

Exploring the use of Artificial Intelligence to support teachers and teacher development

*Discussion report from the International Task Force
on Teachers for Education 2030's Mobile Learning
Week 2019 Strategy Lab*

2019



Foreword

Adopted in 2015, the Sustainable Development Goals (SDGs) recognized the crucial role of education as essential to the success of all. The dedicated goal on education (SDG 4) aims to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”.

The SDG4-Education 2030 Framework for Action highlights teachers as the key to achieving quality, equitable and inclusive education for all by 2030. As such, the SDG 4 target on teachers (target 4.c) states that, by 2030, we need to “substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and Small Island developing States”.

Indeed, according to the UNESCO Institute for Statistics (UIS), the world will be facing an acute shortage of qualified teachers. 69 million teachers must be recruited to achieve universal primary and secondary education by 2030: 24.4 million primary school teachers and 44.4 million secondary school teachers. The greatest teacher shortages are in sub-Saharan Africa, with more than 70% of countries facing shortages of primary school teachers and up to 90% of countries for secondary education.

Created in 2008, upon agreement in the Oslo Declaration, the International Task Force on Teachers for Education 2030 (also called The Teachers Task Force) is a global and independent alliance. Members are national governments, intergovernmental organizations, non-governmental organizations, international development agencies, civil society organizations, private sector organizations and UN agencies that work together to promote teacher-related issues as well as to address the ‘teacher gap’, and implement and monitor target 4.c to achieve Education 2030 targets and commitments.

Edem Adubra

Head of the Secretariat, International Task Force on Teachers for Education 2030

Significance of this Document

Sustainable Development Goal 4.c urges the global community to substantially increase the supply of qualified teachers in developing countries through teacher training. Meeting this goal requires overcoming a number of significant challenges, including the need to train almost 69 million new teachers in areas where existing teacher training infrastructure is currently overextended and underfunded. As an emerging technology, Artificial Intelligence has already proven to be beneficial to other industries as varied as Healthcare, Manufacturing, and Agriculture by providing greater personalization to users, automating processes, and examining large data sets to suggest continuous improvements to work products. This raises the question, does Artificial Intelligence have a role to play in the preparation of teachers in meeting SDG 4.c (especially in the least developed countries and small island developing states) and under what circumstances should it be recommended to policymakers?

Abstract

In an effort to better understand the potential role of Artificial Intelligence (AI) in education, UNESCO Mobile Learning Week 2019 was convened to focus on the role of AI and sustainable development. As a part of this flagship event, a diverse gathering of over 40 international experts in teacher education participated in a strategy lab to explore the potential use of AI to support teachers and teacher development.

Four presentations were offered to provide background and context for a structured dialogue among strategy lab participants. The first presentation focused on exploring AI to support teachers and teacher development within the context of United Nations Sustainable Development Goal 4 and the documented need to recruit and train 69 million new teachers by 2030. The second explored the role of AI to support teachers and teacher development and suggested ten probable ways AI will shape and define the educational experience of the future. The third presentation provided participants with an example of how teachers are currently using AI in teaching. The fourth and final presentation explored the ethical and moral uses of AI to support teachers and teacher development.

Following these presentations, participants engaged in a robust discussion with dialogue focusing around four overarching questions. Upon the conclusion of this conversation, participants agreed that more exploration is needed and recommended the commissioning of an international action plan for the appropriate use of AI for teachers and teacher development with a specific focus on the urgent need to achieve SDG 4 and to address the increasing digital divide between high- and low-income countries.

Authors

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Bijay Dhungana MSc, MBA: MSc, MBA: Vice-President - ICEFIL; an education consortium of 26+ European / African Universities and NGOs dedicated to advancing use of technology in education for teacher training (and which includes appropriate use of AI). He has 20+ years of experience helping education institutions achieve/ implement their digital transformation journey across EMEA and emerging markets of Asia and Africa. Bijay Dhungana is co-coordinator of the Teacher Task Force working groups on 'Education in Emergencies' and 'ICT and Distant Learning'.

Nicky Mohan: Dr. Nicky Mohan is a global citizen by choice. Born and raised in South Africa, she now shares her time between New Zealand and Canada. Nicky has been a classroom teacher, a school administrator, university leader, an instructional designer, a business sector manager, a co-operate trainer, and an international speaker. Dr. Mohan then worked as the Director of Curriculum for the 21st Century Fluency Group (Canada). She is currently the Managing Partner of the InfoSavvy Group (Canada) and Director and co-founder of SpringBoard21 (USA), international educational consulting firms. Nicky has co-written four books including the award-winning *Reinventing Learning for the Always-on Generation*.

George Saltsman: Dr. George Saltsman is an Associate Research Professor in Education Leadership and the Director of the Center for Educational Innovation and Digital Learning at Lamar University (USA). Dr. Saltsman served as a contributor to the the UNESCO Policy Guidelines for Mobile Learning, is the co-author of *An Administrators Guide to Online Education* and author of multiple other works focused on the integration of tech-

nology in education. Dr. Saltsman has delivered over 250 presentations on technology integration and had served as a consultant to numerous ministries of education, NGOs, and corporations during his academic career.

Stan van Ginke: Dr. Stan van Ginke is a lecturer, researcher and founder of the VR-Lab at the Archimedes Institute of the University of Applied Sciences Utrecht in The Netherlands. Previously, he worked as a consultant and teacher educator at the Utrecht University and Wageningen University & Research Centre. His research focuses on the effective design of virtual learning environments aimed to foster students' oral presentation competence in higher education. Findings from these studies, published in top-journals as *Educational Research Review* and *Computers & Education*, are used to optimize personalized, comprehensive learning environments in virtual reality. Further, these environments are being integrated, both nationally and internationally, within primary, secondary and higher education and beyond.

Proceedings

Mobile Learning Week 2019 was convened from 4 to 8 March to focus on Artificial Intelligence (AI) and sustainable development. During this event, a diverse gathering of over 40 international experts in teacher education from each of the UNESCO regional groups participated in a strategy lab to more narrowly focus on the topic of Artificial Intelligence in teacher development. Proceedings of presentations, a summary of discussions, and suggestions for future research and policy consideration are provided.

Presentation 1: Exploring AI to support teachers and teacher development

Ines Da Silva

International Task Force on Teachers for Education 2030
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The International Task Force on Teachers for Education 2030 brings together a variety of perspectives and points of view from partners working together towards one common goal: every learner is taught by a trained and qualified teacher. It aims to raise awareness as well as create and disseminate knowledge on teacher issues. With its thematic working groups, the TTF works to foster research and collaboration as well as share knowledge, ideas and best practices on particular topics. Its thematic group on Information and Communication Technology and distance education for teacher development is tasked with looking at how technology can facilitate and support teachers through all stages of their professional lives.

Why is the Teacher Task Force interested in Artificial Intelligence?

The Teacher Task Force is looking at innovative solutions to achieve its goal. However, the world is currently facing a major hurdle: the “teacher gap”. The teacher gap is a term used to refer to the number of teachers lacking, particularly qualified teachers, to achieve universal primary and secondary education. According to projections made by the UNESCO Institute of Statistics (2016), 69 million teachers need to be recruited in order to achieve universal primary and secondary education by 2030.

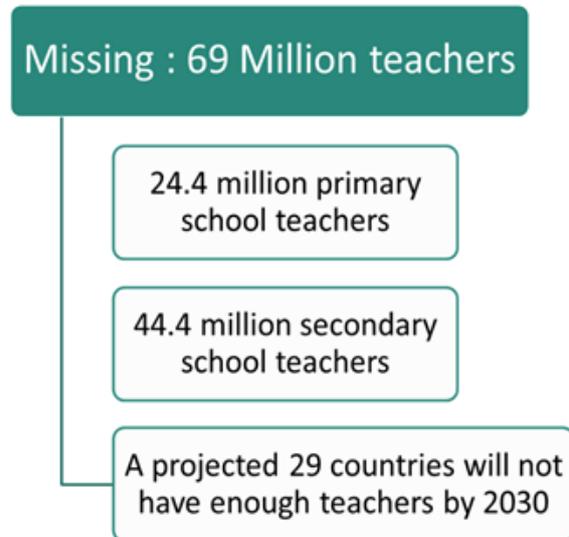


Figure 1 - Quantitative challenges. Source: UIS, 2016 (Elaboration by the authors)

But this gap is not just quantitative, it is also qualitative. Indeed, the current lack of qualified teachers poses the following three challenges.

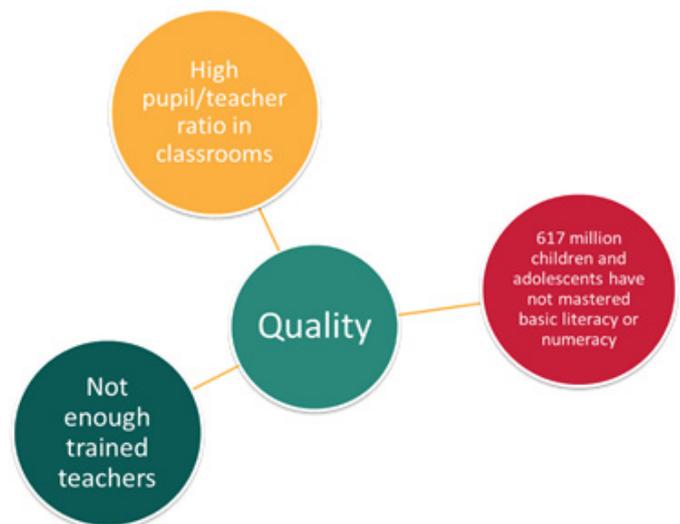


Figure 2 - Qualitative challenges. Source: GEM Report 2019; UIS, 2017 (Elaboration by the authors)

According to the 2018 Global Education Monitoring Report, « Using national definitions, 85% of primary teachers globally were trained in 2017, a decline of 1.5 percentage points since 2013. In addition, the problem is exacerbated in classroom settings. Many countries are still struggling to meet the goal of a 40:1 teacher/pupil ratio. In low-income countries, the teacher/pupil ratio was 53:1 on average in 2017, with the ratio being 60:1 in Sub-Saharan Africa. Finally, 617 million children and adolescents have not mastered basic literacy and numeracy skills.

Artificial Intelligence could be one of the ways to improve the educational system, but we need to look carefully at what kind of programmes and/or projects are being developed and how they are implemented. The debate needs to be centered on the question of AI and teaching. One of the reoccurring questions being looked at is “will AI replace teachers?” We, at the Teacher Task Force, do not believe this is the question to be asked. We define teachers not just as an individual performing routine cognitive tasks such as taking attendance, delivering content, and grading submitted work, but also as someone who can motivate the learner, provide constructive criticism, recognize students interest and provide moral support. Therefore, as such, we do not believe that AI can and will replace teachers. Instead, we want to look at how we can harness the potential AI presents to give teachers the support and tools they need to make a difference.

What is the Teacher Task Force doing to ensure AI solutions are implemented to support and benefit teachers and learners?

Through our thematic working group on ICT and distance education for teacher development, we are mobilising experts to open and lead discussions and possibly extract recommendations to be passed onto policy makers, teacher-training institutions, researchers, etc...

Before putting AI solutions in classrooms, the Teacher Task Force believes some questions should be asked and answered, such as:

- What kind of role can AI play in the critical need for teachers education and training?
- How can AI support existing classroom teachers - especially in large class sizes?
- How should policy ensure AI is used appropriately to support teachers and the teaching profession?
- What are the ethical and moral implications of the use of AI in teacher preparation and teacher support?
- Will AI lead us to rethinking the roles of teachers?

Using AI solutions to support teachers and teacher development means more than just putting tools in the classrooms, it also means looking at the potential impact AI solutions can have on teacher training, teaching standards and teacher policies. It means looking at the context and situation of the education systems in which AI solutions are being introduced to ensure they are in ad equation with their needs.

This Strategy Lab’s objective was to get the discussion started on these issues and guide future reflections on

the topic of Using AI to support teachers and teacher development.

Presentation 2: The Role of AI to Support Teachers and Teacher Development

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Considering the significant challenges to meet the 69 million teacher shortage by the year 2030, the benefit of utilizing Artificial Intelligence to support teachers and teacher development is an attractive option. AI is already being used successfully within several domains in society, and is poised to make significant changes in education. This presentation defines what AI is and also explains what AI is not. Based on the literature ten uses for AI in education are summarized.

What is Artificial Intelligence?

AI is simply a set of technologies for building computer systems that can perform complex analytic tasks independently. Simple examples include everything from speech recognition and decision-making to visual perception. There are a number of narrow-but-useful AI systems in existence, like Siri, Alexa, or Xbox One’s Kinect.

What isn’t Artificial Intelligence?

Machine intelligence has nothing to do with being “alive” or even “conscious.” Modern AI can match or exceed human capabilities in narrow domains (like chess, or answering Jeopardy questions) but lacks the flexibility and generality capacity of the human mind. These systems are not “people” and can only act with close human supervision and direction. They are merely advanced computer systems built to simulate some aspects of human intelligence. AI software is controlled by humans. Modern software is laser-focused on performing a single task – it is not generally creative, and does not act independently outside its domain. As our algorithms become more powerful, perhaps we will begin to see software tools that can operate more independently across a broader and broader range of domains.

The future of AI and education

While we may not see humanoid robots acting as teachers, there are many projects already in the works that use computer intelligence to help students and teachers get more out of the educational experience. Below are ten ways those tools, and those that will follow them, will shape and define the educational experience of the future.

Use 1: AI can automate basic activities in education, like grading. Grading takes up a significant amount of time, time that could be used to interact with students, prepare for class, or work on professional development.

Use 2: Educational software can be adapted to student needs. From kindergarten to graduate school, one of the key ways artificial intelligence will impact education is through the application of greater levels of individualized learning. Some of this is already happening through growing numbers of adaptive learning programs, games, and software. These systems respond to the needs of the student, putting greater emphasis on certain topics, repeating things that students have not mastered, and generally helping students to work at their own pace, whatever that may be. This kind of custom-tailored education could be a machine-assisted solution to helping students at different levels work together in one classroom, with teachers facilitating the learning and offering help and support when needed. Adaptive learning has already had a significant impact on education, especially through programs like Khan Academy, and as AI advances in the coming decades, adaptive programs like these will likely only improve and expand.

Use 3: AI can point out places where courses need to improve. Teachers may not always be aware of gaps in their lectures and educational materials that can leave students confused about certain concepts. AI offers a way to solve that problem. When a large number of students are found to submit the wrong answer to a homework assignment, the system alerts the teacher and gives future students a customized message that offers hints to the correct answer. This type of system helps to fill in the gaps in explanation that can occur in courses and helps to ensure that all students are building the same conceptual foundation. Rather than waiting to hear back from the professor, students get immediate feedback that helps them understand a concept.

Use 4: Students could get additional support from AI tutors. While there are things that human tutors can offer that machines can't, the future could see more students being tutored by instructors that only exist in zeros and ones. Some tutoring programs based on artificial intelligence already exist and can help students through basic mathematics, writing, and other subjects. These programs can teach students fundamentals, but so far are not ideal for helping students learn high-order thinking and creativity, something that real-world teachers are still required to facilitate.

Use 5: AI-driven programs can give students and educators helpful feedback. AI can help teachers and students to craft courses customized to their needs, as well as provide feedback to both about the success of the course as a whole. Some schools, especially those with online offerings, are using AI systems to monitor student

progress and to alert professors when there might be an issue with student performance. These kinds of AI systems allow students to get the support they need and for professors to find areas where they can improve instruction for students who may struggle with the subject matter.

Use 6: AI is altering how we find and interact with information. We rarely even notice the AI systems that affect the information we see and find on a daily basis. Google adapts results to users based on location, Amazon makes recommendations based on previous purchases, Siri adapts to your needs and commands, and nearly all web ads are geared toward your interests and shopping preferences. These kinds of intelligent systems play a big role in how we interact with information in our lives, and could just change how we find and use information in schools.

Use 7: AI could change the role of teachers. There will always be a role for teachers in education, but what that role is and what it entails may change due to new technology in the form of intelligent computing systems. As already discussed, AI can take over tasks like grading, help students improve learning, and may even be a substitute for real-world tutoring. AI could be adapted to many other aspects of teaching. AI systems could be programmed to provide expertise, serving as a place for students to ask questions and find information or could even potentially take the place of teachers for very basic course materials.

In most cases, however, AI will shift the role of the teacher to that of a facilitator. Teachers will supplement AI lessons, assist students who are struggling, and provide human interaction and hands-on experiences for students. In many ways, technology is already driving some of these changes in the classroom, especially in schools that are online or embrace the flipped classroom model.

Use 8: AI can make trial-and-error learning less intimidating. Trial and error is a critical part of learning, but for many students, the idea of failing, or even not knowing the answer, is paralyzing. Some just do not like being put on the spot in front of their peers or authority figures like a teacher. An intelligent computer system, designed to help students to learn, is a much less daunting way to deal with trial and error. AI intelligence could offer students a way to experiment and learn in a relatively judgment-free environment, especially when AI tutors can offer solutions for improvement.

Use 9: Data powered by AI can change how schools find, teach, & support students. Smart data gathering, powered by intelligent computer systems, is already making changes to how colleges interact with prospective and current students. From recruiting to helping students choose the best courses, intelligent computer systems are helping make every part of the college experience

more closely tailored to student needs and goals. Data mining systems are already playing an integral role in today's higher-ed landscape, but artificial intelligence could further alter higher education. Initiatives are already underway at some schools to offer students AI-guided training that can ease the transition between college and high school. Who knows but that the college selection process may end up a lot like Amazon or Netflix, with a system that recommends the best schools and programs for student interests based on their individual abilities.

Use 10: AI may change where students learn, who teaches them, and how they acquire basic skills. While major changes may still be a few decades in the future, the reality is that artificial intelligence has the potential to radically change just about everything we take for granted about education. Using AI systems, software, and support, students can learn from anywhere in the world at any time, and with these kinds of programs taking the place of certain types of classroom instruction, AI will NOT replace teachers but provided support instances for the better. Educational programs powered by AI are already helping students to learn basic skills, but as these programs grow and as developers learn more, they will likely offer students a more extensive range of services.

Presentation 3: An Example of teachers use of AI in teaching

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Presenting is a core competence of the higher educated professional irrespective of domain and country. However, young professionals often fail to acquire public speaking capabilities. Further, presenting is frequently named by individuals as one of their main fears in social contexts. Therefore, a Teacher Education Institution in The Netherlands started, two years ago, a VR-Lab aiming to develop a personalized learning environment in which future teachers can rehearse their presentation performances in front of virtual audiences and receive feedback on presentation delivery aspects provided by the VR-system. The design of the personalized learning environment is based on ongoing scientific research as recently published in the journals *Educational Research Review and Computers & Education*.

This session, that can be considered as a case in which Artificial Intelligence is actively used in teacher education, focused on sharing recent insights, regarding: (a) VR-research and the use of Artificial Intelligence for developing effective learning environments, (b) demonstrating the VR-environment for developing presentation

skills and (c) discussing consequences for teachers' roles in the near future when Artificial Intelligence is increasingly used for preparing teachers for tomorrow.

From researching Artificial Intelligence to establishing a VR-Lab

Previous studies emphasize that feedback is essential for acquiring presentation skills (Bower et al., 2011; Chan, 2011; Van Ginkel et al., 2015). However, it remains unknown whether this competence, consisting of cognition towards presenting, presentation behavior, and attitude towards presenting, can also be encouraged through the use of automated feedback provided by innovative technologies, such as Virtual Reality (VR). An earlier experiment studied the effectiveness of a VR-based presentation task, in which students received feedback after a presentation rehearsal in VR – on eye contact, use of voice, posture and gestures – that was traced by the VR-system and interpreted by a presentation expert (Van Ginkel et al., 2019).

The results showed that students' oral presentation competence increased significantly without a difference in impact between the experimental and control condition consisting of a face-to-face presentation and only expert feedback. In addition, a self-evaluation test revealed that students from the experimental group highly appreciated the analytical and detailed characteristics of the VR-feedback and at the same time shared suggestions regarding the integration of VR in higher education.

The other group, students who presented face-to-face and received feedback from the expert based on observation and interpretation, were also positive about the received feedback because of the positive and constructive elements. This study removed a potential barrier considering the integration of innovative learning environments that are based on Artificial Intelligence, since students developed their presentation behaviors significantly without a difference in impact between a VR- and face-to-face situation.

Moving from a scientific perspective to an educational practice perspective, the authors concluded that virtual learning tools can be interesting for curriculum designers and teachers especially in times when student numbers are rising, while instructional time is under pressure and teacher-student interactions are diminishing (Van Ginkel et al., 2019).

The VR-learning environment for developing presentation skills

Based on the insights of the described VR-study on oral presentation competence, the Teacher Education Institution - Archimedes Institute - facilitated the set-up of a VR-Lab. This Lab can be considered as a team of educational professionals working together with external

partners aiming to develop virtual learning environments fostering students' communication skills.

This initiative can be framed within a broader ambition of the Institution (1) to develop personalized learning environments that directly relate to the learning objectives of individual students instead of constructing education that is solely based on classical instruction, (2) to integrate innovative technologies if effectiveness on the development of students' skills is proven based on high quality research and (3) to prepare teachers for tomorrow in times when required competencies of these educational professionals are rapidly changing due to recent economic, social, educational and technological trends on a global scale.

The first 'educational product' that is produced by the members of the VR-Lab is the VR-app titled 'Presenting with Impact'. Within this environment students can individually follow a personalized learning trajectory focusing on presentation skills irrespective of time and space. The only hardware and software students need is: (1) a smartphone with several requirements, (2) a VR-glass and headset integrated and (3) the VR-app 'Presenting with Impact'.

During their learning trajectories, students can (1) listen to instructions from presentation experts directed to their personal learning objectives, (2) practice presentations in front of differing virtual audiences (see Figure 1) and (3) receive feedback on eye contact, speech rate, speech frequency, speech volume and/or the use of fillers traced by the VR-system during their rehearsals in VR.

Feedback, that is one of the crucial educational design principles within presentation research (Van Ginkel et al., 2019), can be delivered in varying forms, such as: (1) delayed feedback (after a presentation rehearsal), immediate feedback (- based on a limited number of learning objectives - during a presentation) and (3) qualitative feedback messages converted from the quantitative data produced by the VR-system.

The fact that feedback can be provided by the system into qualitative feedback messages means that students can individually interpret the feedback without the intervention of a teacher. Nevertheless, teachers remain essential key actors for guiding students in their learning processes (Van Ginkel et al., 2017a; Van Ginkel et al., 2017b). However, the roles of teachers are potentially changing in new directions with the increasing development and integration of AI and related innovative technologies.



Figure 3 - Presenting in front of a virtual audience in the television studio of 'Presenting with Impact' - © Kees Rutten

Artificial Intelligence: supporting students' learning processes and changing roles of teachers?

The design of the VR-app is based on the ideas of constructive alignment (Biggs, 1996). This means that effective learning environments should incorporate all essential principles regarding (a) instruction, (b) learning activities and (c) formative assessment strategies (Van Ginkel et al., 2015).

The following advantages of integrating such a VR-tool in educational practice can be formulated: (1) the environment relates to personal learning objectives, (2) students can use this tool just-in-time when there is a need to develop their presentation skills (f.e. before providing instructions in classroom situations) and (3) they can individually practice their presentations as many times as they need and also receive feedback by the system during or after every single rehearsal.

Although teachers and teacher educators highly appreciate the integration of this tool in their presentation curricula so far, teachers are increasingly challenged (1) to co-design such virtual learning environments because educational expertise and experience are key for making effective use of VR and AI and (2) to supervise students based on both teachers' observations and evaluations as well as data traced by the AI driven computer system.

However, in order to effectively use AI in education, more research should be devoted to the impact of personalized, comprehensive learning environments fostering students' presentation skills, when students and teachers become more familiar with these kind of technologies. Therefore, more experimental and longitudinal studies should be initiated.

Finally, the following practical implications for adopting AI in education remain: (1) the integration of AI, and VR in particular regarding this case study, means that

teachers, curriculum designers, tutors and students should be trained before entering formative assessment processes and (2) integrating AI means investments in terms of time and financial resources that should directly relate to the strategic policy of primary, secondary and higher education institutions around the globe.

Presentation 4: Ethical and Moral Considerations of AI to Support Teachers and Teacher Development

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AI has tremendous potential to assist education. Standardized online testing, for example, has generated enormous data where the benefits of AI in data analytics could provide great value. Neural networks appear to be ideally positioned to help educators gain insight into how learning is taking place in our classrooms. Informal learning networks such as Khan Academy have already applied machine learning to track student mastery with notable success (Hu, 2011) including the training of teachers (Khan Academy, 2019). We no longer face the question of can we use AI in education, but should we... and if so, under what circumstances?

Futurist Andrew Maynard (2018) once observed that “with great technological power comes great responsibility” and this is certainly true for AI overall and especially for AI in education. Numerous experts such as Oxford’s Nick Bostrom (2003), University of California, Berkley’s Stuart Russell (2017), and even scientists as notorious as Stephen Hawkins (2017) has raised legitimate concerns about the use – or misuse – of AI. Elon Musk, a technologist and who famously employs AI to develop self-driving vehicles and self-landing rockets called AI humanity’s “biggest existential threat” and even suggested it poses more threat to humanity than nuclear weapons (Preliasco, 2018). This dichotomy of risk vs. reward should, at a minimum, inspire education policy makers to examine appropriate policy to balance the potential benefit of AI in education and against the risks of potential for misuse.

Examining the ethical and moral considerations of AI to support teachers and teacher development requires a basic understanding of how AI is currently being used in education, is likely to be used in the future, and the potential misuses along the way. By building on preceding presentations this section further explores AI’s potential for algorithmic bias, the emerging role of the teacher in the world of AI, and concludes with an overview of questions with which policy makers must begin to address.

Algorithmic Bias

By definition, algorithmic bias occurs when a computer system’s behavior reflects the implicit values of its human designers. Bias may emerge due to the design of the algorithm itself, unintended or unanticipated use, or by the way data is coded, collected, or used when training the algorithm. Any bias that exists in the process effectively creates a feedback loop which inherently magnifies the bias over time – often to the point of eroding human trust in the validity of the system as a whole (IBM, 2019). A number of authors such as Cathy O’Neil (2017) examine the use of algorithms in decision making and provide specific examples in education. Books such as O’Neil’s *Weapons of Math Destruction* are recommended reading for policy-makers as they provide valuable insight in the use and misuse of AI today and what we as educators should do to ensure AI is used appropriately in teaching and teacher training.

Algorithmic bias is not a hypothetical concept. Recent examples of algorithmic bias being exposed in AI systems have unintentionally garnered widespread and adverse notoriety for their creators. The outcome of Google Photos image recognition feature misidentifying dark-skinned individuals as gorillas (BBC, 2015) or the way Microsoft’s Tay quickly devolved into shouting racist and xenophobic epithets in less than a day of operation (Lee, 2016) proved deeply embarrassing lessons in how algorithmic bias is difficult to predict.

While these examples are shocking in their own way, there are far more threatening misuses of algorithmic bias currently in practice. The authors of a 2016 Pro-Publica study concluded that the data within AI system used by judges in the United States to determine if a convicted criminal were likely to reoffend appeared biased against racial minorities (Angwin, Larson, Mattu & Kirchner, 2016). Similarly, an AI technology currently used by US police to predict where future crimes are most likely to occur is also corrupted by data which unintentionally reflects previous decades of racial profiling and selective patrolling of minority neighborhoods (ACLU, 2016). In both cases, reality on the ground stands in contrast to the predictions provided by the AI systems and their biased data sets. Yet, given the likely event that authorities in positions of power will continue to rely on these systems to help make decisions, ethnic minorities are more likely to be arrested and once arrested, more likely to serve longer sentences, and thus an inaccurate perception that crime in the United States is mostly perpetrated by ethnic minorities is further reinforced regardless of actuality.

Examples of bias within current education-focused AI systems is also problematic – especially for historically underrepresented populations in educational systems. When data from previous exam takers is used in AI systems, the likelihood of past bias being echoed, or even magnified, is high. For example, minority groups

who have historically been underrepresented due to systemic discrimination will also find themselves underrepresented in the datasets training AI. This is especially troubling when biased data is used to determine acceptance into educational programs or job placements. A specific example of under representation of Guamanian test takers being penalized by a predictive algorithm (Walker, 2108) was provided as evidence during the presentation.

The moral imperative to protect students, teachers, and education records continues to apply in an AI world just as it does in the physical one. Mindfulness in the selection of data fed into educational AI systems, and enlightened use of the outputs from AI systems goes a long way toward minimizing potential risks in the use of AI in education. However, policy makers must also be aware that AI system are susceptible to intentional manipulation by hostile actors both internal and external. Investments in AI must also be met with parallel investments in cyber security in order to protect the integratory of our educational systems and the people who exist within them.

Care must also be taken that policy makers themselves do not breach standards of ethical conduct in the use of AI in education. Data collected for one use can be serendipitously misused for other non-stated uses and that ultimately erodes the trust among educational stakeholders. This is especially true if AI is used to automate the selection of, advancement of, or the dismissal of teachers. Already, examples exist where data collected under the guise of improving student performance was fed into AI systems and used for rating the effectiveness of teachers instead. To build trust in the use of AI in education, policy makers and teacher organizations will need to work together to establish the bounds of ethical conduct and consider what role, if any, AI will play in teacher evaluation.

The emerging role of the teacher in a the world of AI

In many industries, AI already has or will soon replace the human worker. In 2013, researchers identified 12 occupations out of 700 with a 99 percent chance of being automated out of existence in the near future (Frey & Osborne, 2013). The report further concluded that 47% of the remaining occupations could be replaced by computer automation “over the next decade or two”. Now five years later, many of those at-risk positions are already gone (Winick, 2018). Will this trend extend to teachers?

Most educators would likely agree that an automated assistant would not be a suitable replacement for a human teacher, yet each year we see the introduction of more and more sophisticated AI tools designed for direct student interaction. Ideally, teachers are seen as far more than the delivery agents of routine and repetitive information. Teachers are individuals who also nurture and inspire students. They provide motivation and

discipline in appropriate measures to help each student reach his or her full potential. Famous science fiction author Arthur C. Clarke once noted “any teacher who can be replaced by a machine should be” (Matias, 2012) implying that if all a teacher did was what could be done by a machine, they were unworthy of being a teacher at all. This begs the question, what exactly is the role of the teacher in a world of AI?

Examining the potential impact of emerging technologies is notoriously hard to do – especially for those of us who are charged with the task of managing existing organizational systems. Being caretakers of the prevailing paradigm, it is difficult for us to see how an emerging technology might alter what we are empowered to protect -- not because we can't see it, but because we are too personally invested in keeping that paradigm (and our power base) viable. However, in hindsight, it is possible to see how the currently prevailing technologies of our generation rendered the paradigms of our predecessors irrelevant. And with that insight, we gain perspective to extrapolate as a lens beyond our current context.

AI isn't the first technology suggested as an eventual replacement for teachers. Early promoters of the motion picture also foresaw a proximate future where students would receive their instruction by machine. Thomas Edison (1913) suggested:

Books, will soon be obsolete in the public schools. Scholars will be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed inside of ten years.

What Edison didn't foresee was the important role teachers play in student motivation. Edison missed that teachers are more than the unidirectional delivery of information, but part of a structured and interactive learning experience. This is not to say video or AI can't educational. But we need to recognize that each medium carries inherent strengths and weaknesses. It takes a skillful teacher to understand how to best use that medium as a tool for learning.

The greatest influence of AI in education may come from outside the classroom. Just as we must acknowledge how the motion picture (and television and now streaming video) altered our culture, so will AI. Some researchers suggest the current consumption of video may even be physical alternating the very biology of our brains (Crone & Konijn, 2018). While we may not yet be able to fully see the cascading consequences of AI in society (or human biology), we should nevertheless endeavor to prepare our educational systems for this likely systemic shift likely to soon occur.

Questions with no easy answers

Should AI deliver routine instructional tasks with students to free up a teacher's time for more one-on-one interactions? Perhaps AI should only be used with teachers and never directly with students? What are the moral obligations for putting AI in the classroom and what policy directives should help guide these decisions? At this moment in time, there are still a number of unanswered questions on the use of AI in education that still need to be addressed.

Perhaps the greatest moral questions are related to the use of AI with our most vulnerable populations (refugees, high-poverty, under-privileged, special need, etc.) as they most often lack access to qualified teachers. Are we as a society willing to delegate entire segments of our population to learn only from a machine? Or do we to restrict access altogether but continue to leave these populations without any access to education at all?

The use of AI in education also raises additional moral questions regarding the digital divide. Will AI increase that divide as connected countries accelerate away faster or will AI help close that gap? Are we willing to suggest that one set of students get to learn with human mentors and another set learn only what an algorithm can teach them?

AI offers the tremendous power to assist in SDG 4 and education more broadly, but with that power comes responsibility. We must work together with education policy makers, teacher organizations, parents, and society as a whole to harness emerging technologies like AI to support teachers and teacher development. Only by working together will we identify a set of ethical and moral standards that will provide a path for an inclusive, equitable, and quality educational opportunities for all.

Strategy Lab Discussion

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Strategy Labs, as part of UNESCO’s Mobile Learning Week since 2018, were created to help guide the conceptualization and refinement of projects, defining frameworks, assessing digital skills across groups and across time, and anticipating the changing needs for digital skills. They are participatory sessions during which the audience is invited to provide inputs and contributions. Their attendance is open to registered Mobile Learning Week participants. Invited experts may also be included to help enrich the discussion.

In consideration of the Education 2030 targets regarding the challenges of the global teacher shortage, a strategy lab was facilitated during UNESCO Mobile Learning Week 2019 to solicit inputs from a diverse range of education leaders on the topic of artificial intelligence to support teachers and teacher development. During this event, over 40 international experts in teacher education representing each of the UNESCO regional groups participated in a robust discussion of observations from the four presentations and how AI might be used as a catalyst to address these challenges. Participants were further encouraged to frame the inputs into the strategy lab under four overarching questions:

- Q1: Considering the stated need for 69 million new teachers by 2030, what role should AI play in teacher preparation?
- Q2: Considering that our most vulnerable populations (refugees, high-poverty, under-privileged, special need, etc.) are often those who lack qualified teachers, can AI play a role and how?
- Q3: Considering that the populations above are often the most digitally disconnected, what strategies can we use in teaching and learning to address the disparity in the digital-divide?
- Q4: Considering that AI can harbor biases and is susceptible to inappropriate use, what safeguards should be adopted by policy makers to protect and empower teachers?

The facilitation of the strategy lab discussion prompted broad participation through the use of an experienced moderator who encouraged those who were initially more reluctant to engage and to help advance the conversation once a topic was covered in sufficient depth. The conversation that ensued was robust with emphatic audience encouragements offered when a statement resonated within those in attendance. Nevertheless, because

the discussion was conducted in English and without simultaneous translation available, contributions from less fluent English speakers may be underrepresented or absent.

Reflecting on a recurring theme within the formal presentations, participants widely acknowledged that AI will be best used, and perhaps should only be used, to support teachers and teacher development and not used as a replacement for teachers. One specific use of AI that was recommended by numerous participants (Canada, Kenya, Netherlands, NGO, UAE, & UNESCO) was to free up teacher’s time from “back-office tasks” and to “lighten the load... on administrative matters” so more of their time can be focused on the “human element of students in schools” such as coaching and mentoring support to their students. Echoing this sentiment, a participant from Kenya reflected on the need to make “more time available for teachers to address students, especially students who are highly fragile, mobile and isolated in remote parts of the country”. Another participant from Canada emphasized that as of today, “there is an urgent need to define specific AI support roles and activities in helping teachers” and yet, these support roles remain still largely undefined.

Perhaps a teacher support activity that could be most effective would be to “use AI to help teachers address the high dropout rates of students in their classrooms” (UAE) or “to help teachers and students help each other” as they work toward common educational goals (UAE). A participant from Kenya also suggested that AI might be used to help administrators more effectively support teachers and to guide them in finding the roles where they might be most effective. A participant from Switzerland observed that while AI may indeed be a powerful tool for teacher empowerment, we should be cautious in its application as “teachers are very afraid AI may be seen as way to reduce costs of education and hence it puts teachers career at risk” and that policy must protect as well as empower teachers.

The need for formal policy addressing inappropriate uses of AI against of teachers was suggested by another NGO participant and was underscored by a participant from the USA who urged the Teacher Task Force and other teacher-focused organizations such as the International Labour Organization to begin a dialogue around appropriate use of AI in monitoring of teachers and teaching activities. A participant from South Africa suggested that the “first step to address such challenges is through the ‘mobility protocol’ to set some standards locally and internationally” as well as an NGO participant who recommended the introduction of “transparent and respected ethical education standards and policies to govern how AI is used within national and international education communities”. If the desire of educational leadership is for AI “to support teachers [...] we need to have transparent protocols on its use for teachers and

the impact it will have on their students” affirmed a participant from the UAE.

In the use of AI by teachers, participants recommended numerous curricular approaches. The most recommended use of AI was to facilitate peer-to-peer learning” or “personalized learning” (Finland, Kenya, NGO, UAE). An NGO participant extended the curricular use beyond the traditional student population by suggesting using AI “to support lifelong learning for vulnerable people seeking to find a career pathway and using technology to help students understand their strengths and weakness to help them devise a subsequent personalized learning path individually”. Echoing the career pathway approach, participants recognized the potential of AI for teacher education programs and professional learning for teachers where it may better “inform teachers on change in curriculum changes and facilitate peer-to-peer learning online to promote teacher education and support” (Kenya). A participant from the Netherlands suggested using AI as a tool to “make teacher education fun for that is what promotes effective learning”.

Participants also expressed concern regarding the existing digital divide, especially that a “lack of basic technology will have more severe impact on the poor and which will accelerate the ‘North – South’ digital divide” (South Africa) and that we must first “address computer literacy deficiencies currently prevalent among teachers” (South Africa). As observed by another participant (NGO), there are already numerous education-changing technologies such as “wireless audio” that “cannot be used where it is most needed due to lack of local capability and infrastructure deficiencies”. Another participant from South Africa suggested that before investing heavily in AI, governments must “start with the basics and the first step of an AI journey is to invest in the hardware and infrastructure deficiency in most schools within developing countries”. Similarly, an NGO participant from Israel commented on the difficulty for teachers to utilize AI for educational gains when teachers in many countries lack even access to basic desktops or laptops. Focusing on a more human element of the digital divide, a participant from UNESCO noted that we need to ensure that a disproportionate use of AI does not unintentionally disconnect teachers from their peers globally.

The international education community must also quickly educate itself about AI and the potential use or misuse of AI. Indeed, “with the increasing role of AI, we also need to focus on algorithmic literacy to address ethics and digital biases in education” (NGO). This community has a responsibility “to help educate groups who are highly fragile” (Kenya) and to potentially use AI to address populations who experience “high drop-out rates due to lack of quality” (Lebanon). The Lebanese participant continued by remarking on the urgent need for AI to address the growing teacher shortage for Syrian refugees but also how the international community is

currently “focusing on access at expense of quality with Syrian refugees” and we must not let this extend to other at-risk populations. Addressing appropriate use of AI requires the international education community be ready and able to recommend well-informed policy and we’re not able to recommend those yet (USA).

Participants also acknowledged that as of 2019, AI is still a new technology and one that is especially nascent in the field of teaching and teacher training. A NGO participant reminded the group that “introducing AI and bringing change to the teaching profession will take time”. Nevertheless, another NGO participant recommended that to meet SDG 4 goals “we need to bring private sector involvement in addressing this dual challenge: quality and quantitative shortage of teachers”. A participant from the UAE similarly observed that “we need to show some immediate and practical benefits from AI for teachers”.

Numerous participants overall and specifically participants from Nigeria and Lebanon observed that a significant challenge in meeting SDG 4 targets is not something that can be addressed by AI at all, but it directly related to the recognition of teachers and the teaching profession in the countries where teachers are needed the most. Unlike highly developed countries such as Finland, where “teaching is in the top three careers in job satisfaction, is well-paid, with good holidays and valued in community (Finland)” many teachers in the least developed countries and small island developing states must first “address shortage of teachers by making the teaching profession desirable (NGO)”. Furthermore, there is significant concern that even in developed countries, the “introduction of AI may diminish the value of teachers that has taken years to develop (USA)”. Indeed, the recognition of the status of teachers is a concern acknowledged since the founding of the Teachers Task Force and is specifically addressed as a primary goal that must be achieved to realize the Education 2030 targets. A participant from the TTF Secretariat suggested a review of the [nine dimensions](#) when addressing roles of teachers. Finally, as stated so eloquently by NGO participant, “we must empower teachers to change or influence the minds of decision-makers about the roles of teachers” with the use of AI and in all aspects of the teaching profession.

Conclusion

Given the number of teachers urgently needed to achieve SDG 4 and the increasing digital divide between high- and low-income countries, the creation/development of an international action plan for the appropriate use of AI for teachers and teacher development was suggested. Following the contributions from strategy lab participants, this plan would ideally focus on AI's use in supporting teachers and empowering them to improve their practice. This plan should focus on training and educating teachers regarding the use of AI, providing adequate infrastructure and technology, and a policy framework for the use of AI in teaching and teacher training. To succeed, this plan requires the cooperation and investment of the global education community (e.g. governments, private sector, teacher organizations and civil society organizations).

To match the scale of the challenge, such a plan should recommend strategies and guidelines within a framework of ethical and moral considerations that:

- Define appropriate and mutually agreed upon uses of AI to support teachers and teacher development;
- Explore immediate and practical benefits as well as long-range and theoretical benefits of AI to support teachers and teacher development;
- Provide a roadmap for building and sustaining the required physical and digital infrastructure (i.e. hardware, software, databases, internet, etc.) with special attention on closing existing digital divides;
- Recommend programmes to build capacity and raise awareness within policymakers and educators at all-levels on the use of AI to support teachers and teacher development.

To achieve this plan, the Teacher Task Force and other international organizations as appropriate should explore a coordinated and collaborative funding model

1. for future research and consideration of pilots and programmes,
2. to demonstrate the immediate and practical benefits,
3. to conduct training for policymakers and educators at all-levels in the use of AI to support teachers and teacher development.

Such a plan would serve as a foundation for calls for future research, identification of emerging best practice and a catalyst for the creation of policy guidelines. It was the strong recommendation of this strategy lab that such a plan be commissioned.

While this plan is important, it alone cannot be enough. Upon the conclusion of this strategy lab, a number of important questions still exist, such as the role of AI and the critical need for teacher preparation, whether AI will close or widen existing digital divides, what implications for policy and policymakers will emerge, how AI should be used appropriately, and how to transition educational systems to take advantage of AI. As such, the participants of this strategy lab encourage the broader global education community to continue to raise awareness on and participate in exploring the use of AI to support teacher and teacher development.

The presentations and discussions during the strategy lab highlighted potential benefits and challenges of using AI for education. Considering the significant need to educate 69 million new teachers globally by 2030, new and novel approaches are needed. AI is clearly a promising tool to help us meet this significant challenge; however future research and exploration of this topic is required. The participants of this strategy lab strongly encourage the global education community to in this important endeavour.

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The International Task Force on Teachers for Education 2030 (also known as Teacher Task Force) is a global and independent alliance. Members are national governments, intergovernmental organizations, non-governmental organizations, international development agencies, civil society organizations, private sector organizations and UN agencies that work together to promote teacher-related issues.

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