Ten Facts About Artificial Intelligence in Teaching and Learning

01 Artificial Intelligence (AI) is about computer systems that imitate human behaviour

AI in the broadest sense refers to computer systems that undertake tasks usually thought to require human expertise. Apple's Siri voice assistant, Amazon's shopping recommendations, Uber ride sharing, and Google translate are examples of how AI has entered our daily lives. It is now having an impact on higher education too. There is no universally agreed-upon definition of AI, however, here are links to some representative ones:

- EDUCAUSE - Artificial Intelligence in Teaching and Learning - https://library.educause.edu/~/media/files/library/2017/4/eli7143.pdf
- A Brief History of AI - https://aitopics.org/misc/brief-history
- Intelligence Unleashed: An Argument for AI in Education - https://www.pearson.com/content/dam/one-dot-com/one-dot-com/global/Files/about-pearson/innovation/Intelligence-Unleashed-Publication.pdf
- What is Artificial Intelligence? An Informed Definition - https://www.techemergence.com/what-is-artificial-intelligence-an-informed-definition/
- Wikipedia - https://en.wikipedia.org/wiki/Artificial_intelligence

02 AI is paving the way for personalized, adaptive learning

The long elusive goal of designing learning systems to adapt to individual student aptitudes, needs, and prior knowledge is now achievable with AI. These adaptive learning systems build on a student's prior learning to shape pathways for current learning and provide guidance on future learning directions. Here are some examples of adaptive learning systems now in use:

- Critical thinking skills and scientific reasoning taught in game-like environment with ARIES at University of Memphis - https://sites.google.com/site/ariesits/
- AutoTutor, an intelligent tutoring system that engages in natural language conversation with students - http://ace.autotutor.org/IISAutotutor/index.html
- University of Central Florida's PAL team supports faculty use of personal adaptive learning systems - https://cdl.ucf.edu/services/instructional/personalized-learning/
- IBM - Pearson partnership to provide natural language tutoring with the Watson supercomputer - https://www.ibm.com/watson/education/pearson
- Carnegie Mellon University's RoboTutor intelligent system for teaching basic literacy and mathematics skills - https://er.educause.edu/blogs/2017/11/k20-series-robotutor-team-aims-to-help-250-million-children-in-developing-countries

03 AI is enabling advising systems that enhance the student experience

AI is now enabling higher education institutions to provide 24/7 personalized assistance to students to help them navigate the complexities of the campus life and enhance their campus experience. Systems allow students to ask questions using natural language and receive an immediate response about such topics as campus services, their grades, class schedules, and course requirements for graduation. Moreover, these AI systems learn over time from questions asked, so that their accuracy improves. Here are some examples of AI use for student services:

- iTuffy at California State University Fullerton - https://events.educause.edu/~/media/files/events/user-uploads-folder/e17/ps177/educause-flyer--ituffy.pdf
- Deakin University's DeakinSync [video] - https://youtu.be/pehHNkPYhj4
- Genie at Deakin University [video] - https://vimeo.com/227666323
- How Student-Facing Software Transforms Services in Higher Education - https://er.educause.edu/blogs/sponsored/2018/7/biggest-wins-identified-how-student-facing-software-transforms-services-in-higher-education?utm_source=Informz&utm_medium=Email&utm_campaign=ER#_zsrttLf1_zljFFx4
- Echo Dots Say Hello to Arizona State Engineering Students - https://edscoop.com/amazons-alexa-goes-to-arizona-state-university

04 AI is being used for student assessment

Despite concerns about machines not being able to understand the nuances of written text or speech, AI is being used with increasing success in assessing student work. For example, essay assessment requires only examples of strong and weak papers rated by a human to be entered. Similarly, oral language can be assessed on many linguistic dimensions, including fluency, vocabulary usage, and pronunciation. Here are links to papers describing how AI is being used for assessment:

- AI in education—Automatic essay scoring - https://medium.com/hubert-ai/ai-in-education-automatic-essay-scoring-6eb38bb2e70
- Educational Testing Service (ETS) research in automated scoring - https://www.ets.org/research/topics/as_nlp/written_content/
- Automated scoring of speech at ETS using *SpeechRater* - https://www.ets.org/research/topics/as_nlp/speech/
- Neural networks for automated essay grading - https://cs224d.stanford.edu/reports/huyenn.pdf
- Automated essay scoring and the future of educational assessment in medical education - https://www.ncbi.nlm.nih.gov/pubmed/25200016

05 AI can enhance the experience of students with disabilities

The potential of AI to enhance the learning experience of students with disabilities is very promising. Among the systems available or under development are those that can describe the content of photos for the visually impaired, automatically create captions of video for the deaf and hard of hearing, synthesize more realistic voices in multiple languages for text to speech reading, and operate an onscreen mouse and keyboard and text-to-speech using only eye movements for those unable to use a keyboard due to physical impairment:

- Realistic text to speech conversion - https://www.theverge.com/2018/3/27/17167200/google-ai-speech-tts-cloud-deepmind-wavenet

- Navigating the physical world through AI - https://www.zdnet.com/article/microsoft-using-ai-to-empower-people-living-with-disabilities/

- Automated captioning of videos - https://www.technologyreview.com/s/603899/machine-learning-opens-up-new-ways-to-help-disabled-people/

- Using voice command devices to aid students - https://edscoop.com/voice-command-technology-alexa-how-can-you-improve-teaching-and-learning

- Eye control for keyboarding - https://www.zdnet.com/article/microsofts-windows-10-to-get-eye-tracking-functionality/

06 AI is advancing the capabilities of learning analytics

Learning analytics involve the measurement, collection, analysis, and reporting of data about learners and the contexts in which learning takes place, with the aim of improving the teaching and learning environment. AI is enabling learning analytics to detail what is happening (descriptive), why it is happening (diagnostic), predictive (what will happen), and prescriptive (what needs to happen). Here are links to examples how AI is being in this way:

- AI and the Classroom: Machine Learning in Education - https://trueinteraction.com/ai-and-the-classroom-machine-learning-in-education/

- Learning Analytics: Visions of the Future - http://oro.open.ac.uk/45312/

- The Predictive Learning Analytics Revolution - https://library.educause.edu/resources/2015/10/the-predictive-learning-analytics-revolution-leveraging-learning-data-for-student-success

- Exploring the Impact of Artificial Intelligence on Teaching and Learning in Higher Education - https://link.springer.com/article/10.1186/s41039-017-0062-8

- NMC Horizon report: 2017 Higher Education Edition [pp. 14 -15, 46-47] - https://www.nmc.org/publication/nmc-horizon-report-2017-higher-education-edition/

07 AI usage raises ethical, moral, and privacy concerns

AI systems require access to large amounts of data, including confidential student and faculty personal information, depending upon the application. Therefore, its usage raises a myriad of ethical, moral, and privacy concerns, which must be addressed. Among them are data security, consent to use personal data, who is able to access the data, possible misdiagnosis of students' learning, potential faulty student advising, and latent bias and stereotyping in AI algorithms. Below are links to articles that discuss such concerns:

- Sources of Big Data to Support Post-Secondary Education, with Some Cautions - https://teachonline.ca/tools-trends/how-use-technology-effectively/sources-big-data-support-post-secondary-education-some-cautions

- Future of Privacy Forum - https://fpf.org/issues/higher-ed/

- AI is Ideological - https://newint.org/features/2017/11/01/audrey-watters-ai

- Against the 3A's of EdTech: AI, Analytics, and Adaptive Technologies in Education - https://www.chronicle.com/blogs/profhacker/against-the-3as-of-edtech-ai-analytics-and-adaptive-technologies-in-education/64604

- The Ethics of Artificial Intelligence in Education - https://universitybusiness.co.uk/Article/the-ethics-of-artificial-intelligence-in-education-who-care

08 AI is challenging to implement in higher education

Beyond the need to address the ethical, moral, and privacy concerns raised above, institutions attempting to implement and scale up AI systems face numerous challenges. These include questions about who will lead and champion an AI initiative, who will be responsible for developing and monitoring AI policies and practices, what role faculty will have in system design and implementation, who understands the assumptions inherent in the design of AI algorithms other than system developers, what are the legal implications of faulty student diagnosis or advising, and how necessary technical support staff will be recruited and retained? Issues such as these are discussed in articles linked to below:

- The AI Revolution on Campus - https://er.educause.edu/articles/2017/8/the-ai-revolution-on-campus

- Exploring the Impact of Artificial Intelligence in Teaching and Learning in Higher Education - https://telrp.springeropen.com/articles/10.1186/s41039-017-0062-8

- Artificial Intelligence Impacts on Higher Education - http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1041&context=mwais2018

- Higher Education's 2018 Trend Watch and Top 10 Strategic Technologies - https://library.educause.edu/resources/2018/2/higher-educations-2018-trend-watch-and-top-10-strategic-technologies

- Machine Learning and Higher Education - https://er.educause.edu/articles/2017/12/machine-learning-and-higher-education

09 AI is transforming other aspects of academic life, too

Although teaching, learning, and student advising are the leading AI applications in higher education, the technology is making inroads into many other aspects of life in the academy. These applications, for example, are transforming libraries, communication with students, academic research, textbook creation, and external outreach. Here are links to some examples of AI's influence in these areas:

- Artificial Intelligence in the Library [podcast] - https://er.educause.edu/multimedia/2018/7/artificial-intelligence-in-the-library?utm_source=Informz&utm_medium=Email&utm_campaign=ER#_zsrttLf1_zlhFFx4

- Computer Guided Science Tool Advances One Step Further - https://www.bcm.edu/news/technology/knowledge-integration-toolkit-advances

- BBookX Open Source Textbook Generator - http://bbookx.psu.edu/

- How Georgia State University supports every student with personalized text messaging - http://blog.admithub.com/case-study-how-admithub-is-freezing-summer-melt-at-georgia-state-university

- CampusNexus Engage - https://www.campusmanagement.com/products/crm-for-higher-education/

10 AI and the future of higher education

Although there is a plethora of unanswered questions about AI's role and how it will be managed, there is little doubt that the technology is inexorably linked to the future of higher education. Innovative applications will continue to be developed and explored, more programs and courses will include AI and related topics, and existing curricula will be adapted to provide students with the skills needed in a world where many jobs will be taken over by machines and new careers will emerge. Below are links to descriptions of initiatives that are leading the way:

- Georgia Tech Combines Jill with Personalization - http://www.provost.gatech.edu/educational-innovation/reports/lifetime-education/initiatives/AI-personalization

- 7 Things You Should Know About Robot Writers - https://library.educause.edu/resources/2016/7/7-things-you-should-know-about-robot-writers

- NMC Horizon Report Preview 2018 - https://library.educause.edu/~/media/files/library/2018/4/previewhr2018.pdf

- The AI Revolution on Campus - https://er.educause.edu/articles/2017/8/the-ai-revolution-on-campus

- Artificial Intelligence Will Transform Universities. Here's How - https://www.weforum.org/agenda/2017/08/artificial-intelligence-will-transform-universities-here-s-how/