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Opportunities and drawbacks of using artificial intelligence for training

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Opportunities and Drawbacks of Using Artificial Intelligence for Training

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Abstract

Technological developments are one of the major forces behind the need for retraining, but they can also be part of the solution. In particular, Artificial Intelligence (AI) has the potential to increase training participation, including among currently underrepresented groups, by lowering some of the barriers to training that people experience and by increasing motivation to train. Moreover, certain AI solutions for training may improve the alignment of training to labour market needs, and reduce bias and discrimination in the workplace. In order to realise the benefits of AI for training and ensure that it yields benefits for all, it will be necessary to address potential drawbacks in terms of changing skills requirements, inequalities in access to data, technology and infrastructure and important ethical issues. Finally, even when these drawbacks can be addressed, the introduction and expansion of AI tools for training is constrained by the supply of AI skills in the workforce and the availability of scientific evidence regarding the benefits of AI tools for training and whether they are cost-effective.

Synthèse

Les développements technologiques sont l'une des principales forces à l'origine du besoin de reconversion professionnelle, mais ils peuvent également faire partie de la solution. En particulier, l'intelligence artificielle (IA) a le potentiel d'augmenter la participation à la formation, y compris parmi les groupes actuellement sous-représentés, en réduisant certains des obstacles à la formation que les gens rencontrent et en augmentant la motivation à se former. En outre, certaines solutions d'IA pour la formation peuvent améliorer l'alignement de la formation sur les besoins du marché du travail, et réduire les préjugés et la discrimination sur le lieu de travail. Afin de réaliser les avantages de l'IA pour la formation et de s'assurer qu'elle apporte des bénéfices pour tous, il sera nécessaire de surmonter les défis potentiels en termes d'évolution des compétences requises, d'inégalités d'accès aux données, aux technologies et aux infrastructures, ainsi que d'importantes questions éthiques. Enfin, même si ces inconvénients peuvent être résolus, l'introduction et l'expansion des outils d'IA pour la formation sont limitées par l'offre de compétences en IA et la disponibilité d'evidences scientifiques concernant les retours des outils d'IA pour la formation et leur rentabilité.

Kurzfassung

Die technologischen Entwicklungen sind eine der Hauptursachen für die Notwendigkeit zur Weiterbildung, sie können aber auch Teil der Lösung sein. Insbesondere künstliche Intelligenz (KI) hat das Potenzial, die Weiterbildungsbeteiligung zu erhöhen, auch bei derzeit unterrepräsentierten Gruppen, indem sie einige der Hindernisse abbaut, mit denen die Menschen konfrontiert sind, und die Motivation zur Weiterbildung erhöht. Darüber hinaus können einige KI-Lösungen die Anpassung der Weiterbildung an die Bedürfnisse des Arbeitsmarktes verbessern und Vorurteile und Diskriminierung am Arbeitsplatz verringern. Um die Vorteile der KI für die Weiterbildung zu nutzen und sicherzustellen, dass der Einsatz von KI zu Ergebnissen führt, von denen beide Seiten profitieren, müssen jedoch die Herausforderungen in Bezug auf digitale Fähigkeiten, Zugang zu Daten, Technologie und Infrastruktur, sowie zu ethischen Fragen bewältigt werden. Zusätzlich wird die Einführung und Ausweitung von KI-Tools für die Weiterbildung durch die noch geringen KI-Fähigkeiten in der Bevölkerung und die limitierte Verfügbarkeit wissenschaftlicher Erkenntnisse über den Nutzen von KI-Tools für die Weiterbildung und ihre Kosteneffizienz eingeschränkt.

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Executive Summary

The adoption of Artificial Intelligence (AI) in the workplace is one of the major forces behind the need for retraining but it might also be part of the solution. Notably, AI has the potential to improve the targeting of and access to adult learning systems. This is necessary, because the way we work is changing rapidly, and yet only four in ten adults across the OECD participate in education and training in any given year, and these numbers are even lower for vulnerable groups on the labour market (OECD, 2019[1]). Moreover, training quality remains an issue, and aligning training to labour market needs and individuals' career goals can be challenging. Other technologies, such as video-conferencing tools, internet-based platforms or matching algorithms, have been leveraged in the past to deliver training, to spread information on skill requirements and relevant training courses or to match jobseekers to available learning opportunities. AI has the potential to improve significantly on these other technologies and, in some cases, it can enhance or replace human intervention for adults with relatively simple information and training needs.

Drawing on a review of the literature and insights provided by various experts in the fields of AI and training, this working paper sheds light on the potential opportunities and drawbacks of using AI for training, yielding valuable messages for policymakers, public and private employment services and firms that are considering introducing AI tools in the training they offer.

Using AI for training has the potential to increase training participation, including among currently underrepresented groups, by lowering some of the barriers to training that people experience and increasing training motivation. Moreover, certain AI solutions for training may improve the alignment of training to labour market needs, and reduce bias and discrimination in the workplace. Nevertheless, the potential benefits of AI tools for training notwithstanding, there are also important potential drawbacks of using AI for training, such as the risk of decreasing the inclusiveness of adult learning systems due to the digital skills that are needed to use the tools, and the large amounts of data and high-quality technological infrastructure needed to develop AI tools. Using AI for training may also lead to significant changes in skill requirements in jobs related to training and recruitment, generating resistance and negative employment effects for the professionals involved. Moreover, AI brings about important ethical issues. Realising AI's full potential and ensuring that using AI for training has beneficial outcomes for all requires more research and policies that address the need for digital skills, the costs of adoption, and the development of trustworthy, human-centred explainable AI tools for training.

Opportunities of using AI for training

- AI has the potential to help address some of the key barriers to training participation, notably those related to **time constraints**. AI-based content and assessment may significantly shorten the learning process, because it allows learners to skip irrelevant training tasks or entire modules, and only focus on filling their knowledge and skill gaps. Since AI can tailor training to millions of students at the same time, it can do so at a significantly smaller cost than private tutors. Compared to non-AI online courses where there is no live interaction between students and instructors (e.g. Massive Open Online Courses), AI may add value by making sessions more tailored to the individual needs

and interactive, for instance by incorporating chatbot functions. Also, thanks to AI-powered augmented and virtual reality technologies (AR and VR), the advantages of distance learning can be extended to practice-oriented training.

- AI can enable **personalised education at scale**. AI allows developing training that is adapted to specific reskilling needs, at a significantly smaller cost than private tutoring. As discussed above, the advantages can be multiple. Personalisation can be translated into time savings for some trainees while also helping vulnerable populations that need more time to learn. AI-driven personalisation is scalable at little cost as it does not require additional classrooms, teachers or tailored curricula. This scalability has the potential to benefit employers, training providers and policy makers.
- AI can help people **find training programmes** that are most relevant to their needs quickly and easily, which, in turn may **increase individuals' motivation to participate in training**. Many governments are currently scaling up the provision of career guidance and advice by leveraging internet-based platforms that spread information on skill requirements by occupation, emerging skill shortages and available training opportunities. AI can help improve these online career guidance activities by mimicking career counsellors' prompts and interactions to achieve a better assessment of the user's needs and produce tailored recommendations. Tailored training recommendations, as well as AI-based assessments that are tailored to the learners' entry level and progress may also increase training relevance and reduce training drop-outs. Finally, using AI for training may increase motivation to train, particularly as compared to non-AI online training, by expanding the provision of practice-oriented training through AR and VR, which often include playful elements, and by providing instant feedback to the learner.
- **Vulnerable groups** – such as the low-skilled, disabled or non-native speakers – are significantly under-represented in training. Using AI for training may be particularly attractive for them. The practice-oriented component of AR and VR may be more motivating for adults who have become disengaged with classroom-based education and for adults who have trouble understanding written materials and instructions (e.g. non-native speakers or people with low literacy skills). The focus of AR and VR on learning from mistakes in a safe environment may motivate people who suffer from fear of failure to participate in training. Moreover, AI-powered text-to-speech and speech-to-text technology facilitates the captioning or reading aloud of any spoken or written communication in real-time, as well as its translation in any language. This can broaden access to training for the visually or hearing impaired.
- **Employers also stand to benefit** from the provision of training through AI. AR and VR can be interesting for employers, due to their time and place flexibility, but also for the potential savings in raw materials and the avoidance of physical injuries relative to in-person training. Finally, AI may help make training participation more efficient by improving the matching between learning outcomes of training and the skill gaps of individuals
- AI may help **make training more impactful** by enabling a better alignment of training to skill needs, by enhancing human career and training advisors' skill assessment and training suggestions, and by guiding and empowering adults with limited access to human career counselling find the most relevant training. Thanks to AI, skills profiling may become more widely available and the profiling conducted by humans may become more accurate. Moreover, timelier and more granular labour market information can be analysed, which may improve the match between supply and demand for skills. With the increasing availability of large amounts of vacancy data from online job postings, it is becoming increasingly common to use AI to assess which skills employers are looking for and whether skill needs change over time within and across occupations. Using similar techniques, AI can also be leveraged to automatically categorise education and training programmes into skill categories, which helps policymakers and employers find the training programme(s) that teach the

skills in need. AI-powered training suggestions may help people self-select into the training programmes that will teach them the skills they need in order to remain employable.

- Finally, AI could help **increase diversity and inclusiveness** in the workplace, by training humans in making fairer decisions and improving human interaction, for example when recruiting, assessing work performance or providing feedback. Due to its immersive nature and the possibility to create full body ownership illusions, AI-powered augmented or virtual reality training provides the unique opportunity to experience situations through other people's eyes. Automating the assessment of students through AI-powered adaptive assessments or through augmented or virtual reality training may reduce bias in education and training.

Potential drawbacks of using AI for training and how they can be addressed

Despite its potential to address some of the barriers that adults face when approaching training, the use of AI for training could in fact raise other existing barriers and generate new ones, notably:

- Participating in training that is powered by AI requires a **higher level of digital skills** than participating in face-to-face instruction, and in some cases attending a non-AI online training course. Although the digital skills requirements may only be moderate, this still risks excluding groups with lower digital skills, such as older adults and the low-skilled more generally. This may decrease the inclusiveness of adult learning systems instead of increasing it as suggested above. To get a sense of the size of the problem, in the OECD on average, 25% of adults lack even the most basic digital skills and another 14% can only perform basic functions on a computer or other digital device. The expansion of training programmes for digital skills is already high on the policy agenda in most countries. As seen in the context of the COVID-19 pandemic, the delivery of more training online, particularly if through AI technologies, would increase the urgency.
- **High data requirements and costs** can increase inequalities in access to AI tools for training between large and small enterprises. Most AI solutions, including the ones used for training**,** require vast amounts of data and data storage, as well as powerful computers and access to high-speed wireless internet networks. This may be particularly challenging for small and medium enterprises (SMEs), in low and middle-income countries and in rural areas. Moreover, the technical and data needs as well as the required human resources to implement AI solutions can make them quite costly. In order to ensure that AI improves access to training for all rather than for only a minority of larger companies, appropriate mechanisms for sharing AI knowledge and solutions may need to be put in place. These should include mechanisms for sharing data, algorithms and AI knowledge in general, while respecting privacy, intellectual property and other rights. Additionally, external funding initiatives could be targeted for enterprises that face more challenges when it comes to adoption.
- Since AI can perform tasks that are traditionally human (e.g. designing tests or providing career guidance), its introduction in training would significantly **change the skill requirements** in jobs related to training – including teachers, trainers but also Human Resource managers – potentially leading to deskilling in these occupations and resistance in the adoption of AI. One way to address this challenge is by providing opportunities for people in these occupations to reskill in order to leverage their comparative advantage compared to AI systems, such as higher cognitive and social skills. For instance, trainers and career counsellors could use the time gained through AI tools for training to devote more attention to adults with more complex upskilling needs.
- The use of AI for training raises similar **ethical and transparency issues** as in other domains. Many AI systems lack explainability and transparency for the final users. At best, this could reduce the value of using them in some aspects of the training process, for example to tailor training content. At worst, it could lead to bad training decisions, when used to identify skill gaps or assess training outcomes. In addition, the lack of explainability and transparency can discourage adults

from undertaking training that uses AI. People are unlikely to (want to) start using AI tools for training when they do not trust that the tools are easy to use, that they provide high quality unbiased output that is easy to interpret, and that data are well protected and used in an ethical and fair way. Building trust in AI requires the development of trustworthy, human-centred AI. As set out in the OECD AI Principles, trustworthy AI systems benefit people and planet; uphold human rights, democratic values and fairness; are transparent and explainable; robust, secure and safe; and are operated by accountable entities (OECD, 2019[2]). Another way to build trust in AI is to increase public understanding of what AI can and cannot do and to be transparent about when it is being used. Explainability and transparency of AI are essential for people to challenge the outcomes when necessary. Nevertheless, transparency about AI should respect personal data protection obligations and intellectual property. Finally, AI systems should include the capacity for human intervention and oversight, meaning that AI tools for training are intended to empower humans, not to replace their decision-making altogether. Informing people about this empowering role of AI tools for training may help build their trust.

Assuming that the above drawbacks can be addressed, expanding the use of AI tools for training is constrained by the **supply of AI-specific digital skills** needed to develop the tools (e.g. *Machine Learning, Data Structures* or *Natural Language Processing* skills). Even though the demand for AI skills on the labour market is still relatively small (around 2% of IT job postings currently require AI skills), shortages are already emerging. Countries with education systems that are relatively unresponsive to changing skill needs and with relatively few people willing to enrol in AI skills courses may struggle to find enough people to expand the use of AI tools for training. There are various ways in which countries can try to address this challenge, including: i) raising awareness of the demand for AI skills in the labour market and the positive employment prospects they open up through career guidance for youth and adults; and ii) making the development of AI skills more accessible, for instance through targeted financial incentives.

Finally, to date there is a **lack of scientific evidence** about the effectiveness of AI tools for training compared to their non-AI or human alternatives. Without rigorous and robust evidence about the effectiveness of AI tools for training, policymakers and employers cannot weigh the costs of these tools against their benefits in their decisions to implement or expand the use of AI tools for training. Before resources are allocated to the expansion of the use of AI tools for training, further research is needed in order to improve our understanding of these tools, and whether the benefits of the different types of tools outweigh the costs, harms and challenges. Governments should therefore consider long-term public investment and encourage private investment in research and development in trustworthy AI tools for training that outperform non-AI and human alternatives.

Résumé

L'adoption de l'intelligence artificielle (IA) sur le lieu de travail est l'une des forces principales derrière les besoins de reconversion professionnelle, mais elle pourrait aussi faire partie de la solution. L'IA permet notamment d'améliorer le ciblage des systèmes de formation pour adultes et l'accès à ceux-ci. Ces améliorations sont nécessaires, car la façon dont nous travaillons évolue rapidement, et pourtant seuls quatre adultes sur dix dans l'ensemble de l'OCDE participent à l'éducation et à la formation au cours d'une année donnée, et ces chiffres sont encore plus faibles pour les groupes vulnérables sur le marché du travail (OECD, 2019[1]). En outre, la qualité de la formation reste un problème, et aligner la formation sur les besoins du marché du travail et les objectifs professionnels des individus peut être difficile. D'autres technologies, telles que les outils de vidéoconférence, les plateformes sur Internet ou les algorithmes d'appariement, ont été exploitées par le passé pour dispenser des formations, diffuser des informations sur les exigences en matière de compétences et les cours de formation pertinents ou faire la correspondance entre les demandeurs d'emploi et les possibilités d'apprentissage disponibles. L'IA a l'opportunité d'améliorer considérablement ces autres technologies et, dans certains cas, elle peut améliorer ou remplacer l'intervention humaine pour les adultes ayant des besoins d'information et de formation relativement simples.

En s'appuyant sur une analyse de la littérature et sur les idées fournies par divers experts dans les domaines de l'IA et de la formation, ce document met en évidence les opportunités et les inconvénients potentiels de l'utilisation de l'IA pour la formation, et fournit des messages précieux pour les décideurs politiques, les services d'emploi publics et privés et les entreprises qui envisagent d'introduire des outils d'IA dans les formations qu'ils proposent.

L'utilisation de l'IA pour la formation a le potentiel d'augmenter la participation à la formation, y compris parmi les groupes actuellement sous-représentés, en abaissant certains des obstacles à la formation des personnes et en augmentant la motivation à la formation. De plus, certaines solutions d'IA pour la formation peuvent améliorer l'alignement de la formation sur les besoins du marché du travail et réduire les préjugés et la discrimination sur le lieu de travail. Néanmoins, malgré les avantages potentiels des outils d'IA pour la formation, il existe également d'importants inconvénients potentiels de l'utilisation de l'IA pour la formation, tels que le risque de réduire l'inclusivité des systèmes de formation des adultes en raison des compétences numériques nécessaires pour utiliser les outils, et les grandes quantités de données et l'infrastructure technologique de haute qualité nécessaires pour développer des outils d'IA. L'utilisation de l'IA pour la formation peut également entraîner des changements importants dans les compétences requises dans les emplois liés à la formation et au recrutement, générant une résistance et des effets négatifs sur l'emploi des professionnels concernés. De plus, l'IA pose des problèmes éthiques importants. Pour exploiter pleinement le potentiel de l'IA et faire en sorte que l'utilisation de l'IA pour la formation a des résultats bénéfiques pour tous, nécessite davantage de recherches et de politiques qui répondent au besoin de compétences numériques, aux coûts d'adoption et au développement d'outils d'IA pour la formation qui sont explicables, fiables et centrés sur l'humain.

Opportunités d'utiliser l'IA pour la formation

- L'IA a le potentiel d'aider à surmonter certains des principaux obstacles à la participation à la formation, notamment ceux liés aux **contraintes de temps**. Le contenu et l'évaluation basés sur l'IA peuvent considérablement raccourcir le processus d'apprentissage, car ils permettent aux apprenants de sauter des tâches de formation non pertinentes ou des modules entiers, et de se concentrer uniquement sur le comblement de leurs lacunes en matière de connaissances et de compétences. Étant donné que l'IA peut adapter la formation à des millions d'étudiants en même temps, elle peut le faire à un coût nettement inférieur à celui des tuteurs privés. Par rapport aux cours en ligne sans IA où il n'y a pas d'interaction en direct entre les étudiants et les instructeurs (par exemple, les cours en ligne ouverts et massifs), l'IA peut ajouter de la valeur en rendant les sessions plus adaptées aux besoins individuels et interactives, par exemple en intégrant des fonctions de chatbot. De plus, grâce aux technologies de réalité augmentée et virtuelle (RA et RV) alimentées par l'IA, les avantages de l'apprentissage à distance peuvent être étendus à une formation orientée vers la pratique.
- L'IA peut permettre un **enseignement personnalisé à grande échelle**. L'IA permet de développer des formations adaptées à des besoins spécifiques de reconversion, à un coût nettement inférieur à celui des cours particuliers. Comme évoqué ci-dessus, les avantages peuvent être multiples. La personnalisation peut se traduire par un gain de temps pour certains participants à la formation, tout en aidant les populations vulnérables qui ont besoin de plus de temps pour apprendre. La personnalisation basée sur l'IA est évolutive à faible coût car elle ne nécessite pas de salles de classe, d'enseignants ou de programmes personnalisés supplémentaires. Cette évolutivité est potentiellement bénéfique pour les employeurs, les prestataires de formation et les décideurs politiques.
- L'IA peut **aider les gens à trouver rapidement et facilement les programmes de formation** les plus adaptés à leurs besoins, ce qui, à son tour, peut **augmenter la motivation des individus à participer à la formation**. De nombreux gouvernements intensifient actuellement l'offre d'orientation professionnelle en s'appuyant sur des plateformes Internet qui diffusent des informations sur les compétences requises par profession, les pénuries de compétences émergentes et les possibilités de formation disponibles. L'IA peut contribuer à améliorer ces activités d'orientation professionnelle en ligne en imitant les interactions traditionnellement entretenues avec les conseillers d'orientation professionnelle afin de mieux évaluer les besoins de l'utilisateur et de produire des recommandations personnalisées. Des recommandations de formation sur mesure, ainsi que des évaluations basées sur l'IA adaptées au niveau d'entrée et aux progrès des apprenants peuvent également augmenter la pertinence des formations, ce qui pourrait encourager la participation et réduire le taux d'abandon. Enfin, l'utilisation de l'IA pour la formation peut augmenter la motivation à se former, notamment par rapport à la formation en ligne sans IA, en élargissant l'offre de formation axée sur la pratique via la RA et la RV, qui comprennent souvent des éléments ludiques, et en fournissant un retour instantané à l'apprenant .
- **Les groupes vulnérables** – tels que les personnes peu qualifiées, handicapées ou non natives – sont considérablement sous-représentés dans la formation. L'utilisation de l'IA pour la formation peut être particulièrement intéressante pour eux. La fonctionnalité axée sur la pratique de la RA et de la RV peut être plus motivante pour les adultes qui se sont désengagés de l'enseignement en classe et pour les adultes qui ont du mal à comprendre les documents et les instructions écrits (par exemple, les locuteurs non natifs ou les personnes peu alphabétisées). L'accent mis par la RA et la RV sur l'apprentissage des erreurs dans un environnement sûr peut motiver les personnes qui ont peur de ne pas participer à la formation. De plus, la technologie de 'speed-to-text' et 'text-to-speech', alimentée par l'IA, facilite le sous-titrage ou la lecture à haute voix de toute communication orale ou écrite en temps réel, ainsi que sa traduction dans n'importe quelle langue. Cela peut élargir l'accès à la formation pour les personnes malvoyantes ou les malentendantes.

- **Les employeurs ont également des avantages à tirer** de l'offre de la formation par l'IA. La RA en la RV peuvent être intéressantes pour les employeurs, en raison de leur flexibilité en termes de temps et de lieu, mais aussi pour les économies potentielles de matières premières et la prévention des blessures physiques par rapport à la formation en personne. Enfin, l'IA peut contribuer à rendre la participation à la formation plus efficace en améliorant la correspondance entre les résultats de la formation de la formation et les lacunes en matière de compétences des individus.
- L'IA peut contribuer à **rendre la formation plus efficace** en permettant un meilleur alignement de la formation sur les besoins en compétences, en améliorant l'évaluation des compétences et les suggestions de formation des conseillers humaine en carrière et en formation, ainsi qu'en guidant et en habilitant les adultes ayant un accès limité à l'orientation professionnelle humaine, à trouver la formation la plus pertinente. Grâce à l'IA, le profilage des compétences peut devenir plus largement disponible et le profilage effectué par les humains peut devenir plus précis. En outre, il est possible d'analyser des informations plus actuelles et plus granulaires sur le marché du travail, ce qui peut améliorer l'adéquation entre l'offre et la demande de compétences. Avec la disponibilité croissante de grandes quantités de données sur les postes vacants provenant des offres d'emploi en ligne, il est de plus en plus courant d'utiliser l'IA pour évaluer quelles compétences les employeurs recherchent et si les besoins en compétences changent au fil du temps au sein d'un même profession ou d'une profession à l'autre. En utilisant des techniques similaires, l'IA peut également être exploitée pour classer automatiquement les programmes d'éducation et de formation en catégories de compétences, ce qui aide les décideurs politiques et les employeurs à trouver le ou les programmes de formation qui enseignent les compétences recherchées. Les suggestions de formation alimentées par l'IA peuvent aider les adultes à choisir eux-mêmes les programmes de formation qui leur apprendront les compétences dont ils ont besoin pour rester employables.
- Enfin, l'IA pourrait contribuer à **accroître la diversité et l'intégration** sur le lieu de travail, en apprenant aux humains à prendre des décisions plus justes et à améliorer l'interaction humaine, par exemple lors du recrutement, de l'évaluation des performances professionnelles ou de la rétroaction. En raison de sa nature immersive et de la possibilité de créer des illusions de propriété corporelle, la formation via la RA ou la RV alimentée par l'IA offre l'occasion unique de vivre des situations à travers les yeux d'autres personnes. L'automatisation de l'évaluation des étudiants via des évaluations adaptatives basées sur l'IA ou via une formation via la RA ou la RV peut réduire les biais dans l'éducation et la formation.

Inconvénients potentiels de l'utilisation de l'IA pour la formation et comment y remédier

Malgré son potentiel à surmonter certains des obstacles auxquels les adultes sont confrontés lorsqu'ils abordent la formation, l'utilisation de l'IA pour la formation pourrait en fait lever d'autres obstacles existants et en générer de nouveaux, notamment :

- La participation à une formation alimentée par l'IA nécessite un **niveau de compétences numériques plus élevé** que la participation à une formation en présentiel et, dans certains cas, la participation à un cours de formation en ligne sans IA. Bien que les exigences en matière de compétences numériques ne soient peut-être que modérées, cela risque tout de même d'exclure les groupes ayant de faibles compétences numériques, comme les adultes âgées et les personnes peu qualifiées de manière plus générale. Cela peut diminuer l'inclusivité des systèmes de formation des adultes au lieu de l'augmenter comme suggéré ci-dessus. Pour avoir une idée de l'ampleur du problème, dans l'OCDE en moyenne, 25 % des adultes n'ont pas les compétences numériques les plus élémentaires et 14 % ne peuvent exécuter que des fonctions de base sur un ordinateur ou un autre appareil numérique. L'expansion des programmes de formation aux compétences

numériques figure déjà parmi les priorités politiques de la plupart des pays. Comme on l'a vu dans le contexte de la pandémie de COVID-19, la mise en place d'un plus grand nombre de formations en ligne, notamment par le biais de technologies d'AI, en augmenterait l'urgence.

- **Les exigences et les coûts élevés en matière de données** peuvent accroître les inégalités d'accès aux outils d'IA pour la formation entre les grandes et les petites entreprises. La plupart des solutions d'IA, y compris celles utilisées pour la formation, nécessitent de grandes quantités de données et de stockage de données, ainsi que des ordinateurs puissants et un accès à des réseaux Internet sans fil à haut débit. Cela peut être particulièrement difficile pour les petites et moyennes entreprises (PME), dans les pays à revenu faible ou intermédiaire et dans les zones rurales. En outre, les besoins techniques et de données ainsi que les ressources humaines nécessaires pour mettre en œuvre des solutions d'IA peuvent les rendre assez coûteuses. Afin de garantir que l'IA améliore l'accès à la formation pour tous plutôt que pour seulement une minorité de grandes entreprises, il peut être nécessaire de mettre en place des mécanismes appropriés de partage des connaissances et des solutions en matière d'IA. Ceux-ci devraient inclure des mécanismes de partage des données, des algorithmes et des connaissances de l'IA en général, tout en respectant la vie privée, la propriété intellectuelle et d'autres droits. De plus, des initiatives de financement externe pourraient être ciblées pour les entreprises qui rencontrent davantage de difficultés en matière d'adoption.
- Étant donné que l'IA peut effectuer des tâches traditionnellement humaines (par exemple, la conception de tests d'orientation professionnelle), son introduction dans la formation **modifierait considérablement les compétences requises** dans les emplois liés à la formation - y compris les enseignants, les formateurs mais aussi les responsables des ressources humaines -, ce qui pourrait entraîner une déqualification dans ces métiers, et à une résistance à l'adoption de l'IA. L'un des moyens de relever ce défi consiste à offrir aux personnes exerçant ces professions la possibilité de se reconvertir afin de tirer parti de leur avantage comparatif par rapport aux systèmes d'IA, tels que des compétences cognitives et sociales supérieures. Par exemple, les formateurs et les conseillers d'orientation professionnelle pourraient utiliser le temps gagné grâce aux outils d'IA pour la formation afin de consacrer plus d'attention aux adultes ayant des besoins de formation plus complexes.
- L'utilisation de l'IA pour la formation soulève des **problèmes d'éthique et de transparence** similaires à ceux dans d'autres domaines. De nombreux systèmes d'IA manquent d'explicabilité et de transparence pour les utilisateurs finaux. Au mieux, cela pourrait réduire la valeur de leur utilisation dans certains aspects du processus de formation, par exemple pour adapter le contenu de la formation. Au pire, cela pourrait conduire à de mauvaises décisions de formation, lorsqu'il est utilisé pour identifier les lacunes en matière de compétences ou évaluer les résultats de la formation. En outre, le manque d'explicabilité et de transparence peut décourager les adultes de suivre une formation utilisant l'IA. Il est peu probable que les personnes (veulent) commencer à utiliser des outils d'IA pour la formation lorsqu'ils ne croient pas que les outils sont faciles à utiliser, qu'ils fournissent des résultats impartiaux de haute qualité et faciles à interpréter et que les données sont bien protégées et utilisées de manière éthique et équitable. Renforcer la confiance dans l'IA nécessite le développement d'une IA digne de confiance et centrée sur l'homme. Comme indiqué dans les principes d'IA de l'OCDE, les systèmes d'IA fiables sont bénéfiques aux personnes et à la planète ; ils respectent les droits de l'homme, les valeurs démocratiques et l'équité ; ils sont transparents et explicables ; ils sont robuste, sécurisé et sûr ; et ils sont gérés par des entités responsables (OECD, 2019[2]). Une autre façon de renforcer la confiance dans l'IA est d'améliorer la compréhension du public de ce que l'IA peut et ne peut pas faire et de faire preuve de transparence quant au moment où elle est utilisée. L'explicabilité et la transparence de l'IA sont essentielles pour que les gens puissent contester les résultats si nécessaire. Néanmoins, la transparence sur l'IA doit respecter les obligations de protection des données personnelles et la propriété intellectuelle. Enfin, les systèmes d'IA devraient inclure la capacité d'intervention et de

surveillance humaines, ce qui signifie que les outils d'IA pour la formation sont destinés à renforcer les capacités des humains, et non à remplacer complètement leur prise de décision. Informer les gens sur ce rôle d'autonomisation des outils d'IA pour la formation peut contribuer à renforcer leur confiance.

En supposant que les inconvénients susmentionnés puissent être résolus, le développement de l'utilisation des outils d'IA pour la formation est limité par **l'offre de compétences numériques spécifiques à l'IA** nécessaires pour développer les outils (par exemple, des compétences en apprentissage automatique, en structures de données ou en traitement du langage naturel). Même si la demande de compétences en IA sur le marché du travail est encore relativement faible (environ 2% des offres d'emploi en informatique nécessitent actuellement des compétences en IA), des pénuries apparaissent déjà. Les pays dont les systèmes éducatifs sont relativement peu réactifs à l'évolution des besoins en compétences et avec relativement peu de personnes disposées à s'inscrire à des cours de formation en IA pourraient avoir du mal à trouver suffisamment de personnes pour étendre l'utilisation des outils d'IA pour la formation. Les pays peuvent tenter de relever ce défi de diverses manières, notamment : i) en sensibilisant à la demande de compétences en IA sur le marché du travail et aux perspectives d'emploi positives qu'elles ouvrent, grâce à l'orientation professionnelle des jeunes et des adultes ; et ii) en rendant le développement des compétences en IA plus accessible, par exemple par des incitations financières ciblées.

Enfin, à ce jour, il existe un **manque de preuves scientifiques** sur l'efficacité des outils d'IA pour la formation par rapport à leurs alternatives non-IA ou humaines. En l'absence de preuves rigoureuses et solides sur l'efficacité des outils d'IA pour la formation, les décideurs politiques et les employeurs ne peuvent pas peser les coûts de ces outils par rapport à leurs avantages dans leurs décisions de mettre en œuvre ou d'étendre l'utilisation des outils d'IA pour la formation. Avant d'allouer des ressources à l'expansion de l'utilisation des outils d'IA pour la formation, des recherches supplémentaires sont nécessaires afin d'améliorer notre compréhension de ces outils et de déterminer si les avantages des différents types d'outils l'emportent sur les coûts, les inconvénients et les défis. Les gouvernements devraient donc envisager des investissements publics à long terme et encourager les investissements privés dans la recherche et le développement d'outils d'IA fiables pour la formation qui surpassent les alternatives non IA et humaines.

Zusammenfassung

Die Einführung von Künstlicher Intelligenz (KI) ist zwar unter den wichtigsten Gründen für die Notwendigkeit von Weiterbildung, kann aber auch Teil der Lösung sein. Tatsächlich hat künstliche Intelligenz (KI) das Potenzial, die Ausrichtung von Erwachsenenbildungssystemen sowie den Zugang zu ihnen zu verbessern. Dies ist notwendig, da sich die Art und Weise, wie wir arbeiten, schnell verändert und dennoch nur vier von zehn Erwachsenen in der OECD an Weiterbildung teilnehmen in einem bestimmten Jahr. Unter benachteiligten Gruppen auf dem Arbeitsmarkt ist die Teilnahme noch geringer (OECD, 2019[1]). Darüber hinaus bleiben die Weiterbildungsqualität, sowie die Anpassung der Weiterbildung an die Bedürfnisse des Arbeitsmarktes und an die Karriereziele von Einzelnen eine Herausforderung. Andere Technologien wie Videokonferenz-Tools, internetbasierte Plattformen oder Matching-Algorithmen wurden bereits in der Vergangenheit eingesetzt, um Weiterbildungen durchzuführen, Informationen über Qualifikationsanforderungen und relevante Weiterbildungen zu verbreiten oder Arbeitssuchende mit verfügbaren Lernangeboten zusammenzubringen. KI hat das Potenzial, diese Technologien erheblich zu verbessern, und in einigen Fällen kann sie die menschliche Intervention bei Erwachsenen mit relativ einfachen Informations- und Schulungsbedürfnissen verbessern oder ersetzen.

Ausgehend von einer Literaturrecherche und Erkenntnissen verschiedener Expertinnen und Experten aus den Bereichen KI und Weiterbildung beleuchtet dieser Bericht die potenziellen Chancen und Herausforderungen des Einsatzes von KI für die Weiterbildung und liefert wertvolle Botschaften für politische Entscheidungsträger, öffentliche und private Arbeitsvermittlungen und Unternehmen, die die Einführung von KI-Tools in ihr Weiterbildungsangebot erwägen.

Der Einsatz von KI für Weiterbildung hat das Potenzial, die Weiterbildungsbeteiligung zu erhöhen, auch bei derzeit unterrepräsentierten Gruppen, indem sie die Motivation zur Weiterbildung erhöht und einige der Hindernisse abbaut, mit denen die Menschen konfrontiert sind. Darüber hinaus können einige KI-Lösungen die Anpassung der Weiterbildung an die Bedürfnisse des Arbeitsmarktes verbessern und Vorurteile und Diskriminierung am Arbeitsplatz verringern. Ungeachtet der potenziellen Vorteile von KI-Tools in der Weiterbildung gibt es jedoch auch potenzielle Nachteile, wie z.B. die großen Datenmengen und die hochwertige technologische Infrastruktur, die für die Entwicklung von KI-Tools benötigt werden. Der Einsatz von KI in der Weiterbildung kann auch zu erheblichen Veränderungen der Qualifikationsanforderungen an Weiterbildungsanbieter führen, was Widerstand und negative Beschäftigungseffekte für die betroffenen Fachkräfte auslösen kann. Darüber hinaus bringt KI wichtige ethische Fragen mit sich. Um das volle Potenzial von KI auszuschöpfen und sicherzustellen, dass der Einsatz von KI in der Weiterbildung Vorteile für alle hat, bedarf es mehr Forschung und Richtlinien, die sich mit dem Bedarf an digitalen und rechnerischen Fähigkeiten, sowie den Kosten der Einführung und der Entwicklung vertrauenswürdiger, menschzentrierter erklärbarer KI-Tools für die Weiterbildung befassen.

Möglichkeiten der Verwendung von KI in der Weiterbildung

- KI hat das Potenzial, bei dem Abbau von wichtigen Hindernisse an der Teilnahme an Weiterbildung zu unterstützen, insbesondere wo **Zeit eine große Barriere** ist. KI-basierte Inhalte und Auswertungen können den Lernprozess erheblich verkürzen, da sie es den Lernenden ermöglichen, irrelevante Aufgaben oder ganze Module zu überspringen und sich darauf zu konzentrieren, ihre Wissens- und Fähigkeitslücken zu schließen. Da KI die Weiterbildung gleichzeitig auf Millionen von Schüler zuschneiden kann, ist dies zu deutlich geringeren Kosten möglich als bei nicht-KI-Online-Kursen. Darüber hinaus kann KI einen Mehrwert für asynchrone Weiterbildungen schaffen, bei denen es keine Live-Interaktion zwischen Lernenden und Lehrenden gibt (zum Beispiel durch die Einbindung von Chat-Bot-Funktionen). Auch können dank KI-gestützter Augmented- und Virtual-Reality-Technologien (AR und VR) die Vorteile des Fernstudiums auf eine praxisorientierte Weiterbildung ausgeweitet werden.
- KI kann **individualisierte Bildung in großem Maßstab** ermöglichen. Sie ermöglicht die Anpassung von Weiterbildungskursen an die spezifischen Bedürfnisse der Teilnehmenden zu deutlich geringeren Kosten als nicht-KI Angebote. Wie oben erörtert, können die Vorteile vielfältig sein. Die Personalisierung kann für einige Teilnehmende Zeit einsparen oder benachteiligten Menschen helfen, die mehr Zeit zum Lernen benötigen. Die KI-gesteuerte Personalisierung ist zu geringen Kosten skalierbar, da keine zusätzlichen Klassenzimmer, Lehrende oder maßgeschneiderte Lehrpläne erforderlich sind. Diese Skalierbarkeit kann Arbeitgebern, Bildungsanbietern und politischen Entscheidungsträgern zugutekommen.
- KI kann Menschen dabei helfen, schnell und einfach **Weiterbildungsprogramme zu finden**, die ihren Bedürfnissen am besten entsprechen, was wiederum die **Motivation zur Teilnahme an Weiterbildung** von Einzelnen erhöhen kann. Viele Regierungen weiten derzeit Berufsberatung und -orientierung in Form von internetbasierten Plattformen aus, welche Informationen zu Qualifikationsanforderungen bieten organisiert nach Berufen, nach sich abzeichnenden Qualifikationsdefiziten und nach verfügbaren Bildungsmöglichkeiten. Maßgeschneiderte Weiterbildungsempfehlungen sowie KI-basierte Leistungsbewertungen, die auf das Einstiegsniveau und den Fortschritt der Lernenden zugeschnitten sind, können auch die Relevanz des Trainings erhöhen und Abbrüche vermeiden. Schließlich kann der Einsatz von KI in der Weiterbildung die Motivation zur Teilnahme an Weiterbildung erhöhen, insbesondere im Vergleich zu Online-Training ohne KI, da das Angebot praxisorientierter Weiterbildung durch AR und VR erweitert wird, welche oft spielerische Elemente beinhalten und den Lernenden sofortiges Feedback geben.
- **Benachteiligte Gruppen** – wie Geringqualifizierte, Menschen mit Behinderung oder Nicht-Muttersprachler – nehmen aktuell deutlich weniger an Weiterbildung teil. Der Einsatz von KI in der Weiterbildung kann für sie besonders attraktiv sein. Die praxisorientierte Komponente von AR und VR kann für Erwachsene, die das Lernen im Klassenzimmer nicht mehr gewohnt sind, oder Schwierigkeiten haben, schriftliche Materialien und Anweisungen zu verstehen (z.B. Nicht-Muttersprachler oder Personen mit geringen Lese- und Schreibfähigkeiten), motivierender sein. Der Fokus von AR und VR auf das Lernen aus Fehlern in einer sicheren Umgebung kann Menschen Ängste vor dem Lernen nehmen. Darüber hinaus erleichtert die KI-gestützte Text-to-Speech- und Speech-to-Text-Technologie das Untertiteln oder Vorlesen jeder gesprochenen oder geschriebenen Kommunikation in Echtzeit sowie deren Übersetzung in jede Sprache. Dies kann den Zugang zu Schulungen für Menschen mit Seh- und Hörbehinderung erweitern.
- **Auch Arbeitgeber profitieren** von der Weiterbildung durch KI. AR und VR können aufgrund ihrer zeitlichen und räumlichen Flexibilität für Arbeitgeber interessant sein, aber auch wegen des Einsparpotenzials bei Rohstoffen und der Verringerung von Verletzungsgefahren im Vergleich zu

Präsenzveranstaltungen. Schließlich kann KI dazu beitragen, die Teilnahme an Weiterbildung effizienter zu gestalten, indem sie die Übereinstimmung zwischen den Lernergebnissen der Weiterbildung und den Qualifikationslücken der einzelnen Personen verbessert.

- KI kann dazu beitragen, **Weiterbildung wirkungsvoller zu gestalten**, indem sie eine bessere Ausrichtung der Weiterbildung auf den Qualifikationsbedarf ermöglicht. Sie kann die Auswertungen und Weiterbildungsvorschläge der menschlichen Bildungsberatenden verbessern und Erwachsene mit eingeschränktem Zugang zu persönlicher Beratung anleiten. Dank KI kann die Erstellung von Kompetenzprofilen breiter verfügbar und die von Menschen durchgeführte Profilerstellung genauer werden. Darüber hinaus können aktuellere und detailliertere Arbeitsmarktinformationen bereitgestellt werden, was die Übereinstimmung zwischen Angebot und Nachfrage nach Qualifikationen verbessern kann. Mit der zunehmenden Verfügbarkeit großer Mengen an Daten zu Stellenangeboten aus Online-Stellenausschreibungen kann KI genutzt werden, um zu beurteilen, nach welchen Qualifikationen Arbeitgeber suchen und ob sich der Qualifikationsbedarf im Laufe der Zeit innerhalb und zwischen verschiedenen Berufen ändert. Mit ähnlichen Techniken kann KI auch genutzt werden, um Bildungs- und Weiterbildungsprogramme automatisch in Qualifikationskategorien einzuteilen, was politischen Entscheidungsträgern und Arbeitgebern hilft, Weiterbildungsprogramme zu finden, die die benötigten Fertigkeiten vermitteln. KI-gestützte Weiterbildungsvorschläge können den Menschen helfen, selbst die Kurse auszuwählen, die ihnen die gewünschten Fähigkeiten vermitteln, um beschäftigungsfähig zu bleiben.
- Schließlich kann KI die **Vielfalt und Inklusion am Arbeitsplatz erhöhen**, indem Menschen darin geschult werden, fairere Entscheidungen zu treffen und die menschliche Interaktion zu verbessern, beispielsweise bei der Einstellung, Bewertung der Arbeitsleistung oder der Bereitstellung von Feedback. Aufgrund seiner immersiven Natur bietet KI-gestütztes AR und VR-Training die einzigartige Möglichkeit, Situationen durch die Augen anderer Menschen zu erleben. Die Nutzung von KI-gestützten Technologien oder AR und VR-Training kann bei der Bewertung von Lernenden zu objektiveren Bewertungen führen.

Potenzielle Herausforderungen bei der Verwendung von KI in der Weiterbildung und wie sie angegangen werden können

Trotz ihres Potenzials, einige der Barrieren zu überwinden, mit denen Erwachsene bei der Teilnahme an Weiterbildung konfrontiert sind, kann der Einsatz von KI für die Weiterbildung tatsächlich andere bestehende Barrieren erhöhen und neue schaffen, insbesondere:

- Die Teilnahme an KI-gestützter Weiterbildung erfordert ein **höheres Maß an digitalen Fähigkeiten** als die Teilnahme an Präsenzkursen und in einigen Fällen auch als die Teilnahme an einem Online-Schulungskurs ohne Nutzung von KI. Auch wenn die Anforderungen an digitale Kompetenzen möglicherweise nur gering sind, besteht dennoch die Gefahr, dass Gruppen mit wenigen digitalen Kompetenzen, wie ältere Erwachsene und Geringqualifizierte, ausgeschlossen werden. Dies kann die Inklusivität von Erwachsenenbildungssystemen verringern, anstatt sie, wie oben vorgeschlagen, zu erhöhen. Um ein Gefühl für das Ausmaß des Problems zu bekommen: Im OECD-Durchschnitt fehlen 25 % der Erwachsenen die grundlegendsten digitalen Fähigkeiten und weitere 14 % können nur grundlegende Funktionen auf einem Computer oder einem anderen digitalen Gerät ausführen. Der Ausbau von Trainingsprogrammen für digitale Kompetenzen steht in den meisten Ländern bereits weit oben auf der politischen Agenda. Wie der Kontext der COVID-19 Pandemie gezeigt hat, würde die Bereitstellung von mehr online Weiterbildungsangeboten, insbesondere bei KI-unterstützten Formaten, die Dringlichkeit des Ausbaus erhöhen.

- **Hohe Datenanforderungen und -kosten** können die Ungleichheiten beim Zugang zu KI-Tools für Weiterbildung zwischen großen und kleinen Unternehmen erhöhen. Die meisten KI-Lösungen, einschließlich derjenigen, die für Weiterbildung verwendet werden, erfordern riesige Datenmengen und Datenspeicher sowie leistungsstarke Computer und Zugang zu schnellem drahtlosem Internet. Dies kann für kleine und mittlere Unternehmen (KMU), in Ländern mit niedrigem und mittlerem Einkommen und in ländlichen Gebieten eine besondere Herausforderung darstellen. Darüber hinaus können die technischen und datentechnischen Anforderungen sowie die erforderlichen personellen Ressourcen für die Implementierung von KI-Lösungen sie recht kostspielig machen. Um sicherzustellen, dass KI den Zugang zu Weiterbildung für alle, und nicht nur für eine Minderheit größerer Unternehmen verbessert, müssen möglicherweise geeignete Mechanismen für den Austausch von KI-Wissen und -Lösungen eingeführt werden. Diese sollten Mechanismen für den Austausch von Daten, Algorithmen und KI-Wissen im Allgemeinen umfassen, wobei die Privatsphäre, das geistige Eigentum und andere Rechte gewahrt werden. Darüber hinaus könnten externe Finanzierungsinitiativen auf die Unternehmen ausgerichtet sein, die bei der Einführung vor größeren Herausforderungen stehen.
- Da KI traditionell menschliche Aufgaben erfüllen kann (z.B. die Gestaltung von Tests oder Berufsberatung), würde ihre Einführung in die Weiterbildung die **Qualifikationsanforderungen in weiterbildungsbezogenen Berufen erheblich verändern** – einschließlich derer an Lehrende, Weiterbildungspersonal, aber auch an Personalleitungen in Unternehmen – und möglicherweise zu Dequalifizierung in diesen Berufen führen, sowie zu Widerständen bei der Einführung von KI. Eine Möglichkeit, dieser Herausforderung zu begegnen, besteht darin, Menschen in diesen Berufen Möglichkeiten zur Weiterbildung zu bieten, um ihre komparativen Vorteile gegenüber KI-Systemen zu nutzen, wie beispielsweise höhere kognitive und soziale Fähigkeiten. Bildungsanbieter und Berufsberater könnten beispielsweise die durch KI-Tools gewonnene Zeit nutzen, um Erwachsenen mit komplexerem Weiterbildungsbedarf mehr Aufmerksamkeit zu schenken.
- Der Einsatz von KI wirft ähnliche **ethische und Transparenzfragen** in der Weiterbildung auf wie in anderen Bereichen. Vielen KI-Systemen fehlt es Transparenz für die Endnutzer. Dies könnte im besten Fall den Mehrwert ihrer Verwendung in einigen Aspekten des Weiterbildungsprozesses verringern, beispielsweise um Weiterbildungsinhalte zuzuschneiden. Es kann aber auch zu schlechten Weiterbildungsentscheidungen führen, wenn es dazu verwendet wird, Qualifikationslücken zu erkennen oder Weiterbildungsergebnisse zu bewerten. Darüber hinaus kann der Mangel an Transparenz Erwachsene davon abhalten, eine KI-unterstützte Weiterbildung zu wählen. Es ist unwahrscheinlich, dass Menschen KI-Tools für Weiterbildung nutzen (wollen), wenn sie nicht darauf vertrauen, dass die Tools einfach zu verwenden sind, dass sie qualitativ hochwertige, unvoreingenommene Ergebnisse liefern, die leicht zu interpretieren sind und dass die Daten gut geschützt sind. Der Aufbau von Vertrauen in KI erfordert die Entwicklung einer vertrauenswürdigen, menschzentrierten KI. Wie in den KI-Prinzipien der OECD festgelegt, kommen vertrauenswürdige KI-Systeme den Menschen und dem Planeten zugute; Menschenrechte, demokratische Werte und Fairness wahren; sind transparent und verständlich; robust und sicher; und werden von verantwortlichen Stellen betrieben (OECD, 2019[2]). Eine weitere Möglichkeit, Vertrauen in KI aufzubauen, besteht darin, das öffentliche Verständnis dafür zu verbessern, was KI kann und was nicht, und transparent aufzuzeigen wann sie eingesetzt wird. Nachvollziehbarkeit und Transparenz von KI sind für die Menschen unerlässlich, um die Ergebnisse bei Bedarf in Frage zu stellen. Dennoch sollte Transparenz in Bezug auf KI die Verpflichtungen zum Schutz personenbezogener Daten und des geistigen Eigentums respektieren. Schließlich sollten KI-Systeme die Möglichkeit für menschliches Eingreifen und Beaufsichtigen beinhalten, was bedeutet, dass KI-Werkzeuge in der Weiterbildung Menschen befähigen sollen, ihre Entscheidungsfindung nicht vollständig zu ersetzen. Information über diese

stärkende Rolle von KI-Tools in der Weiterbildung kann dazu beitragen, das Vertrauen der Menschen aufzubauen.

Unter der Annahme, dass die oben genannten Nachteile behoben werden können, werden dennoch die eingeschränkten **KI-spezifischen digitalen Fähigkeiten**, die für die Entwicklung der Tools erforderlich sind (z. B. maschinelles Lernen, Fähigkeiten zur Verarbeitung von Datenstrukturen oder natürlicher Sprache), die Ausweitung des Einsatzes von KI-Tools für die Weiterbildung erschweren. Auch wenn die Nachfrage nach KI-Kenntnissen auf dem Arbeitsmarkt noch relativ gering ist (rund 2 % der IT-Stellenausschreibungen erfordern derzeit KI-Kenntnisse), zeichnet sich bereits jetzt ein Mangel ab. Länder mit Bildungssystemen, die nur langsam auf den sich ändernden Qualifikationsbedarf reagieren, und relativ wenig Nachfrage nach KI-Kursen in der Bevölkerung, haben möglicherweise Schwierigkeiten, genügend Personen zu finden, um den Einsatz von KI-Tools in der Weiterbildung auszuweiten. Es gibt verschiedene Möglichkeiten, wie Länder versuchen können, dieser Herausforderung zu begegnen, darunter: i) Sensibilisierung für die Nachfrage nach KI-Kompetenzen auf dem Arbeitsmarkt und die guten Beschäftigungsaussichten, die sie durch Berufsberatung für Jugendliche und Erwachsene eröffnen; und ii) die Aneignung von KI-Kompetenzen leichter zugänglich zu machen, beispielsweise durch gezielte finanzielle Anreize.

Schließlich **fehlt es bis heute an wissenschaftlichen Erkenntnissen** über die Wirksamkeit von KI-Tools in der Weiterbildung im Vergleich zu ihren nicht-KI oder menschlichen Alternativen. Ohne rigorose und belastbare Nachweise über die Wirksamkeit von KI-Tools in der Weiterbildung können politische Entscheidungsträger und Arbeitgeber bei ihren Entscheidungen über die Einführung oder Ausweitung des Einsatzes von KI-Tools für die Weiterbildung die Kosten dieser Tools nicht gegen ihren Nutzen abwägen. Bevor Ressourcen für die Ausweitung des Einsatzes von KI-Tools in der Weiterbildung bereitgestellt werden, ist weitere Forschung erforderlich. Das Verständnis der Wirkungsweisen dieser Tools muss verbessert werden um herauszufinden, ob der Nutzen der verschiedenen Tools den Kosten, Schäden und Herausforderungen überwiegt. Regierungen sollten daher langfristige öffentliche Investitionen in Betracht ziehen und private Investitionen in Forschung und Entwicklung in vertrauenswürdige KI-Tools für die Weiterbildung fördern, die besser sind als nicht-KI und menschliche Alternativen.

Glossary

Artificial Intelligence

The AI Group of Experts at the OECD has defined the Artificial Intelligence (AI) system as a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments. AI systems are designed to operate with varying levels of autonomy. AI system lifecycle phases consist of: 1) planning and design, data collection and processing, and model building and interpretation; 2) verification and validation; 3) deployment; and 4) operation and monitoring (OECD, 2019[2]).

Machine Learning

Machine Learning (ML) is a set of AI techniques that allow machines to learn in an automated manner through patterns and inferences rather than through explicit instructions from a human. Behind ML is a technique referred to as 'neural networks', which is accompanied by growing computational power and the availability of massive datasets, also known as big data (OECD, 2019[2]).

Natural Language Processing

Natural Language Processing (NLP) is a component of AI that enables machines to understand human language. By analysing the meaning of individual words, as well as the grammar that specifies the relationship between the words, NLP can extract meaning from large amounts of text and documents. When NLP is combined with ML techniques (also known as 'statistical NLP'), it becomes possible to identify the most likely meaning of a sentence or phrase (Nadkarni, Ohno-Machado and Chapman, 2011[3]). Common applications of NLP are automatic translations, grammar and spell check software, or automatically producing summaries of documents.

Big Data

The term "big data" refers to data that is so large, fast or complex that it is difficult or impossible to process using traditional methods (SAS, 2021[4]). Using AI, big data can be processed, analysed and summarised so that it becomes manageable and understandable for humans.

1. Introduction

1. Due to technological developments, particularly automation and digitalisation, the way we work is changing and this is reflected in changing skill needs in the labour market. On average, about 15% of today's jobs in the OECD could disappear due to automation, and another 32% of jobs could see significant change in the way they are performed (Nedelkoska and Quintini, 2018[5]). Additionally, recent developments in Artificial Intelligence (AI) are likely to reshape the work environment of many people, by changing the content and design of their jobs, the way workers interact with each other and with machines, and how work effort and efficiency are monitored. AI can play an important role in facilitating human-machine collaboration, helping workers in the execution of tedious or physically demanding tasks while allowing them to leverage their own uniquely human abilities (Lane and Saint-Martin, 2021[6]).
2. These changes and the speed at which they happen increase the need for adults to participate in learning activities throughout their working lives. However, many adult learning systems across OECD countries are unprepared for this task. For instance, adult participation in learning activities is relatively low, particularly for those who need training the most. Only four in ten adults participate in training each year on average in the OECD, and participation is as low as two in ten for low-skilled adults. People experience barriers to participation related to funding and time, or have low motivation to train. Moreover, training quality remains an issue and aligning training to labour market needs and individuals' career goals can be challenging. This highlights the need to improve adult learning systems across the OECD.
3. Based on a review of the relevant literature and discussions with various experts in the fields of AI and training, this working paper shows that, while technological developments such as AI are one of the major forces driving the need for retraining, they have the potential to also be part of the solution. Compared to humans or other technologies that are used for training, such as video-conferencing tools or internet-based training platforms, AI provides valuable opportunities to lower existing barriers to training participation by tailoring content or assessment, providing relevant training suggestions, or changing the overall learning experience. However, AI might also create entirely new barriers to training participation, for instance because people may be unprepared or afraid of using this technology, because smaller firms do not have access to the required data and technologies to develop or adopt AI for training, or because of ethical or even legal risks.
4. These are important and novel insights, because even though AI is not a new technology, its access, speed, availability and affordability has dramatically increased in the past decade. Many public and private employment services and (smaller) companies are only starting to consider the implementation of AI-powered systems, and for many workers it is a relatively new technology to encounter in the workplace. By shedding light on the potential opportunities and drawbacks of using AI for training, this working paper draws valuable messages for policymakers, public and private employment services and firms that are considering introducing AI tools in the training they offer.
5. Chapter 2 provides an overview of the different ways in which AI can be leveraged at each stage of the adult learning process, from the assessment of current or future skill needs and the matching of people to training that address those needs, to the design of training content and assessment,

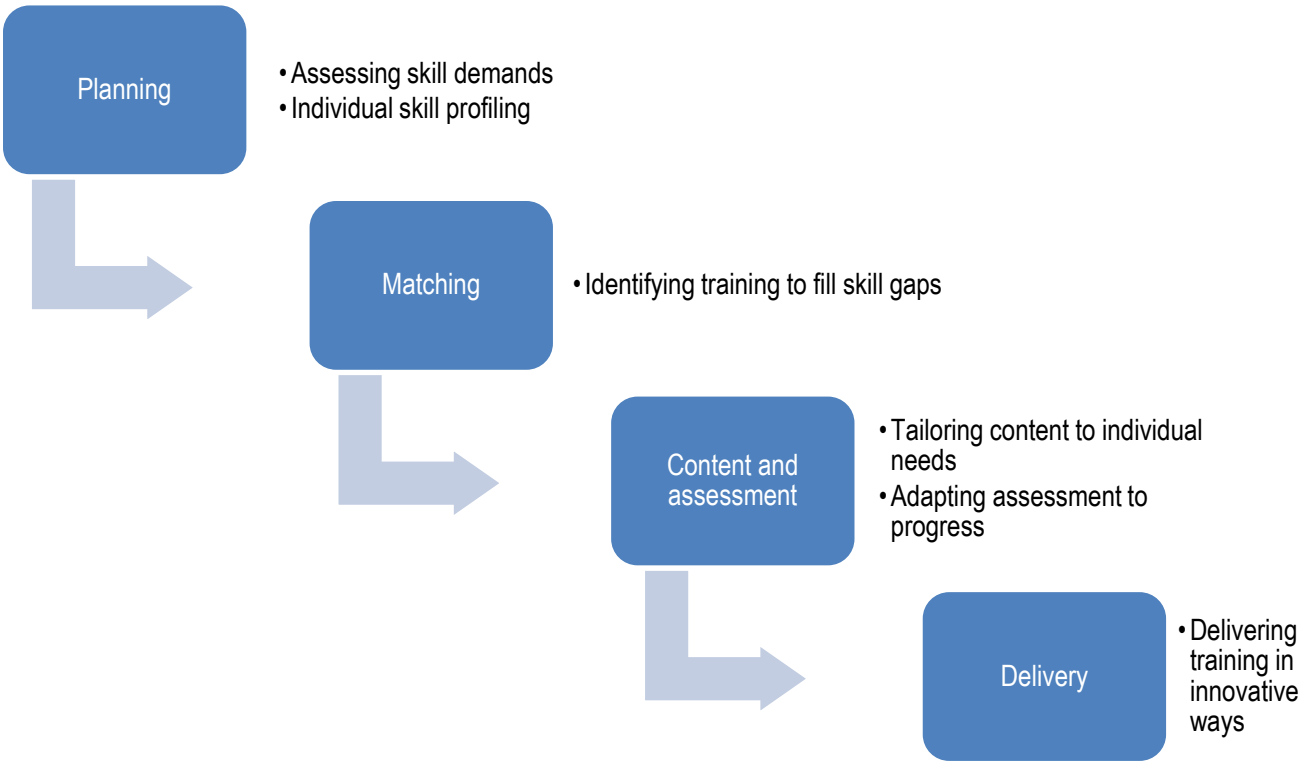
and the identification of innovative modes of delivery. Illustrated by concrete examples, Chapter 3 demonstrates how AI tools for training have the potential to help alleviate barriers to training participation and improve alignment of people's training and skills to labour market needs. Chapter 4 sheds light on potential challenges to be overcome in the use of AI for training in order to realise the benefits and ensure that using AI for training has beneficial outcomes for all. Chapter 5 concludes.

2. How AI can be used for adult education and training

This chapter describes the potential contribution of AI at each stage of the adult learning process. It discusses how AI may help improve the assessment of changing skill needs, sharpen the targeting of training, design content that is in line with individual skill gaps, address barriers to participation through novel delivery channels and continuously assess learning outcomes to achieve a personalisation of learning pathways.

6. AI has the potential to help improve adult learning in many different ways, intervening at different stages of the process (see Figure 2.1). In preparation for training provision, it can help assess skill demand by facilitating the analysis of emerging skill requirements up until the recent past through vast amounts of online vacancy data, and the analysis of skill supply through skills profiling tools. Once skill gaps between individuals' abilities and available jobs have been assessed, AI can help identify suitable training opportunities to fill those gaps. Thanks to AI, the content of training can be tailored to individual needs and continuously adapted to the progress achieved. Finally, AI can help deliver training in innovative ways, breaking physical and psychological barriers to training by providing safe environments for experimentation and trial and error. Each of these areas is described below, highlighting potential uses of AI and current applications.

Figure 2.1. The adult learning process: where and how AI may help



Source: OECD Secretariat.

2.1. Planning: using AI to assess skill demand and supply, and map training provision

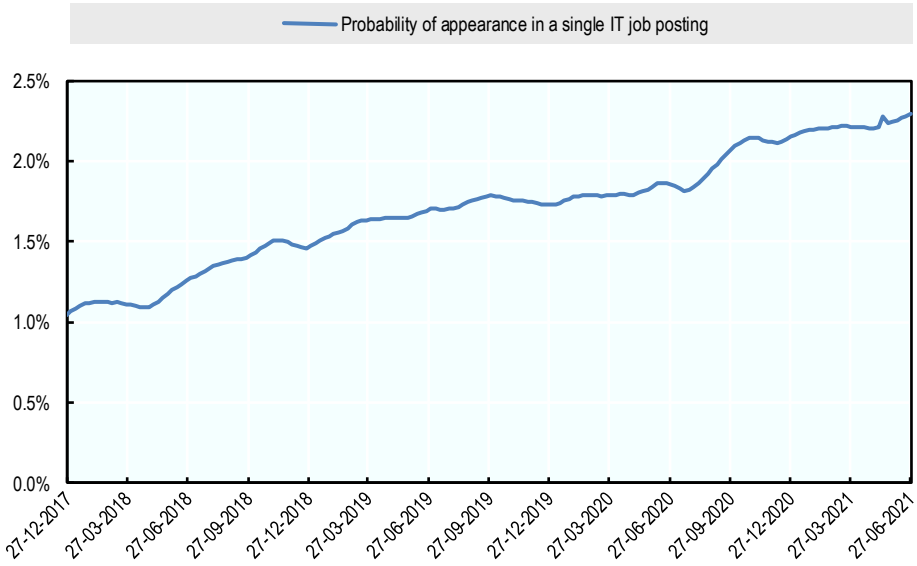
7. Training stands to fill the gap between the skills possessed by individuals and those required by the labour market. As structural trends change skill requirements at work, adults need continuous reskilling and upskilling. Individual skills can also deteriorate if left unused or become obsolete, calling for continuous upgrading throughout the working life. AI has the potential to keep track of changes on both sides, thus facilitating the assessment of training needs.

2.1.1. AI can help analyse emerging skill requirements…

8. Non-AI methods for the identification of changing demand for skills exist (Nedelkoska and Quintini, 2018[5]; OECD, 2017[7]), but using AI can automate and scale-up the exercise, providing more timely and granular information for narrowly defined occupations and geographical locations. For instance, AI can help recognise patterns in vast amounts of vacancy data to identify declining or emerging jobs up until the recent past. It can also automatically classify job descriptions into tasks or skills, which can be converted into an estimated risk of automation, based on previous research. When the data on emerging or declining occupations are combined with a mapping of skills in occupations, it also becomes possible to identify changing skill needs within occupations. Again, non-AI solutions for skills mappings do exist (e.g. O*NET, ESCO, or the UK Skills and Employment Survey) but AI can scale-up the exercise, for instance by automatically classifying vacancy texts into skill categories by occupation. AI can also increase timeliness in a context where job content is changing more rapidly than annual surveys or expert consultations can detect. For instance, by

applying a Machine Learning algorithm on vacancy data from 16 countries, OECD.AI (2021[8]) provides estimates of AI skill demand by week, up until about four months before publication (see Figure 2.2). People working in occupations where skill requirements are changing as a result of the introduction of new processes, products and technologies, can then be encouraged to participate in training that prepares them for the new demands of their profession.

Figure 2.2. Relative international demand for Machine Learning skills



Note: This line chart shows the probability that Machine Learning skills appear in an IT-related job posting within all countries in the database. The data provide a snapshot in time. Caution is advised when comparing different versions of the data, as the AI-related concepts identified by the Machine Learning algorithm may evolve in time. Please see methodological note for more information.
Source: OECD.AI (2021), visualisations powered by JSI using data from Adzuna.com, accessed on 25/10/2021, www.oecd.ai.

Box 2.1. Using AI to assess occupational prospects: Bakhshi et al.

Bakhshi et al. (2017[9]) use a mixed-methods approach to predict employment growth by occupation until 2030 in the United States and the United Kingdom. Their method combines expert human judgement with Machine Learning. First, during foresight workshops, panels of experts were invited to debate the prospects of 30 occupations, and label each occupation according to their view of its future demand prospects (grow, stay the same, shrink), as well as their level of confidence in their responses. This exercise was performed in three rounds of ten occupations. The first set of ten occupations was chosen randomly, but the subsequent sets of occupations to be labelled were chosen by an algorithm. Next, based on the information on the 30 labelled occupations and an existing skills-occupation mapping (O*NET), the researchers trained a Machine Learning classifier to generate predictions for all occupations and 120 skills. They predict that around 10% of the workforce are in occupations that are likely to grow as a percentage of the workforce. Particularly education, health care, and wider public sector occupations are likely to grow. Around 20% are in occupations that will likely shrink, and roughly 70% of people are currently in jobs for which predictions are too uncertain.

2.1.2. …and facilitate skill profiling

9. To plan training provision, the information on skill demand needs to be compared with an assessment of individual capabilities through so-called 'skills profiling exercises'. Skills profiling is often used by public and private employment services to compare jobseekers' skills against available jobs. In its simplest form, it consist of looking at people's level and field of formal education as well as their previous work experience. In more advanced systems, direct and indirect skill testing are also used. AI has the potential to improve skills profiling in several ways. Thanks to the ability to automatically categorise vast amounts of descriptions of education programmes and occupations into skill categories, AI has the potential to translate information on occupation and education background into a profile of individual knowledge, skills and abilities, which the individual can usually adjust as necessary (see Box 2.2). AI can also help integrate additional information with the potential to make predictions more precise. For instance, it can help categorise vast amounts of manually imputed text describing tasks carried out in everyday life or detailing content of non-formal training courses and feed the information into the adult's skills profile (see Box 3.5 in the next chapter). In summary, using AI might make it easier to build an individual's skill profile and compare it to the skills required in available jobs.

Box 2.2. Using AI to infer skills from job titles: Clustree

Using a career dataset with over 58 million job titles, including 80% that are unique, *Clustree* built Deep Learning networks to categorise textual content such as job descriptions or job ads into skills. They deduce complementary skills by analysing the skills other people with a similar job have, as well as the skills that are developed during the current position by analysing the skills of people with similar experience. This helps individuals build their skill profile based on their job and work experience. They can add or adjust the skills suggested by the algorithm as needed. Moreover, they may be directed to the jobs in their organisation that best match their skills, find the skills they may need to develop further to make the next step in their career, or receive training suggestions in the skills that are most commonly developed by people in similar positions. For employers, *Clustree*'s solutions facilitate workforce planning, career development and internal mobility, and discovering talent.

Source: https://www.clustree.com/.

2.2. Matching: using AI to map available training courses into skill units

10. Identifying appropriate training opportunities based on skill gaps requires a reliable mapping of what skills are developed in each training programme. This can be a particularly challenging task in countries with a very fragmented training market, characterised by a large number of training providers offering a wide variety of courses. AI can help structure this information, by automatically categorising (online) descriptions of training programmes into skill categories (see Box 2.3). It can then match individuals to training, based on their current or future skill needs. In several OECD countries, public and private employment services have started experimenting with using AI to match job seekers to jobs and training. In Korea, for example, an AI-powered job recommendation service called *The Work* analyses job seekers' CVs, their past training experience, any funding or grants already received, and their own areas of interest, in order to find relevant vacancies for them (OECD, 2021[10]; OPSI, 2021[11]). AI also enables an objective assessment of the quality of the match between candidates and jobs, e.g. as a share of skills in common.

Box 2.3. Using AI to provide tailored training recommendations: Boostrs

Using online descriptions of education and training programmes, *Boostrs* applies Natural Language Processing algorithms to transform the descriptions automatically into pre-defined skill categories, thereby creating a mapping of skills-to-training. They combine various existing repositories of job descriptions and skills in jobs (e.g. ESCO, O*NET, ROME) to create a comprehensive skills-to-jobs mapping. Combined, these two mappings inform users who want to change jobs about the skills they may need to improve or acquire, and what training programmes are likely to teach those skills. *Boostrs* also informs users which jobs best match their skills, and aims to facilitate job transitions by pointing users to relevant career paths, for instance by indicating which jobs are most similar to their current one in terms of skills. They can also analyse trends in job or skill demand and identify hard-to-fill positions within organisations, in order to inform hiring managers and policymakers about current and future skill needs.

Source: https://boost.rs/en/.

2.3. Training content and assessment: using AI to tailor content and adapt it to the user's progress

2.3.1. Overcoming the one-size-fits-all barrier through AI

11. Non-AI training typically requires all students to go through the same learning materials, irrespective of their abilities, preferences or learning styles. Even though many efforts for personalised learning exist, it remains practically impossible to adjust learning content to every individual student, due to limited human and financial resources. When training content is driven by AI, it can be adapted to the individual starting level and the progress achieved during the course. By linking content to assessments or reading time, for instance, AI can suggest skipping certain content, or providing additional learning materials when the student appears to be struggling.
12. Finally, AI-powered online platforms can provide relevant suggestions for learning content. This requires an analysis and automatic categorisation of the content, on the one hand, and of the individual's learning goals and preferences, on the other. The AI system may then recommend specific reading materials, webinars, videos, or training programmes that are tailored to the individual. There are various interesting examples of initiatives and experiments in formal education regarding personalisation of learning based on students' knowledge, progress or curriculum level (OECD, 2021[12]). Box 2.4 and Box 2.5 provide examples related to non-formal learning.

Box 2.4. Using AI to provide suggestions for training content: eDoer

While every education and training programme consists of learning content (e.g. reading materials, lectures or videos), learning content can also be provided irrespective of a specific programme, such as Open Educational Resources (OERs). *eDoer*, an on-going research project run by Technische Informationsbibliothek (Germany) and the University of Amsterdam (the Netherlands), aims to use AI to automatically extract topics from OERs, in order to provide relevant suggestions to individuals who want to acquire certain knowledge or skills.

The researchers collected over 100 online lectures related to Machine Learning, text mining and SQL language from Coursera and Khan Academy – two large online OER providers – as well as 550 educational videos from Youtube in the area of data science. Thanks to AI and speech recognition software, videos of online lectures and educational videos are transcribed automatically, and advanced Machine Learning techniques are used to extract topics from the video transcriptions. When users search for a topic they want to learn about, they automatically receive suggestions for related online learning content. In the current version, *eDoer* only provides content suggestions for data science related skills, but the researchers aim to apply their approach to other skills in the future.

Source: (Molavi, Tavakoli and Kismihók, 2020[13]).

2.3.2. Adapting training through continuous assessment

13. AI-based assessment makes it possible to adjust the type and difficulty of exercises to the individual's skills and progress. For instance, AI systems can provide additional exercises when the student shows difficulties completing them, or move on to other topics or exercises that are more difficult when the student shows they master the subject at a certain level. AI-based assessment thereby diverts from 'stop and test' assessments in which all students take the same 90-minute exam (Luckin, 2017[14]). Moreover, with AI-based assessment it becomes possible to track the steps taken towards the correct or false answer and analyse the response strategies, because the AI system can compare them to all potential steps and responses. This expands teachers' understanding of why a student fails certain tasks or questions, allowing them to adjust their teaching accordingly. However, the possibilities of AI-based assessment are not restricted to written tests. It is also possible to use AI for speech assessment such as in language training (see Box 2.5), or for expression analysis such as in soft skills training. Ultimately, using AI for training may imply that learning and assessment will merge.

Box 2.5. Using AI for adaptive language training: Duolingo

Duolingo is a language learning application that leverages AI to provide their over 300 million users with tasks that are tailored to their level and development. Users start out by taking a placement test. This test adapts the subsequent tasks based on whether the user has completed the previous one correctly and the difficulty of that task. As the user progresses through the placement test, the AI system refines its assessment of the language proficiency of the user. It can typically determine the user's initial language proficiency in less than five minutes. The placement test allows the more proficient users to skip the easiest tasks, thereby preventing them from dropping out due to under-stimulation.

Once the user starts the training programme at the determined level, AI not only determines which tasks should come next in order to increase proficiency, but it also determines the optimal time interval between task repetitions. Task repetition is important for retention when learning a foreign language, as recently learned or more advanced concepts may need shorter time intervals than basic language principles. AI-powered speech recognition also make it possible to assess the users speaking skills. Game-like features, challenges and reminders are built in with the aim to increase motivation. Since language learning in *Duolingo* is broken up into little exercises of about 5 to 15 minutes per day, the application provides flexibility for the users regarding when and where they learn.

Source: https://www.duolingo.com/.

2.4. Training delivery: innovative delivery channels powered by AI

14. An increasingly popular and affordable mode of training delivery is through extended reality. Training solutions that make use of extended reality are typically powered by AI. There are two main types of extended reality:

i) Augmented reality (AR), which merges the real and virtual world, allowing trainees to learn while looking at real objects surrounding them. For instance, by moving their tablet or smartphone in front of an object, the trainee's screen would show both the object and text, visualisations or sounds related to it. Trainees can also use eyeglasses that project the visualisations.

ii) Virtual reality (VR), which creates a fully immersive virtual environment. Standard VR systems use a headset that allows the user to look and move around and interact in a fully virtual world. The headsets usually provide auditory and video feedback. Some devices also provide haptic feedback.

Tools and technologies using both AR, VR and the real environment are typically referred to as mixed reality (MR). For instance, MR welding training lets students practice their welding skills by physically holding a (fake) soldering iron and applying it to a surface, while the video and audio feedback through the headset gives the student a realistic welding experience. Combined, AR, VR and MR training are referred to as XR training. Although AI is not strictly necessary to create XR training, it can make the learning experience more life-like and interactive. For instance, the use of AI in XR training enables the possibility to use voice commands, animations can respond in real time, information about objects can automatically pop up, and the user can use their hands to interact with the content.

15. AI-powered conversation agents, better known as chatbots, can answer work-related questions people would otherwise ask their colleagues (see Box 2.6). Chatbots are also increasingly used

within training programmes, where they can provide the student with relevant learning materials, quiz them to test their knowledge, or provide tips on how to solve a task. When the algorithm behind the chatbot is sophisticated enough, its questions and responses and the way it talks can seem so natural that it is similar to chatting with a human colleague or teaching assistant. By transferring knowledge, and in some cases learning content, chatbots have the potential to be a delivery channel of informal learning in the workplace that is more easily scaled-up than learning informally from humans.

Box 2.6. Using AI for informal learning: Bob the Bot

In many organisations, work-related information and knowledge is spread across various sources, making it difficult for employees to find the information they need, even when the question is relatively simple and frequently asked. This is particularly challenging for workers whose native language is different from the language at work. Sodexo's *Bob the Bot* is an example of how AI can help employees quickly and easily find the information they need in their own language, by starting a conversation with *Bob,* a chatbot which is currently available in 13 languages.

Initially implemented to guide the transition to a new performance appraisal structure, *Bob* gives Sodexo's employees a single point of entry for their questions on topics such as feedback, competencies, objectives, processes, or learning recommendations. The bot learns and enriches itself thanks to the questions sent by employees and the answers created by the platform administrators. It thereby serves as an enhanced FAQ platform, where – thanks to AI – the questions and answers are automatically and continuously updated and users are guided towards the answer they are looking for, even if their question is less frequently asked.

The developers have tried to enhance workers' feelings of engagement with the bot by making it more "human", e.g. by giving it a name and an avatar, teaching it to tell jokes from time to time and apologise when it makes a mistake. Since the introduction of *Bob the Bot*, the number of emails to HR and support staff has decreased significantly, freeing up time for them to focus on the questions that are more complex.

Figure 2.3. An avatar may help enhance workers' feelings of engagement with the bot

Photo credit © Sodexo.

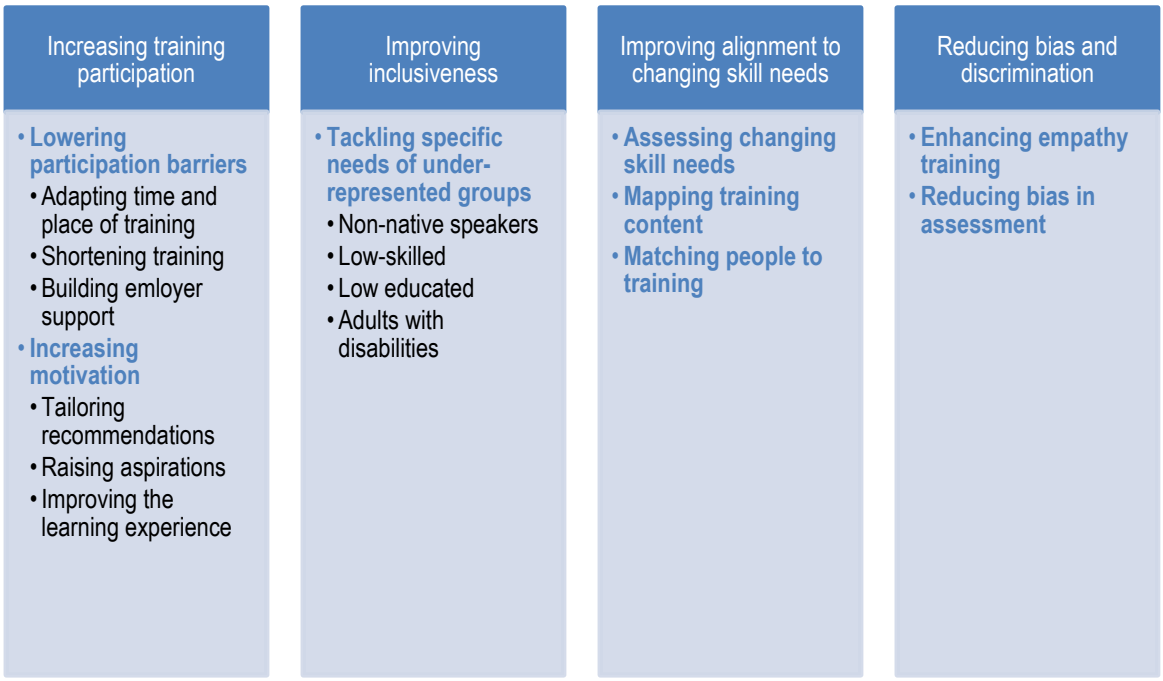
Source : Expert consultations.

3. How using AI for training may improve adult learning systems

This chapter presents the opportunities that AI brings about when it is leveraged to improve the adult learning process. More specifically, it discusses how AI has the potential to reduce some participation barriers, build motivation to train, and broaden access to vulnerable groups in the labour market. It also outlines how AI may make adult learning more effective by improving its alignment with changing skills needs. Finally, it highlights ways in which AI may help reduce bias and discrimination.

16. This chapter takes stock of the ways in which AI has the potential to help improve adult learning processes, breaking up its impact into the four major positive outcomes it may help achieve, namely: increasing training participation; making adult learning more inclusive; improving alignment to emerging skill needs and reducing bias and discrimination (see Figure 3.1).

Figure 3.1. AI's potential to improve adult learning systems



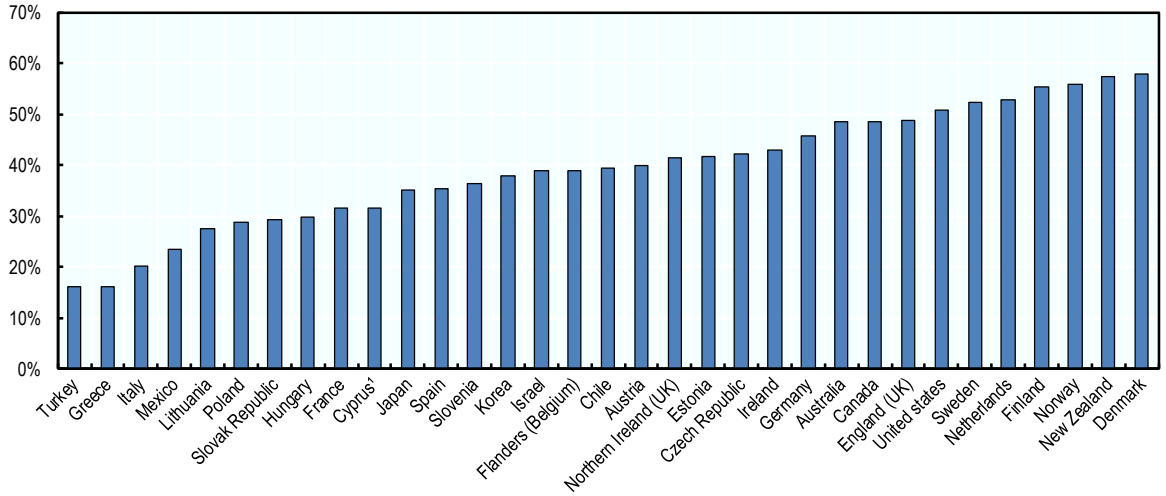
Source: OECD Secretariat.

3.1. Increasing training participation

17. Considering the fast-changing demand for skills on the labour market, adults will need to participate in learning activities throughout their working lives in order to remain productive and employable. However, despite the high urgency, adults' participation in learning activities is relatively low, particularly among vulnerable groups in the labour market. On average across OECD countries, 41% of adults participate in formal or non-formal job-related training in a given year but in some countries training participation is as low as 16% (see Figure 3.2). In order to close existing skill gaps on the labour market and prevent new ones from emerging, it is crucial to find effective ways to motivate more adults to participate in job-related education and training. AI tools for training have unique features that may lower existing barriers to training participation and increase motivation to participate in learning activities, particularly among currently underrepresented groups.

Figure 3.2. Adults' participation in learning activities

% of adults participating in formal and non-formal job-related learning in the 12 months before the survey

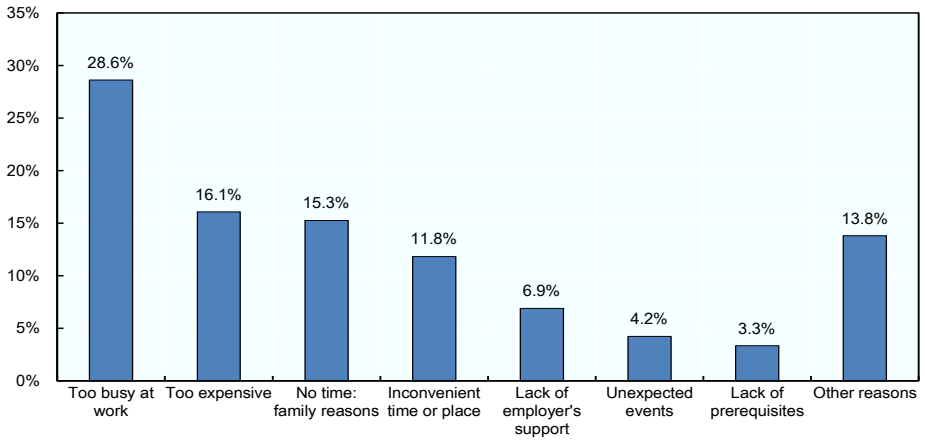


Source: Survey of Adult Skills (2011/12, 2014/15, 2017/18).

18. One in five adults who do not participate in training (11% of all adults) indicate that they actually wanted to participate in training, but did not because they faced barriers. That means that they do not necessarily lack motivation to train, but the opportunity for doing so. The most common barriers for training participation are shortage of time due to work (29%) or family reasons (15%), lack of financial resources (16%) inconvenient time or location of the learning opportunity (12%) and lack of employer's support (7%) (see Figure 3.3). Certain AI tools for training have the potential to lower some of these barriers, thereby increasing training participation.

Figure 3.3. Barriers to participation in adult learning

Reasons for non-participation (% of adults who wanted to participate but did not)



Note: Average across OECD countries participating in the Survey of Adult Skills.
Source: Survey of Adult Skills (2011/12, 2014/15, 2017/18).

3.1.1. Adapting time and place of training delivery

19. Training that is available at any moment during the workday or in an asynchronous manner (i.e., where there is no live interaction between students and instructors), and training that is available outside of the workplace or classroom, have the potential to attract non-participating adults who reported that training was delivered at an inconvenient time or place, who face time constraints or lack the support of their employer. 'Regular' (non-AI) online or distance learning addresses these barriers, by making training available at any place, and at any time (although the latter depends on the type of online learning). However, on average only 19% of adult learners takes part in non-AI online training (OECD, 2019[1]), and in some countries even less than 10% (OECD, 2021[15]). One reason for the relatively low participation in online or distance learning may be that there currently is a trade-off between having a teacher and fellow students to interact with in the online environment during class, and being able to follow the training any time you want. Interactive online learning still ties the individuals to a pre-defined timetable, and the asynchronous options consist of pre-set training files such as Massive Open Online Courses (MOOCs) that do not allow for any tailoring or interaction. AI has the potential to add value to asynchronous training where there is no live interaction, by replacing feedback from an instructor with chatbot functions. Another reason for the low use of online training programmes may be that they tend to focus on skills needed in white-collar jobs (OECD, 2020[16]). Using AI for training delivery can extend online training to crafts-related occupations and training involving a work-based component. Moreover, it allows for providing informal learning online (more on this below).
20. Job-related training for blue-collar jobs often includes a work-based component, which is not easily delivered through regular online training. The increasing use and availability of extended reality technologies opens up possibilities to provide online training to blue-collar workers as well.[1] The vast majority of examples of XR training for adults are designed for crafts-related occupations, such as mechanics, welders, or butchers, and in the manufacturing or transportation industry, such as car manufacturers or the aviation industry. Nevertheless, examples of XR training for soft skills also exist (see Box 3.1).

[1] Note that, although AI is not strictly necessary to create XR training, most XR training is powered by AI, because AI can make the XR learning experience more life-like and interactive.

Box 3.1. Using AI for soft skills XR training: VirtualSpeech

One example of a provider of VR soft skills training is VirtualSpeech, which combines e-learning with VR training and web-based simulations so students can learn from experience in realistic immersive scenarios. Their VR courses range from public speaking and job interview preparation, to business ethics and managing workplace stress. Students often complete a series of videos, quizzes, slideshows and case studies through the online platform before practicing what they learned with VR scenarios. Thanks to AI, users can receive instant feedback on their performance, including information about their eye contact, tone, volume and speaking pace.

The main difference with 'traditional' soft skills training such as e-learning modules or re-enacting scenarios with actors, is that the VR training decreases the cognitive effort needed to imagine how one would react in the real-life situation (Bertrand et al., 2018[17]). For instance, it can be hard to imagine how one would truly react in front of a crowd of hundreds or thousands of people; a scenario that would be very costly to replicate in real life, but that can be replicated in VR. Although the VR experience in this example may still not be identical to the one in real-life, it does reduce the cognitive effort of imagining facing a crowd. Moreover, the scenarios are more easily customised to the individual's specific learning goals. Yet, since the customisation does not depend on human trainers or actors, the quality of the training is the same for all students.

Figure 3.4. AI automatically provides objective feedback during VR soft skills training

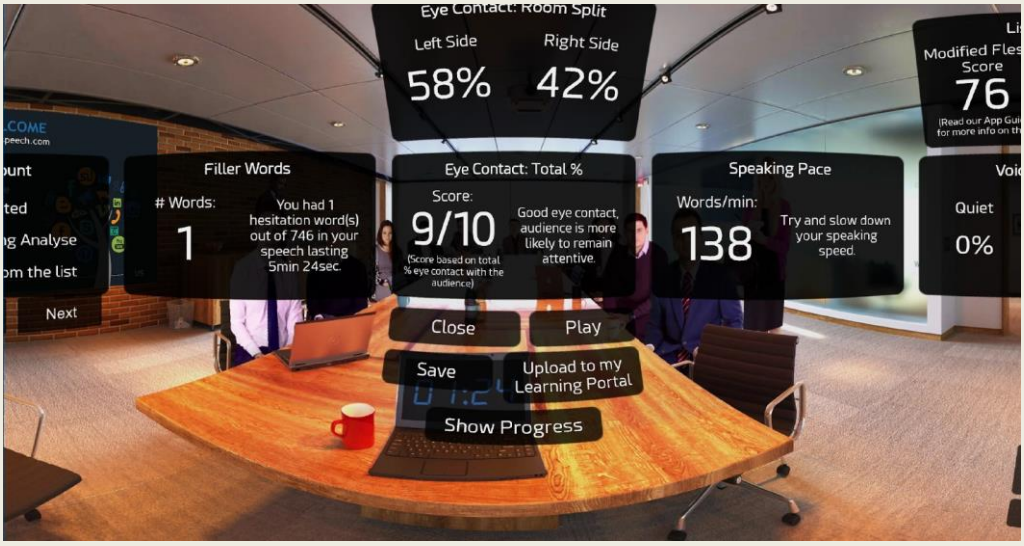


Photo credit © VirtualSpeech Ltd.

Source: (Beqiri and Barnard, n.d.[18]).

21. XR training makes it possible to participate in practice-oriented training online, meaning that, in theory, XR training is available outside of working hours and outside of the workplace or classroom. Although it appears that this type of training is mostly provided within the workplace, it does allow the individual to learn more flexibly than before. For instance, instead of registering for a course about a new type of machine engine on a fixed day and time, it is now possible to learn how the engine works and how to repair it at any time during the workday through XR. Moreover, by

providing training in a virtual rather than a physical environment, individuals can acquire skills through practice-oriented training in a completely safe environment where they cannot get physically injured (see Box 3.2). They thereby develop skills, muscle memory and confidence before applying their skills in the real world, which may prevent accidents. For people who suffer from fear of failure, the safe environment of XR training may have emotional benefits as well. Even though physical and emotional risks are not often mentioned as barriers to training participation, creating safer training environments, where errors and mistakes are seen as part of the learning experience, may motivate individuals to participate in training. In fact, the absence of physical and emotional risks are often mentioned as one of the biggest advantages of XR training provision.

Box 3.2. Using AI in XR training to eliminate physical risks: FLAIM

FLAIM is a fully immersive VR training for firefighters and first aid responders that allows them to learn how to fight fires in safe, realistic, dynamic virtual environments. AI makes it possible to mimic real fire behaviour including movement, smoke, water, foam and explosions. The virtual experience becomes even more life-like thanks to heat suits that replicate the likely temperature in each scenario, by tracking the individual's proximity and orientation to the fire. FLAIM Training can also replicate the force felt from the hose, and simultaneously measure the heart and respiration rate of the trainee.

Since VR fire training eliminates the physical risks students and trainers face during real-life training, it becomes possible to practice even the most dangerous scenarios, and as often as needed. Previous studies have shown that fire training alone constitutes a major portion of some firefighters' occupational exposures to smoke (Fent et al., 2019[19]). Moreover, VR fire training is environmentally friendly, as it has no carbon emissions, PFA discharge or water consumption.

Figure 3.5. AI mimics real fire behaviour during VR fire training

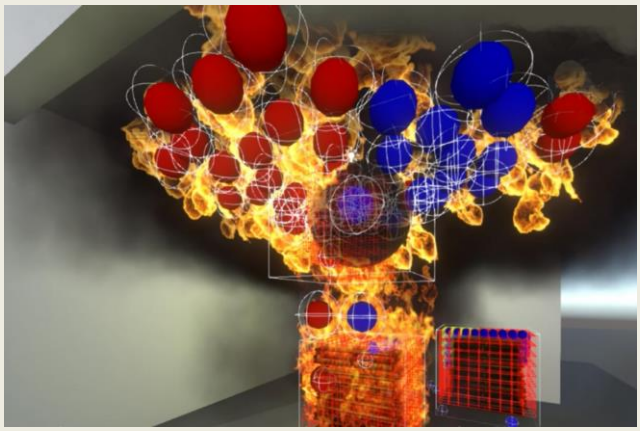


Photo credit © FLAIM Systems Pty Ltd.

Source: https://flaimsystems.com/; (FLAIM, 2020[20]).

22. Another way in which AI has the potential to extend the provision of online learning, and thereby participation in learning activities, is by expanding the opportunities for informal learning online. Traditionally, informal learning takes place during business hours in the physical workplace, because it includes learning from others, learning by doing and learning about new things at work. Informal learning is by far the most common form of learning in the workplace: it is estimated that

approximately 80 to 90% of all learning in the workplace is informal (Borghans et al., 2014[21]; Fialho, Quintini and Vandeweyer, 2019[22]). However, recent OECD calculations show that, due to the COVID-19 pandemic, the shutdowns of economic activities it caused in some sectors and the transition to remote working (teleworking) practices in others, workers' participation in informal learning could have decreased by as much as 25% (OECD, 2021[23]). Since the COVID-19 pandemic may catalyse a wider adoption of teleworking practices in the coming years (OECD, 2020[24]), there is a risk that access to informal learning will be structurally lower than before. AI tools for training delivery may be able to substitute some of the informal learning that is lost when working remotely. First, because XR training allow workers to learn by doing. Even when XR training is mostly provided in the workplace, it allows workers to engage in informal learning without depending on others' availability to teach them. Second, AI-powered chatbots can answer questions workers would otherwise ask their colleagues. Contrary to learning informally from others at work, chatbots are usually available any time and place, and to all workers at the same time.

3.1.2. Shortening the learning process

23. Time constraints of potential training participants can also be addressed through shorter training programmes or modules (OECD, 2019[1]). As discussed in the previous chapter, AI-powered courses and assessments allow the student to skip irrelevant tasks and modules, and only focus on the specific modules the individual needs in order to improve the skills they need for their current or future job. This potentially shortens the learning process. Moreover, AI systems, having learnt the user's strengths, weaknesses and learning preferences, can suggest training courses and modules that are most relevant for the employee. See Box 3.3 for an example.

Box 3.3. Using AI for assessment: Iris

An example of adaptive skill assessment based on AI is Pluralsight's Iris: an assessment algorithm used to measure the proficiency in technology skills, such as Java language, graphic design, or ethical hacking. A network of expert practitioners continuously develops and adds questions to a question database.

Each question served to the user is based on how the previous one is answered and its difficulty. Iris infers the user's skill level based on how they perform on the subsequent questions, and does so with increasing confidence. The assessment ends when a statistically meaningful confidence level about the user's skill is reached. Doing so, the AI system provides consistent results in very little time: users typically need 20 questions (10 minutes) to complete an assessment. The skill assessment score ('Skill IQ') is also benchmarked against other users, which gives the user insights into the skills for which they have a comparative advantage, and the skills they may want to develop further.

Iris is also used to provide a 'Role IQ'. A network including industry leaders continuously develops and updates roles (similar to occupations) and the skills associated to them. Based on how well other people in a given role have previously performed on a given skill assessment, Iris can model the required skill level for each skill in each role. When users select a role, they see the skills assessments related to them. If they completed these assessments, they see their score and how it compares to the required level for the role. A predictive Machine Learning model assigns the assessment score of the user to one of three levels, i.e. novice (1st-20th percentile), proficient (21st-80th percentile) or expert (81st and higher percentile).

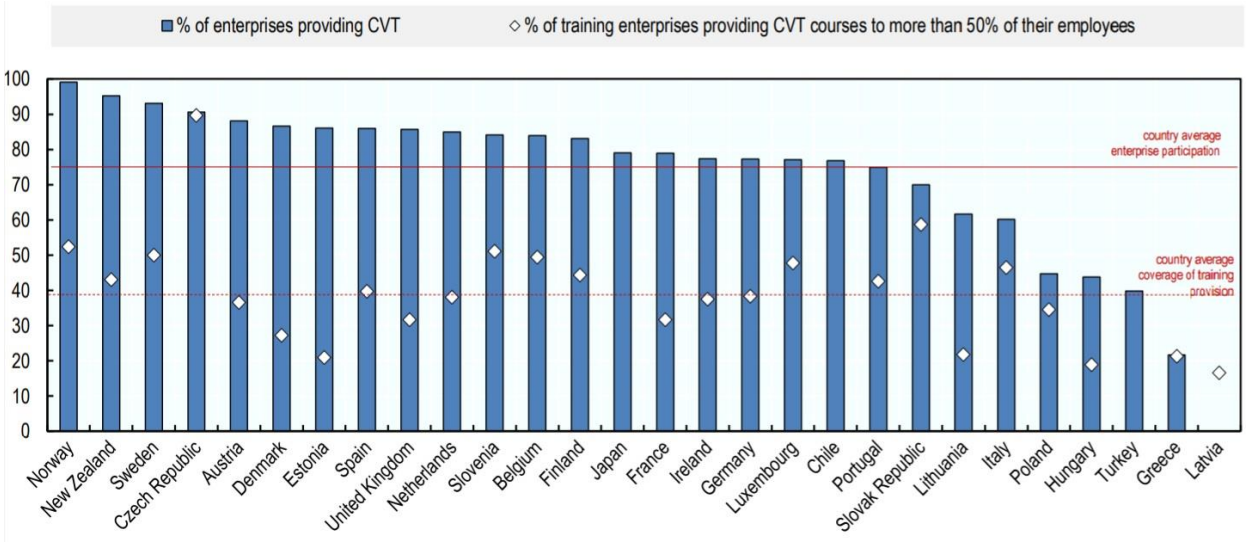
Source: https://www.pluralsight.com/product/iris?exp=2; (Pluralsight, n.d.[25]).

3.1.3. Building employer support

24. Although training participation increases productivity and profitability, only around 40% of firms with at least 10 employees provide training to the majority of their employees (see Figure 3.6) and 7% of adults who do not participate in training consider a lack of employer support the main reason for not doing so (see Figure 3.3 above). New evidence from 100 case studies from five OECD countries shows that lack of time is one of the most important reasons for employers not providing training to their employees, followed by training costs and negative attitudes of employees and managers (OECD, 2021[26]). AI tools for training may lower these barriers to training provision by employers, thereby increasing individual participation in training.

Figure 3.6. Participation of enterprises in the provision of adult learning

Share of enterprises providing continuing vocational training (% of all enterprises) and coverage of provision (% of training enterprises)



Note: Data for Chile refer to provision in the last two years, whereas data for other countries refer to provision in the last year. Excludes enterprises with less than ten employees; Data for Japan excludes enterprises with less than 30 employees. No data on coverage of training provision is available for Chile, Japan and Turkey; Latvian data on the percent of enterprises providing CVT was considered unreliable and was therefore excluded.
Source: (OECD, 2019[1])

25. As explained in the previous section, AI tools for training delivery, such as XR training and conversation agents, may give workers more flexibility regarding where and when they learn (during the workday). Moreover, these AI tools allow them to learn independently, meaning that they do not rely on the time and availability of fellow students, teachers or tutors. To some extent, AI-powered or -enhanced training provision therefore has the potential to reduce time constraints employers face when it comes to training provision.
26. AI tools for training also have the potential to reduce training costs for employers. First, using AI for training, particularly XR training, may reduce training costs by limiting the waste of raw materials and avoiding physical injuries during practice-oriented training (see Box 3.2 above). Second, it may reduce costs per participant by up-scaling training provision: compared to class-based training, AI-powered or -enhanced training can reach many more students at the same time. While non-AI online training allows for significant upscaling as well, AI-powered or -enhanced training has the advantage to allow up-scaling training that is tailored to the individual. Without the use of AI, providing individually tailored training to large groups of people would require significant investments in terms of time and money.
27. A third way in which AI tools for training may reduce training costs, is by making training participation more efficient. For instance, based on large databases on individuals' career moves, the type of training they participated in and several background characteristics, AI-powered career coaches are able to give tailored advice regarding which training to follow in order to reach a set career goal. Moreover, by running Machine Learning algorithms over descriptions of education and training programmes, it is possible to assess which training could be followed in order to fill certain skill gaps within the firm. Combined, these AI tools for training have the potential to improve the allocation of workers to training that best fit their specific skill needs, i.e. potentially improving the worker-training match, and reducing the risk of workers following the "wrong" training, by enhancing

human career and training advisors' training suggestions, and by guiding and empowering adults with limited access to human career counselling due to time, financial or institutional constraints to find the most relevant training for them.

3.1.4. Increasing individuals' motivation to participate in training

28. The vast majority of adults who do not participate in training (80%; equal to 49% of all adults) may not have been able to identify training that suited their needs or did not see value in training: they indicate that there was no training that they would have wanted to attend. Given its size, the inclusion of this group in training is crucial in policies attempting to increase participation overall. AI has the potential to motivate currently underrepresented groups in training, by providing tailored training recommendations and assessments, raising aspirations and improving the learning experience.

Tailoring training recommendations and assessment

29. One reason for people's lack of motivation to participate in training may be that they consider that the available training is not relevant for them or that they face difficulties navigating the available options. Since this does not necessarily mean there are no relevant training options available, providing information and tailored training suggestions may help to increase participation. With the help of AI, individuals can automatically receive tailored training recommendations, thereby avoiding having to browse through training catalogues in order to find the most relevant training for them, or scheduling a meeting with a career counsellor on a fixed day or time. Based on large databases on individuals' career moves (for instance delivered by public employment services), the type of training they participated in, and/or several background characteristics such as the educational and occupational history, AI-powered career coaches are able to give tailored advice regarding which training to follow in order to reach a certain career goal. The type of AI-powered career coaches that currently exist are either targeted at the individual, thereby significantly upscaling and expanding the availability of training and career advice, or to case workers in public or private employment agencies, with the aim of helping them more easily find the best training to help job seekers return to employment.
30. Not only do tailored training recommendations help individuals find the most relevant training, they also reduce the risk of participating in less relevant training, which could discourage people from participating in training again. The same holds for tailored AI-assessment, which allows the student to skip tasks and questions that are less relevant to them because they do not match their learning goals or their starting skills and competencies.

Raising aspirations

31. Personalised recommendations about career and training pathways may also help increase participation by raising aspirations. Some people may not participate in training because they are not aware of how this may help them progress in their career. Some AI-powered career coaches highlight the benefits of training participation, for instance by automatically providing an estimate of the potential wage increase after taking the suggested training, based on the user's background characteristics and the wage increase similar users experienced after participating in that training programme (see Box 3.4).

Box 3.4. Using AI to raise aspirations: Bob

Bob is an online career guidance tool that are provided free of charge by Bayes Impact, an international NGO whose mission is to leverage digital technologies to create a new generation of public services, and empower people at scale. The AI system behind *Bob* makes it possible that millions of people can receive tailored suggestions at the same time.

Bob leverages AI to empower people to navigate their job search, by providing them with a personalised action plan and coaching that aim to help them overcome their barriers to employment. *Bob* first asks its users several questions about themselves and their aspirations, such as their personal goals, what having a job means to them, and whether they have any diplomas or experience that may be relevant for their aspired job. Based on various data sources, including (amongst others) existing job classifications, vacancy data and data on job seeker pathways and employment outcomes, the AI system behind *Bob* provides several suggestions regarding the next steps the user may want to take in order to reach their personal goal. Those that may not yet have the necessary experience or diplomas are not only suggested to participate in training, but they also receive an estimation of the expected wage increase by doing so, as well as relevant training suggestions in their region.

Figure 3.7. The AI system behind Bob provides the probability of a wage increase by participating in training

Photo credit © https://us.hellobob.com/.

Source : Expert consultations.

Improving the learning experience

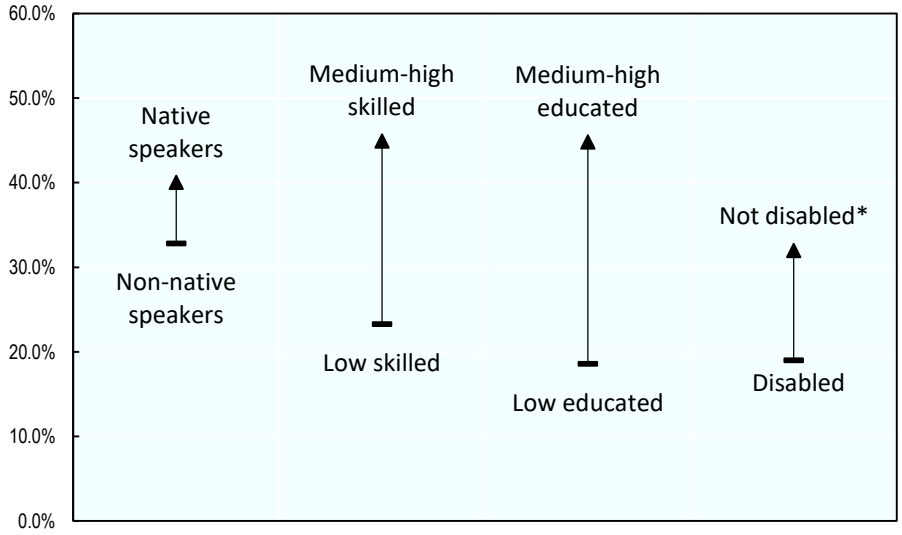
32. Some people who lack motivation to participate in training may find that the way in which training is delivered does not fit their needs and preferences. For instance, some are reluctant to participate in training in a classroom setting and prefer learning by doing. For them, AI-powered XR training might be a solution, since it provides practice-oriented training. Many XR training programmes also have badging and rewards systems for performing certain activities, which add a playful element to the training (i.e., gamification). It has been shown that providing instant feedback and rewards through badges, leader boards and performance graphs foster feelings of competence (Sailer et al., 2017[27]; van Roy and Zaman, 2018[28]; Rapp, 2017[29]).

3.2. Improving the inclusiveness of adult learning systems

33. Some groups of adults participate much less in adult learning activities than others. Across the OECD, participation levels in adult learning are particularly low for adults whose native language is different from the one of their country of residence, those who have low skill levels or low levels of educational qualifications, and those who are permanently disabled (see Figure 3.8). This is problematic since there is no reason to assume that their upskilling needs are lower than average. For some of these groups (particularly the low-skilled) the retraining and upskilling needs are likely higher than average. Evidence on the increasing demand for people with high skill levels as opposed with declining job opportunities for low- and medium-skilled adults abounds as routine tasks are automated or off-shored in advanced economies (OECD, 2019[30]).

Figure 3.8. Adults' participation in learning activities, by subgroups

% of adults participating in formal and non-formal job-related learning



Note: Average of OECD countries. 'Non-native speakers' are native or foreign-born individuals whose native language is different from the one of their country of residence (Survey of Adult Skills). 'Low skilled' are individuals who score at level 1 or below on literacy or numeracy (Survey of Adult Skills). 'Low educated' are individuals whose highest obtained qualification is at ISCED level 2 or below (Survey of Adult Skills). 'Disabled' are individuals who have a long-standing health condition or illness (EU-SILC). *These statistics are based on EU-SILC data, which does not cover all OECD countries.
Source: Survey of Adult Skills (2011/12, 2014/15, 2017/18); EU Statistics on Income and Living Conditions (EU-SILC) ad-hoc module (2016).

34. Certain AI tools for training have the potential to encourage currently underrepresented groups to participate in training, thereby improving the inclusiveness of adult learning systems. One way to engage currently underrepresented groups in training is by tailoring the programmes to these groups' specific needs. AI can help adjust tasks, assignments and suggested content to the individuals' needs in a way a human teacher often cannot, due to time and budget constraints.

3.2.1. Non-native speakers

35. Since XR training focuses on learning by doing, it has the potential to increase the inclusiveness of training provision for non-native speakers such as immigrants, who may find it difficult to read learning material and participate in the course in a foreign language. Other ways in which AI can

be used to engage non-native speakers in training is through its use in automatic translations. AI-powered technology that is similar to what is behind Google Translate and voice commands on smart phones makes it possible to translate reading materials as well speech automatically (i.e. a teacher explaining something). Moreover, AI can automatically classify foreign qualifications into skill categories, which may decrease one of the main barriers to employment of immigrants and refugees (see Box 3.5 below).

3.2.2. Low-skilled individuals

36. One of the reasons for the low training participation rates among low-skilled adults is that they find it more difficult to recognise their learning needs and hence are less likely to seek out training opportunities (Windisch, 2015[31]). According to data from the 2016 Adult Education Survey (AES), only 11.6% of adults with low skills looked for information concerning learning opportunities, compared to 35.5% of adults with high skill levels (OECD, 2019[30]). AI-powered career coaches may help individuals navigate available training programmes and select the ones that are most relevant for them. They can also provide advice on how to tackle barriers to participation, for instance by suggesting training programmes that are free of charge or available online (see Box 3.4 above for an example), or by directing them to adult learning policies they are eligible for, such as subsidies for training costs or training leave. Although human career coaches are able to perform a similar task, AI can scale-up the exercise, and help human career coaches select the most relevant training programmes for their clients.
37. Another reason why low-skilled adults may not participate in training is that fear of failure impedes them to participate (Fouarge, Schils and Grip, 2012[32]). AI-powered XR training provides a safe learning environment where students can – and are often even encouraged to – make mistakes without real-life consequences. This may be an effective way for people to overcome their fears.
38. Certain groups of adults, particularly those with low levels of literacy proficiency, may benefit from visualising learning content and acquiring skills through learning by doing. AI-powered XR training expands the availability of practice-oriented training. Moreover, AR has the potential to assist lower-skilled workers in order to perform tasks that higher-skilled or specialised workers would normally perform. For instance, instead of assigning a higher-skilled specialised worker to repair complex pieces of machinery, AR can guide lower-skilled maintenance workers through the performance of the same task. Although the individual does not necessarily perceive this type of work assistance as training, it certainly includes a learning element (i.e., non-formal or informal learning). AI-powered AR work assistance thereby has the potential to decrease existing skill gaps in high-skilled technical professions, as well as improve the employment opportunities of medium and lower-skilled individuals.

Box 3.5. Using AI to build skill profiles: SkillLab

SkillLab was founded in 2018 with the aim to develop technology-based solutions to help refugees integrate into local labour markets. One of the key barriers to the employment of refugees is the difficulty evaluating their skills, due to experience and qualifications from labour markets and education systems that may be very different from the host country and for which documentation may be missing. Moreover, refugees may find it hard to express their skills correctly in the host country's language. *SkillLab*'s app leverages AI with the aim to help refugees and others vulnerable groups overcome these barriers.

Based on a short questionnaire, the AI system automatically generates a skill profile that can be adjusted and completed as the job seeker sees fit. The questionnaire address the user's education and occupation history, as well as their experiences in daily life, such as doing maintenance work, doing groceries, or childminding. Machine Learning techniques and existing descriptions of education programs, occupations and activities, are used to categorise all experiences into skills. This not only ensures that the skill profile is as complete as possible, but it may also empower homemakers and long-term unemployed to (re-)enter the labour market. Moreover, the app is available in 27 different languages, allowing people to describe their skills in their native language and, with the help of AI, automatically translate that information to the host country's language.

Once the skill profile is complete, users receive AI-powered suggestions for occupations that best match their skills. A detailed description of the extent to which their skills match to each of the required skills in the occupations and benchmarking this to other users' matches, allows users to identify which skills they may need to develop further. Moreover, users can automatically generate customised CVs that are tailored to desired jobs.

Figure 3.9. AI provides suggestions for skills related to activities outside of work

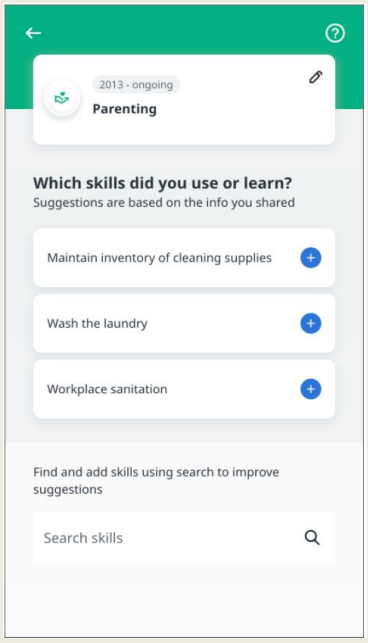


Photo credit © SkillLab.
Source : https://skilllab.io/en-us; (SkillLab, n.d.[33]).

3.2.3. Low educated individuals

39. Although the terms are often used interchangeably, being low educated is not necessarily the same as being low skilled. Low educated workers can face barriers to training participation because they do not have the required diplomas, even when they do have the skills to be able to participate. This is particularly problematic for people who have foreign qualifications that are not recognised in the country of residence. Therefore, recognition of prior learning may increase training participation of low educated individuals. With a certain margin of error, AI can automatically predict which skills people have, irrespective of their background and diplomas. For instance, by running NLP algorithms on education and training descriptions around the world, it becomes possible to assess which skills individuals without nationally recognised diplomas have. It also facilitates assigning skills to activities outside of work, such as cooking, cleaning, childminding, gardening or maintenance (see Box 3.5).

3.2.4. People with disabilities

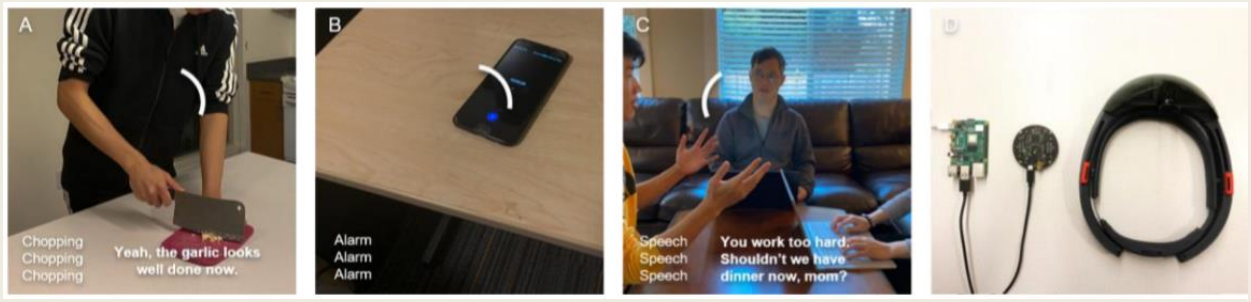
40. Not only is the training participation of people with disabilities relatively low (see Figure 3.8); those who do participate in training are much less optimistic about the effectiveness of training participation in terms of learning outcomes than those without disabilities, even when taking into account their labour market position (OECD, 2021[34]). AI has the potential to help increase the quality and accessibility of training for people with disabilities.
41. AI-powered text-to-speech technology facilitates training participation to the visually impaired who may otherwise not have access to the reading materials. Speech-to-text technology, on the other hand, may increase the inclusiveness of the hearing impaired. For instance, XR heads-up displays can provide users with real-time text captioning of conversations as well as other sounds, such as a phone ringing (see Box 3.6). Moreover, XR training and AI-based content and assessment increase the possibilities for distance learning, which can be helpful for those who are physically impaired (OECD, 2021[34]). For various examples of how AI and other technologies can assist children and adolescents with special needs, see (OECD, 2021[12]).

Box 3.6. Using AI to empower deaf and hard of hearing people: HoloSound

Aimed at people who are deaf or hard of hearing (DHH), *HoloSound* uses speech-to-text techniques to transcribe speech along with deep learning to identify non-speech sounds, as well as the direction of sounds. *HoloSound* overcomes many drawbacks of more common speech-to-text software, which is not always able to caption non-speech sounds such as someone knocking on the door or a fire alarm going off and requires the user to shift their focus away from the conversational partner or the environment to the captioning screen. For instance, when DHH adults want to learn about how a machine engine works with traditional software during practice-oriented training, they have to divide their attention between the teacher, their screen and the engine, whereas other students can listen to the teacher's explanation while inspecting the engine.

With *Holosound*, the captions of all sounds and their directions are displayed on *Microsoft HoloLens* AR glasses. This allows the user to see the real world with an artificial 'overlay', similar to subtitles: in this case captions and a circular arc to indicate the direction of the sound. *HoloSound* may thereby facilitate workplace integration as well as training participation of DHH people.

Figure 3.10. AI automatically captions sounds, their identity and their direction



Note: Panel A: Identification and captioning of speech and chopping sounds and their direction. Panel B: Identification and captioning of a phone alarm and its direction. Panel C: Captioning of multiple conversation partners and their direction. Panel D: AR headset and microphone array. Photo credit © (Guo et al., 2020[35]).

Source: https://makeabilitylab.cs.washington.edu/project/holosound/.

3.3. Improving the alignment of training participation to labour market needs

42. In order to reduce and prevent skill gaps on the labour market, not only is it important that people participate in training throughout their working lives, they also need to participate in training that helps them acquire the skills that are most in need. This requires high-quality detailed information about what skills are needed in the labour market, what training programmes teach those skills, and which groups of people need to be targeted for those programmes. AI can automate and potentially enhance some of these aspects.

3.3.1. Assessing and anticipating skill needs in the labour market

43. In order to improve the alignment of training to labour market needs, the first step is to know what the skill needs are in the labour market. Countries use a range of methods and tools to assess and anticipate their skill needs, including both quantitative and qualitative sources of information.

Traditionally, a common quantitative source of information is employer surveys that include questions about vacancies (OECD, 2016[36]). With the increasing availability of large amounts of vacancy data from online job postings, it becomes increasingly common to use AI to assess and anticipate skill needs. With the help of AI, researchers can identify which skills employers are looking for and whether skill needs change over time within and across occupations, by analysing job vacancy texts (see Box 3.7). Compared to similar non-AI exercises, the potential advantages of AI-driven skills assessment and anticipation analyses are that they are automated, scale-up, and that they provide more timely and granular information for more narrowly defined occupations and geographical locations.

Box 3.7. Using AI to assess and anticipate skill needs: Headai

Headai provides AI-enabled insights into the demand and supply of skills at the local, country, industry, or global level. They use AI to transform vast amounts of vacancy texts and job descriptions into skill categories, and predict current and future skill demand based on past labour market trends. Similarly, AI is used to assess skill supply, by categorising vast amounts of descriptions of education and training curricula into skills. By combining these two exercises, *Headai* can compare the skills produced in the education and training system to the current and future demand for those skills in the labour market, and provide suggestions for curriculum adjustments.

Besides skill needs assessments, *Headai* offers a wide range of other skills-related tools that are text-based, such as *Duunikoutsi* – a digital learning tool for children and adolescents. In the application, an AI-powered chatbot feeds the user tasks and challenges in the order that aims to increase motivation, and then gradually guides to dig into more challenging topics. The bot identifies the user's strengths and interests, with the goal of inspiring and engaging the user. The user learns to learn and to reflect on the learning outcome, as well as to find out what skills should still be practiced.

Figure 3.11. AI can transform curricula and vacancies into measures of skill needs

Photo credit © Headai.

Source: https://headai.com/; (Headai, 2020[37]).

3.3.2. Creating training-skills mapping

44. In most OECD countries, many different adult learning programmes exist, delivered by a broad range of providers, which makes it hard to find the training programme(s) that teach the skills in need. AI has the potential to help individuals navigate the jungle of training offers by using NLP algorithms on descriptions of education and training programmes, and transforming this into a training-skills mapping. See Box 2.3 and Box 2.4 in the previous chapter for examples of how AI

can be leveraged to automatically categorise education and training programmes into skill categories.

3.3.3. Matching people to training

45. Once skill needs have been analysed and the training programmes that teach those skills have been identified, the challenge is to connect this information to the relevant target group – e.g. people who need to acquire these skills because they need them in their current or future job. As discussed above, AI-powered training suggestions have the potential to incentivise people to self-select into the training programmes that will teach them the skills they need in order to remain employable. They may also assist PES caseworkers in placing unemployed individuals into training courses that are likely to increase their chances of long-term employment. Boxes 2.2, 2.3, 2.4, 3.3 and 3.5 all provide examples of how AI can be used to match people to jobs and training.

3.4. Reducing bias and discrimination in the workplace

46. OECD societies and workforces have become increasingly diverse over the past decades. For instance, in many OECD countries, female labour participation has grown significantly, employment rates of older workers are increasing, there are higher numbers of immigrants and people from ethnic minorities, and LGBTI people are more open about their sexual orientation and gender identity, making them more recognisable as a sizeable share of the workforce. Yet, these and other minority groups often struggle to find employment, and those that do are more likely to have lower quality jobs, or do not feel sufficiently included or respected in other ways (OECD, 2020[38]). AI-powered training has the potential to deliver training to enhance diversity and inclusiveness in the workplace as well as soft skills such as empathy and social perspective in a more impactful way.

3.4.1. Enhancing empathy training

47. One way to reduce bias and discrimination is to increase awareness of what kind of behaviour is (perceived as) discriminatory, and by eliciting empathy for marginalised groups through training. Due to its immersive nature and the possibility to create full body ownership illusions, AI-powered XR training provides the unique opportunity to experience situations through other people's eyes – literally (see Box 3.8 below). Although the practice of eliciting empathy by encouraging individuals to imagine others' perspectives is not unique to XR training (e.g., role playing games can be used for the same purpose), XR training significantly reduces the cognitive effort needed for these exercises (Bertrand et al., 2018[17]).

3.4.2. Reducing bias in teaching and assessment

48. Research has shown that when teachers grade exams, they may (subconsciously) favour students with socio-demographic characteristics – such as gender or nationality – that are similar to theirs (Feld, Salamanca and Hamermesh, 2016[39]). Automating the assessment of students through AI-powered adaptive assessments or through XR training may reduce bias in education and training. Reducing bias and discrimination in assessment may, in turn, motivate currently underrepresented groups such as women, migrants or disabled people to participate in training.

Box 3.8. Using AI in diversity and inclusion XR training: Equal Reality

The immersive learning experiences of *Equal Reality* allow the user to "walk a mile in someone else's shoes." By wearing a VR headset and initially being placed in front of a mirror in the virtual environment, a full-body experience is created: the user will feel like the character's body is their own. The character usually has a short bio and their characteristics depend on the learning goal of the course. Next, the user enters different scenarios depending on the course they take. For instance, learners of the "Unacceptable bias and behaviour" training enter scenarios in which they experience verbal abuse from colleagues and have their personal space invaded.

Thanks to the full-body experience, users can learn what it is like to experience discrimination or inappropriate behaviour, and identify bias when they see it. They can also practice making decisions in real time, and rehearse challenging conversations by experiencing the situation from the perspective of multiple people. The aim of *Equal Reality*'s immersive training programmes is to drive behavioural change and help prevent unacceptable behaviour through a better understanding of what it feels like to be the victim, and bystander intervention. Their off the shelf and tailored courses include (amongst others): reducing bias and discrimination regarding gender, race, LGBT+, culture or disability; sexual harassment; domestic violence and challenging conversations.

Figure 3.12. AI-powered VR empathy training creates a full-body illusion with the aim to enhance empathy

Photo credit © EqualReality.com

Source: https://equalreality.com/; (Equal Reality, 2021[40]).

4. Potential drawbacks of using AI for training and how they can be addressed

Despite its potential to address some of the barriers that adults face when approaching training, the use of AI for training could in fact raise other existing barriers and generate new ones. For instance, people may be unprepared or afraid of using this technology, smaller firms may not have access to the required data and technologies to develop or adopt AI for training, and there are important ethical risks. This chapter describes these potential drawbacks of using AI for training, and proposes ways in which they can be addressed.

49. The previous chapter showed that using AI for training has the potential to improve adult learning systems by increasing training participation and inclusiveness, improving the alignment of training to labour market needs, and reducing bias and discrimination in teaching, assessment and the workplace in general. However, despite its potential to address some of the barriers that adults face when approaching training, the use of AI for training could in fact raise other existing barriers and generate new ones. It is possible that using AI for training may increase inequality in access to training, it may significantly change the skill requirements in certain occupations, and there are important concerns regarding ethical and transparency issues. This chapter first discusses these potential drawbacks of using AI for training and how they can be addressed. Next, it shows how the expansion of AI tools for training is constrained by AI skills requirements and a lack of scientific evidence regarding the costs and benefits of AI tools for training.

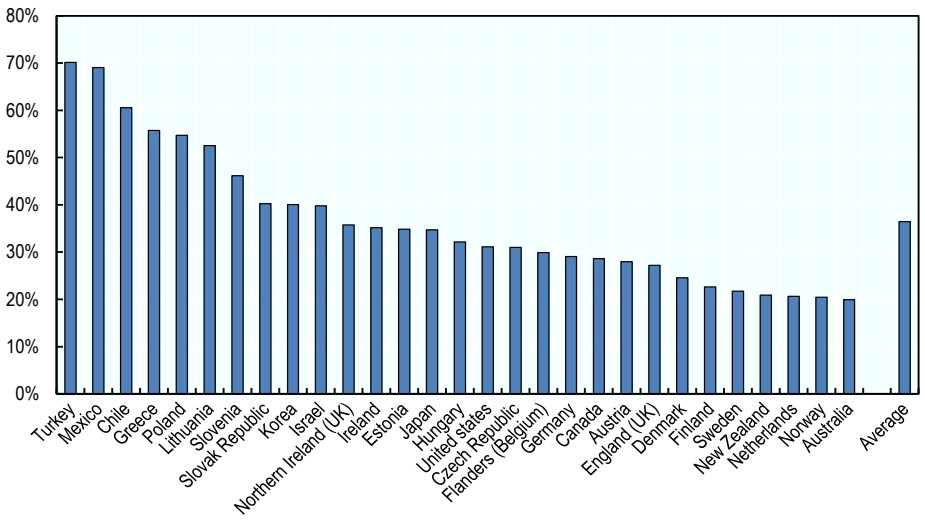
4.1. Decreasing the inclusiveness of adult learning systems

4.1.1. Limited access to AI tools for training for adults with low digital skills

50. In order to be able to use AI tools for training, it is crucial that adults have the skills that are needed to effectively work with or alongside them (i.e., 'skills for AI'). Skills for AI are unlikely to include the more advanced AI-related digital skills such as Machine Learning, but they may include basic digital skills, such as using a computer or filling in online forms. In some cases, skills for AI may include intermediate digital skills as well, for instance in order to be able to mount a VR headset or solve technical issues that arise during AI assessment.
51. Using AI tools for training or participating in training that is powered by AI therefore requires a higher level of digital skills than for instance participating in face-to-face instruction or receiving career advice from a human counsellor, or attending a non-AI online training course. For individuals with low levels of skills for AI, such as older adults and the low-skilled more generally – who are currently already underrepresented in adult learning participation (see Figure 3.8) – it may be hard if not impossible to use AI tools for training. Moreover, low skilled individuals may not be as well placed as their higher skilled counterparts to challenge wrongful outcomes of AI systems, which may increase their distrust (more on this in section Raising ethical below) and thereby decrease their probability to use of AI tools for training.
52. On average across OECD countries, more than a third of adults have low digital problem solving skills or have no experience with a computer (see Figure 4.1). The risk that AI tools for training decrease the inclusiveness of adult learning systems for adults with low digital skills is particularly prominent in countries with large shares of adults with low skill levels in these domains or with pre-existing low participation rates among these groups. Addressing this drawback requires upskilling initiatives for the low-skilled. The expansion of training programmes for digital skills is already high on the policy agenda in most countries. The delivery of more training through AI technologies would increase the urgency.

Figure 4.1. The share of adults with low digital skills

% scoring at level 1 or below on problem solving in technology-rich environments, have no experience with a computer, or failed ICT core

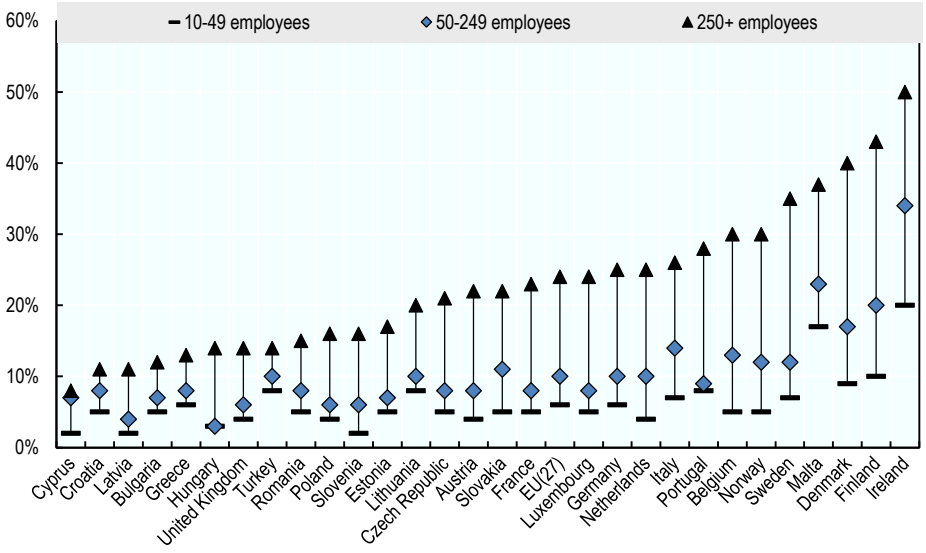


Source: Survey of Adult Skills (2011/12, 2014/15, 2017/18).

4.1.2. Increasing inequalities between large and small enterprises

53. Most AI tools require vast amounts of data and data storage, as well as powerful computers and access to high-speed wireless internet networks. Previous studies confirm that having access to sufficient amounts of (high quality) data (European Union, 2020[41]), as well as having a data or IT infrastructure and mechanisms for responsible data sharing in place (Centre for Data Ethics and Innovation, 2020[42]) can be challenging for employers who want to implement AI solutions. Moreover, companies that already have access to large amounts of high-quality representative data (e.g. multinationals and tech giants) are better placed to develop high quality AI tools. The higher quality products likely attract more customers, leading to even larger amounts of data. Companies without access to large amounts of high-quality data may develop AI tools based on lower quality or less representative data, leading to low quality or biased outcomes.
54. Another potential drawback of using AI for training is that, despite the fact that certain AI tools for training that are available free of charge do exist (see Box 3.4 for an example) the implementation costs of AI (cost of adoption and adapting operational processes, and a lack of external/public funding) are considered one of the two core barriers to the uptake of AI technologies, besides skills barriers (European Union, 2020[41]). The exact costs of AI depend on a variety of factors including the type of tool, the level of intelligence it uses, the performance of the algorithm, the complexity of the solution and the amount of data needed (AnalyticsInsight, 2021[43]). For instance, the software developer EON offers AR/VR solutions from USD 1 500 to up to USD 150 000, depending on their complexity (EON, 2021[44]). Specialised equipment (VR headsets and hand sensors) can be as costly as USD 350 per kit (OCULUS, 2021[45]).
55. Several experts acknowledge that implementing AI tools for training can be costly, particularly since custom solutions are often necessary due to specific requests of the client as well as to relatively few readily available (cheaper) off the shelf solutions. Moreover, successful implementation of the tools may require hiring or upskilling staff in order to have the necessary AI skills, which can be costly for employers. Nevertheless, experts expect prices to decrease as the supply of off the shelf AI tools for training is likely to increase in the near future. Moreover, even when more expensive custom solutions remain necessary, the benefits of the tools are likely to outweigh the costs. Yet, SMEs may continue to find it particularly challenging to afford investments in AI tools for training, which puts them at a disadvantage and could exacerbate already existing inequalities in access to training.
56. When these challenges are not overcome the use of AI tools for training and its benefits will be concentrated in a few companies and nations (OECD, 2019[2]). Indeed, Figure 4.2 shows that, across European countries, enterprises' use of AI is concentrated in the largest companies. In order to ensure that the access to AI tools for training is widespread rather than concentrated in a few companies or nations, appropriate mechanisms for sharing AI knowledge may need to be put in place (OECD.AI, 2021[46]). This may include sharing of data, code, algorithms, models, research, and know-how (e.g. open source tools and high-quality training datasets), while respecting privacy, intellectual property and other rights. Increasing the diffusion of AI technology will also foster competition, which may spur innovation. Additionally, funding initiatives could be targeted for enterprises that face more challenges when it comes to adoption.
57. Many OECD countries have introduced policy initiatives with the aim to encourage SMEs to innovate and adopt AI. Examples include Finland's *AI Accelerator*, the *SME 4.0 Excellence Centres* in Germany, Korea's *AI Open Innovation Hub*, Turkey's SME programme *KOBIGEL*, and Singapore's *AIMakerspace.* Additionally, the European Commission invested EUR 20 million to build the European Network of AI Excellence Centres (*AI4EU*), a European online platform that allows the exchange of AI tools and resources (OECD, 2021[47]).

Figure 4.2. Share of enterprises using AI, by size



Source: Eurostat (2020) *[E_CHTB ; E_BDAML ; E_BDANL ; E_RBTS].*

4.2. Changing skill requirements in jobs related to training and recruitment

58. The introduction of AI in training may change the skill requirements in jobs that are related to training quite significantly, including teachers and trainers but also Human Resource managers. In a context where reskilling adults in these jobs is perceived as too difficult or too expensive, the status-quo of human-managed and -provided training may be preferred.
59. As the previous chapter illustrates, using AI for training implies that AI can perform certain tasks that are traditionally human. For instance, teachers' and trainers' tasks to assess students' skills and design tests can also be performed by AI-powered XR training or AI-based assessment, and the task of a career counsellor or PES case worker to provide relevant training suggestions to job seekers can be performed by AI-powered online career guidance tools. Introducing AI tools for training may also increase the demand for digital skills in occupations related to training and recruitment.
60. The fact that AI is able to perform certain tasks that are traditionally human implies that time can be freed-up for other tasks. Although some of the freed-up time may need to be spent on using or interpreting the AI tools for training, time may remain for other tasks as well. Changing tasks requires a redesign of job content for teaching and career counselling professions, which is challenging if the current labour force does not possess the required skills. For instance, around 16% of teachers in Vocational Education and Training (VET) lack basic computer skills or have poor digital problem solving skills and around one in four do not feel confident using digital technologies in classroom teaching or for providing feedback to students (OECD, 2021[48]).
61. Compared to AI, humans are better placed to perform creative or higher cognitive tasks such as critical thinking or making decisions in complex situations (Holmes, Bialik and Fadel, 2019[49]). Moreover, although AI tools can be "humanised" (e.g. telling jokes or showing empathy), people may continue to want to be around and interact with humans, especially when they are facing difficulties or distress. In light of these comparative advantages, it would be advisable that, for instance, trainers and career counsellors use the time gained through AI tools for training to divide more attention to adults with more complex problems. This, in turn, would shift the focus of the skill

needs in these occupations towards higher cognitive and social skills. For some, this may require additional education and training.

62. Many national AI policies emphasise retraining for those displaced by AI, in order to ensure a fair transition as AI is deployed. For instance, Singapore has developed a guide to job redesign in the age of AI (IMDA and PDPC, 2020[50]), which emphasises the need for social dialogue about why there is a need to transform jobs, what will need to be transformed (including social dialogue about which tasks should remain human), and how the transformation will happen.

4.3. Raising ethical issues

63. Similar to the use of AI in general, and the use of AI for formal education (see (OECD, 2021[12]), using AI for adult learning can bring about important ethical issues. First, although the previous chapter showed that AI has the potential to reduce bias and discrimination in the workplace, there is a risk that AI also embeds and scales-up pre-existing human biases (OECD, 2019[2]), due to biased data that feed into the algorithms. Without the proper mechanisms in place such as human intervention and oversight, this could for instance imply that adults who are currently underrepresented in training participation will receive fewer or lower-quality AI-powered training recommendations than those who participate more often, thereby further increasing the participation gap.

64. Additionally, many AI systems are complex and difficult to understand and replicate. This lack of explainability and transparency makes it hard for the final users to challenge wrongful outcomes of AI, including algorithmic bias. In addition, the lack of explainability and transparency can discourage adults from undertaking training that uses AI. People are unlikely to (want to) start using AI tools for training when they do not trust that the tools are easy to use, that they provide high quality unbiased output that is easy to interpret, and that data are well protected and used in an ethical and fair way. For instance, the United States National Institute of Standards and Technology (NIST) has defined four fundamental properties for explainable AI systems (Phillips et al., 2020[51]): i) Explanation: AI systems should deliver accompanying evidence or reasons for all their outputs; ii) Meaningful: AI systems should provide explanations that are meaningful or understandable to individual users; iii) Explanation Accuracy: The explanation should correctly reflect the system's process for generating the output; iv) Knowledge Limits: The system should only operate under conditions for which it was designed or when the system reaches sufficient confidence in its output (OECD, 2021[47]).

65. Building trust in AI requires the development of trustworthy, human-centred AI. As set out in the OECD AI Principles, trustworthy AI systems benefit people and planet; uphold human rights, democratic values and fairness; are transparent and explainable; robust, secure and safe; and are operated by accountable entities (OECD, 2019[2]). Previous studies have found that employers consider a lack of rules and regulations around AI a key barrier to trustworthy AI deployment (Centre for Data Ethics and Innovation, 2020[42]; European Union, 2020[41]). One way to encourage the development of trustworthy AI tools for training is therefore to put clear laws and regulations in place regarding data and privacy protection. These could also include accountability mechanisms for outcomes of AI, and robust metrics for performance. For instance, the European Commission has stated that AI technology used in educational and vocational training and those used for employment, workers management and access to self-employment (e.g. CV-sorting software for recruitment procedures) are high-risk AI systems that will therefore be subject to strict obligations before they can be put on the market. These obligations could include an adequate risk assessment and mitigation systems; high quality of the datasets feeding the system to minimise risks and discriminatory outcomes; logging of activity to ensure traceability of results; detailed documentation providing all information necessary on the system and its purpose for authorities to

assess its compliance; clear and adequate information to the user; appropriate human oversight measures to minimise risk; and high level of robustness, security and accuracy. The regulation could enter into force in the second half of 2022 in a transitional period (European Commission, 2021[52]).

66. Another way to build trust in AI is to increase public understanding of what AI can and cannot do, and to be transparent about when it is being used. The latter is particularly important, considering that many people are not aware that they are using AI-powered tools (Pega, 2017[53]). Increasing public understanding also includes understanding how specific AI tools work, i.e. how they reach certain outcomes and why. This does not necessarily include access to codes or datasets, which are often too complex and subject to intellectual property, but it does imply that AI tools for training need to be explainable and transparent. For instance, Finland's AI strategy sets the goal to educate the entire nation with basic AI – including people who are employed and the elderly – to build "civic competence". Finland's *Elements of AI* programme is a ten-hour Massive Open Online Course that seeks to ensure that all citizens have a basic understanding of AI. While Finland initially targeted the training of 1% of its population, the course attracted more than 100 000 participants, representing more than 2% of the population. This course is now provided in several official languages in the EU and will soon be in all of them. Another course on the Ethics of AI was launched in Finland in November 2020 (OECD, 2021[47]).
67. Many OECD countries have introduced guidelines for trustworthy explainable AI that are largely in line with the OECD AI Principles. Other examples include Australia's *AI Ethics Framework*; Belgium's online self-assessment tool to foster trustworthy AI specifically tailored to the public sector; Colombia's *Ethics Framework for Artificial Intelligence*; Hungary's *AI Ethical Guidelines*; Japan's *AI R&D Guidelines and AI Utilisation Guidelines*; and Scotland's *AI explainability framework*. At the EU level, the European Commission's independent AI High-Level Expert Group (AI HLEG) introduced *Ethical Guidelines on AI* in December 2018 (OECD, 2021[47]).

4.4. Barriers to the introduction and expansion of AI tools for training

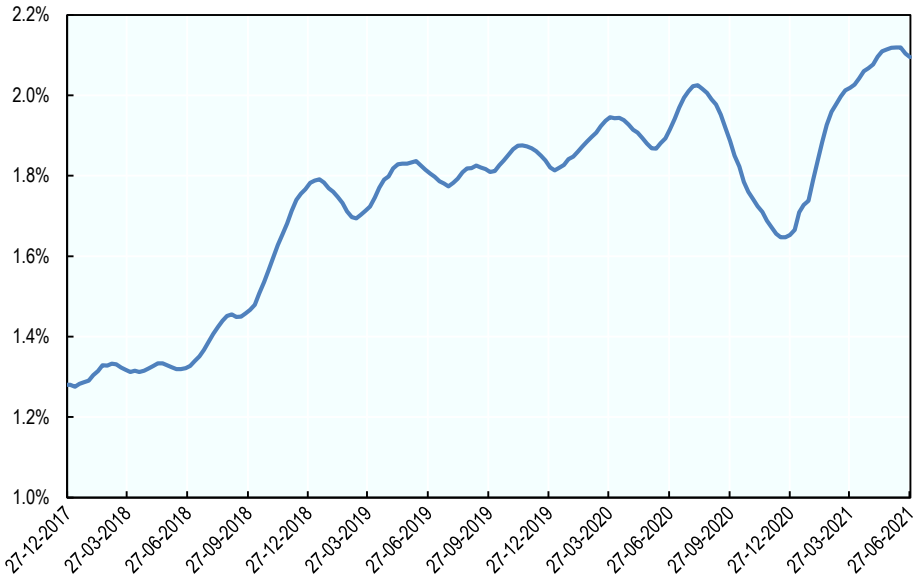
68. Assuming that the above-mentioned drawbacks can be addressed, expanding the use of AI tools for training is constrained by the supply of AI-specific digital skills needed to develop the tools (e.g. *Machine Learning, Data Structures* or *Natural Language Processing* skills). Additionally, policymakers and employers may be reluctant to adopt AI for training purposes when it is not (yet) proven that the potential benefits are met and that they are cost effective. This section discusses these barriers to widespread AI adoption for training in turn.

4.4.1. Having a sufficient supply of AI skills

69. In order to successfully develop AI solutions, employers may need workers with AI-specific digital skills ('AI skills'). The most prevalent AI skills include *Machine Learning, Data Structures, Deep Learning, Natural Language Processing,* and *Computer Vision*. Across OECD countries the demand for AI skills is increasing, and even though the demand is still relatively small (around 2% of IT job postings currently require AI skills: see Figure 4.3), shortages are already emerging in a subset of these skills, notably in *Programming, Big data management* and *Machine Learning or modelling* skills (European Union, 2020[41]). Using "off the shelf" AI tools for training instead of tailored ones may help reduce skill shortages, but even off the shelf solutions require a minimum level of AI skills in order to be implemented correctly.

Figure 4.3. Relative international demand for Artificial Intelligence skills

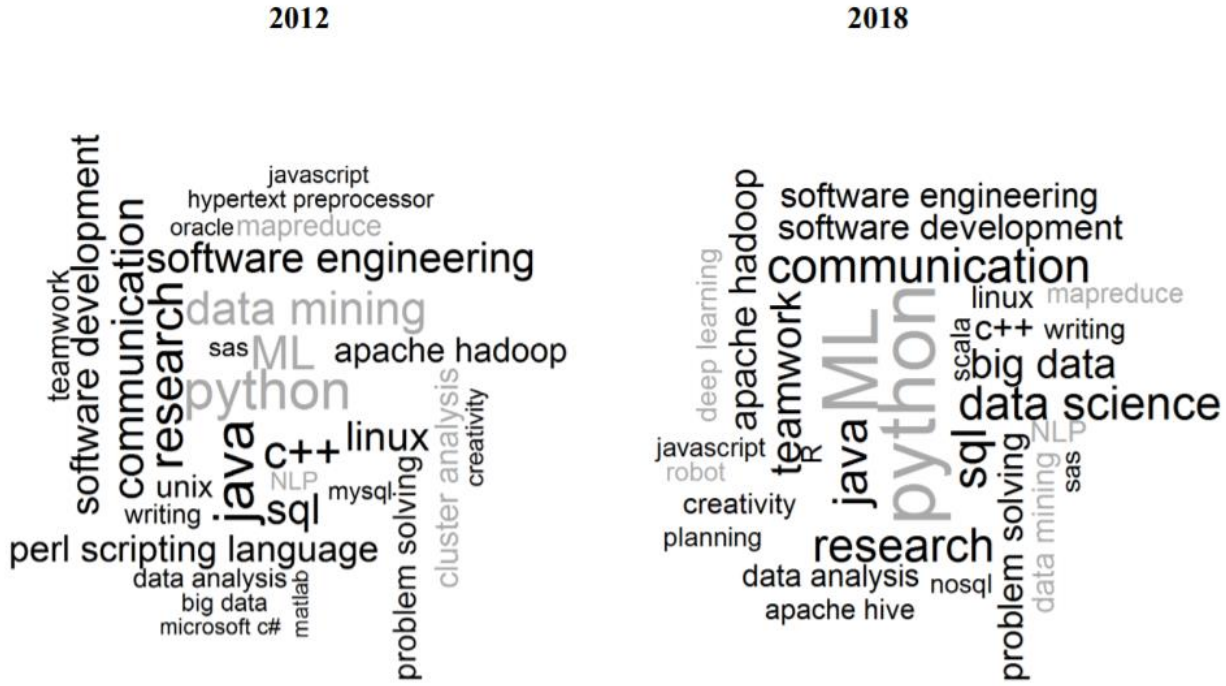
Probability of appearance in a single IT job posting



Note: This line chart shows the probability that the AI skill 'Artificial Intelligence' appears in an IT-related job posting (average across the OECD countries included in the database). The data provide a snapshot in time. Caution is advised when comparing different versions of the data, as the AI-related concepts identified by the Machine Learning algorithm may evolve in time. Please see methodological note for more information.
Source: OECD.AI (2021), visualisations powered by JSI using data from Adzuna.com, accessed on 27/10/2021, www.oecd.ai.

70. Several studies on opportunities and challenges of AI conclude that a lack of staff with appropriate skills is one of the key barriers to AI deployment (Centre for Data Ethics and Innovation, 2020[42]; European Union, 2020[41]; McKinsey, 2018[54]). Countries with education systems that are relatively unresponsive to changing skill needs and with relatively few people willing to enrol in AI skills courses may struggle to find enough people with AI skills to successfully expand the use of AI tools for training. Increasing the supply of AI skills starts in initial education, but it should continue throughout the working life, since the definition of AI skills is likely to change over time. For instance, Figure 4.4 below shows that, even within the relatively short time period of six years, the demand for Machine Learning and python skills has gained in relative importance in AI-related jobs, whereas data mining skills have lost relative importance.
71. In Korea, the Ministry of Science and ICT established the *ICT Innovation Squares* in Seoul and 13 regions. These Squares offers working-level AI education programs in conjunction with regional industries. 600 professionals from 6 industry domains participated in this programme in 2020, and industry domains were expanded to 12 areas in 2021 (OECD, 2021[47]). Other policy initiatives to increase AI skills include: establishing formal education programmes on STEM and AI-related fields (Australia, Finland, Turkey, United Kingdom, United States); devising vocational training and lifelong learning on AI-related programmes to help citizens keep up with technological and societal changes (Finland, Singapore); providing financial and non-financial support to retrain and attract top AI talent (Belgium, Canada, Turkey, United Kingdom); fostering academic partnerships between public and private AI research institutions (Chile, Egypt, Korea, Germany, Turkey); and monitoring the impact of AI on the labour market for policy intervention (Germany) (OECD, 2021[47]).

Figure 4.4. Top 30 skills demanded in AI-related jobs



Note: The size of the skill-related keywords in the word cloud represents the relative (i.e. quantitative) importance among the top 30 skills in the given year. The scale of the size relation between the most and least frequent skill plotted, is the same across both word clouds. The absolute values of word sizes on the other hand do not provide a mean to compare frequencies across word clouds or years. The largest word in each word cloud indicates the most frequent skill, relative to all other skills in the given top 30 distribution. Keywords in grey present AI skills. In 2012 and 2018, the frequency of the top 30 skills accounts for around 32% and 34%, respectively, of the frequency of all skills.
Source: Squicciarini and Nachtigall (2021[55]).

4.4.2. Limited scientific evidence

72. Without rigorous and robust evidence about the effectiveness of AI tools for training, policymakers and employers cannot make informed decisions that weigh the costs of these tools against their benefits. However, to date there is only a limited set of scientific papers addressing the question whether AI tools for training are indeed significantly better than their non-AI or human alternatives. For instance, Pricewaterhouse Coopers recently conducted an experiment where they evaluate the effects of an in-house designed VR soft skills training module on inclusive leadership for new managers, compared with the equivalent in an e-learning or classroom-based setting. They found that, compared to e-learners and classroom-learners, those who took the training in VR ('v-learners') were more focused and emotionally connected to the content during training, they completed the module faster, and they were more confident to act on what they learned after training. On top of those benefits, v-learning was estimated to be more cost-effective than classroom or e-learning modalities when delivered at scale (PWC, 2020[56]). Another example is the study by (Vanlehn, 2011[57]), who reviewed experiments comparing the effectiveness of human tutoring, computer tutoring, and no tutoring. He finds that, contrary to common belief, there is no significant difference between intelligent tutor systems and human tutors in terms of their effectiveness. A Danish study shows that two-thirds of students from social and healthcare programmes who used VR for training find VR a good supplement for regular teaching, and that 43% found learning outcomes to be better than in regular classes (Videnscenter for Velfærdsteknologi, 2020[58]).

73. Public and private investments may be needed to encourage researchers to conduct more evaluations on AI tools for training. For instance, many OECD countries are starting to consider experimental models or co-regulatory approaches. These approaches aim to allow experimentation to better understand the effects of AI systems and provide controlled environments to facilitate the scale-up of new business models. These take place in parallel to regulatory approaches that help create a policy environment that supports the transition from research to deployment of trustworthy AI systems. Other countries have established AI centres of excellence to strengthen AI research capabilities and to create interdisciplinary research communities. (OECD, 2021[47]).

5. Conclusion

74. AI has the potential to improve adult learning systems. This is necessary, because the way we work is changing rapidly, and yet only four in ten adults across the OECD participate in education and training in any given year, and these numbers are even lower for vulnerable groups on the labour market. Moreover, training quality remains an issue, and aligning training to labour market needs and individuals' career goals can be challenging. In this context, AI can improve significantly on other technology-powered training solutions and, in some case, it can also improve on some aspects of human-provided services.
75. When AI is used for training, it can intervene at different stages of the adult learning process. In preparation for training provision, it can help assess skill demand by facilitating the analysis of emerging skill requirements up until the recent past through vast amounts of online vacancy data, and the analysis of skill supply through skills profiling tools. Once skill gaps between individuals' abilities and available jobs have been assessed, AI can help identify suitable training opportunities to fill those gaps. Thanks to AI, the content of training can be tailored to individual needs and continuously adapted to the progress achieved. Finally, AI can help deliver training in innovative ways, breaking physical and psychological barriers to training by providing safe environments for experimentation and trial and error.
76. Drawing on a review of the relevant literature and discussions with various experts in the fields of AI and training, this working paper takes stock of the potential opportunities and drawbacks of using AI for training. By doing so, it draws valuable messages for policymakers, public and private employment services and firms that are considering introducing AI tools in the training they offer.
77. Using AI for training has the potential to increase training participation, including among currently underrepresented groups, by lowering some of the barriers to training people experience and increasing training motivation. Moreover, certain AI solutions for training may improve the alignment of training to labour market needs, and reduce bias and discrimination in the workplace. Nevertheless, the potential benefits of AI tools for training notwithstanding, there are also important potential drawbacks of using AI for training, such as the risk of decreasing the inclusiveness of adult learning systems due to the digital skills that are needed to use the tools, and the large amounts of data and high-quality technological infrastructure needed to develop AI tools. Using AI for training may also lead to significant changes in skill requirements in jobs related to training and recruitment. Moreover, AI brings about important ethical issues.
78. Realising AI's full potential and ensuring that using AI for training has beneficial outcomes for all, requires more research and policies that address the need for digital skills, the costs of adoption, and the development of trustworthy, human-centred explainable AI tools for training. Indeed, many OECD countries have already started to introduce policy initiatives to expand training programmes for digital skills (including but not limited to AI skills); encourage SMEs to innovate and adopt AI; offer retraining opportunities for those displaced by AI; provide guidelines for trustworthy explainable AI that are largely in line with the OECD AI Principles; and facilitate experimental models or co-regulatory approaches to formally test and better understand the effects of AI systems. Considering that, when AI is used for training, it may determine the professional course of someone's life, it would be advisable that future policy and research pay special attention to AI applications in this domain.

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