizations (the third sector); practitioners who impart training online or face-to-face; and administrators of digital services in education organizations. The compendium is presented in a format that will allow this information to be shared well beyond the delegates who attended the event in March 2019. This non-exhaustive publication also aims to be **an invitation to the international community** to send UNESCO information about new AI in Education initiatives that may be relevant to advancing progress towards SDG 4.

AI for, as and in education

For the purpose of understanding the role of AI in the various education projects and initiatives included in this compendium, the observation that ‘the education sector is both customer and actor in the face of sweeping developments in AI-powered technology’¹ is useful. As a customer, the education sector, like many other sectors, uses AI as a tool to support its practices. AI offers a diverse range of solutions, apps and techniques *for* use by the education sector to enhance teaching and learning. Sophisticated algorithms not previously possible have now become commonplace in many of these products, leading to increased pressure towards the commodification of education as different vendors, ranging from large multinationals to teenagers coding in Python, vie for the attention of public education systems.

In its most advanced form, AI itself becomes the mechanism that delivers learning. Here we look beyond AI-supported learning environments to AI *as* education and the education sector as an actor in driving AI development. Many fears associated with AI, such as

‘robots will steal our jobs’ and ‘AI is taking control of my learning’, are located in this scenario.

As both a customer and an actor in relation to AI, the education sector has an obligation to offer education *in* AI as a subject, building capacity and training educators² and managers on developments in the field, and informing learners so that they are able to function effectively in an AI-driven world.

These three roles of AI – *for*, *as* and *in* education – are interrelated and often cannot be separated in a clinical manner. All were featured at MLW 2019 and deliberated over in many of the sessions throughout the week. Some countries or regions may be farther along the path of AI in Education development, while others may still be in the early stages. The more than 200 proposals for workshops and symposium presentations that provided the basis for this compendium all demonstrate elements of each three roles of AI – *for*, *as* and *in* education.

Analysis of proposals received for presentation of initiatives

Initiatives were categorized according to their internal focus areas, which were identified as they emerged through analysis for this compendium. Three out of the four broad objectives for MLW 2019 were used as a first-level categorization for initiatives:

1. Ensuring inclusive and equitable use of AI in education

The deployment of AI in education can exacerbate digital divides and learning inequalities, with marginalized and disadvantaged groups most at risk of being excluded from AI-powered education. To ensure equitable use of AI in education, large-scale initiatives are needed to support developing countries in boosting the development of AI technology, enabling access to AI platforms and resources and nurturing local innovations in AI. Can AI break through access barriers to quality education for vulnerable groups? What kind of strategies or programmes are needed to prevent gender bias in AI applications and AI skills development?

1 Pedró, F., Subosa, M., Rivas, A. and Valverde, P. 2019. *Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development*. Paris, UNESCO.

2 Luckin, R., Holmes, W., Griffiths, M. and Forcier, L. B. 2016. *Intelligence Unleashed: An Argument for AI in Education*. London, Pearson.

2. Leveraging AI to enhance education and learning

AI developments promise revolutionize education delivery and management, content provision and learning analytics. But how can AI solutions improve learning outcomes? Will AI help scientists better understand how learning happens? There is little chance that teachers will be replaced by machines in the future, but how will the use of AI in education and learning transform the role of teachers? What continuous support is needed to prepare teachers to work with AI in an AI-rich education environment? As AI might transform all areas of human life, how can education prepare learners with human-machine collective intelligence to live and work together with AI?

3. Promoting skills development for jobs and life in the AI era

Emerging technology trends related to digital transformation, such as AI, the Internet of Things and big data analytics, have profound implications in terms of the skills required for the evolving digital economy. In particular, the notion of lifelong learning has emerged as one of the key strategies for job security and employment in the digital era. How will AI impact the labour market, and what AI-related skills are needed today and in the future by different sectors? How can education institutions and training providers from both the public and private spheres address existing and emerging skill gaps? What recent developments and concrete case studies in industry talent development programmes, academic programmes or other initiatives have been implemented to address emerging skill gaps?

Insufficient submissions were received for the fourth MLW objective, *safeguarding transparent and auditable use of education data*, to illustrate the range of issues involved as well as their ethical implications³, and the few initiatives that might have been included here have been placed in other categories of equal relevance.

In addition to this categorization, which was largely self-organized through the submission process to UNESCO, the writing team completed a thorough rereading of each submission. Careful attention was paid to the description of the initiative, including initiators, supporters and implementers; the problem addressed; how AI is used (in this case, using the lens of *AI for, as and in* education); successes and challenges;

and lastly, practical and theoretical issues raised. Other features of initiatives that affected their inclusion and categorization in the compendium include the ecosystem in which they are located, and factors enabling their conceptualization and implementation as projects. Projects' geographical representation, scale and impact were also taken into account.

Each selected initiative is summarized briefly according to the following aspects:

1. What: a description of the initiative
2. Who: initiators, supporters and implementers
3. Why: the problem addressed
4. How: AI for, as and in education
5. Results: successes and challenges
6. Insights: practical and theoretical issues raised
7. Strength: stand-out feature of the initiative

When available, a link is also provided to the source of the intervention. For some initiatives, no information is available about one of the six aspects, in which case the aspect is not included. This applies particularly to the results aspect, for which very few submissions included substantial information. Further assessment is needed to further validate the impact of the initiatives presented in this compendium.

The following categories of tags are used for ease of reference and to highlight important features for the reader.

³ For Ethics considerations, please see: World Commission on the Ethics of Scientific Knowledge and Technology (COMEST). 2017. Report of COMEST on Robotics Ethics. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000253952.locale=en>

Geographical reach	National	Continental	International
Results and impact	Not available	Internally reported	Externally evaluated
Focus on ensuring inclusivity and equity	Somewhat	Yes	Strong focus
Focus on leveraging AI to enhance education and learning	Somewhat	Yes	Strong focus
Focus on promoting skills development for jobs and life in the AI era	Somewhat	Yes	Strong focus
Focus on safeguarding transparent and auditable use of education data	Somewhat	Yes	Strong focus

The authors would like to emphasize that the meta-level analysis of the submissions received for MLW 2019 is not a judgement on the quality or substance of any one contribution. On the contrary, the purpose of the analysis has been primarily to identify themes

and content that are the focus of the initiative and that can serve as a basis for future deliberations on the relationship between AI and education. We welcome further additions and clarifications that can enhance the compendium.

1. Ensuring inclusive and equitable use of AI in education

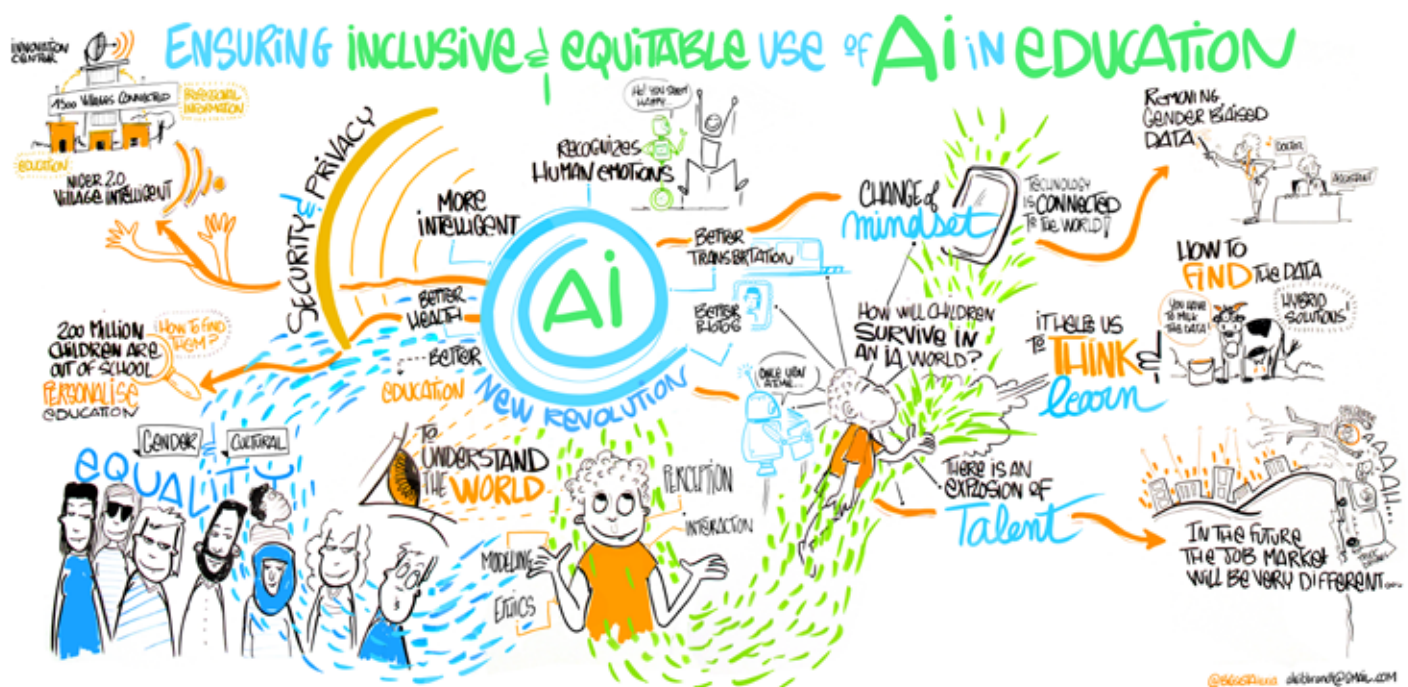


Figure 2 Ensuring inclusive and equitable use of AI in education

Source: Alexia Leibbrandt and UNESCO, 2019

Introduction

The initiatives reported in this section of the compendium focus on the inclusive and equitable use of AI in education. The scope of the initiatives ranges from large-scale, running across numerous countries with thousands of participants, to country- or sector-specific, including school-based initiatives or those focused on a specific language or social grouping within a country.

The programmes target children, adults, job seekers, and stakeholders in education and other government departments. Some of the initiatives aim to support developing countries in boosting the development of AI technology for education, enabling access to AI platforms and resources, and nurturing local innovations in AI. In some cases, the strategies are part of already successful projects, while in others, AI solutions represent more exploratory attempts to break

through barriers to help vulnerable groups gain access to quality education. Strategies and programmes aim both to prevent bias and discrimination from being built into algorithms and principles used in the design and development of AI, and to promote equality in accessing and applying AI technology for life, learning and work.

The contexts in which the initiatives are implemented are equally diverse, spanning from well-resourced cities to developing countries and rural contexts without electricity or internet connectivity.

Within this section, initiatives are grouped according to their focus: refugees, out-of-school populations, gender inclusion, people with disabilities and language inclusion.



Descriptions of initiative

1.1 USING AI AND GAMIFICATION TO BRIDGE LANGUAGE BARRIERS FOR REFUGEES

Travis Foundation

Geographical reach	Europe, Australia, United States, United Kingdom, Canada, Ethiopia, Eritrea	International
Results and impact	Internally reported	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Somewhat

What – a description of the initiative

A successful machine translation for Tigrinya, the language of Eritrea, developed through crowdsourcing, strategic communication, gamification, data creation and neural networks.

Who – initiators, supporters and implementers

The Travis Foundation, a non-profit initiative based in the Netherlands, was established late in 2017 to challenge language inequality by digitizing resources for underrepresented languages. The foundation creates a global community around any new language to be digitized. Native speakers are hired and engaged through crowdsourcing and games, digital corpora of languages are collected, people are engaged worldwide to translate texts, machine translation experts are hired, and various other experts are engaged to implement technical solutions. The foundations' employees are hired to professionally manage and grow the organization to meet and exceed its goals.

Why – the problem addressed

As long as language is a barrier, opportunities for communication and education are limited. AI tools such as neural networks often require huge amounts of data which, for many languages spoken by refugee and migrant communities, are non-existent. Lack of data availability is the main reason engines like Google Translate support only 100 of the world's 6,500 languages, and it is also what prevents many technologies from being inclusive. With the speakers

of only 100 languages being fully able to harness translation technology for education, the digital divide is growing, especially as AI furthers the development of highly resourced languages.

Prolonged conflict and an unsettled political climate in Eritrea have resulted in enormous numbers of refugees from Eritrea. Without digital language tools, many Eritrean people struggle with language learning, education and integration into new societies.

How – AI for, as and in education

By compiling digital corpora for a language and applying machine-learning technology, resources are created that bring the language into the digital age. These resources can then be used to translate, preserve and create digital education tools for these languages and cultures. Tools such as chatbots, gamification and AI are used to generate machine translation for lesser-resourced languages, thus narrowing the digital divide and creating opportunities in education for refugees.

Results – successes and challenges

In less than four years of activity, the initiative has made substantial progress with Tigrinya. Some 2,000 volunteers have been engaged, a game has been created to collect data, and a data set of 200,000 sentences has been compiled. The challenge has been engaging the community to volunteer. This was overcome by changing to more traditional communication methods, implementing an

ambassador programme and using gamification to make contributing fun.

Insights – practical and theoretical issues raised

Aid organizations, refugee reception centres and language schools use translation technologies, and these technologies need to be an option for everyone. The initiative raises questions about the potential of machine translation in communication, skills building and language learning, particularly in light of growing

research around the importance of mother tongue languages for education.

Strength

The initiative offers an example of an AI strategy that has been implemented to develop digital resources for languages previously excluded from this medium.

Link(s)

<https://travis.foundation/>

1.2 AI TO ENSURE EQUITABLE ACCESS TO EDUCATION GLOBALLY

CENTURY Tech

Geographical reach	Lebanon – example presented in this compendium. However, the platform has been used in Bahrain, Belgium, Brunei, Egypt, India, Italy, Saudi Arabia, United Arab Emirates, United Kingdom.	International
Results and impact	Pilot underway; internal evaluation of the AI learning platform has been conducted	Internally reported
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

This initiative uses an AI learning platform to provide accessible, effective education for Lebanon’s population of Syrian and Palestinian refugee children.

Who – initiators, supporters and implementers

CENTURY Tech, a private sector organization based in the UK and founded by Priya Lakhani. This organization, in partnership with the Ministry of Education and Higher Education in Lebanon, implemented a pilot programme in a group of public schools in Lebanon.

Why – the problem addressed

Refugee migration into the country has resulted in Lebanon being among the countries with more refugees per capita of any country in the world⁴, resulting in an increased student population and

greater demand on existing educators to provide equal access to effective education.

How – AI for, as and in education

Through use of an internet-enabled device, AI is used to learn how each individual student learns and to set out a personalized learning path for each student, providing learning support through access to a vast library of learning content. As students learn on the CENTURY platform, every click, score and interaction is recorded. These data feed into AI algorithms that learn how each individual learns and then plot the most effective route through learning material for each individual. Gaps in foundational knowledge are quickly identified and remedied, weaknesses are scaffolded, and strengths are built upon, all with automated, constructive feedback provided at the point of need. Tailored material is provided based on a range of factors, including a

4 UNHCR, 2015. *Executive Committee of the High Commissioner’s Programme*. p. 1. Available at: <https://www.unhcr.org/excom/excomrep/560505e09/update-unhcrs-operations-middle-east-north-africa-mena.html?query=per%20capita%20lebanon>

student's focus, emotional state and pace of learning. The platform also learns how each learner retains knowledge and develops their understanding of topics, using this information to provide everyone with the best possible learning experience.

Teachers are provided with meaningful insights into learners' needs through data dashboards, allowing them to personalize learning even further. Teachers also benefit from the platform's time-saving features, such as auto-marking questions, automatically collating data and providing a ready-to-use bank of high-quality resources.

Results – successes and challenges

Results are not yet available for the initiative in Lebanon. However, the same learning platform has been active for almost five years in the UK and has achieved significant, positive outcomes for teachers and learners.

A study conducted with University College London involving 11,000 students showed that using the platform improves students' understanding of a topic by 30 per cent on average. The attainment gap between the highest and lowest achieving students in the study was 18 per cent, compared with the national gap of 64 per cent. A survey of teachers reported that automating administrative tasks reduced their workload by an average of six hours per week. Reports from schools in the UK include the following findings:

- ▶ an 'increase of 15 per cent in [students reaching the] expected standard since the previous year', with a 'considerable number' working at greater depth
- ▶ a link between students with the greatest use of the platform and those who achieved Level 8s and 9s in their science General Certificate of Secondary Education (GCSE) exams

- ▶ increased pass rates for those resitting exams, by 9 per cent for English GCSE and 21 per cent in Maths GCSE, after only two-and-a-half months of using the platform.

The organization recently agreed to a rollout of its AI system in schools across Flanders in Belgium.

One of the main challenges in deploying technology in the education sector has been change management with stakeholders. An evidence-based approach was developed, aimed at engendering teachers' trust, in parallel with the design of a change management process for adopting the product service.

Insights – practical and theoretical issues raised

The initiative indicates that the use of an AI learning platform to provide customized education for a school-going population substantially increased by an influx of refugees and migrants is a feasible and effective approach to improving learning.

Implementation of the project highlighted the importance of using evidence in planning, as well as working directly with communities when implementing technological solutions in order to ensure that they provide support rather than hinder progress.

Strength

The pilot initiative in Lebanon is an example of a public-private partnership that enables the use of AI to extend the range of education provision without reducing its quality.

Link(s)

<https://www.century.tech>

1.3 LEARNING BEYOND BORDERS: REFUGEE CAMP EDUCATION

Gingkoo and Penta Global Foundation

Geographical reach	Uganda, Mexico	International
Results and impact	Not available	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Promoting skills development for jobs and life in the AI era	Strong focus
	Safeguarding transparent and auditable use of education data	Strong focus

What – a description of the initiative

The project aims to establish mobile learning infrastructure that (1) delivers qualitative skills-based education, (2) tracks learning progress and skill level and (3) provides trustworthy credentials.

Who – initiators, supporters and implementers

Through the Learning Beyond Borders project, Ginkoo, a private sector organization, and its USA-based partner Penta Global Foundation, working with leading academic institutions in the USA and Australia, targets (1) South Sudanese refugee camps in northern Uganda (through partnership with the Empowerment Through Education Fund [ETE]), and (2) migrant caravans in Tijuana, Mexico (through partnership with Emerge Studio and an existing relationship with the Honduran ambassador to Mexico).

Why – the problem addressed

A critical challenge facing the currently unprecedented numbers of displaced people and refugees is access to education, job skills, and trusted, portable credentials to support real-life job applications.

How – AI for, as and in education

The project offers blockchain and AI courses and will use the STRIDE security model on devices such as computers and tablets provided to enable remote learning in target sites to:

- establish a secure digital learning identity for each student that tracks learning progress and assigns trusted credentials;
- deliver high-quality skill-based coursework co-developed by Penta and accredited schools in the USA and Australia;

- issue credentials for completed coursework and successful skill tests, which will be secured on a blockchain that can be accessed by employers and government organizations reviewing education and work-related history; and
- design incentive programmes to encourage students to complete their coursework, using reward tokens with which goods provided by community partners can be purchased.

Insights – practical and theoretical issues raised

The principle of providing a decentralized, blockchain-based application that allows for traceability of source and content material has been used elsewhere by the Emerge Studio and Penta partners in the newly launched Trusted Voices, an open-source news and information platform that allows for verifiable content to be uploaded and tracked, thereby fostering transparency and accountability in the gathering and presentation of news stories. The first topic taken up by Trusted Voices was the Central American migrant caravan.

Strength

The multi-organizational partnership embodies the potential of combining quality coursework, secure digital learning identities for students, and verifiable credentials to address the common problem of refugees accessing job markets.

Link(s)

<https://www.emergedev.co>

1.4 DEVELOPING AI SKILLS TO ENSURE AN INCLUSIVE SOCIETY

Odyssey Educational Foundation

Geographical reach	Nigeria	National
Results and impact	Not available	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Promoting skills development for jobs and life in the AI era	Yes

What – a description of the initiative

The initiative offers training on AI and machine learning to schoolchildren together with their families in an after-school and weekend setting.

Who – initiators, supporters and implementers

Odyssey Educational Foundation, formed in 2013 by Stella Uzochukwu, is a non-governmental, not-for-profit organization based in Abuja, Nigeria. Odyssey works in partnership with the Nigerian Universal Basic Education Commission, the National Office for Technology Acquisition and Promotion, and Coderina Education and Technology Foundation.

Why – the problem addressed

While it is commonly agreed that schoolchildren need to develop skills for dealing with AI, their parents and guardians, as stakeholders, also need to develop relevant AI and machine-learning skills in order not to be left behind.

How – AI for, as and in education

Schoolchildren and their parents are introduced to topics such as self-driving cars, neural networks and machine learning, using the Machine Learning for Kids tool developed by IBM. They are exposed to a curriculum developed by Odyssey's partners that takes them through a practical course of about eight classes, followed by a machine-learning class where they learn Animal Classifier and object recognition and use the skills they have gained to train their model and test it. They are then tasked to look for a problem in their communities and use their skills to provide an AI or mobile app solution to the identified problem.

Schoolgirls in Odyssey's after-school STEM (science, technology, engineering and mathematics) programme

are being encouraged to pursue careers in science and technology and have built a robot to tackle the country's waste problem. The girls' efforts were part of the FIRST LEGO League competition, which drew contributions from 233,000 children across 80 countries. In 2016, students had to build and program robots that could pick up and drop off pieces of garbage on a play area. Unused plastic bags have also been turned into play marbles by the girls.

Results – successes and challenges

Odyssey has successfully reached out to over 8,600 STEM-trained students, 80 per cent of whom are in public schools in the areas of FCT-Abuja, Enugu, Port Harcourt, Niger and Kogi, while the remaining 20 per cent are from private schools that signed up for the programmes.

Increasing attacks on schools by the Islamist militant group Boko Haram, mainly in northeastern Nigeria and its capital Abuja, pose a challenge to the initiative, as more than half a million children were kept out of school in 2016 due to security fears.⁵

Strength

The partnership provides the means to bring machine-learning skills to a broader audience by using a targeted delivery model.

Link(s)

<http://www.odysseyedufoundation.org>

⁵ Gbadamosi, N. 2016. "The girls learning science in defiance of Boko Haram." CNN, 7 June 2016.

1.5 HELPING SOCIALLY VULNERABLE CHILDREN THROUGH ARTIFICIAL INTELLIGENCE IN SCHOOLS

Quirós Tanzi Foundation

Geographical reach	Costa Rica	National
Results and impact	Not available	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Promoting skills development for jobs and life in the AI era	Yes

What – a description of the initiative

This initiative is a process of training and educating girls and boys in public schools for the development of skills in AI, using digital twin technology through programming. The programme seeks to empower children and promote their proactive leadership to design proposals and create solutions for solving socio-economic and educational problems they are facing.

Who – initiators, supporters and implementers

The Quirós Tanzi Foundation manages education projects that use mobile technologies to promote digital social inclusion, using social corporate responsibility funds from public and private entities. The Quirós Tanzi Foundation believes that any education project must comprehensively support its participants and provide them with the necessary tools and resources to have full control over their learning process.

Why – the problem addressed

The objective is to offer better opportunities for digital social inclusion to children and to develop their technological fluency to improve their learning processes.

How – AI for, as and in education

This programme seeks to provide and utilize the best tools, in terms of new technological trends, to train socially vulnerable children with little access to technology or digital media. The programme uses a virtual training process to enable children to learn and apply AI within their community and educational

reality. The students develop some of the necessary competences of the AI era from an early age, so that over time they can become high achievers in their future work and businesses, and thereby improve their life opportunities and contribute to sustainable development. These children not only develop an understanding of new technology trends but also cultivate a process for reflecting on and creating projects to implement solutions to challenges.

Results – successes and challenges

The Quirós Tanzi Foundation has been developing and implementing their children's leadership programme for 5 years, impacting more than 1,200 socially vulnerable boys and girls from various public schools.

Insights – practical and theoretical issues raised

Learning dynamics involve children, teachers and families.

Strength

The initiative can contribute significantly to the development of the country by providing new opportunities in technological fluency and mitigating social circumstances that force people to devote themselves to unpaid work. Within 2 years, the foundation aims to benefit more than 1,920 participants by empowering and strengthening leadership in new technological trends for the public schools of the country, with applications for addressing social vulnerability.

Link(s)

<http://www.fundacionqt.org>

1.6 EMPOWERING GIRLS AND MOTHERS TO USE AI TO SOLVE PROBLEMS IN THEIR COMMUNITIES

Iridescent

Geographical reach	13 countries	International
Results and impact	Externally evaluated	Externally evaluated
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Promoting skills development for jobs and life in the AI era	Strong focus

What – a description of the initiative

A 15-week AI programme running across 13 countries, aiding approximately 4,500 underserved participants. The AI Family Challenge is a free, hands-on, online AI education programme that aims to bring together families, schools, communities and ‘technology know-it-alls’ to give everyone the chance to learn, play and create with AI.

Who – initiators, supporters and implementers

Iridescent is a USA-based global engineering and technology education non-profit organization that supports low-income communities (especially girls and mothers) to solve problems in their community using engineering and technology. Tara Chklovski is the founder and CEO.

Why – the problem addressed

In the digital age, change occurs faster than ever and is fundamentally transforming the world. Preparation for the future workforce becomes paramount across all populations. There is a real danger that new technologies, such as AI, will accelerate the widening skills gap, and that the dwindling representation of women and minorities in these technological fields will persist. There has been some progress, with growth in coding movements bringing technology experiences to more students, especially girls and minorities, but the numbers are still low. There is a risk that disenfranchised communities (especially girls and women) will not succeed in a technology-dominant future because they will not have access to programmes that help them pursue and retrain for jobs created through automation and AI.

How – AI for, as and in education

The AI Family Challenge is a global, two-generational AI literacy programme that empowers underserved third-to-eighth-grade students and parents (especially girls and mothers) to understand basic AI technologies

and develop AI-based solutions to solve community problems. People are invited online to sign up and create an account to explore machine learning, different types of predictive models and foundational AI concepts like neural networks. Identification of community problems is encouraged, and completion of the programme entails working together to create a solution and a prototype using an AI technology.

Results – successes and challenges

Over the past 13 years, Iridescent has engaged 120,000 participants across more than 100 countries through its flagship programmes, Technovation and the AI Family Challenge. Lessons learned from the programme include methods of introducing AI concepts in hands-on, low-cost ways to audiences with low literacy levels. The programme also engages educators with no technology experience to teach an AI literacy programme, and engages industry and local businesses to support the programme. These are crucial considerations when working with populations most at risk of being left behind, especially in developing countries.

Insights – practical and theoretical issues raised

Methods of addressing the digital divide require engagement at the level of those affected by the digital divide. Specialized programming is therefore necessary to target the needs of populations with low literacy levels. Large-scale recruitment of participants was made possible by online registration.

Strength

This programme uses a low-cost delivery model that has been well-trialled, with proven capacity to attract participants. Its continuum implementation will yield useful data.

Link(s)

<https://www.curiositymachine.org/aichallenge/>

1.7 PREDICTIVE MODELLING AND MACHINE LEARNING TO DRIVE READER ENGAGEMENT

Worldreader

Geographical reach	Ghana	National
Results and impact	Results available	Internally reported
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

An initiative that provides people in the developing world with free access to a library of digital books, tailored to appeal to identified user groups, including girls and women, via e-readers and mobile phones.

Who – initiators, supporters and implementers

Founded in 2010, Worldreader is a global non-profit organization that champions digital reading in underserved communities to create a world where everyone can be a reader.

Why – the problem addressed

According to a number of international studies, literacy is the most accurate predictor of an individual's earning power and has the ability to decrease inequality. Yet 1 in 4 young people in developing countries are unable to read a single sentence, and millions more have limited access to books. While efforts to expand access to books in their traditional format can be costly, a child with a Kindle or other e-reader device can hold a portable library in their hands. By boosting confidence and ambition through literacy, a reading group supported by Worldreader's programme in Ghana is giving girls in slum communities opportunities to end the cycle of poverty and attain a better quality of life.

How – AI for, as and in education

Worldreader receives over 1 million rows of data a day through its mobile phone applications available on web and Android. Over the past couple of years, Worldreader has been experimenting with an unparalleled data set on reading trends around the globe to build machine-learning models that will allow prediction of reader behaviours, with the goal of improving reader retention and driving user acquisition.

Through data analysis and predictive modelling, Worldreader's data science team has built profiles for three different types of users from the Anasoma project

in Kenya. Anasoma was a two-year research project that sought to understand the barriers and drivers for women and girls in Kenya to read using their mobile phones. The project built a collection of books for women and resulted in a campaign for better encouraging women and girls to read on their mobile phones.

Data and machine learning can be leveraged to identify user groups, and these insights can be used to improve content and programmatic designs. Using reader engagement analysis, big data can be leveraged to track book performance and automate processes to build predictive machine-learning models. With further investment in these tools, Worldreader will be able to establish links between mobile reading of e-books and improved digital literacy skills by tracking user paths and behaviour evolution through the mobile reading app.

Results – successes and challenges

Worldreader has over 34,000 curated books and more than 494,000 monthly readers. Further information on all their programmes, including some results sorted by sex-disaggregated data, can be found on their website at: <https://www.worldreader.org/learnings/>

Insights – practical and theoretical issues raised

In the age of big data, it is important to ensure that data in the mobile learning space are being collected responsibly, with a clear goal of improving education outcomes.

Strength

This is a well-established programme that uses AI to promote reading, one of the most fundamental skills for access to education and learning.

Link(s)

<https://www.worldreader.org/our-solution/programs/lifelong-reading/anasoma/>

<https://tascha.github.io/Mobile-Reading-Data-Exchange/>

1.8 GLOBAL DIGITAL LIBRARY

Global Book Alliance

Geographical reach	Based in Norway Trialled in Kenya, Bangladesh, Cambodia, Ethiopia	International
Results and impact	No evaluation done	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Somewhat

What – a description of the initiative

A digital platform with AI components aimed at increasing the availability of high-quality, early-grade reading resources, including reading instruction books and storybooks, in underserved languages worldwide.

Who – initiators, supporters and implementers

The Global Digital Library (GDL) was launched in April 2018 by the Global Book Alliance. The GDL-platform is being developed and will initially be operated by the Norwegian Digital Learning Arena (NDLA), based on NDLA's open-source digital infrastructure. The Norwegian Agency for Development Cooperation (Norad) has the overall project management responsibility.

GDL content is currently being provided by the following initiatives and organizations: Book Dash, the Asia Foundation's Let's Read, StoryWeaver, the African Storybook project, the USAID programme All Children Reading: A Grand Challenge for Development, URC and the Global Reading Network. GDL's open-source digital infrastructure has so far been provided by NDLA and the New York Public Library.

A GDL advisory group provides technical advice and expertise for project implementation. The group is composed of representatives from the following organizations: USAID's All Children Reading: A Grand Challenge for Development, UNESCO, the Global Partnership for Education, UNICEF, the Global Book Alliance, Benetech, StoryWeaver, Creative Commons and the GSMA. In addition, a range of institutions and individuals have provided and continue to provide invaluable input.

Why – the problem addressed

Major progress has been made towards increasing primary-school enrolment rates. Still, 617 million youth and adolescents worldwide are unable to read, despite most of them having attended school for several years. One reason for this is that many do not have access to quality early-grade reading resources in a language they understand.

How – AI for, as and in education

The GDL and the open educational resources (OERs) available on the platform are integrated with AI components that offer application program interfaces (APIs) that allow software applications to communicate with one another. AI can help to reach new users on emerging platforms and enhance the quality of content and metadata. The GDL is accessible for users on most common platforms and devices like smartphones, computers, wearables or tablets.

Results – successes and challenges

The GDL platform was launched in April 2018 with an initial total of 900 resources in 15 languages, including Kiswahili, Bangla, Hausa and 7 Ethiopian languages. At the time of the launch, the GDL platform included a website and a native app for Android, providing users with the option of:

- Reading titles on their mobile phone, tablet or computer
- Downloading for print
- Downloading the mobile app, which provided with extended offline capabilities
- Translating titles into an increasing number of languages

User testing has been conducted in Kenya and Bangladesh, and workshops were conducted in Cambodia in 2018.

Insights – practical and theoretical issues raised

Icons are all taken from Google Material Icons, Google’s open-source icon library (Apache License, Version 2.0). They are lightweight, easy to use and well-tested for overall use. The icons are also available as a Git repository, making them even easier for developers to customize, share and reuse.

Strength

The Global Digital Library has a strategy of sharing all system code under a free license. This will make it possible for other projects to reuse the technology to create new solutions. APIs give easy access to all GDL resources.

Link(s)

<https://digitallibrary.io>

1.9 ENHANCING THE LEARNING PROCESS OF PEOPLE WITH SPECIAL NEEDS USING WEARABLES AND AI

University of Surrey, Plymouth University

Geographical reach	UK	National
Results and impact	Not available	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Somewhat

What – a description of the initiative

This research proposes enhancement of learning for individuals with special needs by collecting holistic data through wearable technology, commonly used in monitoring individuals’ various physical activities and biological signals, and analysing these data through machine-learning models. The models can then be used not only to identify, classify and understand the factors that influence learning but also to enhance the learning process overall.

Who – initiators, supporters and implementers

Karthik Shivashankar of the University of Surrey and Venkat Bakthavatchalam of Plymouth University in the UK.

Why – the problem addressed

The research seeks to contribute to inclusivity by attempting to understand and enhance the learning process for individuals with special needs.

How – AI for, as and in education

A holistic (physiological, psychological and technical) picture is explored by using multiple sensors that measure both physical and emotional states. The wearable device is equipped with sensors measuring skin temperature and conductivity, muscle activities, heart rate and motion. Data points can be visualized

using a mobile app in real time, thus making it easy and quick to view data on anxiety and heart-rate levels during different learning processes. The data collected from the wearable device can be analysed to form models using machine-learning algorithms such as K-Nearest Neighbours (KNN) or Multilayer Perceptron (MLP). This data-driven process can provide insight into the mutual interplay of both physical and emotional states influencing an individual’s learning processes and enable recommendations for enhancing developmental strategies.

Insights – practical and theoretical issues raised

A practical use of AI is to enhance learning processes for people with special needs. One method of engaging in this is monitoring the effects of physical and emotional states on individual learning processes, as well as the effects of learning processes on physical and emotional states.

Strength

This initiative combines the capacities of existing data collection devices with machine-learning algorithms in pursuit of deeper understanding of the learning process.

Links(s)

None

1.10 DESIGNING AI PROJECTS WITH LOW-COST TECHNOLOGY FOR RESEARCHERS AND LEARNERS IN DISADVANTAGED POPULATIONS

Science Resources Africa (SRA)

Geographical reach	Guinea-Bissau, Sierra Leone	Continental
Results and impact	Not available (experimental)	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Promoting skills development for jobs and life in the AI era	Yes

What – a description of the initiative

This initial exploratory work in AI-based projects, using the Raspberry Pi computer, is informing the development of AI teaching materials in a low-resourced context.

Who – initiators, supporters and implementers

Science Resources Africa (SRA) is a new non-profit organization based in sub-Saharan Africa and focused primarily on Guinea-Bissau and Sierra Leone.

Why – the problem addressed

The aim is to develop projects in which AI is used to tackle some of the challenges faced by vulnerable populations, particularly women and girls, in these regions.

How – AI for, as and in education

SRA has launched the Digital Innovators Collaborative Development programme to facilitate the use of AI with Raspberry Pi computers, which are used for mapping epidemics by tracking disease outbreaks in low-resourced communities. Twenty digital innovators (DIs) were appointed, equipped with Raspberry Pi computers and trained online and in face-to-face sessions at Jean Piaget University in Guinea-Bissau and the University of Sierra Leone.

Given the constraints imposed by lack of electricity and internet connectivity in remote regions, SRA's DIs trialled machine-learning projects on Raspberry Pi computers used as cloud-based servers. Inquiry-based activities were explored, including programming with Python, as well as activities involving measurement, sensors and physical computing as teaching materials for college students.

Practical and theoretical issues raised

Use of low-cost computing technology to facilitate inclusive and equitable education among vulnerable populations with the aim of promoting good health.

Strength

The strength of the initiative lies in the choice of available, cost-effective technology as a means to explore the development and applicability of AI in low-resourced, underdeveloped contexts.

Link(s)

<http://scienceresourcesafrica.com>

1.11 AI FOR LITERACY EDUCATION IN LEAST DEVELOPED CONTEXTS

Ladder Education Group

Geographical reach	Africa, Caribbean	International
Results and impact	Pilot stage	Internally reported
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

The Solar Friend, an educational AI tool invented in 2016/17, was designed, from hardware to software to content, to accommodate contexts with no electricity or connectivity and a lack of teachers. It offers children spoken engagement on topics relevant to their local scenario, in both dialect and basic English.

Who – initiators, supporters and implementers

Bosen Liu is the founder of the Ladder Education Group.

Why – the problem addressed

Technological developments and applications in education further increase the digital divide globally. Children in geographically isolated, impoverished and under-resourced areas are beyond the reach of educational opportunities that allow them to experience the excitement and virtual companionship that can be brought by cheap, AI spoken exchange.

How – AI for, as and in education

The Ladder Education Group invented a solar-based hardware tool for processing offline-based software that includes an offline voice recognition system, to support content aimed at teaching basic English through instruction using local dialect. The educational content consists of an initial 'Friend to Talk' function, which uses voice recognition technology for spontaneous conversational exchange in dialect-to-English; a second 'Friend to Explore the World' function, which uses voice recognition games to promote global citizenship education using local dialect; and a third 'Friend to Learn' function aimed at providing pronunciation correction for English.

Results – successes and challenges

Learning outcomes have been measured quantitatively in terms of recognition rate, correction rate, effectiveness of using AI as a learning companion, and other aspects. Students' user experiences have been reviewed qualitatively, including reactions to being exposed to a smart device, acceptance of voice recognition technology, challenges in using the device for learning, and other aspects. One conclusion reached is that the application of AI in education for disadvantaged groups is realistic; however, the point of the exercise should be education, not the technology.

Insights – practical and theoretical issues raised

There are ethics and readiness issues involved in bringing new technology to less developed regions, including affordability, interference with local culture, international communities' efforts, and so on. Implementation of the programme has included field observations related to these issues.

Strength

The strength of this initiative lies in its research and exploration of the application of offline-based software in contexts with no power supply.

Link(s)

<https://dig.watch/resources/innovative-applications-ai-education-and-youth>

1.12 AI FOR EDUCATION INTERVENTIONS BEYOND THE CLASSROOM

National Information Technology Agency (NITA)

Geographical reach	Ghana	National
Results and impact	Conceptual stage	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Somewhat

What – a description of the initiative

An initiative involving the use of AI to construct a virtual learning environment that engages students when they are away from the physical classroom.

Who – initiators, supporters and implementers

Kwaku Kyei Ofori of the National Information Technology Agency in Ghana.

Why – the problem addressed

With a mobile voice penetration rate of 136.68 per cent and a mobile data penetration rate at 80.33 per cent, Ghana is eminently suitable for adopting digital student engagement strategies beyond the classroom.

How – AI for, as and in education

Innovative AI applications and tools have potential for building a low-cost virtual learning environment and making learning more interactive. Methodologies are available for measuring the effectiveness of the virtual learning environment as well as use of personalization strategies to improve sustainable development in Ghana.

The initiative is focused on adaptation of AI applications and virtual learning environments for mobile technology. It also raises considerations about enrolling and assessing students for specific courses such as STEM via mobile digital learning platforms.

Insights – practical and theoretical issues raised

AI can be used as a cost-effective strategy for the education sector, and AI initiatives may provide learning opportunities beyond the classroom, increasing available learning time and engagement.

Strength

The prevalence of mobile technology provides a suitable environment for the conceptualization and implementation of AI-driven virtual learning environments.

Link(s)

<http://freeshs.gov.gh/>

1.13 OFFLINE DATA AND MODEL TRAINING FOR INCLUSIVE AI FOR STUDENTS AND TEACHERS

Learning Equality

Geographical reach	Guatemala, India, Jordan, Kenya, Mexico, Tanzania, Uganda	International
Results and impact	No evaluation done	Not available
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

The Kolibri initiative is a cloud-based platform that explores the challenge of using machine learning to support education in communities without internet access.

Who – initiators, supporters and implementers

Learning Equality is a non-profit organization officially incorporated in 2013, with twenty full-time employees and offices located at the University of California, San Diego. Learning Equality was co-founded by Richard Tibbles, who helped create the Kolibri application and learning platform. Kolibri has been active for three years. The platform brings curriculum-aligned open educational content to offline learners and allows teachers to track and monitor student progress.

Why – the problem addressed

Lack of internet access is one of the greatest barriers to taking advantage of machine learning. Simply waiting for improved internet access will not help narrow the digital divide. In addition, machine-learning models are largely driven by data collected from the 50 per cent of the world that has internet access. As such, learning pathways and personalized learning using these models will tend to be implicitly biased towards those who already have cheap and fast access to the internet and to online learning. The Kolibri application is an offline learning platform designed to bring the benefit of digital experiences to places with no or limited internet connectivity.

How – AI for, as and in education

Through the Kolibri application, AI targets populations in places with limited internet connectivity by using heuristics to make predictions specific to the disconnected servers from which offline learning data are collected.

The data collection happening in these offline contexts can then slowly be synchronized back to a larger, more comprehensive and inclusive data set that can be used for training more sophisticated predictive models. By relying on this two-stage approach (local heuristics, inclusive global model generation), students and teachers get the benefit of guidance now, and the data they generate have the potential to unlock more sophisticated predictions in the future, which will benefit not just their communities but also many others.

Results – successes and challenges

The Kolibri platform organizes content in a cloud-based library, where it can be downloaded by teachers and learners and used offline, whether they are in schools, refugee camps or orphanages. This open-source technology is designed to work in a variety of education contexts, including crisis settings, and to run on numerous devices, from repurposed desktop computers to low-cost, off-the-shelf hardware. Kolibri is being used in over 150 countries worldwide, with estimated hundreds of thousands of users.

The challenge of supporting implementing partners was addressed by creating structured resources to support training and implementation. Curriculum alignment was tackled by creating the Studio tool, which allows content to be aligned with local curricula. In order to provide content diversity, Studio allows the aggregation and import of a huge range of content from all over the world for use in offline contexts with Kolibri.

While heuristics can provide some advantages, due to the limitations of computational resources in these contexts, the sophistication of the predictions and the ability to properly validate them are limited.

Insights – practical and theoretical issues raised

Kolibri provides access to educational resources and machine learning in areas lacking internet access. It also provides a method for gathering more inclusive data, which can assist in reducing the implicit bias inherent in AI built using information solely from the portion of the population with internet access.

Predictions, whether they are used to directly drive student recommendations for learning pathways or to help suggest interventions or differentiation to teachers, must be used within any platform in such a way that

empowers students and teachers and respects their autonomy.

Strength

This initiative offers the benefits of AI-driven learning systems to those in offline contexts, while utilizing the data gathered to enable more sophisticated learning systems to be developed for both offline and online contexts.

Link(s)

<https://learningequality.org/kolibri/>

1.14 HOW WIKIPEDIA IS USING AI IN EDUCATION

Wikimedia Foundation

Geographical reach	Global	International
Results and impact	External evaluations conducted	Externally evaluated
Primary focus area	Ensuring inclusive and equitable use of AI in education	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Yes

What – a description of the initiative

Wikipedia is a free online encyclopedia, created and edited by volunteers around the world and hosted by the Wikimedia Foundation. It is a global open knowledge resource that leverages crowdsourced information and contributions as well as AI to improve its content.

Who – initiators, supporters and implementers

The Wikimedia Foundation is the parent company of Wikipedia.

Why – the problem addressed

The initiative allows teachers to leverage projects to teach skills, including skills for the AI era such as evaluating and leveraging content and collaborative creation.

How – AI for, as and in education

Around the world, students are both consuming information on Wikipedia and contributing to its content. AI tools used in the platform, such as ORES (Objective Revision Evaluation Service), play an important role in helping maintain the quality of articles on Wikipedia.

Results – successes and challenges

Wikipedia and its sister projects are powerful platforms that have the potential to reduce educational inequalities, avoid replicating existing biases and help students learn vital twenty-first-century skills.

Insights – practical and theoretical issues raised

Though AI presents valuable opportunities, the Wikipedia community is the heart of how knowledge gaps are bridged. The global Wikipedia community of dedicated volunteers works to ensure that everyone has the opportunity to access meaningful information in their own language. By participating in that community, students learn vital skills for life and the AI era.

Strength

This global collaborative initiative has the potential to reduce educational inequalities combining human and machine intelligence for a public good.

Link(s)

<https://wikimediafoundation.org>



Section summary and key takeaways

Broadly, inclusive and equitable use of AI involves access to and effective use of relevant AI technology. A key enabler, in addition to the technical hardware and software capacities needed to leverage AI, is the development of foundational digital literacy, which always requires attention to the cost of access and development. In the context of SDG 4, AI and AI applications are being developed and delivered that are responsive to both environmental and situational contexts and are relevant to the needs of vulnerable populations.

The initiatives outlined in this section target refugees and migrants, learners with special needs, girls and women, schoolchildren and their parents, and people in developing countries. The AI platforms and projects described aim to facilitate inclusion in schooling systems and education, equitable access to employment and language resources, and awareness and understanding of AI itself.

The initiatives are at various stages of development. Some are in nascent states, taking early steps in exploring how AI may be useful, tentatively identifying tools for investigation, experimenting with technological applications and raising questions of principle related to implementation. Others are farther along and have examples to offer of successful

strategies, models that can be replicated, and resources for sharing. Research into enhancing and extending the applicability and development of AI has also been reported by some initiatives.

The contexts in which the initiatives are being implemented are diverse, with some initiatives operating in environments with no internet connectivity or electricity, while others are utilizing large-scale AI platforms to explore and push the boundaries of what is technologically possible.

The various delivery models illustrate the different relationships programmes have to the contexts in which they are implemented and to their target groups. In some cases, partnerships between organizations have helped focus the AI technology on specific populations, bringing together complementary areas of expertise. Delivery strategies can also be tailored to reach specific target populations. The initiatives illustrate that adaptations are necessary to apply AI solutions and strategies in unfamiliar contexts, particularly those without power, connectivity or other resources. Such contexts present opportunities for creative solutions that enable access to expanded learning opportunities for underdeveloped areas and underserved communities.

2. Leveraging AI to enhance education and learning

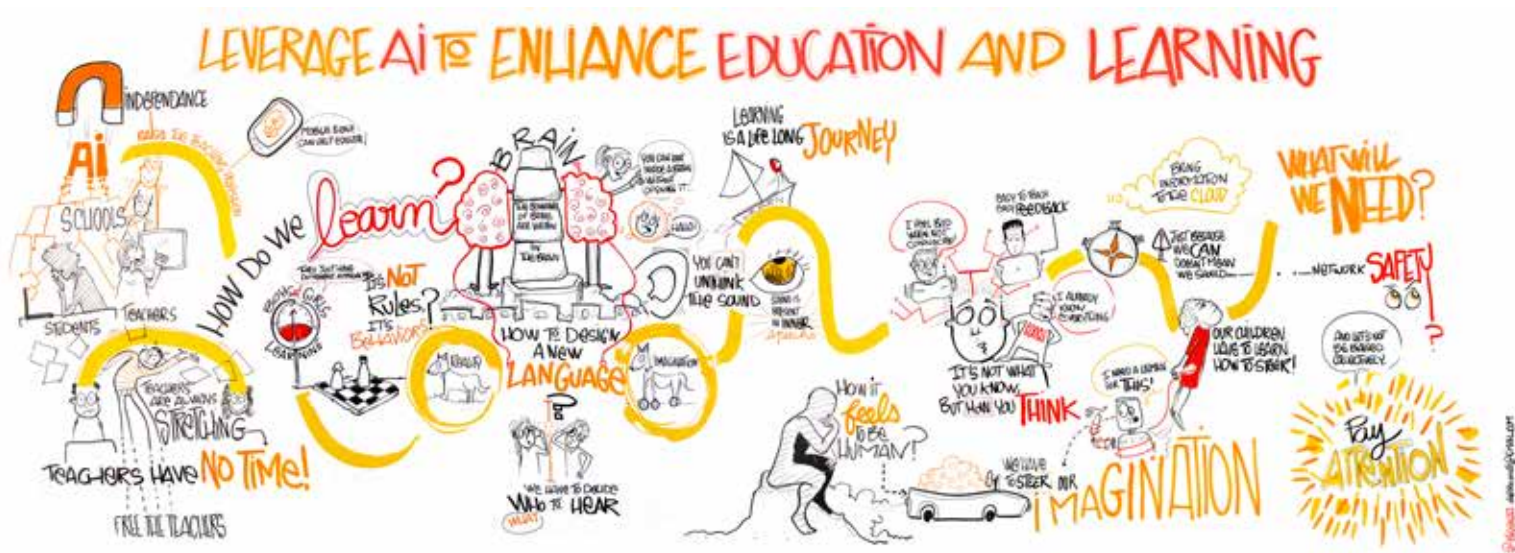


Figure 3: Leveraging AI to enhance education and learning

Source: Alexia Leibbrandt and UNESCO, 2019)

Introduction

The contributions presented in this section all incorporate elements of leveraging AI to enhance education and training. The initiatives include research or projects that dynamically define human independent cognition functions that are machine-resistant, and human capabilities to live and work together with AI – namely, human-machine collective intelligence. Illustrating this relationship are a number of initiatives that offer examples of AI-driven tutoring systems being used to support programmes delivered by teachers, or initiatives that provide a tool for teachers to write their own machine-learning programs.

AI-enhanced education management information systems (EMIS) and education planning systems are also described. Examples are provided in which data accumulated through tutoring systems inform the management of an education system; some of these initiatives are closer to the pilot stage, whereas others

are evaluating the impact of an intelligent tutoring system on children’s learning. Strategies are being used, explored and enhanced to digitally manage the selection and coordination of available educational resources into coherent learning paths.

Research into AI-enhanced learning management systems or other AI in education applications (for example, chatbots and gamification) is investigating learning patterns and how they can be optimized digitally or used in support of teachers working with students and administering assessments more efficiently and effectively, rather than ‘replacing’ teachers.

AI applications and AI-based solutions that have been applied to improve learning outcomes in subject-specific areas are also included. Linked to this is research on whether and how AI can enhance the quality of learning, and how AI in education will transform teachers’ roles.



Descriptions of initiatives

2.1 AMRITA LEARNING: AN INTELLIGENT TUTORING SYSTEM FOR URBAN AND RURAL SCHOOLS

Amrita Center for Research in Analytics and Technologies for Education (AmritaCREATE)

Geographical reach	India	National
Results and impact	Internal evaluation with control group	Internally reported
Primary focus area	Leveraging AI to enhance education and learning	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Strong focus

What – a description of the initiative

A personalized learning system used in urban and rural schools across India.

Who – initiators, supporters and implementers

The Amrita Center for Research in Analytics and Technologies for Education (AmritaCREATE), which is part of the Amrita Vishwa Vidyapeetham teaching and research institution in India.

Why – the problem addressed

The initiative facilitates large-scale individualized learning in schools, measurable against a common standard.

How – AI for, as and in education

Built on the Knowledge Space Theory model, a personalized learning system, Amrita Learning, integrates formative and summative assessment processes and provides multiple stakeholders with real-time feedback about both individual learners and groups of learners. Content is adapted based on the users' knowledge levels, language, curriculum and cultural background. Further, the AI-enhanced system provides information to educators on predicted performance, the risk of drop-out and the possibility of reading disabilities.

Results – successes and challenges

After more than 5 years in implementation, Amrita Learning has over 65,000 registered users in schools across India.

There were challenges in incorporating the solution into the school system. While some teachers welcomed the initiative, there was also resistance among teachers who did not want any e-learning to directly support their class curriculum and were sceptical about adaptive and personalized systems that allow students to learn at their own pace, often working ahead or below what is being taught in the class. This resistance was largely overcome by educating teachers, ensuring Amrita Learning was included in the school timetable and providing the additional possibility of working in a non-adaptive mode.

Insights – practical and theoretical issues raised

This large-scale learning management system demonstrates how the use of prediction models can facilitate the identification of reading disabilities and at-risk students.

Teachers must be supported and enabled in order to effectively implement self-paced programmes, which may not directly link to curriculum in a given grade. Effective support required both training of teachers and adjustments on the bureaucratic side, namely the inclusion of the programme in the school timetable.

Strength

The initiative demonstrates the use of a well-established system to provide personalized learning pathways within a large-scale learning management system.

Link(s)

www.amrita.edu/create

2.2 EDUCATION AND COMPUTER GAMES: USING AI TO IMPROVE LEARNING WITH GIDIMO IN AFRICA

Gidimo

Geographical reach	Francophone Africa, Ghana, India, Kenya, Nigeria	International
Results and impact	Internal evaluation conducted by staff and collaborators	Internally reported
Primary focus area	Leveraging AI to enhance education and learning	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Strong focus

What – a description of the initiative

A research project aimed at investigating the effect of initial systemic implementation of the Gidimo AI-based education and mobile learning application on learning patterns and outcomes and on barriers to learning.

Who – initiators, supporters and implementers

Joy Okah-Edemoh, of Pan-Atlantic University in Nigeria, is researching the use of the Gidimo application, a learning management system launched in Nigeria with the support of Microsoft, Google and the Lagos State Ministry of Education.

Why – the problem addressed

Gidimo seeks to reduce barriers to learning and improve learning outcomes.

How – AI for, as and in education

Gidimo is a learning management system, serving as a platform for online content and incorporating computer games with education. The project intends to access and analyse learning patterns with an optimized learning process, aiming to investigate whether it is possible to eliminate education barriers and improve personal advancement with an AI-powered education and mobile learning application.

Results – successes and challenges

The initiative has been in implementation for more than five years. Findings show that the learning management system improves learning outcomes and personal advancement.

Like most start-ups, the Gidimo project faced challenges, such as funding, finding the right people to drive the initiative and poor time management, which were gradually overcome through planning, review and perseverance.

Insights – practical and theoretical issues raised

Gidimo demonstrates how AI as an educational application can be used to overcome barriers to learning.

Strength

This initiative represents a promising example of a project that examines the effects of an AI-powered learning management system contributing to improving learning outcomes.

Link(s)

<https://www.gidimo.com>

2.3 EVALUATION IN EDUCATION WITH AI

Department of School Education in Haryana, India

Geographical reach	India, Kyrgyzstan, Nepal	Continental
Results and impact	Evaluated by Manav Rachna University in Faridabad (Haryana, India)	Externally evaluated
Primary focus area	Leveraging AI to enhance education and learning	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Strong focus

What – a description of the initiative

Use of various AI strategies for learning management in a government-run education system.

Who – initiators, supporters and implementers

The Department of School Education in Haryana State, India.

Why – the problem addressed

AI in education allows for a combination of the best of human and machine for the benefit of the learner.

How – AI for, as and in education

The Department of School Education in Haryana, India, is using AI in the following ways:

- Adaptive learning: AI in the schools provides students with adaptive learning by tracking their academic progress and informing their teachers of their difficulties in comprehension.
- Automated grader: The use of automated grading is in the initial phase. Teachers submit graded essays as samples of satisfactory and unsatisfactory work. The software becomes more effective as it accumulates information by grading more essays. Instant feedback is provided.
- Chatbot: Chatbot interviews collect students' opinions through a dialogue interface and analyses reasons for variability. The system is unbiased.
- Data accumulation: Data accumulated through previous search queries are used to inform suggestions for related content for students.
- Personalized learning: Information about individual students' pace and learning needs is gathered

and used to deliver personalized learning methodologies and activities, driven by learners' interests.

- Smart content: With the help of AI, textbooks are divided into chunks of small, digestible study guides, which are easy to read and understand. The study guides include flash cards, multiple-choice questions, fill-in-the-blank questions, pointers, true/false questions, chapter summaries and other learning aids.
- Virtual facilitator: AI is being used successfully to respond to students' queries and act as a teacher's assistant in remote training programmes.

Results – successes and challenges

The project has been in implementation for more than 4 years and involves over 5,000 teachers in 1,500 schools.

The challenges experienced have principally been the low level of motivation of policy-makers, which corresponds to a lack of awareness and lack of funding.

Insights – practical and theoretical issues raised

AI holds significant promise to revolutionize education systems, but further work in addressing the readiness of policymakers and education stakeholders should be taken into account.

Strength

The initiative demonstrates how the use of AI in learning management allows for a strong combination of machine learning with human intelligence.

Links(s)

None

2.4 USING AI AND LEARNING ANALYTICS IN COMPLEX ENVIRONMENTS ON A GLOBAL SCALE

ProFuturo Foundation

Geographical reach	33 countries in Latin America, Africa and Asia	International
Results and impact	Results available	Externally evaluated
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

A global education data network consisting of thirty-three countries in Latin America, Asia and Africa, and data analytics tools to measure programme results and evaluate education impact.

Who – initiators, supporters and implementers

ProFuturo Foundation, a non-governmental organization (NGO) launched in 2016 and underpinned by two major institutions in Spain, Telefónica Foundation and La Caixa Banking Foundation.

Why – the problem addressed

Digital education has the power to narrow the education gap, reduce poverty and improve people's lives.

How – AI for, as and in education

Insights are gained from data analytics and used to inform data-driven decisions based on learning analytics. AI tools and initiatives are used to assess both the programme results and the impact on education quality and transformation, and to determine how these changes improve the community. Randomized control trials are used to investigate whether a cause-and-effect relationship exists between the strategy and any resulting impact. The system offers continuous feedback on students' learning and allows teachers to personalize their students' education through specific applications. A Teacher Assistant app has been launched that uses prescriptive analytics to detect on a daily basis whether individual students are falling behind or moving ahead, so lessons can be adapted to meet their needs and keep

them engaged and interested in learning. ProFuturo analytics are displayed on a dashboard.

Results – successes and challenges

In 2018, ProFuturo launched its initiative in five countries in Africa (Ethiopia, Liberia, Rwanda, Senegal and Zimbabwe) and five countries in the Caribbean; by the end of 2018, it had reached a total of thirty-three countries in Latin America, Africa and Asia. ProFuturo, in collaboration with La Caixa Banking Foundation, reached a total of 5.8 million child beneficiaries by the end of 2017.

Insights – practical and theoretical issues raised

The education strategies employed can be adapted to any environment and context, both with and without an internet connection. Technologies and educational resources are incorporated in an interrelated way, and teaching and learning methodologies are designed to empower teachers and provide students with training in skills and competences for their personal and professional future.

Strength

The strength of this initiative lies in the sophistication of the digital strategies for analysing and using data to personalize children's learning pathways and to inform the relationship between a strategy and any resulting impact.

Link(s)

https://solution.profuturo.education/landings/index_EN.html

2.5 HOW 'AUGMENTED INTELLIGENCE' CAN RAISE LEARNING OUTCOMES

Whizz Education

Geographical reach	Kenya, UK	International
Results and impact	Results available	Externally evaluated
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

Maths-Whizz is an AI-powered virtual tutor for mathematics for 5–13-year-olds.

Who – initiators, supporters and implementers

Maths-Whizz is developed by Whizz Education.

Why – the problem addressed

The initiative aims to provide a learning experience that caters to children’s individual needs and pace of learning.

How – AI for, as and in education

The intelligence of the virtual tutor resides in analysing students’ learning patterns on a granular scale and selecting content of appropriate form and difficulty. Coupled with real-time reporting, the technology carries transformative potential for education that can only be realized when teachers are empowered. AI tutoring systems have the potential to enhance the quality of learning while amplifying the best of classroom practice. To develop tutoring algorithms, cutting-edge machine-learning models are blended with classical AI approaches, which rest on hard-coded human judgements. Live assessment reports support teachers’ analysis of students’ needs and inform the delivery of richer lessons. Real-time learning analytics enable a course-correction approach to implementation that promotes long-term efficacy.

Results – successes and challenges

Maths-Whizz has delivered personalized learning in mathematics to over half a million students worldwide over the past fifteen years. Whizz Education was one of the partners in the EU’s three-year (2012–2015) collaboration project iTalk2Learn, which aimed to develop an open-source intelligent tutoring platform to support mathematics learning for students ages 5 to 11.

Insights – practical and theoretical issues raised

Educators are needed to retain human oversight over automated decision-making tools in order to offset risks of bias. Teachers are thus placed at the heart of implementation, with AI interpreted as ‘augmented intelligence’. The express goal is to empower teachers with efficient and reliable modes of continuous assessment that offer unprecedented insights into students’ learning.

Strength

The use of AI strategies to analyse students’ learning patterns and report in real time, and to empower teachers with assessments that offer insights into student learning, contributes to the strength of this initiative.

Link(s)

- <https://www.whizzeducation.com>
- <https://www.imlango.com>

2.6 REALIZING SHIRAX: AN OPEN-SOURCE PLATFORM THAT CREATES TURNKEY AI-BASED EDUCATIONAL APPS FOR AUTONOMOUS LEARNING

Midnight Illusions Ltd

Geographical reach	Primarily continental Africa, India and continental South America	International
Results and impact	Results available	Internally reported
Primary focus area	Leveraging AI to enhance education and learning	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Somewhat

What – a description of the initiative

ShiraX is an open-source digital platform supporting the creation of AI-based educational apps for autonomous learning.

Who – initiators, supporters and implementers

ShiraX is developed by Midnight Illusions Ltd, a media development company based in Canada.

Why – the problem addressed

ShiraX seeks to address global inequalities by improving access to digital teaching solutions.

How – AI for, as and in education

ShiraX is an open-source, layperson-friendly web-based platform that facilitates the creation of AI-based educational mobile apps for autonomous learning. The ShiraX system was created through the development of a set of challenges issued on a crowdsourcing platform for programmers to solve. AI built into the app facilitates interaction with children's environments and also allows children to engage their friends. ShiraX offers speech recognition, natural language processing, storytelling, Wikipedia, handwriting recognition in 105 languages and image recognition, all usable without an internet connection.

Results – successes and challenges

The project has been in implementation for more than four years. The initiative was featured on the HeroX platform (<https://www.herox.com/shirax>), which was used to crowdsource coders to help develop the various components required to build ShiraX. Once completed, it was placed in the top 20 cohort for the Global Learning XPRIZE. ShiraX is an industrial partner of the UNESCO Chair on Global Smart Disruptive Learning at TÉLUQ University in Quebec, Canada.

The most significant initial challenge was securing financial resources to cover costs associated with paying the final team of researchers, educators, programmers and designers to develop the system. This was an anticipated challenge from the start, so the assembled team consisted of 'cause-driven' individuals who were passionate about the project and its goals. All twenty-two team members from eleven countries volunteered their time to help realize the project, with no individual receiving any financial compensation.

The most significant ongoing challenge continues to be financial in nature. A timeline for maximum volunteer contribution hours was set and reached, meaning further project development is currently on hold pending the identification of funding sources. Many members of the team wish to continue development of the system and are ready to be brought back on board, once a funding source has been identified. To this end, the initiative has partnered with the UNESCO Chair on Global Smart Disruptive Learning. Recognition at this level allows the initiative to pursue federal-level grant opportunities through TÉLUQ University, which gives it a greater likelihood of success.

Strength

The initiative constitutes an invitation for teachers to create AI-based education apps for their learners.

Link(s)

<https://apps.mi.ca/xprize>

<http://apps.mi.ca/xprize-shirax.pdf>

2.7 HOW CAN WE INCREASE STUDENTS' MOTIVATION AND ENGAGEMENT IN AN INTELLIGENT LEARNING MANAGEMENT SYSTEM USING GAMIFICATION AND AI?

University of Sao Paulo

Geographical reach	Brazil	National
Results and impact	Results available	Internally reported
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

Using AI to research and explore strategies and effects of gamification on the motivation of students learning through intelligent tutoring systems.

Who – initiators, supporters and implementers

Seiji Isotani, professor of computer science and learning technology at the University of São Paulo in Brazil.

Why – the problem addressed

Web-based intelligent tutoring systems are a type of learning management system that use AI to personalize learning experiences in both individual and collaborative settings. Intelligent tutoring systems have proven to be quite effective in improving students' robust learning as well as increasing their cognitive and metacognitive skills. Nevertheless, one of the main challenges of intelligent tutoring system research and application is related to maintaining students' motivation and engagement during the learning process. Several research findings indicate that advanced learning technologies should take students' emotions and affect into consideration in order to increase the technology's effectiveness in supporting learning.

How – AI for, as and in education

Several experiments, conducted with hundreds of students in STEM subjects at the K–12 and

undergraduate levels, have suggested that combining an intelligent tutoring system with gamification – that is, using game-design elements in non-game contexts – effectively promotes motivation and engagement and supports learning while students are interacting with the learning environment. Work has also been done to explore ways of combining gamification with AI techniques in order to adapt the learning environment so as to select and present to students those game elements that optimally meet their needs and desires.

Insights – practical and theoretical issues raised

Recent work has focused on data-driven gamification that can help teachers to better understand their students (i.e., automatic classification) and that offers intelligent pedagogical recommendations to increase students' motivation using gamification.

Strength

The initiative uses AI to research strategies for using intelligent tutoring systems to improve students' motivation to learn.

Link(s)

<https://doi.org/10.1016/j.chb.2016.06.049>

<https://doi.org/10.1016/j.chb.2016.07.048>

2.8 NEXT-GENERATION BY DESIGN (NGBD): OPTIMIZING DIGITAL EXCHANGE FOR CHATBOTS AND AI TECHNOLOGIES TO ENHANCE LEARNING

DXtera Institute

Geographical reach	USA, Spain	International
Results and impact	No evaluation done	Not available
Primary focus area	Leveraging AI to enhance education and learning	Strong focus
Secondary focus area(s)	Safeguarding transparent and auditable use of education data	Yes

What – a description of the initiative

Optimization of digital exchange for chatbots and AI technologies in order to enhance conversation-based learning in education.

Who – initiators, supporters and implementers

Dale Allen is president and co-founder of DXtera Institute, a non-profit, collaborative, member-based consortium of universities and education institutions dedicated to transforming student and institutional outcomes in higher education. DXtera Institute was established in 2016. Next Generation By Design (NGBD) is an initiative of the DXtera Institute.

Why – the problem addressed

Now that there is greater public understanding of the opportunities, limitations and risks associated with the most advanced applications of AI currently available for sustainable development, the objective is to give greater control to the consumer. DXtera Institute aims for next-wave systems to be designed and integrated in ways that allow information to be shared easily, quickly and accurately across systems. The goal is to enable richer user experiences with clearer information ownership and governance roles, less redundancy and greater security of sensitive or private data.

How – AI for, as and in education

Conversation-based learning is a learning methodology in which a student and instructor talk together to achieve learning goals. Teachers are thus in a privileged position to learn from each learning experience, unlike any other learning methodology. This initiative uses chatbots and AI technologies in order to revisit and enhance conversation-based learning in education through the optimization of digital exchange. Learning management system classrooms can be boosted by learning resources and new conversational tools such as Slack, Telegram and Messenger to efficiently support personalized learning environments.

Results – successes and challenges

The initiative has been in implementation for more than four years. DXtera Institute was established as the culmination of work involving the creation of a common data integration framework allowing for integration of education and workforce data from multiple data systems, through a real-time digital exchange between two community colleges in Massachusetts and the Massachusetts State Department of Career Services (DCS). DXtera Institute's integration framework was used to scale a homegrown predictive analytics product across a state higher-education system, enabling the use of data to identify and intervene with academically at-risk students at critical points, and to provide guidance and support for data-driven decision-making.

At the Open University of Catalonia in Spain, DXtera Institute and NGBD have transformed the university's ability to remove integration barriers and exchange digital information in real-time for over 55,000 students each year. The initiative has encountered numerous challenges while working to create a next-generation education system that enables consumers to choose where, when and how their data can be utilized for all aspects of learning, not just AI.

Insights – practical and theoretical issues raised

Control of the use of digital information remains a key unresolved issue in the modern era.

Strength

Chatbots and AI technologies are explored in order to revisit conversation-based learning in education, and data are collected and stored with a student/user focus.

Link(s)

<http://dxtera.org/solutions/next-generation-by-design/>
<https://www.uoc.edu/portal/en/elearncenter/index.html>
<http://elc.blogs.uoc.edu/briefing-paper-the-chatbots-in-education/>

2.9 DIGITAL INTELLIGENCE VIRTUAL ASSISTANT (DIVA)

Old Dominion University

Geographical reach	USA	National
Results and impact	A full internal evaluation will take place at the end of 2019	Not available
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

Chatbots are becoming commonplace on the web, with small chatbot windows that digitally respond immediately via text. This initiative uses a chatbot powered by IBM Watson (a computer system capable of answering questions posed in natural language) to provide college students with immediate support for their queries, including basic questions they may be less inclined to ask their human instructors.

Who – initiators, supporters and implementers

Helen Crompton of Old Dominion University in Virginia, USA.

Why – the problem addressed

Students may have questions at times when faculty members are unable to provide immediate support. If faculty members could gather these questions, trend analysis of the data could provide information to drive future instruction. A chatbot embedded in the course platform, powered by IBM Watson, will be able to complete these tasks for faculty members.

How – AI for, as and in education

The chatbot, named Digital Intelligence Virtual Assistant (DIVA), will answer student questions at any time of the day or night and collect that data for the instructor. While this chatbot is being tested in North America, it has potential uses in other contexts. For instance, it might be used to serve displaced populations by answering questions and directing them to resources, or to empower women and girls in developing countries with access to knowledge about health care and finance. The initiative also brings attention to the various free AI chatbot tools available on the web.

Results – successes and challenges

The initiative has been active for one year. In that time, DIVA has been able to take a significant burden from faculty by answering students' questions and collecting data on the questions, so that faculty members can spend more time on developing their courses and working one-on-one with students who need additional assistance.

Challenges the initiative has encountered include students' failing to question DIVA or confirm the guidance it provides, students' developing a preference for interacting with DIVA rather than their human instructor or classmates, and students' engaging with DIVA in unintended or unexpected ways. Additionally, monitoring, with the goal of collect information for instructors, has raised questions about how frequently monitoring is conducted and by whom.

Insights – practical and theoretical issues raised

The research team carefully considered the name of the chatbot, especially in light of concerns related to perpetuating gender stereotypes that have emerged with first-generation AI assistants that have female names and voices (e.g., Siri, Alexa, Erica). Though the name DIVA could be construed as feminine, it implies a celebrity status rather than subservience.

Strength

While the initiative explores the development and use of chatbots as intelligent tutoring systems, their use in alternative settings is also considered.

Link(s)

https://clt.odu.edu/fig/awards.details.php?id=2019_hcrompton

2.10 AI TO SUPPORT HUMAN INTELLIGENCE

Common Sense eLearning and Training Consultants

Geographical reach	Europe, Malawi	International
Results and impact	Not available	Not available
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

An online monitoring and tutoring system.

Who – initiators, supporters and implementers

Common Sense eLearning and Training Consultants.

Why – the problem addressed

Intensely tutored courses are restricted in participant size due to the limited capacity of the human input required. AI solutions can help to reduce the workload of online tutors, so that they can focus on value-adding activities like providing feedback to learners.

How – AI for, as and in education

The monitoring of learners and their activities can easily be automated. Intelligent reporting systems can take care of monitoring activities and alert tutors only in cases where their input is needed. Tutors can see at a glance whether learners are on track and whether there are delays or user patterns that need more attention. In this initiative, Moodle installations enhanced with intelligent reporting systems supported the human tutoring process. This approach can be further enhanced in the future.

Results – successes and challenges

Common Sense eLearning and Training Consultants has been offering e-learning services for corporations, non-profits and international organizations since 1999. Projects have addressed e-learning for orthopaedic technologists in Tanzania, for judicial training in Romania and for work in the Kofi Annan International Peacekeeping Training Centre, as well as many other uses.

Insights – practical and theoretical issues raised

In many cases, the human intelligence of online tutors cannot be replaced by AI. Human feedback and learning support will always remain an important pillar of learning, including online learning.

Strength

Sophisticated online tutoring systems can be used in conjunction with human feedback and learning support.

Links(s)

None

2.11 MULTI-AGENT TECHNIQUE TOWARDS ENHANCING LEARNING MANAGEMENT SYSTEMS

Al-Azhar University

Geographical reach	Egypt	National
Results and impact	Theoretical studies, research	Not available
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

This initiative uses intelligent agent technology as a means of addressing challenges in a learning management system, including self-adaptivity in a course, course personalization, intelligent collaborative groupware, and intelligent e-exam.

Who – initiators, supporters and implementers

Dr Mohammed Abdel Razek of Al-Azhar University.

Why – the problem addressed

Advances in intelligent e-learning enhance learning management systems.

How – AI for, as and in education

In order to build a dynamic adaptive course in a learning management system, information is needed about students' behaviours, preferences, needs and learning styles. To achieve this goal, AI technology is used to gather information about student behaviours, such as which learning objects a student prefers, and to combine that with information gathered from previous students' data records, in order to identify similarities between students. A machine-learning technique is used to predict students' learning styles. Intelligent agent technology analyses a learner's behaviour during the learner-driven stage and uses this information

to adapt the next step in the learning process, thus drawing on modelling to help students in their courses.

The ability to find helpers (tutors or other learners) is still a challenging and important problem. Helpers could offer a lot of useful information about courses to be taught; however, many learners fail to understand their presentations. The initiative uses a pyramid collaborative filtering model to build an intelligent collaborative groupware learning management system. Finally, the initiative builds an intelligent e-exam based on personalization and the course's intended learning outcomes.

Insights – practical and theoretical issues raised

The initiative demonstrates the use of intelligent agent technology to enhance learning management systems.

Strength

The initiative explores advances in the field of intelligent agent technology.

Link(s)

<https://www.scirp.org/journal/PaperInformation.aspx?PaperID=51690>

<https://ieeexplore.ieee.org/document/6571387>

2.12 LABXCHANGE: AN OPEN-SOURCE PLATFORM FOR PERSONALIZED LEARNING AND CHALLENGE-DRIVEN EDUCATION ON A GLOBAL SCALE

Harvard University (LabXchange)

Geographical reach	Global	International
Results and impact	Results available	Internally reported
Primary focus area	Leveraging AI to enhance education and learning	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Somewhat

What – a description of the initiative

An open-source course platform with the ability to dynamically deliver different discrete learning components as part of personalized learning.

Who – initiators, supporters and implementers

Robert Lue is the leader of Harvard University's new LabXchange initiative, which explores innovative online education and new ways to expand its reach and impact globally. Open edX is the massively scalable learning software platform behind edX, the non-profit, massive open online course (MOOC) provider founded by Harvard University and the Massachusetts Institute of Technology, whose courses can be audited for free.

Why – the problem addressed

Enormous investments have been made by governments, philanthropic organizations and private industry in developing online courses addressing nearly every field imaginable. But the dream of their widespread use to support more personalized or adaptive learning has been hampered by the resulting millions of individual learning assets being locked in the indivisible unit of the course. True personalized learning requires that individual learning assets, such as videos, graphics, text and interactives, be searchable and dynamically remixed to meet the assessed need of the individual learner.

How – AI for, as and in education

LabXchange, by introducing the next-generation content storage system – Blockstore architecture – to the core of Open edX, enables AI to determine what learning experience is best for each learner and remix assets to deliver a personalized learning experience. In addition, LabXchange integrates this open architecture for personalized learning with social networking designed to promote the sharing of learning experiences as well as their collective application to global challenges.

Results – successes and challenges

An initial focus on life sciences and education (SDGs 3 and 4) will eventually expand to address all seventeen SDGs through partnerships with other organizations.

Insights – practical and theoretical issues raised

By transforming a large, globally accessible, open-source learning platform, LabXchange supports the first personalized and challenge-driven learning effort that is both free and at a global scale.

Strength

The initiative demonstrates the use of AI to enhance the flexibility of personalized online learning.

Link(s)

<https://labxchange.org>

2.13 SYMBOLIC AI AND MACHINE LEARNING: PLAYING NICELY TOGETHER AT LAST

Collabrify Roadmap Platform (CoRP)

Geographical reach	Global	International
Results and impact	Results available	Internally reported
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

The Collabrify Roadmap Platform (CoRP) is a free, AI-enhanced platform for management of open education and OERs.

Who – initiators, supporters and implementers

Elliot Soloway of the University of Michigan; Cathie Norris of the University of North Texas, USA; and Nandini Chatterjee Singh, Roy Saurabh and Anantha Duraiappah of the UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development (MGIEP), India.

Why – the problem addressed

Open education and OERs promise to power education into the digital age. But educators all over the world are finding that tools in general, and AI-based tools in particular, are needed to manipulate these resources in order to stitch OERs together intelligently into effective instruction and to analyse student performance.

How – AI for, as and in education

CoRP is an easy-to-learn, easy-to-use, device-independent, browser-based, collaborative, graphical, open platform that supports the full life cycle of a digital lesson. CoRP supports educators in:

- creating and modifying OER-based lessons, called ‘roadmaps’;
- distributing lesson roadmaps to learners for use on their devices;
- monitoring learners in real-time as they move through the roadmaps;
- assessing the artefacts developed by learners during roadmap enactment; and

- sharing roadmaps in a professional community.

Additionally, CoRP draws on AI to support educators’ personalization of their lessons by searching for appropriate OER elements and analysing learning analytics. This helps teachers to improve their identification of learners who are struggling and include more scaffolding in their roadmaps.

CoRP is fully ‘collabrified’ in that it supports both teachers and students in working together synchronously, whether they are co-located or not.

In contrast to text- and card-based lessons, lesson roadmaps are graphical, making them much more understandable and inviting for both teachers and students. Students have been found to enjoy working with graphical roadmaps, and teachers find it easy to change the graphical roadmaps as needed.

Results – successes and challenges

CoRP is being used in classrooms and has been adopted by Michigan State’s Department of Education as part of its #GoOpen effort.

Insights – practical and theoretical issues raised

Socio-emotional learning and gamified instructional elements can be integrated into lesson roadmaps.

Strength

The initiative demonstrates the use of an AI-enhanced platform for managing open education and OERs.

Link(s)

<https://roadmap.center>
<https://goopenmichigan.org/curated-collections/38>

2.14 CREATING NEXT-GENERATION DIGITAL COURSES: USING AI TO SUPPORT PERSONALIZED, COLLABORATIVE, SOCIO-EMOTIONAL LEARNING

UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development (MGIEP)

Geographical reach	India, South Africa, Sri Lanka, Bhutan, Kyrgyzstan	International
Results and impact	No evaluation done	Not available
Primary focus area	Leveraging AI to enhance education and learning	Strong focus
Secondary focus area(s)	Promoting skills development for jobs and life in the AI era	Strong focus

What – a description of the initiative

An AI-powered digital knowledge-sharing platform that supports the creation of online courses and connects learners to peers and creators through AI.

Who – initiators, supporters and implementers

Roy Saurabh, chief technology officer at UNESCO MGIEP, is responsible for the solution architecture of FramerSpace, an AI-powered Collective Human Intelligence (CHI) platform, along with Anantha Duraiappah, inaugural director at UNESCO MGIEP.

Why – the problem addressed

Current platforms offer limited content design tools and delivery modes and provide limited data insights for the creator community. In addition, ownership of the data generated by existing platforms lies solely in the hands of for-profit organizations, thus depriving the world of invaluable insights that could lead to corrective measures for general improvement.

How – AI for, as and in education

The CHI platform is UNESCO MGIEP's AI-powered digital platform that facilitates delivery of global citizenship education, teacher education and student assessments (SDG 4.7) with embedded socio-emotional learning (SEL) components (empathy, mindfulness, compassion and critical inquiry) at scale.

CHI analyses learning patterns and provides educators with deep insights that help to achieve learning outcomes by optimally leveraging AI. CHI incorporates the 'human in the loop' concept to create training data for educational use cases, tune the model with human insights and test it recursively, checking that the insights are accurate and actionable.

Results – successes and challenges

This is a new project in its first year, with five countries involved in phase 1 of the pilot. Affective computing in multilingual and multicultural contexts is a key challenge, which was countered by the inclusion of journaling modes beyond text. Further challenges revolve around enabling each learner to make a distinct digital footprint in the absence of infrastructure (systems and network). These are being countered through system partnerships with companies like Samsung and Dell, and by creating offline and 'lite' versions of the platform.

Insights – practical and theoretical issues raised

The CHI platform utilizes the following:

- Interactive pedagogical tools, such as games and multimodal journaling options for teaching, learning and assessing: CHI's Game and Multimodal Journaling tool goes beyond the passive audio-visual modes being utilized in existing MOOCs.
- Embedded SEL components within mainstream courses: CHI's rich SEL libraries, and detailed implementation guidelines help educators to embed mainstream courses with appropriate components that help engage learners socio-emotionally.
- Collaborative work tools used by educators and learners while engaging with course content: CHI's contextual discussion functionality facilitates peer-to-peer engagement, powering automated identification of 'influencers' based on 'sentiment shift' analysis of digital interactions.

Strength

The initiative demonstrates the embedding of socio-emotional learning components into an AI-powered digital knowledge-sharing platform that supports the creation of online courses.

Link(s)

<https://chi.buzz>
<https://mgiep.unesco.org/framerspace>

2.15 MOODLE, THE DE FACTO LEARNING PLATFORM TO FACILITATE RESEARCH AND EXPERIMENTATION WITH EDUCATION DATA

Moodle

Geographical reach	Global	International
Results and impact	External evaluation has been done	Externally evaluated
Primary focus area	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

An improved analytics engine constituting a first step towards making Moodle an AI-boosted learning platform to empower educators to optimize learning processes and actively support learners throughout their studies.

Who – initiators, supporters and implementers

Moodle headquarters.

Why – the problem addressed

Moodle’s open-source nature have made it an ideal learning platform for learning analytics (LA) and educational data mining (EDM) researchers. The large number of LA and EDM publications that use Moodle as their main source of data is proof of this. Moodle has developed a new analytics engine powered by machine learning and is exploring how the open research principles that guided the project design can position Moodle as the de facto learning platform to facilitate research and experimentation with education data.

How – AI for, as and in education

The analytics engine is composed of multiple elements that can be used to create predictive and prescriptive models. The final purpose of these models is to generate insights for educators and learners, and to suggest to them actions to prevent undesirable situations or outcomes.

The engine features evaluation tools to verify the accuracy of each model. This allows researchers to discard some of their hypotheses and tune the models until they are accurate enough to start generating

insights. A predictive model to identify students at risk of dropping out of a course is included in Moodle. However, the model can be customized according to the needs of each different Moodle site. These models can be packaged as Moodle plug-ins and shared with the community of Moodle users, so that Moodle users can benefit not only from the models developed by Moodle headquarters but also from models developed by other institutions.

Results – successes and challenges

Moodle is well-established, the first version having been released in 2002. More than 18 million courses have been created in Moodle, and more than 156 million people have studied a course in Moodle.

The challenges encountered are those of managing an open-source community of contributors.

Insights – practical and theoretical issues raised

The fact that Moodle is an open-source product with no licensing costs, which has been localized and translated to many different countries and languages, makes this machine-learning-powered engine available for everyone, in alignment with the education-related SDGs.

Strength

An open-source engine can be used to create models that generate insights for educators and learners.

Link(s)

<https://docs.moodle.org/36/en/Analytics>
https://docs.moodle.org/dev/Analytics_API



Section summary and key takeaways

This section offers examples of how AI can be used to support individual learning in education institutions and systems. The initiatives present opportunities for machine-learning systems to bring improvements, while at the same time pointing out the need to introduce AI strategically and evaluate progress. Some of the initiatives offer useful tools and resources that are accessible and available to be explored. Others convey some sense of the work being done to forge further enhancements to the already astonishing capabilities of AI.

The initiatives illustrate a variety of different approaches. An expanded range of possibilities is enabled by AI-powered education, such as advanced learning management systems; personalized training paths consisting of elements selected from discrete learning components according to individual needs; the potential for development through creating dialogues and coalitions of projects; and the use of insights gleaned from big data analysis to inform policy development. The initiatives include those that are well-established and widely used in support of national education systems, as well as those in the initial stages of implementation and engaged with early research to gauge their impact.

AI strategies are being used to improve learning outcomes by providing additional support to teachers as well as learners. Some initiatives focus on specific subjects, such as English language, mathematics and physics, while others are more broad-ranging. In some initiatives, teachers used digital tools to develop their own machine-learning lessons, and in others, teachers have their students use AI tools as a means of enhancing their specific subject learning.

More sophisticated use of AI is focused on strategies for enhancing and improving online learning, such as gamification and chatbots. Various initiatives are exploring linkages with OER to provide more flexible online learning. The application of and need for AI in teacher education is also addressed.

The breadth and variety of interventions already on offer in this realm highlight the potential of AI in various aspects of education, including administration, teacher training, lifelong learning and learner achievement. In the most innovative models, an emphasis on the individualized aspects of education are balanced with the need for personal and interpersonal development, with an emphasis on the development of creativity, problem-solving, resourcefulness and adaptability.

3. Promoting skills development for jobs and life in the AI era

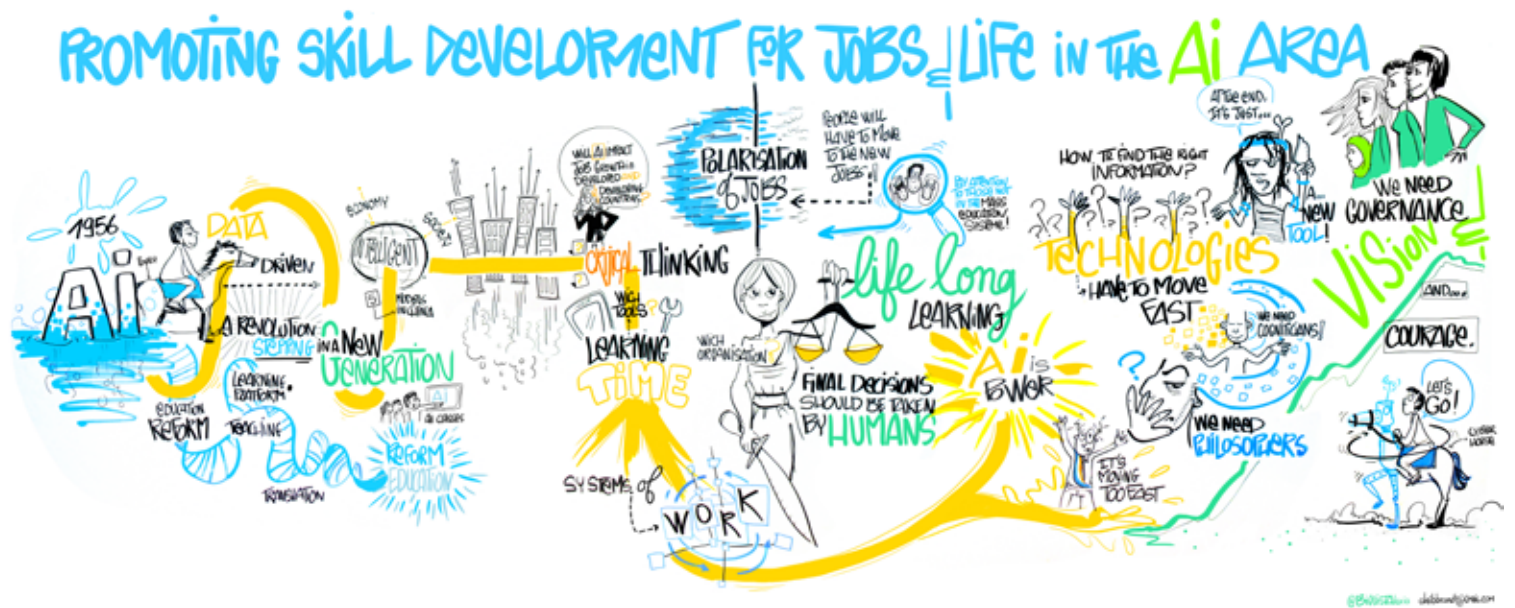


Figure 4 Promoting skills development for jobs and life in the AI era

Source: Alexia Leibbrandt and UNESCO, (2019)

Introduction

The initiatives presented in this section focus strongly on skills development and the impact of AI on jobs. The examples include initiatives defining AI-driven platforms and frameworks for skills, both AI-related skills and others, that address the need for upskilling and reskilling the existing workforce. Mappings of individual and job-skill profiles are being produced and linked to those of available training programmes, for various purposes.

AI-related skills development initiatives address adult illiteracy and the development of AI skills in schools and higher education, as well as the questions that

should be asked and preparations that are necessary before AI can be used to promote skills development for jobs and life. There are examples of programmes on AI targeting education professionals, and programmes and initiatives that develop and promote relevant AI skills for those most at risk of being left behind in both developing and developed countries.

A few submissions were received that promote the development of AI literacy for all citizens who are exposed to AI in daily life and work without awareness of how AI technologies are utilizing their personal data.



Descriptions of initiatives

3.1 QUESTIONING INCLUSIVENESS: USING AI TO BRIDGE LEARNING GAPS MATCHING INDUSTRY NEEDS AND PROFILES FOR ENGINEERS

InnoEnergy

Geographical reach	Europe, North America	International
Results and impact	Not available	Not available
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus

What – a description of the initiative

The use of AI to identify learning gaps for international engineers wanting to work in sustainable energy.

Who – initiators, supporters and implementers

Inge de Waard of InnoEnergy.

Why – the problem addressed

Understanding the learning gap between industry needs and the worker/learner profiles of engineers working in rapidly developing fields, such as sustainable energy, helps education institutions operating in those fields become more competitive in meeting the needs of the industry. This information is also useful as guidance to engineers wishing to develop their career paths in these directions.

How – AI for, as and in education

AI in education is no longer limited to using learning analytics and big data to understand how undergraduate and graduate students acquire new knowledge; it is now being used to assess what learning demands to expect in the future. Algorithms are built based on facts that are perceived as crucial to predicting future learner needs. Machine learning, AI, learning analytics and data science are combined to understand the learning gap.

At InnoEnergy, a digital tool is being built to enable analysis of what the industry is looking for (based on a system of natural language processing of industry reports, vacancies, etc.) and to compare those requirements to the existing engineering skills of those working in sustainable energy (based on CVs, résumés, etc.). The tool will help to pinpoint necessary courses, available or not, to bridge a possible learning gap between the demands of industry and the profiles of current engineers.

Insights – practical and theoretical issues raised

With a tool of this nature, inclusivity for engineers coming from less prestigious universities might become a problem. These universities or professional schools would need to deliver courses in a rapidly changing field, while ensuring that such courses meet the emerging demands of industry.

Strength

The matching of skills mapping in the developing sustainable energy sector with appropriate education and training provision in order to inform institutional programme development, while also linking in individual needs, is an important contribution to development in sustainability and SDGs.

Links(s)

<https://www.innoenergy.com>

3.2 AI IN EDUCATION IN KENYA AND MALAWI: A VIEW FROM THE GROUND

Frontier Technologies Hub, in partnership with the British Department for International Development (DFID)

Geographical reach	Africa	Continental
Results and impact	Results available	Internally reported
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus

What – a description of the initiative

Application of AI to education in Kenya and Malawi, and exploration into its potential impact on development challenges related to connectivity in education, health and humanitarian response areas.

Who – initiators, supporters and implementers

Frontier Technologies Hub working in partnership with the UK’s Department of International Development (DFID) on two programmes: Frontier Technology Livestreaming and Frontier Technology Futures.

Why – the problem addressed

Livestreaming enables DFID to apply cutting-edge technology to solve development goals. Futures is an immersive week-long experience that enables DFID departments or country offices to be at the technological forefront of development.

How – AI for, as and in education

The adopted work methodology in the Livestreaming programme includes matching projects (selected through DFID advisors) with private-sector technology entrepreneurs and innovators. Implementation is supported with coaching in lean start-up business methodologies. The projects entail an in-depth co-creation phase aimed at ensuring that the proposed technological solution targets the real problem, after which local facilitators are brought in to connect the DFID department or country office to local tech innovators, advise on local tech trends and support or lead legacy initiatives.

A framework of predesigned activities is available, falling into general categories of need such as exploring the technology, meeting the ecosystem and connecting the opportunities. These activities are connected with the local tech ecosystem, in order to nurture its development.

In addition, the *Frontier Technology Playbook* is a set of activities, strategies and methods that can be used to overcome common challenges such as regulatory barriers; unsupportive supply-chain infrastructure; an infrastructure and ecosystem lacking adequate technical skills for local installation, maintenance, development and sustainability; difficulties fitting into existing systems; post-pilot sustainability; and awareness building.

Results – successes and challenges

Currently twenty-two pilot projects are operating in twelve countries.

Strength

The initiative tailors the process of matching projects with technology entrepreneurs and innovators providing developmental coaching and skills development in the AI era.

Links(s)

None

3.3 MHEALTH LEARNING AND APP DEVELOPMENT FOR HEALTH DIAGNOSES, TRACKING WITH AI AND SAFEGUARDING PATIENT DATA

Columbia University

Geographical reach	USA, China, France, South Africa, Nigeria	International
Results and impact	Internal evaluation conducted by participants, institutional representatives and institution	Internally reported
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus
Secondary focus area(s)	Safeguarding transparent and auditable use of education data	Strong focus

What – a description of the initiative

An innovative mobile health course for students entering and working in various medical fields.

Who – initiators, supporters and implementers

Dominic Mentor of Columbia University in New York, USA.

Why – the problem addressed

While medical students are entering a work environment rich with technology and digital data in the age of AI, their work preparation is sparse regarding technology use.

How – AI for, as and in education

With the lack of universal health care in many states, rising medical costs and the ubiquity of mobile phones, the application and utilization of mobile devices for both patients and health workers is relevant. Existing and prospective medical and health care workers can be empowered by equipping them with mobile health app development skills.

Through this initiative, students learn how to bridge the gap between business operations, information and communication technology, AI, and their respective health care departments, in pursuit of maximizing mobile health learning and promoting skills development in their work and life in the AI era.

Results – successes and challenges

This is a new initiative in its first year of implementation. Its achievements to date have largely centred around its contribution to awareness and capacity-building, particularly:

- promoting understanding of techniques for applying mobile learning and education theories in a practical manner, and the importance of doing so;
- providing measured skills and knowledge for differentiating and learning about mobile health technologies;
- increasing the measured ability to determine and utilize appropriate mobile learning activities; and
- expanding the scope of opportunities to design learning activities and/or apps for mobile phones by people with no coding or technology experience.

The project is geared towards non-technology graduate students who have little to no experience with computer and mobile technology courses. The initial steep learning curve of technology terms and design thinking was addressed with a scaffolded approach to building knowledge blocks and skills.

Evaluations found that participants learned about new career trajectories. In addition, they learned technical terminology that facilitated communication with coders and programmers, and developed the confidence to learn simple code app development. With the data gathering and data collation skills they gained, they grew confident in their ability to learn about the back-end data analytics that will fuel future AI and machine learning. All apps were required to address the identified threats and pitfalls of privacy concerns from the onset of prototype design.

In addition, through their involvement in the projects, participants acquired practical experience of how to apply mobile learning and education theories

and learned how to differentiate and learn about mobile health technologies. The project gave them the opportunity to determine and utilize appropriate mobile phone learning activities, by understanding pedagogical opportunities for mobile phones and designing learning activities accordingly.

In another iteration of the project with a leadership development focus, participants returned as guest speakers, sharing their new vocabulary and the way in which the project helped them to develop design thinking from front end to back end, as a consequence of which new career opportunities have emerged.

Insights – practical and theoretical issues raised

The initiative showcases the development of mobile health apps from paper to prototypes, as well as

findings from usability tests and the pursuit of transparent and auditable learning analytics. There is also an emphasis on compliance with safeguarding patient data and how this could be fed into data systems for inclusive and equitable AI.

Strength

The strength of this initiative is the application of AI-driven technology and digital skills to the preparation of medical and health care students, with attention to the need for cautious and ethical approaches to the use of the data involved.

Link(s)

<https://www.tc.columbia.edu/faculty/djm2123/>

3.4 INTELLIGENT MOBILE LEARNING FOR THE HARDEST TO REACH: TACKLING ADULT LITERACY WITH CELL-ED

Cell-Ed and Wizenoze

Geographical reach	Chile, Kenya, Ghana, Nigeria, Somalia, UK, USA	International
Results and impact	Not available	Not available
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Yes

What – a description of the initiative

A mobile learning platform delivering skill-building information and learning tailored for illiterate or low-literate adults and their families.

Who – initiators, supporters and implementers

Two global social enterprises, Silicon Valley-based Cell-Ed and Amsterdam/London-based Wizenoze.

Why – the problem addressed

Illiteracy poses a barriers to accessing education and lifelong learning for nearly 600 million girls and women worldwide.

How – AI for, as and in education

Information and learning is tailored illiterate to low-literate adults and their families using Cell-Ed’s mobile learning platform, which delivers AI-powered skill-building micro-learning (e.g., literacy, language, vocational skills) over any mobile device, with or

without internet, together with Wizenoze’s readability analysis engine and curation solution.

Results – successes and challenges

Customizable solutions are currently serving communities in the USA, UK, Chile, Nigeria, Kenya, Ghana, and Somalia.

Insights – practical and theoretical issues raised

This partnership provides pathways for women by providing fundamental skills to improve their lives while simultaneously connecting them with the information and resources they need to take their next steps.

Strength

Collaboration with networks of partners enables the solution to be contextualized to local populations and needs.

Link(s)

<https://www.cell-ed.com>
<https://www.wizenoze.com>

3.5 LEVERAGING AI WITHIN CONNECTED LEARNING: OPPORTUNITIES AND CONSTRAINTS

Connected Learning in Crisis Consortium (CLCC)/UNHCR

Geographical reach	Global	International
Results and impact	External evaluation available	Externally evaluated
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Yes
	Ensuring inclusive and equitable use of AI in education	

What – a description of the initiative

An organization that implements programmes through the use of information technology to enable learning in contexts of fragility, promote embeddedness in local and global learning communities and teach new media literacies. This is accomplished by linking student interest to relevant, flexible, accredited and sustainable academic learning; creating interconnected learning communities; and ensuring academic achievement through dedicated learner support.

Who – initiators, supporters and implementers

The Connected Learning in Crisis Consortium (CLCC), established by the UN High Commissioner for Refugees (UNHCR) in 2016, is a twenty-three-member organization of actors supporting and providing tertiary-level, blended learning in contexts of forced displacement.

Why – the problem addressed

In the age of AI, digital literacy, critical thinking and intercultural communication are among the pre-eminent skills requested by employers and required for success in the competitive global marketplace. The CLCC focuses particularly on addressing the unmet needs of refugees and displaced communities.

How – AI for, as and in education

CLCC members' programmes prioritize digital literacy, critical thinking and intercultural communication skills, weaving them throughout accredited certificate, diploma and degree courses undertaken by refugee and

host community students alike. Member programmes, such as those run by Southern New Hampshire University, employ AI to evaluate student work and determine which competences learners have achieved and which they must revisit.

Results – successes and challenges

The CLCC website includes access to publications and links to relevant resources.

Insights – practical and theoretical issues raised

There are increasing opportunities for using AI in the provision of education, not only in terms of student services and performance tracking but also in terms of which courses are taught and how they are delivered. The questions raised by this initiative include: As the future will be led by machine learning, how can providers of higher education best equip their learners with essential skills? How can they maximize data to improve their systems, and who else can join this space to partner for increased impact?

Strength

The strength of this initiative is in the use of machine learning to deliver programmes interweaving digital literacy, critical thinking and intercultural communication with accredited qualifications.

Link(s)

<http://www.connectedlearning4refugees.org>

3.6 DIGITAL INCLUSION IN THE AI ERA: ENSURING WORK SKILLS RELEVANCY FOR REFUGEES AND MIGRANTS

Konexio

Geographical reach	France	National
Results and impact	No evaluation done	Not available
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Yes

What – a description of the initiative

Konexio is a social enterprise based in Paris that aims to create digital inclusion and accelerate refugee and migrant integration through employment, by placing students with corporate partners who have difficulty finding suitably skilled digital talent.

Who – initiators, supporters and implementers

Jean Guo co-founded Konexio in Paris in 2016. Konexio is a certified training provider that offers refugees and migrants digital training and access to networked support from a team of teachers, support staff, interns and volunteers. The enterprise has an advisory board to guide and support its growth, and numerous corporate partners and collaborators in the education, financial, NGO and university sectors.

Why – the problem addressed

To address the current digital divide, the project aims to meet corporate needs for middle-skilled talent, particularly in industries that have high potential to leverage AI technology and contribute to economic growth, by boosting the skills of trainees to meet high-demand labour gaps. By targeting trainees from migrant and refugee populations, the programme enables long-term digital inclusion, access to employment and higher levels of social integration for refugees and migrants.

How – AI for, as and in education

Digital education and mobile technology are used to deliver programmes that equip students with job skills in preparation for an employment landscape dominated by AI.

Insights – practical and theoretical issues raised

The training model is easily adapted to shift focus from simply gaining employment to meeting the requirements of middle-skilled jobs with high lifetime career value. Such jobs offer the potential for both skills and wage growth over a long period of time and are likely to be flexible in adapting to AI technologies rather than being replaced or offshored.

Strength

The strength of the initiative lies in the combination of meeting corporate needs for skilled employees with machine-learning delivery of digital education and job skills suitable for an employment landscape dominated by AI.

Link(s)

<https://www.konexio.eu/en.html>

3.7 THE LINK FOR PREPARING STUDENTS TO THRIVE IN AI CAREERS OF THE FUTURE

International Society for Technology in Education (ISTE)

Geographical reach	Global	International
Results and impact	Results available	Externally evaluated
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus
Secondary focus area(s)	Leveraging AI to enhance education and learning	Strong focus

What – a description of the initiative

A collaboration that provides scholarships for teachers to learn how to teach AI in schools.

Who – initiators, supporters and implementers

The International Society for Technology in Education (ISTE) is a membership organization serving educators and education leaders committed to empowering connected learners in a connected world. Richard Culatta is the CEO of the ISTE, which has collaborated in a public-private partnership with General Motors.

Why – the problem addressed

Jobs of the future will increasingly demand knowledge of how to leverage and program AI as a tool for problem-solving. Unfortunately, most teachers around the world are not equipped to provide students with the basic skills required to understand how to use AI for work and learning. In fact, the ISTE has found that most teachers cannot even explain what AI is or identify AI when given specific examples.

How – AI for, as and in education

An online programme has been developed aimed at preparing teachers to understand the basic skills and concepts related to AI and how to facilitate discussions with their students on what they will need to know about AI to be successful in their future lives and careers.

Results – successes and challenges

The ISTE has established a set of standards providing a framework for students, educators, administrators, coaches and computer science educators to rethink education and create innovative learning environments. The standards are helping educators and education leaders worldwide re-engineer schools and classrooms for digital-age learning, no matter where they are on the journey to effective edtech integration.

Insights – practical and theoretical issues raised

The value of working in public-private partnerships can be replicated by education systems around the world to make sure all students will be successful in an AI-intertwined era.

Strength

The collaborative nature of the initiative, which delivers an online programme that targets educators, ensures the widest reach in the shortest amount of time.

Link(s)

<https://www.iste.org/explore/articleDetail?articleid=2197>
<https://www.iste.org/explore/articleDetail?articleid=2229&category=Press-Releases&article=>

3.8 HUMANIZING ALGORITHMIC SOCIETIES: NEW APPROACH TO MEDIA AND INFORMATION LITERACY EDUCATION

UNESCO Institute for Information Technologies in Education (IITE)

Geographical reach	Global	International
Results and impact	Results available	Externally evaluated
Primary focus area	Safeguarding transparent and auditable use of education data	Strong focus

What – a description of the initiative

Ongoing project on the development of mobile learning resources for media and information literacy for teachers.

Who – initiators, supporters and implementers

UNESCO Institute for Information Technologies in Education (IITE).

Why – the problem addressed

The rate at which AI-based digital technologies are being introduced and used is far faster and more wide-ranging than the rate at which the general citizenry is developing the skills, knowledge and attitude competences necessary for them to be able to use networks consciously, safely and responsibly. This is also the case with education technology.

As AI becomes increasingly interwoven into our lives, fuelling our experiences at home and work, the intangible nature of its intervention is difficult to identify and analyse critically. Thus, it is increasingly important for all citizens to develop new awareness.

Promotion of digital literacy, particularly media and information literacy, could be a useful strategy for closing this gap, but only with substantial enhancement of related skills and knowledge.

How – AI for, as and in education

AI algorithms for digital services are essentially powerful and sophisticated black boxes that establish the nature, ways and formats of human interactions – not only interactions with digital services themselves but also social communication more broadly.

Increasingly, service and application providers collect, save and utilize large amounts of people’s data. Algorithms, produced on the basis of these data,

effectively reinforce human biases and propagate ‘filter bubbles’ – states of intellectual isolation that can result from personalized searches when a website algorithm selectively guesses information that a user would like to see, based on the user’s own information, such as location and past click behaviour.

Results – successes and challenges

IITE’s e-learning resource can be utilized in a non-formal teacher training format aligned with lifelong learning. Its learning content incorporates new media and information literacy topics such as algorithms for digital services and social networks, digital media phenomena, attention management, behavioural economy, societal aspects of the Fourth Industrial Revolution’s technologies such as AI, and others.

Insights – practical and theoretical issues raised

Since they have been developed by the behavioural economy and use persuasive design principles, AI-driven technologies and services are not neutral; rather, they are aimed at pursuing the goals of their creators or owners. The decision-making processes on which AI-driven technologies and services are based are hidden, thus displaying no accountability or ethics.

Strength

The strength of this initiative is the deeper understanding and insight that it offers into AI processes and information available through AI means, and its contribution to media literacy.

Link(s)

<https://iite.unesco.org/media-and-information-literacy/>

3.9 EXPERIMENTING WITH AI IN THE CLASSROOM

mSchools (GSMA)

Geographical reach	Spain	National
Results and impact	Results available	Internally reported
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus

What – a description of the initiative

mSchools is a public–private education programme that strives to integrate mobile learning and technology in the classroom in ways that improve learner engagement and employability, transforming education to cope with shifting job markets and societal needs.

Who – initiators, supporters and implementers

Albert Forn leads the mSchools programme at the GSMA, a public–private partnership.

Why – the problem addressed

The rise of AI, robotics and other digital technologies is profoundly changing the job market, creating a demand for new professions and individuals with evolved digital skills and mindsets. Education systems must adapt in order to promote skills development and empower students to lead active and creative digital lives that meet the demands of this future society.

How – AI for, as and in education

mSchools promotes digital and critical thinking skills, utilizing collaborative learner-centred methodologies that harness the power of technology and mobile devices. mSchools also advocates for the digital

transformation of schools and of the education system as a whole, in order to fully integrate technology as a means of promoting inclusiveness, maximizing student achievement and transforming pedagogy.

Results – successes and challenges

To date, over 130,000 students and 3,700 teachers are part of the mSchools community.

Insights – practical and theoretical issues raised

Future-ready students will emerge from authentic skills-based learning experiences that incorporate innovative pedagogies and tools that can empower them to lead creative and critical digital lives in the AI era.

Strength

The strategy of a partnership to integrate mobile learning and technology into schools and facilitate the digital transformation of schools is a strength of this initiative.

Link(s)

<https://mschools.mobileworldcapital.com/>

3.10 AI CURRICULUM FOR K–12 TEACHERS AND STUDENTS

Kids Code Jeunesse (KCJ)

Geographical reach	Canada	National
Results and impact	Not available	Not available
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus

What – a description of the initiative

An AI curriculum that aims to prepare a generation of K–12 students and teachers who are experienced in AI skills, from data collection to automated decision-making, and equipped to build a meaningful understanding of technology.

Who – initiators, supporters and implementers

Kids Code Jeunesse (KCJ) is a Canadian not-for-profit organization that has been teaching coding skills to teachers and children since 2013. The 2019 curriculum was built in partnership with the Montreal AI Ethics Institute and the International Observatory on the Societal Impacts of Artificial Intelligence and Digital Technologies.

Why – the problem addressed

With AI spreading rapidly, the way much of the world works will be radically different by the time today's young generation grows up. Children must be equipped with the skills they need to thrive in a technology-driven society and the knowledge they need to make informed decisions.

How – AI for, as and in education

As of 2019, KCJ priorities are to ensure K–12 teachers and their students are equipped to create, communicate and innovate with AI, and are prepared to use these skills to address the UN SDGs. The 2019 AI curriculum explores data collection and categorization, privacy, bias and equity. Workshops from this curriculum aim to:

- demystify AI with unplugged and digital activities that open up conversations about both artificial

and natural intelligence, building appreciation of AI systems, what they are made of, their powers and their limitations;

- engage participants in hands-on projects like collecting data, training a neural network, or experimenting with bias, all using student-accessible technological tools; and
- encourage reflection in open discussions about the opportunities brought by the AI system just explored, the ethical responsibilities that come with it, and the power of citizens to meaningfully contribute to its development.

Results – successes and challenges

KCJ has introduced computational thinking through coding and physical computing, with a particular focus on girls and children from disadvantaged groups, to over 100,000 children and 6,000 educators.

Insights – practical and theoretical issues raised

AI can be taught at the K–12 level using unplugged and digital tools, with ethics concepts meaningfully woven into educational experiences. Teachers and students can learn to see AI systems as tools that powerful but fallible, and not immune to bias or the socio-ecological system around them.

Strength

The strength of this initiative lies in the combination of AI skills with ethical issues.

Links(s)

<https://kidscodejeunesse.org>

3.11 MJANGALE: TEACHING STEAM TO YOUTH IN SENEGAL THROUGH AI

mJangale

Geographical reach	Senegal	National
Results and impact	Published and reported at academic and professional conferences	Externally evaluated
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Yes

What – a description of the initiative

An after-school programme established in Senegal and targeting youth from primary to secondary school, offering STEM workshops and coding in particular.

Who – initiators, supporters and implementers

Christelle Scharff of Pace University in New York, USA, is the co-founder of mJangale, a social start-up.

Why – the problem addressed

mJangale's goal is to reduce social inequalities.

How – AI for, as and in education

mJangale offers a variety of workshops introducing Python, JavaScript, robot and drone programming, connected objects, mobile app and web development, and data science. There is also a programme to create and code fashion tech.

Robot programming was introduced in the context of AI and augmented by discussions on the impact of AI on society. A new curriculum focusing on AI will be rolled out soon, providing exposure to different concepts and common applications of AI such as pattern and voice recognition, computer vision, and natural language processing. The curriculum will provide a space for discussion of AI and ethics.

Results – successes and challenges

More than 1,000 children to date, 55 per cent of whom are girls, have been trained in 5 cities in Senegal. The results of mJangale have been published at academic and professional conferences, including USAID mobile education and UNESCO Mobile Learning Week conferences.

Insights – practical and theoretical issues raised

The teaching and learning methodologies focus on short lectures, hands-on coding sessions, projects, design-thinking activities, teamwork, oral presentations and talks from guest speakers. mJangale emphasizes data collection for monitoring and evaluation, collaboration with education and tech experts, creation of a network of tutors, and involvement of parents in their children's learning.

Strength

The delivery model emphasizes data collection for monitoring and evaluation and uses a variety of methodologies and activities to embed the programme into the community in an after-school setting, including teamwork, guest speakers, collaboration with experts, a tutor network and parental involvement.

Link(s)

<http://mjangale.com>

3.12 THE IMPACT OF AI ON OCCUPATIONS: IS THERE A PLACE FOR INTERMEDIATE-LEVEL OCCUPATIONS?

JET Education Services, UNEVOC

Geographical reach	Global	International
Results and impact	This is a research initiative with results pending	Not available
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus

What – a description of the initiative

Research underway by a joint JET/UNEVOC team examines the ways AI is slated to continue changing economies and labour markets, and specifically how intermediate-level work will be further affected. The analysis includes case study reviews of intermediate-level skills and related jobs in the AI sector itself as well as in the greening, marketing and digital sectors.

Who – initiators, supporters and implementers

JET Education Services in collaboration with UNEVOC.

Why – the problem addressed

The initiative aims to investigate the question of how AI will impact intermediate-level skills.

How – AI for, as and in education

Tacit object modelling (TOM) provides an example of a practical way in which intermediate-level skills could be replaced by AI.

Results – successes and challenges

Research is underway. TOM has been applied in other sectors with success.

Insights – practical and theoretical issues raised

It is argued that the hollowing-out thesis is multidimensional in nature and should be interpreted in a much more nuanced manner than is prevalent in the current overly hyped and weakly researched discourse on AI in education.

Strength

The initiative explores emerging potential for averting the negative social impact that the development of AI will have on employment patterns and suggests strategies for achieving this.

Link(s)

<https://www.jet.org.za>
<https://www.merlynn.co.za>

3.13 USING A MOBILE APPLICATION AND TANGIBLE TOKENS TO INTRODUCE RURAL LEARNERS TO CODING

Nelson Mandela University

Geographical reach	South Africa	National
Results and impact	Not available	Not available
Primary focus area	Promoting skills development for jobs and life in the AI era	Strong focus
Secondary focus area(s)	Ensuring inclusive and equitable use of AI in education	Somewhat

What – a description of the initiative

A mobile app-based strategy for introducing children in resource-poor contexts to concepts of coding and image recognition.

Who – initiators, supporters and implementers

Jean Greyling of Nelson Mandela University in South Africa.

Why – the problem addressed

Software development is a scarce skill in South Africa, as in many other countries. In developing countries, this challenge is worsened by the fact that large numbers of schools and learners have very little access to computers, or none at all. Learners in these contexts are unaware of career opportunities in the field of software development and so never choose this as a career path.

How – AI for, as and in education

A mobile app, developed by a computer science student at Nelson Mandela University in South Africa, makes use of tangible paper tokens and image recognition to introduce children to programming concepts such as the basic Turtle graphics commands, loops and 'if' statements. The app has thirty-five levels of increasing complexity, which introduces a strong gaming aspect to the app. The strength of the initiative is its capacity

to introduce children to actual executable coding in contexts with no access to computers. Combining this with gamification and the tangible aspect of the code, which encourages enthusiastic group work, provides a means of introducing children to these concepts in a resource-poor context, laying the groundwork for skills development for the AI era.

Results – successes and challenges

In 2018, workshops reached 2,300 learners, mainly in poor township and rural schools. Without exception, the workshops were received very well, with considerable energy and enthusiasm. The final round of a national championship gathered 100 learners from 5 provinces together in Johannesburg. The contest was won by a sixth-grade girl from rural Eastern Cape, one of the poorest provinces in the country.

Strength

The initiative tackles the introduction of programming concepts to children within a gaming framework, in contexts with no access to computers.

Links(s)

None



Section summary and key takeaways

Given the extent of the labour market transformation that is already taking place, there is a need both to respond to current changes and to anticipate the skills needed for future work environments. A shift from the view of education as a time-bound and localized event to that of an ongoing process of lifelong learning has accelerated with shifts in labour markets. The question of skills development for jobs and life in the AI era is one not only of initial education but also of continuous upskilling and reskilling. This trend invites yet more AI-driven innovation into the education space, with opportunities and innovations arising in systemic, personal and career skills mapping, career guidance, professional development, and of course AI education itself.

The initiatives included in this section illustrate how digital skills development and AI strategies can be employed for a diverse range of purposes for work and life. Among other services, the skills mapping projects offer assistance and educational guidance to work seekers, while providing information on labour market trends and guidance to education institutions interested

in keeping pace with industrial developments. AI advancements are reported that allow for personal health monitoring as well as specific skills acquisition and work readiness.

As in the previous sections, the initiatives in this section illustrate the value of collaboration, cooperation and partnership, in order to target technological expertise in areas of specific need and to combine complementary areas of expertise in ways that offer effective opportunities for development. Evidence is also provided of the value of human-machine partnerships.

Some of the examples given focus on educators and schools. Among these examples, the question of human consideration is again raised. Consideration must be given to whether it is appropriate to use an AI strategy in a specific instance, what the implications might be, and which ethical questions should be examined.

Again, as in other sections, the nature of the delivery model impacts the nature and achievements of the initiatives.

Overview and concluding comments

As the variety of initiatives attest, a wide range of AI offerings for, as and in education are being implemented with a variety of purposes, beneficiaries and education contexts. The potential of AI is being realized in all sectors, including the education sector, which is unique in that it must grapple with establishing the adaptability necessary to integrate new forms of technology while simultaneously training individuals to respond to a swiftly shifting labour market. As a result, education systems must identify and respond to new skills challenges and act to upskill teachers as well as learners not only in technological areas such as ICT and AI but also in other projected areas of demand such as creativity, empathy, resilience, creative problem-solving and entrepreneurship.

At the same time, conversations around ethical and equitable research and development as well as implementation of AI continue, with issues of transparency, privacy, bias and inclusion, and governance at the forefront of discussions.

One of the fundamental challenges needing to be addressed, which is tackled by some of the initiatives reported, revolves around simple access to technology. Currently half of the world's population is not able to access the internet due to a combination of factors, including network coverage, access to hardware and/or software, and circumstantial factors such as culture, gender and socio-economic status. Although national and international initiatives are being undertaken to increase access to hardware and software, both in homes and at schools and public institutions such as libraries, and offline solutions are being explored and utilized at some scale, the goal of equitable access to technology is still far in the future, and exclusion based on cultural and socio-economic factors may be more difficult to address.

Considerable effort must be expended to ensure women, girls and other marginalized groups have the access and support necessary to attain digital literacy and enter technology fields, particularly because exclusion from the world of AI is multifaceted. In addition to the importance of skill acquisition for labour market participation, the exclusion of certain types of individuals from large data sets used to train AI has implications for the AI products themselves. Examples of such implications include lower accuracy rates of facial recognition software for Africans, and dialect, accent and gender biases in voice recognition software⁶. Historical prejudice can also be amplified by AI when its development is based on historical data sets. These considerations must be taken into account in any discussion around the use of big data.

At the national and international levels, governments must develop policies that enable their countries to take advantage of AI's projected productivity gains and associated growth in gross domestic product, while simultaneously mitigating risks such as inequitable access to data and AI technology, fair and transparent creation and use of AI, and national and personal security. In order to create enabling environments for AI development and use, governments are embarking on a number of initiatives, including research; the development of new partnerships with academia, industry and civil society; investments in infrastructure and initial training as well as upskilling; reform of education curricula; and the revision of policies. Governments and international bodies such as UNESCO have also initiated work around the development of ethical frameworks for the development and use of AI⁷.

MLW 2019 provided an opportunity for discussions to further develop, with over 1,500 participants from 140 countries, including policy-makers, practitioners, academics, educators, private companies and third-sector organizations. The prominent role UNESCO has

6 UNESCO, EQUALS Skills Coalition, 2019. *I'd blush if I could: closing gender divides in digital skills through education*. <https://unesdoc.unesco.org/ark:/48223/pf0000367416>

7 <https://en.unesco.org/artificial-intelligence>

had in bringing stakeholders together to make positive contributions in the education and development spaces and in researching and disseminating knowledge – as well the Organization’s potential future role in developing an overarching framework of ethical principles and/or recommendations for the ethical use of data and AI – were acknowledged at the conference.

In the meantime, academics, industry and third-sector organizations are actively pursuing the development of AI in order to solve challenges related to education, skills and work, by attempting to remove persistent barriers to education experienced by minority and vulnerable groups; providing equitable learning opportunities; using AI to improve teaching, learning and school administration; expanding and re-evaluating curricula to include new and emerging skill sets; and reaffirming and demonstrating commitment to the transparent and ethical use of AI.

Initiatives in most of these areas are already underway. MLW 2019 participants demonstrated and discussed large-scale initiatives to support developing countries with: access to and development of AI technologies for education; hardware and proven AI solutions for vulnerable populations from refugees, girls and women to persons with disabilities; research and projects attempting to define cognition, new skills, human-machine collective intelligence and the changing role of teachers; new and advanced learner management systems, education planning systems and personalized and optimal learning programmes leveraging AI; programmes both in industry and in academia that respond to AI skills needs; AI literacy initiatives for

use by teachers, policy-makers and development practitioners and in everyday life; and projects that explore the transparent and auditable use of education and personal data, including user-controlled decentralized data technologies.

These initiatives take the form of gamification of traditional subjects, challenge-driven education programmes, chatbots, education management information systems, learner management systems and learning platforms, and they include technologies such as satellite imagery and geographic information systems, natural language processing, wearable technology, predictive modelling and augmented reality. Significantly, they also include the traditional relationships of education – between teachers, learners and peers.

There is no doubt that AI is transforming the way we live, work and learn. Equally certain is the fact that the human element remains an important component of the way we think about education. It is clear that further research is needed, and evidence-based best practices must be developed. As a contribution to this effort, MLW 2019 and this compendium provide an opportunity to better understand the breadth and depth of promising education initiatives already in use around the globe, as well as the conversations that underpin the strategic guidance of AI and its contribution to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

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UNESCO
7, place de Fontenoy
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