Artificial Intelligence Transforming Higher Education

VOLUME 1

Geesje van den Berg
& Erna Oliver (Eds)

UNIVERSITY
OF
JOHANNESBURG

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Abbreviations

Abbreviation	Term
3-D	Three-Dimensional
4IR	Fourth Industrial Revolution
5IR	Fifth Industrial Revolution
6IR	Sixth Industrial Revolution
7IR	Seventh Industrial Revolution
AAG	Automated Article Generator
AD	Academic Dishonesty
ADB	African Development Bank
Admin	Administration
AES	Automated Essay Scoring
AGI	Artificial General Intelligence
AI	Artificial Intelligence
AIED	Artificial Intelligence in Education
AI-ML	Artificial Intelligence and Machine Learning
AIWBE	Adaptive and Intelligent Web-Based Educational System
ALICE	Artificial Linguistic Internet Computer Entity
ALS	Adaptive Learning System
ANN	Artificial Neural Network
APFEI	Assessment of Process for Efficiency Improvement
API	Academic Performance Index
APT	Automated Paraphrasing Tool
AR	Augmented Reality
ASIS	The American Society for Information Science
AT	Auto Tech
ATS	Aided Teaching System
AWA	Automated Writing Assistant
AWE	Automated Writing Evaluation

Abbreviation	Term
AWG	Australian Writers' Guild
AWT	Automated Writing Tool
BBC	British Broadcasting Corporation
BMI	Brain-Machine Interface
BYOD	Bring Your Own Device
CAAF	The Collaborative Assessment Analytical Framework
CAI	Computer-Aided Instruction Systems
CALL	Computer-Assisted Language Learning
CAPS	The South African Curriculum and Assessment Policy Statement
CAT	Computerised Adaptive Test
CCR	The Center for Curriculum Redesign
CF	Cooperative Filtering
ChatGPT	Chat Generative Pre-Trained Transformer
CHE	Council on Higher Education
CHELSA	The Committee of Higher Education Libraries of South Africa
CIT	Computers and Information Technology
CMCSS	Canadian Mission Control Space Services
cMOOC	'Connectivist' or 'Constructivist' Massive Open Online Course
CMU	Carnegie Mellon University
CNN	Convolution Neural Network
COL	Commonwealth of Learning
COMEST	Commission Mondiale D'éthique des Connaissances Scientifiques et des Technologies (The World Commission on the Ethics of Scientific Knowledge and Technology)
COVID-19	Coronavirus disease of 2019
DBTS	Dialogue-Based Tutoring System
DevOps	Development Operations
DHET	Department of Higher Education and Training
DL	Deep Learning

Abbreviation	Term
DM	Data Mining
DoE	Department of Education
DSRPAI	Dartmouth Summer Research Project on Artificial Intelligence
DWA	Digital Writing Assistant
E4.0	Education 4.0
E5.0	Education 5.0
E-A-T	Expertise, Authority, and Trustworthiness
ECTS	European Credit Transfer and Accumulation System
EDM	Educational Data Mining
EdTech	Educational Technology
edX Mooc	Electronic Data Exchange Massive Open Online Course
EFL	English (as a) Foreign Language
EI	Emotional Intelligence
ELE	Exploratory Learning Environment
ETS	The Educational Testing Service
EU	European Union
FAFSA	Free Application for Federal Student Aid
FIP	Fair Information Practice
GAIED	Generative Artificial Intelligence for Education
GAN	Generative Adversarial Network
GDPR	General Data Protection Regulation
GEM	Global Education Monitoring
Gen-AI	Generative Artificial Intelligence
GIGO	Garbage in, Garbage out
GMAT	The Graduate Management Admission Test
GPT	Generative Pre-Trained Transformer
GRE	The Graduate Record Examination
H5P	HTML5 Package
HCI	Human-Computer Interface/Interaction
HE	Higher Education

Abbreviation	Term
HERNANA	The Higher Education Research and Advocacy Network in Africa
HITL	Human-in-the-Loop
HLEG	The High-Level Expert Group on Artificial Intelligence
HoTEL	Holistic Approach to Technology Enhanced Learning
I4R	Industry 4.0
I5R	Industry 5.0
IALS	Individual Adaptive Learning System
IAS	Institute Administration System
IBM	International Business Machines
ICAF	The Intelligent Collaborative Assessment Framework
ICAI	International Centre for Academic Integrity
ICIE	International Center for Information Ethics
ICT	Information and Communication Technology
ID3	Iterative Dichotomiser 3
IDG	Inner Development Goal
IE	Information Ethics
IEA	The Intelligent Essay Assessor
IEEE	Institute of Electrical and Electronics Engineers
IES	Intelligent Educational System
IFC	International Finance Corporation
IFLA	The International Federation of Library Associations and Institutions
IHE	Institution of Higher Education
IIoT	Industrial Internet of Things
ILE	Interactive Learning Environment
ILO	International Labour Organization
IoDSA	Institute of Directors South Africa
IoT	Internet of Things
IP	Intellectual Property
IPA	Interpretative Phenomenology Analysis

Abbreviation	**Term**
ISS	International Space Station
IT	Information Technology
ITS	Intelligent Tutoring System
IWBE	Intelligent Web-Based Education
JRC	Joint Research Centre
KPMG	Klynveld, Peat, Marwick, and Goerdeler
LA	Learning Analytics
LEK	Lawrence, Evans, and Koch
LINC	Logic and Information Network Compiler
LLM	Large Language Model
LMS	Learning Management System
LPM	Language Processing Model
LSA	Latent Semantic Analysis
LSTM	Long-Short Term Memory
MIT	Massachusetts Institute of Technology
ML	Machine Learning
MOOC	Massive Open Online Course
NLG	Natural Language Generation
NLP	Natural Language Processing
NLU	Natural Language Understanding
NNAPI	Neural Networks Application Programming Interface
NOAI	Natural Organic Artificial Intelligence
NQF	National Qualifications Framework
NTU	The National Taiwan University
ODeL	Open Distance e-Learning
ODL	Open Distance Learning
OECD	Organisation for Economic Cooperation and Development
OER	Open Educational Resources
OPT	Open Pre-Trained Transformer
OSRQ	Open Short Response Question

Abbreviation	**Term**
PA	Predictive Analytics
PAPA	Privacy, Accuracy, Property, and Accessibility
PAPAS	Privacy, Accuracy, Property, Accessibility, and Security
PBCL	Project-Based Collaborative Learning
PBL	Project-Based Learning
PEG	Project Essay Grade
PI	The Philosophy of Information
PLA	Predictive Learning Analytics
PLATO	Programmed Logic for Automatic Teaching Operations
PPDM	Privacy Preserving Data Mining
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
Prof	Professor
QA	Quality Assurance
R&D	Research and Development
Rand	Research and Development
RERC	Research Ethics Review Committee
RFID	Radio Frequency Identification
SAKI	Self-Adaptive Keyboard Instructor
SDG	Sustainable Development Goal
SEE	Social, Emotional, and Ethical
SEL	Social and Emotional Learning
SEO	Search Engine Optimisation
SMART	Specific, Measurable, Achievable, Relevant, Time-Bound
SSA	Sub-Saharan Africa
STEM	Science, Technology, Engineering, and Mathematics
SVM	Support Vector Machine
SVVR	Scientific Visualisation and Virtual Reality
TA	Trustworthy Assessment
TEA	Technology Enhanced Assessment

Abbreviation	Term
TICCIT	Time-Shared Interactive Computer-Controlled Information Television
TVET	Technical and Vocational Education and Training
UK	United Kingdom
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
UNICEF	United Nations Children's Fund
US	United States (of America)
VR	Virtual Reality
WBE	Web-Based Education
WEF	World Economic Forum
WGA	Writers Guild of America
WHO	World Health Organisation
WI	Web Intelligence
XAI	Explainable Artificial Intelligence
xMOOC	Extended Massive Open Online Course
ZB	Zettabyte

Foreword

When the rhythm of the music changes, the dance step must change also

Tony J. Mays
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Burnaby, Canada

Introduction

When Prof (Professor) Geesje van den Berg first informed me that they were working on a book about AI in education, I was thrilled, as discussions surrounding technological innovation are often dominated by the discourse of the Global North, meaning that the voices from the developing economies of the Global South are insufficiently represented. When she later invited me to contribute a foreword, I felt both honoured and intrigued to be considered, as there are many individuals undertaking pioneering work in this field who might offer a more unique perspective. However, Prof Van den Berg and I have known each other for many years, having collaborated at UNISA on an interim educator qualification called the National Professional Diploma in Education, and subsequently on a Master's programme in open and distance learning (ODL), as well as having contributed to the same textbook on Curriculum Studies. Therefore, I was confident that the new publication would be something to eagerly anticipate.

I also have a longstanding interest in the use of technology, particularly, though not exclusively, in the provision of ODL. As noted in a recent keynote presentation for UNISA (Mays 2024a) several years ago, I worked with a large group of out-of-school youths aged around 23 who had completed their matriculation but were unable to pass a standard industry mathematics test required for entry-level employment opportunities. We needed a responsive online platform to motivate these learners to re-engage with mathematics at approximately a Grade 6 level. We opted for Khan Academy, which was already utilising a form of AI (artificial intelligence). Students worked through activities and earned badges for motivation. A dashboard displayed their progress, showing how each small achievement contributed to completing the overall programme. Within minutes, each student was following a slightly different trajectory through the subject content in a manner that would have been difficult for a lone educator in a physical classroom using printed textbooks to replicate (there were more than 100 students in the group). Furthermore, the backend tutor functionality allowed me, as their chosen tutor, to monitor their progress and provide additional personalised feedback as needed. Most of the time, only a small percentage of students required this personalised human engagement. I was very impressed by how the technology enabled me to offer more tailored support.

Now that I am Director of the Education Sector at the COL (Commonwealth of Learning), that interest in technology continues. I believe that the COL has a key role to play in supporting the development and dissemination of useful knowledge in an open way to address practical, theoretical, and policy issues in the use of technology in education provision generally and with the evolving possibilities of Gen-AI (generative artificial intelligence) in particular. For example, as reported in our news stories, the COL recently collaborated with the National University of Samoa to use Gen-AI to develop a virtual tutor, able to answer most recurring questions about the Moodle platform being used (COL 2023). Subsequently, the COL worked with the University of the South Pacific to successfully enhance its Semester Zero induction programme, using similar technology to address both learning management systems and content queries (COL 2024). Learning from these experiences, COL recently inaugurated a collaborative project called 'Teacher-in-the-Loop,' in which several of our initiatives work together to use Gen-AI to help educators develop OER (open educational resources) for STEM (Science, Technology, Engineering, and Mathematics) and TVET (technical and vocational education and training) subjects, which is not only scientifically accurate but also actively seeks to pre-empt any possible biases, particularly in terms of gender equity. A key proposition of this ongoing project is that although Gen-AI is the tool, the educator makes the final decision on what to use and how.

The COL also recently published the results of a survey indicating that more support was needed for policy development in relation to AI deployment (Paskevicius 2024) – a need which was confirmed by other research (Linderoth, Hultén, & Stenliden 2024; Ratten & Jones 2023) – and followed up on the findings of this report by developing policy guidelines (Mohamed & Mishra 2024). So, our interests are aligned.

In the balance of this foreword, I want to reflect a little on the notion of human intelligence, the evolving field of AI, and some of the practical implications for teaching and learning, and then use these reflections as lenses for my initial engagement with this exciting new publication.

Reflection on Intelligence

The African proverb that heads this foreword offers a pragmatic insight into how to deal with change. This seems like a good starting point because, at least to my mind, change seems central to the concept of intelligence, whether reactive or proactive. Moreover, a publication focused on 'artificial' intelligence presupposes a contrast with 'non-artificial,' presumably human intelligence. Sternberg (2024), writing for the Encyclopedia Brittanica, offers the following definition: '[H]uman intelligence, mental quality that consists of the abilities to learn from experience, adapt to new situations, understand and handle abstract concepts, and use knowledge to manipulate one's environment.'

Sternberg notes that there are various theories about the nature of human intelligence and identifies the following core groups, among others: Psychometric, cognitive, cognitive-contextual, biological, and hemispheric. He also observes that our intelligence/s may change over time. We do not have space to explore all these perspectives here, but it seems useful to include a short reflection to help explain the complexity. Human beings access information and experiences through their senses, so it is important for us to ask questions like, 'Did I really see what I thought I saw?,' 'Did I really hear what I thought I heard?' and so on. Once we have clarity on these questions, we tend to have an emotional response, for example, 'I don't like that, so I won't engage further,' while a more intelligent response might be, 'I don't like that; why do I not like it? What can I learn by trying to understand my dislike?'

In a similar vein, human beings live in a cultural context and might react to information or an experience by not wanting to engage further because what is said or done and by whom run counter to their own cultural norms. However, they might learn something by consciously examining their own norms and comparing them with those of others. Once we have passed through these initial filters, we might bring to bear our reasoning and logic to examine the information or experience in a critical way to understand it better, and then once we have a better understanding, we will likely evaluate that understanding from the perspective of our own worldview. The point being made is that human beings engage with the world in a multi-faceted way. They also make many daily decisions which are not necessarily based on logic or on an analysis of huge datasets and, in fact, human beings often infer meaning and make decisions based on very limited data. Moreover, human beings make connections between data, ideas, and phenomena that are sometimes not obviously connected at all and often also disparate in form. In addition, we have a strong propensity to imagine that which does not exist, or at least not yet in some cases; so authors like Jules Verne, Isaac Asimov, and Arther Clarke were able to write novels about journeys to the bottom of the sea or to the moon, and about robots and earth satellites, even before such things became possible technologically. Human intelligence (or intelligences) is therefore a complex field, but is the key counterpoint to the current focus on AI.

The evolving field of Artificial Intelligence

Oxford Languages (2024) defines AI as 'the theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.' Although the concept of non-human intelligence can be found in ancient mythology and in a sense, began to seem practicable near the start of the industrial era with the invention of machines like Babbage's difference engine, Scott (2024) observes that what we now refer to as AI has been around for a long time even in the modern era, with a focus on 'programmed learning' in the 1960s and 1970s, which advanced in the 1980s and 1990s into basic personalisation, the development of more adaptive virtual systems in the 2000s, and the more recent LLMs (large language models) revolution which has paved the way for virtual tutoring, chatbots for teletutoring, personalised learning content, automated grading, and automated administrative tasks. As with any new technology, there are potential opportunities, potential risks, and the need for experimentation and discourse (Baidoo-Anu & Owusu Ansah 2023). We also need to learn how best to use the evolving affordances of the technology, including gaining a nuanced understanding of its strengths and weaknesses in different contexts (Bozkurt & Sharma 2023; Cooper 2023; Du, Sun, Jiang, Atiquil Islam, & Gu 2024; Smolansky, Cram, Raduescu, Zeivots, Huber, & Kizilcec 2023).

As Denny, Gulwani, Heffernan, Käser, Moore, Rafferty, and Singla (2024) observe, the appropriate use of AI in an education context requires technical expertise, experience of working with students, and knowing how to deploy technology at scale. It will impact how we teach, design a curriculum, manage assessment, work with OER, and manage tensions such as between homogenisation, creativity, and the personalised/individualised. It will allow personalised, real-time feedback and create more time for human facilitation, but it also raises concerns about data privacy, algorithmic bias, academic integrity, and the need for substantially more educator training (Eke 2023; Nikolic, Daniel, Haque, Belkina, Hassan, & Grundy 2023; OER Africa 2023; Onesi-Ozigagun, Ololade, Eyo-Udo, & Ogundipe 2024).

In the most recent (7th) edition of their research on AI, Perrault and Clark (2024) conclude that AI beats humans on some tasks, but not all, that it can make workers more productive and lead to higher quality work, and also that it can accelerate scientific progress. However, they note the lack of robust and standardised evaluations for LLM responsibility and observe that as people become more aware of what AI can do, they also become more concerned about the implications. This would include concerns related to ethics, curriculum design, continuous learning, and industry alignment, among others (Abulibdeh, Zaidan, & Abulibdeh 2024).

Williamson (2024) observes that while we cannot anticipate all future risks, we know from our past experience that the deployment of new technologies is not a linear process. We therefore need an active discourse between the technology developers on the one hand and educators on the other to pre-empt any unintended consequences.

Overall, this suggests the need for a pragmatic response to use human intelligence and human-made intelligence in a synergistic way. However, some things already seem obvious to implement: We can automate routine administration and teaching tasks; manage a balance between personalised support and over-dependence; support students and educators to use and critique AI responses; focus on more authentic assessment; address cybersecurity and academic integrity issues; make ethical use of analytics; provide ongoing professional development for educators; and be open to trying new things in a responsible and ethical way (Bates 2024; Du *et al*. 2024; Kizilcec 2024; Law 2024; Sevnarayan & Potter 2024; Williamson 2024).

Implications for Practice

As noted in another discussion (Mays 2024b), we need to explore the link between pedagogy and technology and the implications for educators' practice. Having established a framework, we can then explore the possible disruptive influence of AI. We also need to revisit assessment because if we change our assessment, then other things will fall into place (Rowntree 1987). In this context, we should think of pedagogy as an overarching term meaning the art and science of teaching, realising that it needs to be nuanced for different populations and contexts – for example, for adults (andragogy), for self-directed learning in ODL (heutagogy), and for appropriateness for cultural context (e.g., ubuntugogy from southern Africa). Overall, we should promote the notion of 'open' pedagogy (Bates 2022; Hegarty 2015).

We have no shortage of theories about how people learn, as the interactive map created by Millwood (2021) demonstrates. Despite this diversity of learning theories, we can identify at least four broad approaches: Behaviourist/instructivist, cognitive/constructivist, socio-constructivist, and connectivist. These should not be regarded as mutually exclusive positions – our practice likely draws on all four to a lesser or greater extent at different times. Depending on our perspective, we will then use a particular technology in a different way, for example, the use of instructivist lecture-type videos in xMOOCs (extended massive open online courses) as opposed to the use of videos in cMOOCs ('connectivist' or 'constructivist' massive open online courses) where the video content will likely be scaffolded and presented differently but be augmented by additional applications like discussion forums. How we engage with AI or Gen-AI will similarly be influenced by what we believe about how learning happens.

Given the continuing challenges of the digital divide, we need to adopt a pragmatic approach to the use of technology. In many countries we still need to make provision for content that can be printed and/or shared digitally to a basic device at a Wi-Fi-enabled centre, especially for the more rural areas. We can, however, enrich the core content with, for example, video and audio content – whether using broadcast technology or embedded in an open textbook for students with higher end devices but limited access to the internet. We might then also need a version that is fully online, exploiting H5P (HTML5 package) for interactivity and including online discussion fora, which could have both synchronous and non-synchronous elements, as well as involving social media. As noted in the recently published GEM (global education monitoring) report for the Pacific (COL &

UNESCO 2024), despite challenging contexts, we can and often do adapt technologies to find solutions that are more fit for context – AI and Gen-AI are no exception.

Once we know what we want to teach, why, and how, there is no shortage of technologies to choose from. The latest version of the 'padagogy' wheel, recently updated to include AI (Carrington 2024), provides some examples. However, we should remember the creator's earlier observation that it is not fundamentally about the technology but the pedagogy (Carrington 2015). Bates (n.d.) offers a useful heuristic SECTIONS in this regard.

Stoker (2024), a LINC (logic and information network compiler) instructor for the ISS (international space station) of British Columbia, regularly uses Chat GPT (generative pre-trained transformer) in his work. He notes that it helps him to reduce the time needed for planning, assessment design, differentiation, and analysis of what is working in his presentations and what not, so that changes can be made before a topic is taught again and that over time, working with the application, it has learned what he likes and makes increasingly useful recommendations. Stoker also observes that AI has been used to support learning in multiple contexts ranging from Georgia State University, which in 2013 introduced AI to identify and automate feedback to at-risk students, linking them directly with a human tutor where indicated, to schools in rural India which developed AI tools for tablets to provide feedback to students on their subject-based learning. In both cases, these interventions resulted in improved retention and success. He notes that Singapore even experimented with humanoid robots to provide support for students whose educators were on sick leave. He notes that AI in the classroom can take care of many routine tasks freeing the educator to spend more time interacting directly with their students.

As with all new technologies, AI presents both opportunities and challenges. We should not, perhaps, succumb to the hype of the early adopters, but at the same, we should guard against being overly conservative and deny our educators and students the opportunity to exploit some of the more obvious early benefits. This publication can help us make more informed choices.

Overview of the Chapters in this Publication

This publication is divided into two volumes. In Volume 1, Chapter 1, Garth Aziz discusses the potential use of AI in pedagogies employed in the humanities. The author notes that educators are responsible for preparing students to succeed in an AI-mediated world, but this should not be limited to a pragmatic preparation for employment but should rather foster a pedagogy of care, ethics, and good judgement, while retaining a sense of exploration and wonder. In Chapter 2, Lorette Jacobs and Karin McGuirk explore the changing roles of information professionals in a HE (higher education) sector increasingly using AI, noting the increasingly central importance of this role as part of a wider professional community of practice. In Chapter 3, Erna Oliver identifies the need to work more intelligently and responsibly with AI to foster creative innovation.

In Chapter 4, Johannes Cronjé explores an integrated, process-based framework for writing with AI, but finally suggests that from a posthuman perspective, the focus should not be on the student but on the task. In Chapter 5, Karen Ferreira-Meyers examines the potential role of AI in the instructional design process. The author observes that while AI presents an immense potential for transforming HE, carefully considering ethical, social, and pedagogical dimensions is essential. The author argues the need to foreground cooperation, wisdom, and responsibility as educational values no less important than efficiency or personalisation, and the need to harmonise automation with our deepest humanity. In Chapter 6, Lilia Cheniti-Belcadhi, Mohamed Mitwally, and Asma Hadyaoui explore intelligent frameworks for assessment in AI-enhanced learning environments. They observe that while AI has the potential to greatly improve the accuracy, customisation, and efficiency of assessments, leading to a more adaptable, inclusive, and effective era in education, there are still several concerns that need to be addressed. For example, they suggest that AI assimilation and the processing of educational data pose major dangers to the privacy and integrity of such sensitive information, making student data privacy a critical issue. The authors further suggest that an effective resolution of ethical concerns requires collaboration among professionals from diverse fields such as technology, education, ethics, and policymaking.

In Chapter 7, Elmarie Kritzinger and Sarah Jane Johnston present a multi-dimensional approach to a digital transformation process in HE. They explore the interplay between key stakeholders, AI drivers, and a systematic process of commitment, strategy, testing, implementation, and evaluation. In Chapter 8, Hiro Saito argues the need to look beyond the economic and work-related potential of AI to consider how AI might be utilised to augment humanity itself in service of greater equity, solidarity, freedom, and inclusiveness, and to accelerate learning and flourishing toward collective wellbeing.

In Chapter 9, Joseph Evans Agolla and Phineas Sebopelo observe that many claims currently being made about the potential of AI are not grounded in empirical evidence and that in the African context, it is necessary to find a balance between various competing interests concerning other developments and the implementation of AI tools in education systems. In Chapter 10, in a related discussion, Phineas Sebopelo and Joseph Evans Agolla then argue that AI technology will generate opportunities for accelerating transformation in education. ODL institutions should therefore strategise on how to leverage AI and new technologies to enhance efficiency, encourage learning, and foster creativity while ensuring fairness and equity. They suggest using AI to reshape students' experiences, enhance assessment, streamline administrative tasks, and personalise learning.

In Volume 2, Chapter 1, Samuel Amponsah, Micheal van Wyk, and Michael Adarkwah call for a more holistic and adaptive approach to academic integrity in the digital age. They suggest that integrating GPT detectors and technological tools should be complemented by a commitment to addressing the root causes of academic anxiety. By fostering a culture of trust, transparency, and resilience, they suggest that we can navigate these challenges successfully, ensuring that the pursuit of knowledge remains a transformative and enriching experience for students.

In Chapter 2, Nicky Tjano argues that there is a need to create an educational future that is both technologically advanced and morally sound. This involves tackling issues presented by concern about mounting students' dependency on AI, reduced human interaction, communication, and ethical gaps. The author suggests that the journey to maintaining academic integrity in the AI age requires ongoing self-examination, adjustment, and a resolute dedication to the values that constitute the core of intellectual endeavours.

In Chapter 3, Faiza Gani explores the link between AI and QA (quality assurance) in HE. The author notes that the opportunities presented by AI link to QA factors and can improve these factors. On the other hand, there is also a link between the challenges provided and QA factors. Consequently, for QA factors not to be compromised, the challenges presented by AI must be carefully mitigated.

In Chapter 4, Brenda van Wyk and Marlene Holmner trace developments in information ethics through history. They suggest that we are currently at a critical point where the swift progress in AI technology necessitates a proactive and deliberate approach to ethical considerations. They also suggest that the OECD (Organisation for Economic Cooperation and Development) FIP (fair information practice) standards serve as a fundamental framework for safeguarding data and ensuring privacy, which are of utmost importance in the era of AI. These principles, in conjunction with the guidelines for responsible AI, they argue, provide a clear path for the ethical, transparent, fair, and inclusive development of AI.

In Chapter 5, Nicky Tjano unpacks the role of big data, AI, and predictive analytics in education, suggesting that creating hybrid mechanisms for review processes will assist in mitigating risks. He further adds that this can be augmented by introducing new specialised committees to ensure that unfamiliar or too technical research projects related to AI and big data are properly assessed for ethical compliance. These changes mean that educators, research review committees, and educational institutions need to relook at their governance processes, protocols, and policy frameworks.

In Chapter 6, Geesje van den Berg suggests that as AI tools will only get better and more human-like, so HE will have to adapt accordingly. Although Gen-AI has the potential to improve teaching and learning for everyone, the key is finding a balance and using Gen-AI to enhance, rather than replace, traditional educational practices. The author argues that collaboration among lecturers, researchers, policymakers, and students will then be essential to ensure that AI is used ethically and responsibly in education. The goal is to create a more equitable and effective education system that provides students with personalised teaching, feedback, and support by addressing the challenges posed by AI technologies and leveraging their benefits.

In Chapter 7, Geesje van den Berg and Patience Mudau explore the potential benefits and challenges that AI presents from the perspective of educators. They note that from their research, the most prominent benefits identified were that these digital tools can provide individualised, 24/7 guidance and support, and also augment learning content. They also note that these tools can assist with simplifying language, a unique benefit in multilingual contexts. Furthermore, they argue that Gen-AI tools provide opportunities for active involvement and that they can save time and make information and knowledge accessible. However, they note concerns that the technologies could provide biased information, lead to decreased human interaction and lack emotional intelligence. Additionally, it could provide inaccurate information and has a risk that students can over-rely on these tools. They have further identified the risks of plagiarism and data privacy and security as challenges. These guidelines focus on the need for policies and AI literacy training, setting an example and providing guidelines to students using Gen-AI. Another important point is that the Gen-AI tools should complement, and not replace, the human elements of teaching and learning, ensuring a holistic and inclusive educational approach.

In Chapter 8, Elize du Plessis argues the need to reimagine online assessment methods observing that Gen-AI holds immense potential to revolutionise how we evaluate knowledge and skills. From adaptive assessments to automated grading and feedback, these models can enhance student and educator assessment experiences. However, careful attention must be given to addressing challenges such as bias, reliability, security, and privacy. Collaboration between researchers, educators, and policymakers is necessary to leverage the benefits of LLMs while upholding ethical standards and ensuring the fairness and validity of online assessments. She further argues that academics should investigate Gen-AI, identify its limitations, evaluate its potential applications within the relevant disciplines or teaching contexts, and engage in discussions about all these aspects with students, who are likely already familiar with the technology.

In Chapter 9, Micheal van Wyk explores the issue of academic dishonesty and how it might be prevented. The author suggests that academics must redesign authentic context-based assessment tasks, such as specific case studies, problem-solving activities, project-based learning tasks, and academic writing skills. The research report suggests that education faculties need to update AI policies, provide guidelines, and educate students about AI literacy skills and AI detector tools for the ethical use of Gen-AI tools in teaching and learning. The author argues that this must include developing students' ability to use AI in appropriate ways.

The nineteen chapters in this two-volume publication offer insights into both challenges and opportunities for working with AI in general and Gen-AI in particular. Overall, the argument that emerges is for a reasoned engagement with the evolving possibilities of the new technology, but as Mark Twain is credited with observing, gradual improvement is probably going to be more useful than delayed perfection.

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Section 1

General Introduction to AI: Transformative Pedagogies, Professional Roles, and Philosophical Inquiry

Chapter 1

Transforming Higher Educational Pedagogies in the Humanities through Artificial Intelligence

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Introduction

AI (artificial intelligence) is no stranger to education as it has been implemented extensively in education and is continuing to gain interest and attention (Chen, Chen, & Lin 2020:75265). AI has been part of education since the early 1950s to 'understand and improve human and machine cognition' in the advancement of education (Doroudi 2022:885). Understandably, this strive for educational advancement was mainly in the learning sciences, associated with computers, underpinned by behaviourism, and may not have had any consideration for other disciplines or theories in education that may be deemed as 'antiscience,' such as the humanities (cf. Doroudi 2022:895; Chen *et al*. 2020:75267). Consequently, it is construed that the situated learning theories did not only rise as a response to the limitations of cognitivism but also to that of AI (cf. Doroudi 2022:896; Chen *et al*. 2020:75267). The response from the situated learning theories to cognitivism and AI was immersing itself in qualitative research. While some of the proponents of situated learning leaned toward AI, this was not the dominant response (Doroudi 2022:897).

Understandably, AI continues to be a part of the educational landscape and processes (Chassignol, Khoroshavin, Klimova, & Bilyatdinova 2018:22) even though its function and purpose is markedly different from what its initial purpose was (Doroudi 2022:916-924). AI has since grown and developed into both a field and theory (Chassignol *et al*. 2018; Chen *et al*. 2020:75267) aimed at cognition to solve problems associated with human intelligence and the development of computers to perform human-related tasks, respectively.

Unfortunately, the role and relation between AI and education have been reduced to 'applications of AI to enhancing education' in administrative processes such as registrations, administration, tutoring, and scoring systems to reduce challenges encountered in education (Doroudi 2022:886). This role of AI is evidenced in 'content development, teaching methods, student assessment, and communication between teacher and students' (Chassignol *et al*. 2018:22).

I write this chapter not as an expert in AI but as an academic in the discipline of humanities in HE (higher education). My interest therefore leans more toward how the humanities can benefit from AI. The missing gap, it may seem, is how AI assists in transforming HE and specifically the humanities when it has a subservient role to merely improve educational systems for a more efficient administrative function. To explain this challenge, the chapter will first conceptualise AI; this chapter will subsequently discuss the importance of the humanities as a study discipline; thereafter it will discuss the value of AI in the humanities as a transforming agent; and finally, it will discuss some approaches to better utilise AI to transform the humanities instead of simply being an administrative function for more efficient systems.

Conceptualising AI in Education

There is no doubt that AI in education has received an increased amount of attention and interest (Chen *et al*. 2020:75265). Naturally, this increased interest in attention gives rise to many different understandings and definitions of AI as well as its role and function, specifically in HE. Considering the historical roots of AI in education, most research in the contemporary context does not focus on its historical purpose and function (cf. Doroudi

2022). Ahistorical perspectives tend to define AI in isolation from its historical functions, become discipline-specific, and are often conceptualised in administrative functions (Chen *et al.* 2020:75265).

The first task in conceptualising AI must be to differentiate between AI and augmented intelligence. The second task in conceptualising AI would also be differentiating between AI and educational technologies. While these may be interrelated, they serve different purposes and functions in the educational sector.

AI means 'to reproduce human intelligence, function autonomously, and replace human intelligence with computer system' (Crowe, LaPierre, & Kebritchi 2017:494). AI can therefore be defined as

> the culmination of computers, computer-related technologies, machines, and information communication technology innovations and developments, giving computers the ability to perform near or human-like functions...encompasses the development of machines that have some level of intelligence, with the ability to perform human-like functions, including cognitive, learning, decision making, and adapting to the environment (Chen *et al.* 2020:75265, 75267).

AI is utilised to make machines smarter, therefore to complement or even supplement and augment the human exercise to complete tasks (Murphy 2019:2 of 21). However, AI has not yet reached the point where it can completely replace human intelligence (Crowe *et al.* 2017:495). There seems to be an automatic evolution from earlier educational technologies to eventually give rise to the development of AI (Chen *et al.* 2020:75276).

Augmented intelligence aims to assist or increase the human ability to solve complex problems through computers or other related technologies. Augmented intelligence serves as a support to human intelligence and not a replacement for human intelligence (Crowe *et al.* 2017:494). In augmented intelligence, the human and human intelligence remain the focus and at the centre (Lavenda 2016).

AI must also be differentiated from educational technologies such as personal computers and laptops, social media, and discussion forums. While computers were initially introduced and were the domain of AI in education, the latter has since evolved into web-based and online applications (Chen *et al.* 2020:75277). The use of MOOCs (Massive Open Online Courses) and various LMSs (learning management systems) such as Blackboard and Moodle can be classified as educational technologies (Chassignol *et al.* 2018:17). Educational technologies are employed in HE to allow students to have an immersive experience in their academic journey and to 'foster continuity of teaching, learning, research and other activities' (Durodolu, Enakrire, Chisita, & Tsabedze 2023:4). The use of educational technologies typically translates into student support.

Key characteristics for AI, therefore, must include the ability and intelligence to perform specific functions that are required of human actions as this is evidenced in the development of speech recognition and systems for deep learning. AI also has the ability to customise and personalise the content and learning experience of students to meet their needs.

The Purpose of AI in Education

The education sector is perhaps the one industry that stands to change the most due to the impact of AI (Chen *et al.* 2020:75269). Indeed, AI and its usage present endless opportunities to transform and revolutionise education (Chen *et al.* 2020:75273). I, however, am particularly interested in how AI can enhance the student's learning experience and promote deep learning without compromising academic and ethical standards, such as plagiarism, which has become a concern in recent publications (Huang 2022:1863; Irshad, Azmi, & Begum 2022:23). Another area that needs further attention is the concern that educators may have of becoming obsolete in teaching as AI may threaten the teaching enterprise (Irshad *et al.* 2022:22).

AI and its various applications are widely used in the educational sector 'including such tools and technologies as teaching robots, intelligent tutoring systems, and adaptive learning systems. We can also mention such AI applications as adaptive skill building, scheduling, career education, and many others' (Chassignol *et al.* 2018:17). In other words, there is sufficient evidence on how AI is being used in administrative functions for a more efficient educational process. These administrative functions are vital especially in student support by presenting continuous, immediate, and meaningful feedback on student progress and guidance by the educators. With the bulk of the administrative tasks performed by AI, the educators can be free to focus on student engagement and craft a personalised learning plan for each student. While feedback on assessment and learning is both an administrative and academic task, it remains an important part of the academic journey of each student. AI has made significant inroads into areas of feedback through intelligent tutoring systems (Rus, D'Mello, Hu, & Graesser 2013) which increase student understanding and performance (Crowe *et al.* 2017). These intelligent tutoring systems allow for an individualised tutoring system between the educator and the student which caters for a more personalised learning approach not only for assessing the student's level of learning and understanding but also to assist students in deep learning by addressing their needs (Chen *et al.* 2020:75267). Deep learning also requires the student to carefully consider and process ideas, content, and approaches so that they may clearly articulate and explain their perspectives on AI technologies to address challenges (Rus *et al.* 2013:43). AI, therefore, can be a useful pedagogical tool for educators and can improve the overall quality of the curriculum design, content, delivery, and engagement with the student. Murphy (2019:14 of 21) narrates:

> I have identified three areas in which AI-based solutions have shown promise for supporting teachers in challenging areas of instruction: adaptive instructional systems that allow teachers to differentiate instruction at the student level for certain topic areas and skills; automated scoring of student writing assignments, which supports teachers' ability to assign more writing in the classroom; and early warning systems, which alert administrators and teachers

> when students may need additional support to stay on track and progress toward graduation.

The evolution of AI in developing tools for academic integrity should allay the concerns and fears of educators that the students will not commit themselves to completing their work. Instead, tools for plagiarism checking and proctoring have greatly assisted educators in identifying and maintaining academic integrity (Chen *et al.* 2020:75274).

While there will always be areas of risk in academic honesty (Crowe *et al.* 2017), the benefits of AI in education surpass the risks and concerns that educators envisage (Chen *et al.* 2020:75275). Academic dishonesty did not start with AI, instead, it just brought it more to the fore. However, AI allows and fosters deeper learning by leading students to ask more specific, relevant, and critical questions and to explain and articulate their questions and responses fully and clearly (Chen *et al.* 2020:75275; Rus *et al.* 2013:47). This deeper engagement allows for the retention of information and generation of new knowledge (Chen *et al.* 2020:75275). The personalisation of AI allows this process of interrogation and articulation to favour individualised learning as it starts fashioning its assistance to suit the student's strengths and capabilities. These further assist students who may not have a strong comprehension of language and grammar by highlighting and revising work so that it is on an acceptable standard. AI also allows students to track their learning and progression of their studies having a motivating effect on the students and their progress.

AI systems will be utilised more extensively in the education sector and will extend the educators' functions beyond just assisting students to grasp specific content. It will have a significant impact on the students' 'personal skill, knowledge mastery, learning ability, and career development' (Chen *et al.* 2020:75276), thereby extending beyond the classroom setting and infiltrating the life of each student.

Why the Humanities?

The humanities, often used interchangeably with the liberal arts, pose a basic question, 'What does it mean to be human?' as it explores the human condition about oneself and the natural world without limiting the answer to a preset of ideas and criteria enforced by a patriarchal and colonial world (Smith 2015:741). That is why characteristics of the humanities include 'values, emotions, and relational learning[, and] are critical professional competencies, thus are core assessment areas' (Palahicky, DesBiens, Jeffrey, & Webster 2019:83). Disciplines in the humanities generally include 'philosophy, political science, religious studies, history, anthropology, sociology, literature, art, music, and studies of language and culture' (Nussbaum 1998:11) and these characteristics of the humanities must form part of the pedagogy employed. In HE, the humanities, like many other disciplines, also places more value on 'utility and cost' often at the expense of human values (Gorny-Wegrzyn & Perry 2021:221). Utility and cost are evident in the cost-to-expense ratio of programmes and modules to meet university viability standards, the need for a higher cohort of student success rates, and the employability of the students. The humanities serves various functions in society whether it is economic upliftment and medical or health-related needs through 'social prescribing' (Smith 2015:747). However, this is merely considered instrumentalism and flippantly reduces the humanities to pragmatic causes instead of considering its real value without any concerted effort (Smith 2015:742). In addition, research in the humanities should not be reduced to trivialism but should be allowed to have its rightful place in academic research (Smith 2015:751). It must also be noted that research and teaching are inseparable as the one cannot exist in isolation from the other. Indeed, '[h]umanities centers are highly adept at circulating new ways of undertaking research and of learning' (Woodward 2009:114). Research in the humanities should also not only seek causations or solutions to challenges. Instead, research and teaching in the humanities should foster interpretation, wonder, exploration, reflection, and even the reinvention of the human experience through care and hope and its relation to the broader natural world. The humanities provides the best answer to teaching and preparing students for a new world that is heavily influenced by AI so that they can create a better world that is characterised by care and hope (Caplan, Selingo, Kitcher, Robbins, Underwood, Starr, Vinsel, Chiang, Clark, Botstein, Pines, & Boyd 2023).

Pedagogies in the Humanities

Pedagogy is not just how students learn but also how the educator approaches teaching, which involves the philosophy, theory, and construction of the practice of teaching (Hirsch 2012:6). Additionally, '[w]hen we [educators] reflect on our values and teaching practices, it's just as important to think about how we engage, support and interact with our students, as it is to think about design of course content and learning activities to facilitate the holistic development of students' (Palahicky *et al.* 2019:81). It would be illogical to assume that the approaches to teaching, called pedagogies, are stagnant. Pedagogies should, and usually evolve to meet the new demands and challenges inside and beyond the academy (Hirsch 2012:6).

The humanities, to a large extent, has not always included the use of computers (Barman & Baishya 2023:305). However, computers and various technologies are now almost extensively used in the humanities, which have changed how one perceives and conceptualises this discipline (Barman & Baishya 2023:305). Whether AI is used as part of the curriculum or is influencing the curriculum, the use of technology has influenced and introduced the term 'digital humanities' (Barman & Baishya 2023:305). Digital humanities, while not focusing on AI, shows how technology not only shapes education but introduces new aspects and even disciplines as it 'looks at how people use digital technologies and approaches to address problems in the humanities, as well as how they think and behave when using them' (Barman & Baishya 2023:305). The challenge, as is evident in this book project, is that pedagogy usually plays second fiddle to research and sometimes becomes oppressed in the search for publications, research grants, and even promotions. Hirsch (2012:5) raises this concern about pedagogy losing its importance to research and warns against this trend. AI, in this case, should not only be a subject of research but also a part of pedagogical processes and even pedagogy itself. Pedagogy is the ideal means to stabilise a field by not only introducing a specific subject but by making it part of its existence or 'canons' (Hirsch 2012:13). In other words, it is what gets taught. In this case, AI does not just become research, but pedagogy.

AI should form part of the humanities curriculum, like Spector (1995:1) argues, 'Modern liberal arts pedagogical methods are successful in introducing students to large, diverse, interconnected bodies of knowledge; they can be similarly successful in introducing students to the large, diverse, interconnected bodies of knowledge that constitute AI.' This approach to an AI curriculum in the humanities could align the themes to institutional vision and agendas. AI topics should be thoroughly addressed as these relate to the humanities, and it could attract a new cohort of students (Spector 1995:2). However, AI education should not exist as a single course but through a collection of interspersed modules.

The facilitation by AI should not create uneasiness among educators who may fear that machines will replace humans and therefore steer the students in a completely different direction (Crowe *et al.* 2017:495). Instead, AI should be harnessed to facilitate learning through content engagement, knowledge production, applying practical or experiential experience, and work-integrated learning in the humanities through 'virtual reality, 3-D, gaming, and simulation, thereby improving the students' learning experiences' (Chen *et al.* 2020:75276). Murphy (2019:13 of 21) relates:

> The work of teachers and the act of teaching, unlike repetitive tasks on the manufacturing floor, cannot be completely automated. Good teaching is complex and requires creativity, flexibility, improvisation, and spontaneity. At the same time, teachers need to be able to think logically and apply common sense, compassion, and empathy to deal with the everyday nonacademic issues and problems that arise in the classroom – abilities famously lacking in even the most advanced AI systems. In addition

> to providing students with opportunities to develop narrow procedural knowledge and skills across a range of content areas (something that AI is particularly good at), schools and teachers must support the development of the whole child and provide students with rich opportunities to develop higher-order critical thinking and communication skills, as well as important social and emotional skills and mindsets (such as interpersonal skills, self-efficacy, and resiliency).

As discussed above, in areas of deep learning, students in the humanities are required to carefully consider the content and not merely regurgitate content in order to make a meaningful contribution to their disciplines as well as their contexts. AI requires explicit and thoughtful responses from students so that it may provide possible solutions to challenges (Rus *et al.* 2013:51). Therefore, a level of critical reasoning and articulation is required by students in the humanities to speak the language of the specific discipline and acquire industry-specific knowledge and language (Rus *et al.* 2013:51). Apart from these, students should approach the subject and discipline to acquire more in-depth knowledge.

The Role of the Educator

The role of the educator is paramount in this discovery. However, the educator should not pose as a specialist focusing to publish new research on the matter. Instead, the educator should be a facilitator and sojourner alongside the student in the quest for deeper learning without having to make a stance of being the professional and purveyor of all knowledge on a particular subject. After all, AI, while it is not a new concept, remains an emerging concept in the humanities as educators try and make sense of its purpose and function in the academy and society. This points to the need for pedagogical transformation in the humanities.

Pedagogy is the heart of the educational journey and academy. While there is a symbiotic relation between pedagogy and research, pedagogy should not be reliant on research but inform research (Hirsch 2012:16). Therein lies the need for pedagogical transformation, and this transformation must start with the educator. Yet, educators must be granted the assurance that AI will neither supersede nor replace teaching (Crowe *et al.* 2017:495). The educator, by nature, should be a critical thinker, therefore critically ponder about the purpose and role of AI in teaching. The educator should not be dismissive of new trends or evolution in education for fear of extinction and pursue self-preservation. Instead, when the educator critically reflects on the matter of AI, pedagogies in the humanities can be reinvented and transformative. This critical reflection of pedagogy and AI in the humanities require that educators must become well-versed in the current AI trends and technologies (Crowe *et al.* 2017:495).

Upskilling of educators is not a new challenge and it should therefore not come as a novelty in education. However, upskilling should exceed merely familiarising oneself with the available AI technologies. Instead, an educator like an instructional designer 'should have multiple roles as researcher, innovator, and informer' (Crowe *et al.* 2017:505). While speaking in the field of digital humanities, Hirsch (2012:17) raises the ultimate challenge of every educator: 'To reflect critically about pedagogy is to reflect critically about what it is that we do.' Is the job of the educator to teach what they know, reflect on what they teach, or reflect on what they know and how they know it? What is it that the educator in humanities does? Pedagogical processes are central to what the educator does and in return has a profound effect on the student. Therefore, pedagogy and reflecting on our pedagogy remain an important task of our teaching, while failing to consider this becomes a disservice to the humanities (Hirsch 2012:17).

The humanities should not just be educating students to upskill them for pragmatic purposes like employability. Instead, the humanities should assist students in discovering beauty and meaning and wonder about what it means to be human in the quest to further discover the human condition. After all, learning is a social activity 'in which we discuss, dispute, verify, reject, modify, and extend what we (think we) know to other people and the world around us. These are fundamentally human endeavors' (Caplan *et al.* 2023). AI will not pose any threat to this humanistic endeavour, instead, it will not only assist students with what they know or ought to know but also with the 'why' and 'how' of knowing (Caplan *et al.* 2023). AI in the humanities should excite the educator and student with the 'pleasures of learning' as both discover new knowledge or arrive at possibilities that support various opinions or hypotheses (Caplan *et al.* 2023). This endeavour of discovery is what the humanities should pursue for students to be enthusiastic in finding meaning, value, joy, and not just being employable (Caplan *et al.* 2023).

Pedagogical values, therefore, determine the educator's input and approach to the curriculum and programme design and will reflect on what is delivered to the student. What an educator believes is important, as these beliefs influence the pedagogical values that guide the educator to design courses for student success (Palahicky *et al.* 2019:80). This is especially important in the era of AI, where the human touch is still an essential element for the student. The pedagogical values of care, diversity, community, and justice are essential to instil an ethic of integrity and create an environment that is favourable for student-centredness (Palahicky *et al.* 2019:80). After all, students will be entering a world that will be greatly influenced by AI and should take with them not only skills but also ethics and values suitable for a dynamic world (Caplan *et al.* 2023; Palahicky *et al.* 2019:80).

Educators in the humanities, while sometimes not feasible, should learn to know their students through engagement and by working closely with them and create relationships that are defined by care. In this way, the educator can inspire the students to not cheat, pride themselves in their work, and submit their work timeously (Caplan *et al.* 2023). This is especially vital in online and distance HE. It will also require the educator, through their pedagogical values, to design better course material that would minimise and even detect cheating. The humanities, after all, should not just focus on the curriculum at the expense of the human aspects (Palahicky *et al.* 2019:82).

AI and Humanities – a Pedagogical Dance

AI is interdisciplinary and intersects more disciplines than just being limited to the sciences (Spector 1995:1; Barman & Baishya 2023:308). While the sciences are the majority stakeholder in the design of AI, there is a need to consider and include the humanities in the process to mitigate against the redundancy or replacement of human intelligence and agency (Dimock 2020:450). Furthermore, 'AI is going to transform every discipline, including and especially the humanities...[It will ask] fundamental questions that the humanities are best equipped to answer' (Dimock 2020:450). In this sense, the humanities will have more of an effect on AI than AI on the humanities. Perhaps, if AI is influenced by the humanities, the impact and transformation will not be that great as it becomes a tool by the humanities for the humanities.

Pedagogy is King

The humanities should shift its focus away from how AI operates or how to define it. Instead, the humanities should consider what AI can do in pedagogical planning. The focus should be on pedagogy as it is pedagogy that determines and directs the philosophies and approaches of the educator and how these will affect the student. In addition, or even more importantly, pedagogy will determine the direction of the discipline. In the same manner that instrumentalism has been critiqued, so too should humanities step back and have a more open stance to AI. The relation between AI and the humanities should become more cooperative and explorative, a dance where each is reliant on the other for direction, rhythm, tempo, and trust – a pedagogical dance that is defined by 'mutual standards' and 'meaningful interactions' (Bearman & Ajjawi 2023:1164) as well as care (Palahicky *et al.* 2019:82).

Mutual Standards

The standards required for a pedagogy between AI and the humanities must be mutually agreed upon between an educator and their students (Bearman & Ajjawi 2023:1164) as AI will be used for student assessment, feedback, and personalisation. Additionally, AI will be used for student upskilling in language, as well as critical and deep thinking. Yet, these functions remain a social endeavour where it is not isolated from the human condition and its pursuit of beauty, mystery, discovery, and translation. The standards must not only embrace what the humanities is but also pursue its purpose. This has a direct bearing on the choice of AI in the humanities and also on how AI should be used to achieve the overarching goals of the humanities. These overarching goals can be realised to achieve quality standards and best practices using rubrics to avoid ambiguity and to provide creativity and exploration, ethical standards for research and assessments, the limit of standards that prescribe the use of AI, and disciplinary guidelines and implications (Bearman & Ajjawi 2023:1165).

Meaningful Interactions

Meaningful interactions with AI can also be a journey of self-discovery and knowledge systems as it relates to AI and the humanities about society. Through meaningful and appropriate pedagogies, a student is able to develop the skills and ethics required to understand and use AI that is appropriate for their context but also not to misuse AI systems when it is not aligned to sound ethics and morals within the course and even society at large. These interactions, when correctly administered, will reduce cheating and promote honesty and collaboration. Through this process the student is faced with situations where they have to make choices on how to proceed with the utilisation of AI and reflect on their self and how they would want to engage with AI in their studies. In other words, the student will have to face and develop evaluative judgement, be confident in their abilities, and understand their positive contribution to society as one who has completed what was required (Bearman & Ajjawi 2023:1167).

Care

A pedagogy of care can arguably positively affect a learning environment as well as a student’s engagement with their studies and ultimately a positive outcome of learner success (Gorny-Wegrzyn & Perry 2021:222). A pedagogy of care is more than merely identifying students’ struggles but how to understand their struggles so that these can be translated into new teaching strategies for student success, collaboration, and sharing of new ideas, and create positive learning outcomes for students to be positively active as citizens in pursuit of social and political justice through 'kindness, respect, and empathy' (Gorny-Wegrzyn & Perry 2021:222). A pedagogy of care can ultimately create an environment where honesty and ethics abound as these are vital in the student's engagement with AI to create an ethic of honesty.

A pedagogy of care allows educators to invite students to contribute to the subject matter no matter how knowledgeable the educator may be in that subject. This allows for innovation as students feel more valued and committed and may also contribute new understandings of the subject especially as it may relate to new areas of AI. A pedagogy of care, therefore, afford opportunities for innovation as the context allows for a space that resembles the ideals of the humanities of what it means to be human amidst an AI- mediated space.

AI Functionality in the Humanities

AI should not just be utilised to realise solutions to problems but also to discover. In other words, students in the humanities must understand how to work 'meaningfully' with AI (Bearman & Ajjawi 2023:1167). Three specific guidelines are: '1) [D]eveloping critical digital literacies for an AI-mediated world; 2) tasks that develop evaluative judgement; and 3) acknowledging emotions, and the role of trust and doubt' (Bearman & Ajjawi 2023:1167). The three guidelines have specific outcomes of self-awareness, discovery, and upskilling, which are valuable traits within the humanities.

Developing Critical Digital Literacies

Digital literacy, according to Bearman and Ajjawi (2023:1167), is the ability to read the world and the student's needs to develop the ability to navigate and critically engage with AI-mediated environments. This requires that students must be able to assess and acquire skills beyond simple skill development to more critical and evaluative approaches by not just acquiring digital skills but learning how to critique and work with the digital within an AI system.

Bearman and Ajjawi (2023:1167) discuss and emphasise the importance of critical thinking and evaluation in the context of digital literacy by aligning these with contemporary educational needs. Students must also learn about the challenges or potential drawbacks of relying on AI in academic practices. However, both students and educators learn and understand the evolving role of AI technology in education and its impact on society. While it encourages students to acquire digital literacies, it encourages educators to foster a balanced understanding of AI's impact on students. Acquiring digital literacies goes beyond mere skill development and encourages a critical evaluation of AI-mediated information aiming to equip students with the ability to navigate the complexities of the digital world.

Developing Evaluative Judgement

Evaluative judgement, according to Bearman and Ajjawi (2023:1168), is when a student can make decisions about the quality of their own and others' work by recognising and evaluating quality standards. Students, therefore, actively contribute to their studies and society through their work by building an evaluative judgement. The promotion of evaluative judgement is crucial in preparing students for an AI-mediated world by shifting the focus from mere task completion to understanding its value and how their work aligns with societal notions and expectations of quality. This allows them to assess their contributions within AI interactions by 'leveraging knowledge of disciplinary quality standards…acknowledging that social actors' contributions are often unexplained[, and] utilizing digital literacies in evaluating AI interactions' (Bearman & Ajjawi 2023:1168). Evaluative judgement goes beyond cognition, as students are confronted with acknowledging the role of emotions, especially in dealing with ambiguous, complex, and unknown situations, and concretises the role of the student in contributing to the world with their work through evaluative judgement.

The focus on evaluative judgement is also indicative of the evolving educational landscape and recognises the need for students to navigate and critically engage with AI-mediated environments. The focus on evaluative judgement aligns with the broader goal of fostering critical thinking skills through various pedagogies with practical tasks and acknowledging the affective domain and not only cognition.

Acknowledging Emotions

Emotions play an important and crucial role when students engage with technology in the same way that they navigate relationships with people, spaces, and objects (Bearman & Ajjawi 2023:1169). Technology is not excluded from emotional engagements. Acknowledging and understanding emotions is important when dealing with AI technologies. The educator's role is vital in prompting a consideration of the role of emotions, especially trust, and not just helping students to regulate emotions. Trust involves both cognitive and affective elements and requires the student to take a 'leap of faith' towards a favourable outcome. 'Epistemic doubt' is thus introduced (Bearman & Ajjawi 2023:1169). Epistemic doubt is described as both cognitive and affective – a state of uncertainty and discomfort. Students are encouraged to hold AI interactions in epistemic doubt, which is the uncertainty about the link between recorded data and real-world objects by recognising that information may be partial, biased, or incorrect. This uncertainty allows students to navigate between trust and distrust and encourages a critical analysis of their interactions with AI systems.

Emotions, therefore, are not sidelined or dismissed when dealing with AI technologies. Instead, students are presented with situations that link emotions with human action as they engage with the uncertainty of technology. In addition, it also assists students in understanding how emotions shape interactions with AI systems. Emotions, trust, and epistemic doubt are highly relevant to the ethical considerations and challenges faced by students who engage with AI systems especially as they are confronted with nuanced perspectives on the complex relation between human emotions and technology (Bearman & Ajjawi 2023:1169).

Conclusion

The humanities are interested in researching the human question and the human dilemma. In the same way, AI in HE should also be implemented to assist the human question and the human dilemma. When employing a pedagogical dance between AI and the humanities, the reasons and purposes must be explicit, and neither the educator nor the student should be left wondering why it is implemented. The pedagogical dance should be considered one that is intentionally implemented to meaningfully utilise AI in the humanities so that the student is prepared for an AI-mediated world. The pedagogies utilised must prepare the student wholistically not only with the desired skills for an AI-mediated world for employment but also with the ethics and judgement required of them.

In addition, the humanities should utilise AI in such a way that the student is always wondering, exploring, and translating the pursuit of meaning and purpose in a world that offers more than just economic satisfaction. These traits must be evidenced by a pedagogy of care where the educator instils these desires and traits in the curriculum and utilises AI to further these ideals. The humanities should not be defined by pragmatism but by exploration and wonder.

AI is meant to supplement and augment the educator so that they may have greater capacity and tools to be more effective and efficient to support the student. AI in education will never replace the educator and the level of intelligence required to meaningfully journey with the student. Discovery and assigning meaning will always remain a human activity.

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Chapter 2

Ahead of the Artificial Intelligence Curve: Changing Roles of Information Professionals in Higher Education

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As an information professional,
I always thought my role in higher education was clear,
but that no longer seems to be the case
(Adapted from Jenkins 2016).

Introduction

In the digital era technological advancements brought about by AI (artificial intelligence) have extensively altered the manner in which information professionals should offer services and resources to cater for individualised information needs. Technological advances in AI combined with institutional changes, budget constraints, and alternative modes of delivery are affecting the scope and scale of services required of traditional information professionals. Information professionals therefore find themselves in a distorted and surreal world – a world that has changed in a way where AI and technological advancement create a context that is unfamiliar. Within the HE (higher education) sector where the focus is on fostering education, research, and societal development, the importance of information professionals in leading these institutions into the 5IR (fifth industrial revolution) by advancing their own skills and utilising technology towards personalising information services and resources, cannot be overemphasised. More research is required to assess whether the vision proposed by the researchers will prepare information professionals effectively to stay ahead of the AI curve.

Exploring the role of the academic information professional in such unknowns, is only possible by attempting to predict the future based on existing knowledge about a particular situation or scenario. Towards such predictions, the chapter utilises an interpretive present future framework and explores the topic via the application of autoethnography. Discussions among the researchers and supported by existing literature conclude that skills of information professionals should expand to include social intelligence, cross-cultural competencies, computational thinking, trans-literacy skills, and adaptive thinking. These skills are to be applied in creating smart libraries founded on principles of automating manual functions, developing creativity, and innovation in a world founded on human-machine interaction. Information professionals should become cybersecurity managers, ethical ambassadors, advocates for inclusive access, data scientists, and open access and open science activists.

Although the central mission of modern HE is the production, transmission, and acquisition of knowledge (Le Grange 2009:103), the environment and context in which HE qualifications and support services, such as information access are provided, have changed significantly (UNESCO 2023). This is due to a variety of factors, such as changing policies, internationalisation, demand for study places, democratic changes, technological advances, and budget constraints, which combine to put increasing pressure on IHEs (institutions of higher education) (West 2016; Songkaeo & Yeong 2016:3 of 25).

In the South African context, there is a concerted drive for further change in terms of student access, funding, and curriculum redesign (Habib 2016). As a result, there is an increasing pressure on IHEs to create opportunities for access to information resources and services that support the advancement, creation, and dissemination of knowledge and research opportunities

(Akobe 2019). Conceptualising and organising how information professionals are to become part of the required changes in HE, are arduous and involve poorly constructed parameters (Nitecki & Davis 2017:3). The reason for this ambiguity lies primarily in technological advances, which have led to a change in educational paradigms, as well as in the increasing importance of information and digital literacy (Mandal & Dasgupta 2019:4).

While information professionals are embroiled in the speculations, concerns, and promises for HE under the 4IR (fourth industrial revolution), the 5IR with its discourses on AI and machine learning has begun to eclipse what used to be at the forefront of much academic discussion and research. AI has been around for some time; it is like a ‘slumbering giant’ that has now awakened with full force. For HE, this ‘giant’ is a game changer, affecting not only how students should be taught, but also how they and the academic community should be encouraged to engage in the creation, evaluation, use, dissemination, and application of information.

Considering that there are more than one billion websites worldwide, more than 16,000 open access journals, and about 30,000 closed scientific journals (Zul 2021), it is not surprising that technological interventions through AI and machine learning are needed to analyse and provide relevant information to support students in their academic endeavours. Due to the sheer volume of information available, the role and function of information professionals must change. Humans are no longer able to manage, organise, and disseminate information due to its expansive volume. The role of information professionals must change to reflect the dynamic landscape in which they play a central role in supporting the information needs of the academic community in a different way that enables university staff to acquire skills and competencies to navigate the vastness of information resources (Ngulube & Mosha 2024:4).

The focus of this chapter is on reconceptualising the role of information professionals in a changing HE context. In conjunction with the factors that impact the subject, it will explore how academic communities can be supported by information professionals in the digital age. The focus of the chapter is on uncovering the role of information professionals in the HE context, considering the transformative impact of technology and the general availability of information. As access to quality information becomes increasingly important in various sectors of society, this chapter highlights the role of information professionals in HE as architects of knowledge, guardians of data integrity, and guides through the vast information landscape.

Transformation of Higher Education

To place the issue in a better perspective, it is necessary to briefly consider the broader context of HE and the changes that affect the role of information professionals in this environment. Songkaeo and Yeong (2016:3 of 25) note that the concept of HE is perceived differently due to different discourses in different countries. Maassen, Nerland, Pinheiro, Stensaker, Vabø, & Vukasović (2012:8) agree, noting that academic institutions have regularly faced pressure to change their focus and meaning over the course of their long institutional history. Since the early 1990s, for example, universities have been forced to rethink their purpose. This is mainly due to the development of the knowledge economy, massification, technological expansions, and the globalisation of both conceptual knowledge and acquired skills, to contribute to economic development (Johnstone & Marcucci 2007:2 of 36). In Europe, the Bolonga degree structure and the ECTS (European Credit Transfer and Accumulation System) have had a major impact on the purpose and scope of HE (Hay & Monnapula-Mapesela 2009:9; Sursock 2015:18).

Massification, global competitiveness, funding, curriculum structures, and the relations between teaching, learning, assessment, research, and access to information through HE have transformed Europe into a competitive knowledge economy (Garben 2012:8 of 44). As part of the Lisbon strategy, IHEs are expected to refocus and use limited resources to achieve maximum success. Like their European counterparts, IHEs in the US (United States) are shaped by the market, as they are dependent on external stakeholders for funding. Massification to improve equity and social mobility influences organisational structures, the size and shape of systems, the nature of service delivery, and interinstitutional partnerships for academic programmes.

Various government policies have led to more open access to HE in China since 1999. The admission of workers, farmers, and soldiers has resulted in HE changing from an elitist approach to mass education (Songkaeo & Yeong 2016:1 of 25). The aim is to provide equal educational opportunities to boost the emerging economy. Despite the increase in student numbers, financial support from the government has decreased, forcing IHEs in China to rely more on nongovernmental funding for their operating costs (Kapur & Perry 2015:13 of 29). Under these pressures, HE staff, including information professionals, must provide services that go beyond their traditional roles. These include serving an increasing number and diversity of student profiles, providing tutoring support, utilising various forms of access to information resources, using technology to promote access to information resources, and performing functions that include advocacy and promoting the use of information resources (Marr & Forsyth 2011:65).

Like the transformation in HE that has occurred globally, IHEs in Africa, with few exceptions, have faced similar challenges to train a highly skilled workforce, build an academic tradition associated with universal knowledge, and become a driving force for economic development (Eshiwani 1999:32). These challenges, combined with inadequate financial resources, prolonged economic and social crises, as increasing technological advances have impacted on the role of HE in Africa. Countries such as Botswana, Algeria, Zimbabwe, Mali, and Tanzania report that IHEs are unable to meet development needs, and have opted for an Africanised model that is relevant, incorporates indigenous knowledge, and makes courses more wholistic (Eshiwani 1999:31).

However, due to political turmoil and despite the best intentions to create quality IHEs for the masses, a few reforms have transformed HE in African countries sufficiently to create a more egalitarian society. Rather, universities have become microcosms of societal structural problems (Assié-Lumumba 2006:96). Institutions such as the World Bank and the United

Nations, through Kofi Annan, have called for a revitalisation of African IHEs to support the development of Africa's knowledge economy and act as a driving force for development (DHET 2023:xii). HERNANA (The Higher Education Research and Advocacy Network in Africa) was established in 2008 to raise funds for the development of HE in Africa (MacGregor 2009). In 2009, participants from 41 African countries at the Africa Regional Conference on Higher Education called for more effective policies to promote the revitalisation of HE in Africa (Teferra & Altbach 2003:4). The conference called for strengthening human capacity to deliver services related to the highly demanding HE environment, including skills development in training, research information, and digital literacy (MacGregor 2009).

In South Africa, the restructuring of the HE system after 1994 initially focused on shaping macro-politics. The Programme for the Transformation of Higher Education (DoE 1997a:13) provided a framework for transformation based on equality. This was followed by the Green Paper on Transforming Higher Education (DoE 1997b) and the subsequent White Paper (DHET 2013), which aimed to address institutional inequalities, meet development needs, and create equal learning opportunities (cf. Subotzky 2003:550). In 2016, 20 years after the advent of democracy, however, the CHE (Council on Higher Education) highlighted the gap between high expectations and the harsh realities of state and institutional resources and capacity. Issues such as student access and success, research and postgraduate education, transformation, institutional diversity, funding, and the development of the current and next generation of academics, all impact the success of IHEs. In terms of growth and development, it is important that the HE sector responds by creating opportunities to expand the pool of skills and knowledge available to the country. Innovative pedagogical approaches, sustained student support, developing flexible curricula, and improving literacy and digital skills are potential means of addressing key issues in HE (CHE 2016:147).

However, Llopis (2022) argues that HE is facing one of its biggest unknowns despite the changes to date. Since COVID-19 (Coronavirus disease of 2019), all IHEs have had to rethink their strategies, learning methods, access to teaching materials, budgetary structures, and the way in which students and staff are supported through access to information, among other things. Technology has changed the landscape for service delivery in HE, forcing IHEs to constantly rethink their purpose and operations due to continuous technological change. El-Azar (2022) points out that technology allows students to learn from anywhere, which requires a different contextualisation of immersive learning.

Many functions of educators can be replaced by active learning using AI tools, where real learning is based on principles such as spaced learning, emotional learning, and the application of knowledge. AI tools can support automated assessment by generating tests with multiple questions, providing detailed guidance and feedback, and evaluating and suggesting high-quality educational resources (Crompton & Burke 2023:14 of 22). Gen-AI (generative artificial intelligence) can create ecosystems for advanced teaching, learning, and research that require deliberate and purposeful thinking to promote transparency, accountability, and access to HE for the common good (Witwatersrand University 2023). AI thus opens tremendous new opportunities for HE, where one moves away from labour-intensive tasks and provides services that enable rigorous, adaptive, and personalised experiences for students and researchers (Klutka, Ackerly, & Magda 2018:6).

Transformation of Information Professionals

Given the changes in HE, Akobe (2019) argues that the role of information professionals has also changed. Originally regarded as custodians of information dissemination, information professionals in the digital age are competing with technology that provides instant access to vast amounts of information and data to anyone from anywhere. Lund and Wang (2023:27) believe that technology such as GPT (generative pre-trained transformer) and the technology underlying ChatGPT (chat generative pre-trained transformer) can access, disseminate, and integrate information in a more efficient and effective way than an information professional can. Mandal and Dasgupta (2019:1) argue that if information professionals want to remain competitive, they must learn to make digital repositories their researchers. This means that the information professional in the digital age, competing with technology to provide high quality, accurate, and reliable information, must have skills in selection, content management, knowledge management, organisation of information on intranets and the internet, and the ability to develop and maintain digital libraries and bring information resources to the user's desktop (Nikta 2022:254). Tappenbeck and Sühl-Strohmenger (2023) rightfully claim that only a few professions have changed as much as the information professional in an academic setting because of technological advances.

The profession has undergone a significant revolution, particularly in the context of AI (Cox, Pinfield, & Rutter 2019:431). Various descriptions of AI have been cited in relation to the profession. Hare (2022) defines AI as systems that change behaviour, usage, and observations without being explicitly programmed to do so. Tähti (2024) describes AI in information science as a cluster of technologies designed to make flexible and rational decisions in response to unpredictable environments. Floridi (2023:6 of 12) presents AI in the context of the information profession more specifically as big data, analytics, machine learning, data visualisation, and natural language processing. With AI, certain workflows such as inventory management or the indexing of media and documents can be mechanised. AI technology in the context of the IoT (internet of things) can create digital reference networks and provide expertise that surpasses that of humans (Jacobs 2022).

Due to changes driven by technology, information professionals need to become versatile, not only in terms of their expertise, but also in developing technical skills to ensure they keep up with modern technological advances (Akobe 2019). Nikta (2022:256) therefore suggests that information professionals in academia are called upon to play a visionary role in transforming the information science industry, so that new technologies, new organisational structures, and new services can be cultivated to promote knowledge that is quickly and easily accessible. To achieve this, one of the things that needs to change is the way in which information professionals participate in and support the academic environment (Nikta 2022:256). Professional development opportunities, supported by workshops, seminars, project-based interventions, peer mentoring, formal qualifications, rewards, incentives, research and innovation funding, professional associations, conferences, and special interest groups can help to develop visions for roles in which AI is used to benefit the delivery of information services (Banks 2023). However, such visionary tendencies are often incoherently structured, resulting in information professionals being inadequately prepared for a world in which technology is in vogue (Librarika 2022).

Contextualising the Challenge

Jacobs (2022) argues that the pace of change in HE has caught information professionals off guard. Whether regarded as a threat or a promise for useful applications in HE, the changes brought about by technological advances are impacting how people read, learn (and teach), evaluate, and therefore, think. Duggal (2023) explains that one of the main disadvantages of technology, and of AI in particular, is that people no longer need to memorise information or solve puzzles to find solutions to challenges. Humans are therefore using their brains less and less, which can lead to a lack of creativity, innovation, and even emotional disturbances (Greene-Harper 2023). In the information industry, the negative effects of AI have already been identified in the creation of information sources (Murphy 2023), language development, the E-A-T (expertise, authority, and trustworthiness) of information (Hare 2022), and in ethical areas of data protection (Palaha 2023).

In HE, information professionals are experiencing changes in the areas of academic engagement, innovation, technology utilisation, content development, and skills development. Technological advances in AI, combined with institutional changes, budget constraints, and alternative modes of delivery, are affecting the scope and scale of services required of traditional information professionals. Preparing information professionals for current (where we are) and future (what is coming) disruption, requires consideration of a variety of factors that guide and inform their roles and responsibilities as information professionals in the digital age. Palaha (2023) refers to this as 'unknown unknowns.' The author explains that the environment in which information professionals operate in IHEs is riddled with knowledge gaps. It is in this area of 'unknown unknowns' that the challenge lies because it is impossible to ask and prepare for something you know nothing about.

We know that traditional information institutions, such as academic libraries, are no longer the one-stop shop for accessing information. Many users access large amounts of information via the internet (Mandal & Dasgupta 2019:1). Therefore, the value of academic libraries, and therefore academic information professionals, has diminished. Technological advances and the extensive formats in which data and information are developed and exchanged, require a rethinking of the position of information professionals in HE to embrace uncharted areas.

Through the Looking Glass – in Search of a Futuristic Frame

In his sequel to *Alice's Adventures in Wonderland* from 1871, Lewis Carroll metaphorically describes a situation in which things in the 'Wonderland' are viewed from a different, distorted, and surreal perspective (Carroll 2020). Looking through the mirror gave Alice the feeling of entering an alternative and unfamiliar reality. Similarly, in the reality of 'unknown unknowns,' information professionals find themselves in a distorted and surreal world, a world that has changed in a way where AI and technological advancement create a context that is unfamiliar. Exploring the role of the academic information professional in such unknowns, according to Omoogun (2019) and Padgett (2021), is only possible by attempting to predict the future based on existing knowledge about a particular situation or scenario. According to Minkkinen (2020:16), such predictions are highly dependent on the choice of a future-orientated theoretical framework. Fischer and Mehnert (2021:26) explain that a futuristic theoretical framework refers to a set of concepts, principles, and hypotheses that attempt to predict future developments in a specific environment. It draws on current knowledge trends to envision scenarios about what the future may hold, either as the present future or as the future presents. Future presents refer to a situation later than now, a future present that is a point in time yet to come. Present futures on the other hand, refers to images of the future, thus descriptions of futures later than now, but embedded in the current discourse. Both these types of futuristic framework are speculative and used as tools for exploration, rather than prediction. Malhotra, Das, and Chariar (2014:123) argue that creative thinking is the foundation of both types of frameworks, where freedom of thought inspires a futuristic vision.

Within the context of this research, present futures are considered as frameworks that incorporate interdisciplinary perspectives, considering interactions between technological advancements, society, environment, and culture to propose a future. Though various classifications of futuristic theories are available, such as human augmentation and transhumanism, post-capitalism, environmental sustainability, six-pillar approach and cogent futuristic frameworks (Suckert 2022:402), to name but a few, the interpretive present futuristic framework as proposed by Inayatullah (2024), is applied to this research. Towards exploring a topic through an interpretive present future framework, Hejazi (2011:81) suggests that a process be followed to support or guide the building of present future suggestions into useful predictions. The proposed process comprises three distinctive steps as presented in Figure 1.

Linked to the figure, Hejazi (2011:84) proposes that the first step should identify variables that influence phenomena or challenges. Previous sections within this chapter already contextualised the changes in HE and the influence of AI and fourth and fifth technological advancements on the way IHEs operate, as changing expectations of information professionals manifest in these institutions. The issues related to the expectations of the roles of information professionals in the AI era receive further attention when this chapter examines the role of the information professional in the age of disruption.

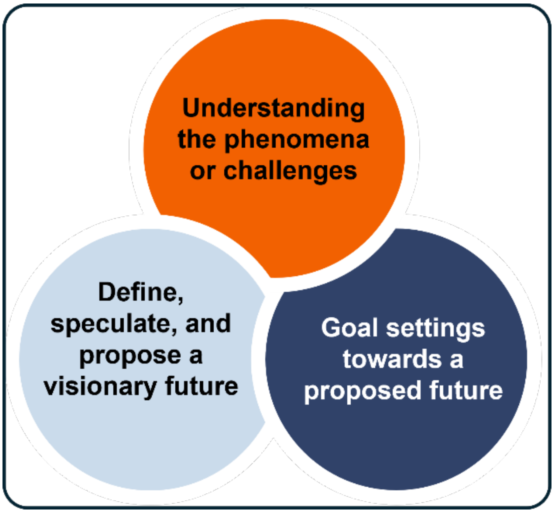

Figure 2.1: Proposed steps towards an interpretive present future framework *(Source: Adapted from Hejazi 2011:81)*

Pertaining to the second step proposed by Hejazi (2011:81), the aim of setting goals towards a proposed future relates to considering what is expected of a present future embedded in the current discourse. The aim of goal setting is to identify possible changes that will encourage a performance approach (Riopel 2019), where academic information professionals are able to use AI in a manner that will advance services and resources offered to users. Such goals are to guide predictions towards a transformative visionary future. The focus of the final step, in the words of Peter Drucker, relates to '[t]he best way to predict the future is to create it' (Goodreads 2024). In conclusion, the chapter will focus on suggesting alterations in the roles of academic information professionals, where AI tools can be used to advance and enhance the user experience.

Methodological Approach

Given that the proposed theoretical framework aligns to an interpretive present future framework, the paradigm applicable to this research is interpretivist by nature. Aligned to interpretivism, reality is socially constructed with many intangible realities, based on subjective meanings that individuals create, based on their experiences of ever-changing worlds (Creswell 2009:8). The main point of following an interpretivist paradigm is that we as researchers are interested in the changing roles brought about by technology and specifically AI within the context of libraries in IHEs. This links to the ontological view of interpretivism, where reality is socially constructed (McMillan & Schumacher 2010:370). Interpretivists do not try to conduct value-free research but share and discuss the values that shape their research with those that form part of the research (Grant & Osanloo 2014:17). Following an inductive approach, the focus of the research is on proposing futuristic roles for information professionals, by theorising about the current trajectory of changes, based on AI advancements.

The emerging inductive technique of autoethnography allowed the authors to explore the topic of the changing roles of information professionals to stay ahead of the AI avalanche in a highly personalised manner (Guzik 2013:269). Autoethnography has its roots in two focus areas: Inquiry and meaning making (Edwards 2021:2 of 6). It requires a deep emergence in self-experience and reflection. During autoethnography, the authors retrospectively and selectively write about their experiences (Riordan 2014:3). The aim is to take an analytical look at experiences and present them in such a way that they may relate to others (Stigter 2016:229).

Being researchers, our interest in this topic stems from the fact that we have prior experience as information professionals in IHEs and are currently involved in the education and training of future information professionals. From an educational point of view, future predictions in the discipline are important to ensure that current programme offerings prepare future information professionals for the changes that await them. Following the interpretive present future framework as per Figure 2.1, the researchers engaged in conversation to explore the steps towards proposed roles for information professionals in IHEs. The selection of conversations to explore a possible present future aligns with the views of Lapadat (2017:600) that the acknowledgement of personal experiences embedded in workplace and social structures are likely to bring about plausible solutions. Autoethnographic discussions revolve around questions about the disruption of AI on the work environment of information professionals, what the skills set of information professionals in academic organisations of the future should comprise of, and what roles information professionals should focus on to use AI in such a way as to offer innovative and ingenious services to users. Autoethnographic engagement findings are presented in the remainder of the chapter content.

Disruptions Caused by AI in the Professional Academic Information Work Environment

In the context of the digital era, disruption refers to the rapid change or transformation brought about by the introduction of new technologies, business models, or innovative ideas that fundamentally alter the way things are done. Puplampu, Hanson, and Arthur (2020:4) explain that the pace at which technology is transforming our lives is exponential, while the role of disruptive technologies is imperative for the development of innovation in Africa. Tarr (2021:68) agrees and states that disruptive technologies are bringing about robust transformative social advancements to promote economic growth. Linked to the education industry, Timotheau, Miliou, Dimitriadis, Sobrino, Giannoutsou, Cachia, Mones, and Ioannou (2023:6696) report that disruptive technologies such as augmented reality, virtual reality, blockchain, and smart devices have increased opportunities for advanced teaching and learning. The researchers can attest to this as technology has revolutionised the way in which teaching is being offered online through gamification, the use of virtual reality, and the creation of augmented realities through, for example, digital twinning.

Where the 4IR has provided opportunities for mechanisation and mass production, automation, and digitalisation (Shadrach 2022:4), the 5IR offers improvements on and applications of mechanical and digital technologies, especially wireless technologies, developed during the 4IR such as AI, robotics, IoT, cloud computing, and big data (Ibinaiye & Jiyane 2021:87). These technological advancements offer significant changes to the way information professionals in IHEs function and the services and resources they provide.

Guided by the suggestions of Guzik (2013:269) that individuals represent their own experiences through autoethnography, researchers can attest that the roles and responsibilities of academic information professionals include organising and managing library resources so that the needs of users can be met to advance their academic and/or research careers. This view is supported by Abels, Jones, Latham, Magnoni, and Marshall (2003:1), who explain that the traditional role of information professionals is to advance the mission of an organisation by developing, deploying, and managing information resources and services. Where information professionals traditionally were responsible for managing physical collections of books and other materials, the advancement of technology has brought about disruptions to the type of information resources that should be managed and how information resources are retrieved, data managed, and services offered. Disruptions due to technological advancements impact existing business models (Patel 2012:73). The result is that information professionals face challenges related to making effective use of technology and responding to changing user needs as part of their service delivery business model.

Academic information professionals are required to anticipate and embrace change constructively, and to be visionary in the business model that is applied to meet technological advancements. For example, instead of being collectors of sources, academic information professionals must offer access to digital information resources including e-books, online journals, databases, and multimedia resources, often through virtual reference services, rather than reference interviews. This requires new skill sets to mediate the increasingly digitally orientated academic library environment (Lapuz 2005:79). Ogedengbe, James, Afolabi, Olatoye, and Eboigbe (2023:317) suggest that such skill sets should include the ability of information professionals to advance connectivity and big data management, display analytics and intelligence skills, promote human-machine interaction through robotics, VRs (virtual realities), and AR (augmented reality), and engage in advanced engineering through 3-D (three-dimensional) printing.

New skills are needed in areas such as data literacy, critical thinking about AI-generated information, and teaching students how to effectively use AI tools (Floridi 2023:2-3 of 12). Shadrach (2022:7) also mentions that for information professionals to make the paradigm shift towards utilising 4IR and 5IR technologies effectively, they will require softer skills related to learnability, critical thinking, growth mindset, self-regulation, and perseverance. Aligned to the views of Ashikuzzaman (2019:2) that information professionals should present a stronger voice, researchers are of the opinion that information professionals in academic libraries require an advanced scope of skills to offer seamless and swift access to information resources and services to the right user at the right time and in the most suitable format. Academic information professionals should be able to take advantage of the wide scope of technologies that have emerged as a result of industrial revolutions, to foster a culture of intellectual growth and exploration.

Regarding the use of specifically AI technologies, Copeland (2024:1) states that information professionals should know how to most effectively use digital computers or computer-controlled robots to perform tasks commonly associated with intelligence, such as the ability to reason, discover meaning, generalise, or learn from past experiences. Computer search engines, chatbots, and LLMs (large language models) perform certain tasks at the level of experts and professionals (Floridi 2023:1 of 12). The advancement made with LLMs and GPT software such as ChatGPT, enables AI to process texts with extraordinary success and in a way that is indistinguishable from human output. Through such AI, technology is more effective than humans in arriving at outcomes within an increasingly complex world (Zielinski, Winker, Aggarwal, Ferris, Heinemann, Lapeña, Pai, Ing, Citrome, Alam, Voight, & Habibzadeh 2023:1). In fact, within the context of the roles and responsibilities of information professionals, such AI technologies have completely transformed the way in which traditional roles are executed.

AI is used to automate tasks such as cataloguing, interlibrary loans, and basic reference services. AI can assist information professionals in conducting literature searches, data analysis, and visualisation, leading to more efficient and innovative support for researchers. AI can be used to personalise learning material and resources for individual students that are adapted to their learning needs and styles. Examples of how AI is currently being used in HE settings include the use of chatbots for reference services, personalised learning platforms, and AI-powered research assistants. The successes and challenges of these implementations offer important lessons for future applications and require continued research into these areas. As per our views, the use of AI in academic libraries can lead to new career opportunities for information professionals in areas such as data curation, AI literacy instruction, and the development of AI-powered research tools and IoT applications towards creating a more modern, effective, and user-centric library experience.

The views of Corrall and Jolly (2019:115) support the perceptions of the researchers by explaining that information professionals in academic environments should be able to effectively use AI technology to enhance search and data discovery abilities through the application of AI algorithms. Additionally, Akobe (2019:4) encourages information professionals to utilise AI tools for automated cataloguing and metadata creation, to provide virtual assistance through chatbots, and to improve accessibility to information resources by AI-powered tools able to convert text to speech and supply audio descriptions for visual content.

In terms of the operations and management of academic libraries, information professionals are well aware of the time and energy spent on repetitive tasks. Shelving, inventory management, and book tracking can be improved with AI technologies (Ciccone & Hounslow 2019:8 of 21). For example, RFID (radio frequency identification) technology can track the movement of physical objects. This can simplify checkout and return processes and help with inventory control. Mobile and beacon technology can be used to send notifications to users on information services or direct them to information about events, new arrivals, and their location within an academic library

(Jacobs 2022:118). Information professionals can thus use mobile technology to engage with communities through social media, blogs, and other on-line platforms. In this way, users can be made aware of library events and resources and be encouraged to participate in on-line forums for discussions.

It is our view that AI technology used to globalise connectivity has the advantage that it provides opportunities for library services to be offered on a more global scale, and this increases interconnectedness to engage in and collectively find solutions towards achieving sustainable development goals. Using AI tools for such connectivity increases not only the ability of information professionals to benchmark against international best practices, but provides vast opportunities to support one of the key functions of academic libraries, namely to promote research.

Goal Setting towards Proposed Future

In the second component of the interpretive present future theoretical framework, the focus is on considering what is expected of a present future embedded in the current discourse. Towards setting such goals, it was necessary for the researchers to consider the views of, for example, CHELSA (the Committee of Higher Education Libraries of South Africa – CHELSA 2021) and the Academic and Research Libraries Section of IFLA (the International Federation of Library Associations and Institutions – IFLA 2024). CHELSA (2021:9) argues that academic libraries must shed old restraints, utilise unlimited opportunities, and present an optimism towards the future. In the context of unknown unknowns, it is expected from information professionals in IHEs to play a pivotal role in utilising technological advances, new pedagogies, and transformative drivers to bring about change aligned to the needs and expectations of users. Similarly, IFLA (2024) encourages information professionals to advance their skills, so that they are able to engage in and embrace trends such as open access publishing, open data management, e-research, and digital information literacy.

The use of technology to engage in such advanced skills requires a responsive AI library strategy, so that skills development can be linked to the roles and responsibilities expected from information professionals in the digital era (Cox 2024). Similarly, CHELSA (2021:14) emphasises the importance of strategies to enhance the integration of technology tools, to allow for on-demand services and resource access in academic libraries. The goal to consider as part of this research and in alignment with the above directive sources, thus involves considering future strategies that will guide roles, responsibilities, and skill requirements of information professionals based on the current trajectory of AI use in academic libraries.

A Visionary Future Based on the Current Curve

Cox (2024) explains that AI is not new. Information professionals are already familiar with many of its applications related to text summarisation, text and data mining, as well as machine learning. The most powerful AI applications currently in use relate to descriptive and Gen-AI (Tähti 2024). Where descriptive AI aims to make all kinds of material such as photos, videos, and sound machines readable, Gen-AI focuses on generating responses from data that humans accept as valid communication.

Within the academic library environment, descriptive AI provides opportunities of access to specialised collections that can now be shared with users. Descriptive AI can generate metadata from unstructured records, and extract as well as classify documents and records with high accuracy. Through Gen-AI, information can be created and used for communication purposes. Augmented with chatbots, Gen-AI consists of powerful tools for information sharing. According to Kaur (2024:31), utilising such AI technologies requires of information professionals to look beyond walls, campuses, and even borders to offer global opportunities to information access and use that serve students and faculty through more open access to knowledge. This requires the extended use of AI towards deep learning, reinforcement learning, and context-aware computing.

Linked to machine learning, deep learning involves artificial neural networks to expand tasks, such as image and speech recognition, natural language processing, and pattern recognition (Reyes 2023). Extended from deep learning, reinforcement learning involves AI learning to make decisions by interacting with an environment. Reinforcement AI learning allows for improved decision-making that may advance services and resources offered by academic libraries (Brooks 2024). Through context-aware AI, the available information related to user contextual information such as user location, time, devices, behaviour, and input data, can be analysed to provide continuous improved services to users based on their current and changing situations. Context-aware AI thus can recognise user behaviour and provide intelligent services based on analysed results (Kaur 2024:32). Through the application of these types of AI, information professionals in academic libraries can shift their centres of gravity from storage and physical collections to environments that support 'high energy learning,' providing expansive opportunities for users to engage and immerse themselves in the information and resources available through library collections.

However, while AI offers numerous benefits and advancements, there are also concerns related to its use. Because AI algorithms that are currently available are still regarded as general or strong, results can be biased based on the current data (Marr 2024). AI systems may extend current social biases that may extend to unfair or discriminatory outcomes. AI systems can also be vulnerable to adversarial attacks where carefully presented data can mislead AI models. Until artificial superintelligence systems are available, where AI capacity can outperform humans in all tasks, the use of AI technologies still requires a type of 'human quality assurance' to validate the accuracy of outputs, to minimise social disruption and the negative reliability of society on AI over dependency (Masaar 2022).

In addition, concerns have been raised about data privacy and the use of personal data (Arena 2022). Ensuring that AI applications adhere to privacy regulations and protect sensitive information, is a continuous challenge that information professionals must consider. Bartley, Kerjouan, and Shahidullah

(2024) thus call for increased considerations of AI regulations to offer a common minimum level of ethics to safeguard privacy, security, fairness, accountability, and transparency in the use of AI.

Considering the extent to which AI can be utilised effectively to offer a variety of personalised services and resources to users, and the potential issues in using it, the goal on strategies to be applied to ensure the effective use of AI by academic information professionals remains unanswered. Moving from Library 4.0 to 5.0 sets, according to Noh (2022:902), the foundation for creating strategies is to move libraries to community centric, highly digitised, and intelligent information services.

Within the context of Library 5.0 the emphasis is on personalised user experiences, big data analytics, and the IoT. According to the view of Oliveira and Rodrigues (2021), Library 5.0 should understand the needs of users and how ease of access can be improved in a relevant and immediate way. It requires a retriangulation of knowledge to include education, research, and innovation for the renewal of intellectual potential (Denchev & Varbanova-Dencheva 2021:111). Where the academic Library 4.0 was based on creating smart services, spaces, technologies, and resources, academic Library 5.0 should build on this progress through the application of technology that continues to progress tremendously. Aligned to the vision of the 5IR, Library 5.0 should place the wellbeing of users and staff at the centre of the information cycle and use new technologies to provide prosperity and growth, whilst respecting innovation, inclusivity, and cooperation between humans and machines (Ambasna-Jones 2023).

Homing in on important skills that information professionals need to acquire to prepare for the Library 5.0 future include, according to authors such as Mandal and Dasgupta (2019:8-9), Momoh and Folorunso (2019:7-8 of 10), as well as Ayinde and Kirkwood (2020:143-145), the following:

- Sense making where information professionals can identify and establish a deeper meaning of what is expressed to answer queries and can work with technology to exact and ensure 100% perfection of sources retrieved versus the needs of users.

- Social intelligence to bring a deep connection to users to stimulate reactions and desired interactions through social relationships.
- Novel and adaptive thinking where human intelligence, coupled with technological innovations move beyond rote thinking to predict unexpected circumstances and modify ideas towards problem-solving.
- Cross-cultural competency, where information professionals are able to operate in different cultural environments and disciplines, to be open minded and promote a mutual understanding within relationships.
- Computational thinking, where interrelations exist between humans and machines to analyse, evaluate, and create information/data, by breaking complex problems down into smaller chunks to find solutions.
- Transliteracy skills that will enable information professionals to train and develop new content via new media and reinforce changes in the mindsets of users.
- Makerspace creators that can offer various tools and material to facilitate inventions, creativity, and ingenuity.
- Transdisciplinary skills to understand concepts across different disciplines and to know how to link these to the offering of individualised services and support to users.

Aligned to the advanced skills required of information professionals to stay ahead of the AI curve, authors such as Tembe and Mkhathali (2019:7), Ocholla and Ocholla (2020:364), Nkiko and Okuonghae (2021), Jacobs (2022:126), and Santhi and Muthuswamy (2023) propose a number of strategies that should be considered. All these strategies relate in one way or another to academic libraries becoming 'smart.' In lucid terms, 'smart' academic libraries refer to libraries that integrate advanced technology and human intelligence to improve services, methods, automation, resources, and technology to advance library services (Orji & Anyira 2021:266). Within the context of existing smart academic libraries, technology has already been used to improve services, advance methods to manage manual tasks, automated functions such as circulation, lending and acquisition, digitised library resources, and utilised technology such as cloud computing to ensure optimal access and use of library resources.

Moving into the Library 5.0 space, more advanced management of technology and human resources are required to provide access to information, knowledge, cultural heritage, and opportunities for collaboration, creativity, and innovation. AI technology should be used to enhance library services by providing access to online resources, digital collections, and enhanced value-added user experiences (Hoque 2023:a816).

Aligned to the views of the abovementioned authors and towards advancing library services based on current trajectories, the researchers are of the opinion that the roles and responsibilities of academic information professionals should expand towards digital resource managers, digital literacy educators, collaborative and creative space makers, cybersecurity managers, ethical ambassadors, advocates for inclusive access, data scientists, and open access and open science activists. The use of a variety of existing and future AI technologies will offer opportunities for information professionals to leverage human-machine collaboration for greater societal wellbeing (Noble, Mende, Grewal, & Parasuraman 2022:202). As digital resource managers, academic librarians can utilise AI, such as the IoT, to offer extensive ranges of digital resources to support learning in current and emerging fields, such as biotechnology and nanotechnology.

Within the context of digital literacy educators, information professionals play a vital role to educate users about AI technologies, their capabilities, and limitations. This involves offering information literacy instruction sessions through virtual spaces, and using augmented technologies to help users understand and develop the ability to critically evaluate AI-generated content and the ethical implications of AI in information retrieval. As collaborative and creative makers of learning spaces, information professionals can create collaborative and flexible spaces to accommodate various learning styles and groups, thereby fostering interdisciplinary collaboration, which is imperative in the digital era (Masenya 2023:4).

As cybersecurity managers and ethics ambassadors, information professionals should not only be responsible for monitoring data privacy, but also propose policies and standards that can be applied to security data and information that are easily accessible by AI technology. Consideration should be given to prevent advanced malware and evasion techniques, phishing, social engineering, and reverse engineering to bypass AI tools. This requires that information professionals be educated in advanced technology programmes and systems to fulfil this role (Hoque 2023:a817). Similarly, as ethics ambassadors, information professionals should be educated and be able to educate others on privacy and ethical data practices.

Information professionals must advocate for responsible data management, protection of user privacy, and the adherence to ethical principles in handling information. As ethics ambassadors, information professionals should actively participate in identifying standards and guidelines for the use of data in AI (Ankamah, Vidza, & Addo 2024:63). The consideration, development, and implementation of such standards should extend to inclusive access to AI-powered resources and services. It is the responsibility of information professionals to ensure that AI technologies and services offered with the support of such technologies, do not create or perpetuate disparities in information access.

The monitoring role of information professionals thus includes ensuring that tools such as deep learning and artificial neural networks offer access to information via speech, video, 3-D imaging, and virtual reality simulations (Li 2018:3 of 5). As advocates for open access and open science, the role of information professionals should change to advocating with students, faculty, and researchers that research outputs should be made open to support science initiatives. This links closely to the revised role of information professionals as data scientists rather than data managers. This requires information professionals to be familiar with software related to data mining, data processing and modelling, and data visualisation.

Moving into the data science role provides information professionals with the opportunity to make libraries even more powerful sources of knowledge. As stated by Discover Data Science (2024), information professionals 'have a unique set of skills that makes them uniquely able to advise library patrons on the best practices for the collection, management, and organisation of data.' Information professionals, such as data scientists, are therefore in a unique position to usher in a new generation of data-driven insights that can be used by others interested in big data. By actively changing the current roles of information professionals to prepare them for a future where AI driven technologies may take over many current jobs, we will not only enhance the quality of library services, but also ensure an individualised, on-time, and in-demand delivery of information to support the needs of academic communities. As argued by CHELSA (2021:17), 'the efficacy of services and systems of a 21st-century academic library is contingent on the competencies and skills of its librarians.' Academic information professionals should therefore develop an array of competencies to take on new roles within the industry to advance scholarly communication, data management, data analytics, and user analytics.

Conclusions

Moving ahead of the AI curve provides a dynamic future to academic information professionals that is transformative in the way they shape technological advancements towards improved services. Learning how to use technology effectively and integrating AI technology with human expertise, creates a dynamic and multifaceted future for information professionals. Through their adaptability, expertise, and dedication to the mission of HE, information professionals are well-positioned to navigate the opportunities and challenges that exist and will be brought about by advanced AI technologies.

As technology continues to advance in IHEs, the role that information professionals will play is central in ensuring that these institutions remain at the forefront of education, training, and research. The digital age has elevated the importance of information and the need for more accessible and interconnected engagement with a variety of information resources. Within the HE sector, where the focus is on fostering education, research, and societal development, the importance of information professionals in leading these institutions into the 5IR cannot be overemphasised. Information professionals are essential partners in the achievement of the mission of IHEs. Their expertise and advanced knowledge of managing AI-human interaction will in future be key to support academic experiences, research, innovation, and knowledge generation.

More research is required about remaining ahead of the AI curve and utilising AI technology to the advantage of offering library services and resources to promote critical thinking, knowledge creation, and innovation. As a starting point, the researchers aimed to provide a present future vision of what is expected of information professionals and what roles they need to engage in as part of Library 5.0. As limited research on the topic is currently available (cf. Noh 2022), more empirical research is needed to assess where and how information professionals feature in the changing roles of information professionals. Such research will investigate the issue in more detail and offer innovative and creative views to ensure the advancement of information professionals toward the future.

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Chapter 3

AI and the Existence of Everything

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Artificial intelligence is one of the most significant developments in the age of digitalization. Perhaps it can be described as the third major evolutionary step following the invention of computers and their interconnection (the Internet), ushering in comprehensive everyday support based on machine learning, which we considered impossible just a few years ago
(Ebner, Schön, & Jahic 2023).

The Digital Transformation of Education[1]

Two outstanding truths that the educator of the 21st century is confronted with, are first, that we have entered the 4IR (fourth industrial revolution), also called the age of 'big data' (Anyoha 2017) and second, the acknowledgment that every student studies in a different/unique way. It is imperative for IHEs (institutions of higher education) to take note of the fact that there is no one-size-fits-all package for education (cf. Gous 2022:215), while the 4IR with all its disruptive elements is currently presenting itself in almost every aspect of our life.[2] One of the best examples in which the 4IR presents itself

1 The title of this section compares much to the chapter written by Thoring, Rudolph, and Vogl in 2018.
2 The 4IR can be described as (part of) a fragmented, liquid, and uncertain revolution. This 4IR world is already expanding into the 5IR (fifth industrial revolution), called the cognitive age (cf. Ziatdinov,

is AI (artificial intelligence),[3] although the latter has preceded the former with quite a couple of years. For many people AI has become part of their everyday existence and life. This also rings true for educators and administration personnel in IHEs. Holmes *et al*. (2019:202) put it this way: 'AI has become an often hidden but integral, pervasive, and inescapable part of our daily lives. In fact, paradoxically, the more it is integrated into our lives, the less we tend to think of it as AI.' Due to larger amounts of big data, new computational approaches, and faster computer processors the development of AI 'has been both groundbreaking…and transformative' (Holmes *et al*. 2019:202). A focal part of AI for education is that it is student-centred (Owan, Abang, Idika, Etta, & Bassey 2023:2 of 15).

However, all these developments do not mean that there will soon be robot educators in class (Holmes *et al*. 2019:80). Many people associate AI with (humanoid) robots. Fact is that robotics is key to AI research, although AI can be applied within many different contexts and ways (cf. Holmes *et al*. 2019:84).

Definitions of AI

There is no common definition for AI (cf. Chen, Xie, Zou, & Hwang 2020b:4 of 20). According to Coppin (2004:4), AI can be described as the ability given to a machine (sometimes a computer) to act humanlike by dealing with emerging situations, handling the user's problem/s and answering their questions.

Atteraya, & Nabiyev 2024), into the 6IR (sixth industrial revolution) presenting us with AI (cf. Di Nardo & Yu 2021), and even the 7IR (seventh industrial revolution) with NOAI (natural organic artificial intelligence) systems (cf. Ruiz Estrada 2024). Added to these are, *inter alia*, the fourth communications revolution (cf. Katsh 1984), the fourth education revolution (Seldon 2018), as well as the fourth revolution of human self-understanding (Floridi 2014). The conflation of these eras present the educator of today with challenging new encounters and suggestions on how educators should support their students.

3 Holmes, Bialik, and Fadel (2019:195-196) have a strong argument that AI should rather be called 'augmented intelligence' which is, according to them, more accurate and useful, thereby referring to the human brain as the source of intelligence instead of the computer because a computer cannot really act intelligently equal to the level of a human. Computer programmes can therefore act as a sophisticated tool to augment the human brain.

In more advanced AI programmes, the user may ask the AI bot to devise a plan or perform other intelligent functions. Chen, Chen, and Lin (2020a:75265) define AI as follows: '[A]rtificial intelligence is the culmination of computers, computer-related technologies, machines, and information communication technology innovations and developments, giving [these machines] the ability to perform near or human-like functions.' Devedžic (2004:29) elaborates that WI (web intelligence) must be added, as it creates a balance between web technology and AI, thereby producing a better learning environment for the student. Chassignol, Khoroshavin, Klimova, and Bilyatdinova (2018:17) argue that AI is a theoretical framework that acts as a guide in developing computer systems which have the capability to act humanlike, with the ability of advanced intelligence, being able to perform human tasks like having visual perception, the ability to recognise speech, decision-making, and being able to translate languages. Haenlein and Kaplan (2019:5) conclude that AI is a 'system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation.' Baker, Smith, and Anissa (2019:10) shortly refer to AI as 'computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving.' Pokrivcakova (2019:138) points out that the implementation of AI, incorporating its design, *inter alia* involves a myriad of professionals, 'including system designers, data scientists, product designers, statisticians, linguists, cognitive scientists, psychologists, [and] education experts.' Lastly, a comprehensive definition or explanation of AI is given by Butterfield, Ngondi, and Kerr (2016:26), stating that AI is a 'discipline concerned with the building of computer programs that perform tasks requiring intelligence when done by humans. Examples of tasks tackled within AI are: game playing, automated reasoning, machine learning, natural-language understanding, planning, speech understanding, and theorem proving.'

AI can therefore be considered as a 'broad field with many subsets, such as [ML] machine learning, [DL] deep learning, expert systems, machine vision, etc.,' already being utilised in HE (higher education) (Jahic, Ebner, & Schön 2023:1463). It is also fully interdisciplinary, covering disciplines like ‘information science, [cognitive] psychology, linguistics, neuroscience, philosophy, mathematics, and many others’ (Chen *et al.* 2020b:4 of 20). With all these definitions in mind, AI can be categorised into analytical, human-inspired, or humanised AI, differing from each other on the level of intelligence that each exhibits, be it cognitive, emotional, or social intelligence, or when taking the evolutionary stage of AI into account, into artificial narrow, general, and super intelligence (Haenlein & Kaplan 2019:6).

All the above definitions and descriptions make one wonders what can really be classified as AI, as opposed to ‘normal’ programmes. If one looks deeply into all the programmes pointed out in this chapter, one could make a case for many of them to not meet or satisfy a good description of AI. However, as we are still trying to settle into this developing environment, many a programme may ‘slip through’ as AI, while it may not really be AI. From its inception in the 1950s, scholars were continuously predicting and guessing about AI, while often warning that AI will soon reach the level of AGI (artificial general intelligence), where its behaviour will indistinguishably be humanlike on the levels of cognitive, emotional, and social intelligence (Haenlein & Kaplan 2019:6).

History of AI

Precursors of AI can be traced back to as far as 1763 when the mathematician Thomas Bayes has developed the *Bayesian Inference*, which was a decision-making method, being adopted by teaching machines and people on how to make ‘decisions using pattern recognition and predictions based on probability’ (Meacham 2021). In 1837 Charles Babbage has created an analytical machine made for mathematical calculations. Ada Lovelace has created the programme for his machine. Babbage’s machine is referred to as the first computer, while Lovelace is considered to be the first programmer (Meacham 2021).

Two more prominent precursors were Sydney Pressey and BF Skinner – both being psychologists. In the 1920s Pressey was an educator at Ohio State University. He devised a machine that aimed to give immediate feedback to student assessments, as well as being some sort of a mechanical typewriter (Holmes *et al.* 2019:95). His aim was to make life easier for educators so that they could give more attention to their students (not their research!) (Pressey 1926:374). Skinner, an educator at Harvard University between 1948 and 1974, followed in Pressey's footsteps and is well-known as the father of behaviourism (Holmes *et al.* 2019:94). He created a teaching machine as a personal tutor for students, thereby 'foreshadowing AIED's [artificial intelligence in education's] [ITSs] intelligent tutoring systems' (Holmes *et al.* 2019:96), although it was not adaptive. 1939 was the year in which Westinghouse created the first robot, called *Elektro*. This bot could already respond to a limited number of questions, while he could also walk, smoke a cigarette, and blow up a balloon (Meacham 2021). His robot dog's name was Sparko.

The 'real beginnings' of AI can be traced back to 1942, where Isaac Asimov (an American Science fiction writer) drafted a novel called *Runaround*. In this story, the robot, which was the creation of two engineers, Gregory Powell and Mike Donovan, had to adhere to the so-called Three Laws of Robotics, entailing that a robot had to protect and obey a human, as well as its own existence (Haenlein & Kaplan 2019:6). Asimov followed this up with *I, Robot*, published in 1950.

However, the 'official history' of AI (where AI 'that either completely replaces humans in performing some tasks or helps perform human tasks' – Jahic *et al.* 2023:1462) goes back to 1950[4] when the English mathematician, Alan Turing[5] invented the most basic AI chatbot called the *Imagination Game* (later renamed to *Turing Test*[6]). With this 'game' he attempted to test the intelligent behaviour (humanlike responses) of a machine (Oppy & Dowe

4 The good reason why AI's history only started here, is because before 1950, computers could only execute commands and not store it (Anyoha 2017).
5 He was the 'father' of the fourth revolution of human self-understanding (cf. Floridi 2014:231-232).
6 In his ground-breaking article called 'Computing machinery and intelligence,' published in 1950, Turing published his so-called 'Turing Test,' with which he gave an indication of how one must test the intelligence of a machine. Up to this day, the Turing Test still acts as a benchmark for the identification of intelligent machines.

2021). He also created *The Bombe*, which was a code breaking machine, specifically used by the English government to decipher the Enigma Code of the German army being used in World War 2 – something no human was able to do during that time (Haenlein & Kaplan 2019:6). This one tonner was considered to be the 'first working electro-mechanical computer' (Haenlein & Kaplan 2019:6).

In the 1950s, Norman Crowder developed the forerunner of the adaptive teaching machine, where a student gets some information about a subject and is then presented with multiple questions. When a student answers one question correctly, the programme moves on to the following question. Should the student's answer be wrong, a page appears where the student is given more information. State Holmes *et al.* (2019:97): 'Crowder's system adapted the pathway through the teaching materials according to the individual student's developing knowledge, such that each student might see quite different sets of pages.'

In 1956 the British polymath, Gordon Pask developed the 'real' adaptive teaching machine (Watters 2015), calling it *SAKI* (self-adaptive keyboard instructor). This machine was invented for 'trainee keyboard operators learning how to use a device that punched holes in cards for data processing' (Holmes *et al.* 2019:97; cf. Pask 1982). What distinguishes this machine from its predecessor, is that it adapted tasks to every individual's performance by building a probabilistic model for that specific person.

Also in 1956[7] the DSRPAI (Dartmouth summer research project on artificial intelligence) presented a workshop at Dartmouth College,[8] which was a US (United States) Ivy League research university. At this workshop, the small group of scientists discussed the first AI programme called *Logic Theorist*. John

7 According to Meacham (2021), it was 1955.
8 According to Meacham (2021), this conference was the first to be held where scholars in computer science discussed the possibility to programme computers with human language; to mimic human thought-processing in computers by making use of neural nets ML, which would be a 'truly intelligent machine that will carry out activities which may best be described as selfimprovement;' to programme a computer to be able to 'think orderly,' and be creative.

McCarthy is regarded as the person who coined the term 'artificial intelligence' there, defining it as 'the science and engineering of making intelligent machines' (Jahic *et al.* 2023:1462). Other scientists who would become leading AI researchers, and who attended the workshop, are Marvin Minsky, Allen Newell, and Herbert Simon (Holmes *et al.* 2019:196).

1957 saw the creation of the *General Problem Solver* programme by Herbert Simon (who won a Nobel prize) and two Rand[9] Corporation scientists, Cliff Shaw and Allen Newell. In line with its name, it could solve simple problems. In 1964 the computer scientist Joseph Weizenbaum wrote a computer programme called *Eliza*,[10] which was a natural language processor that could simulate a conversation with its user (Haenlein & Kaplan 2019:7; HistoryofInformation 2023; cf. Guan, Mou, & Jiang 2020:135). Haenlein and Kaplan (2019:8) refer to these two programmes as 'Expert Systems, that is, collections of rules which assume that human intelligence can be formalized and reconstructed in a top-down approach as a series of "if-then" statements,' which are 'technically speaking' not AI.

During the 1960s and 1970s many CAIs (computer-aided instruction systems) were drafted, of which *PLATO* (programmed logic for automatic teaching operations) is a prime example. Being developed at the University of Illinois, *PLATO* was a mainframe computer system for students to access their study material and it could accommodate up to 1,000 students at a time (Holmes *et al.* 2019:98). What makes this system outstanding, is the fact that it introduced many features or forums that are currently still in use, like the use of instant messaging, e-mail, remote screen-sharing, and multiplayer games (Holmes *et al.* 2019:98-99). Two other CAIs which were used with limited success during these days, are 1) a system made available to a few elementary schools by Stanford University and IBM (International Business Machines), and 2) *TICCIT* (time-shared interactive computer-controlled

9 Rand = research and development.
10 An advanced *Eliza* (now called 'the chatbot therapist') is still in working order (cf. web.njit n.d.). What is a bit annoying of *Doctor* is that she is programmed to mostly ask open-ended questions – a good therapist?

information television), being launched by Brigham Young, focusing on courses like chemistry, various language courses like English, freshman-level mathematics, and physics (Holmes *et al.* 2019:99).

Come 1966 Ellis Page developed *PEG* (Project Essay Grade), which was a marking programme, at Duke University. The programme was based on already marked assessment documents, but was not very successful as it only marked surface features like the number of sentences and grammar (Holmes *et al.* 2019:130).[11] This can be regarded as the beginnings of AWE (automated writing evaluation).

In 1970 the computer scientist Jaime Carbonell created *Scholar* which was a communicating AI system 'capable of reviewing the knowledge of a student in a given context' (Carbonell 1970:190), with emphasis on the geography of South America. *Scholar* was the initial example of an ITS,[12] something we still have with us today. What makes this programme unique, is that it does not only present instructional material as well as learning activities to a student, but it also converses with the student about the contents of the subject, giving rise to a better form of ITS, called DBTS (dialogue-based tutoring systems).[13]

11 Shermis (2014) reports that PEG was later upgraded to a 'State-of-the-art automated essay' marker.

12 ITSs are used for subjects like mathematics and science, providing elaborated tutorials which are individualised for each student, leading them step-by-step to successfully complete the subject's learning material and all the activities (Holmes *et al.* 2019:102). ITSs make use of three models: 1) The *domain model* covering the contents of and knowledge about the subject; 2) the *pedagogy model* contains effective approaches for the educator on how to teach the subject; and 3) the *learner model* constitutes personalised knowledge about the student's way of learning (Luckin, Holmes, Griffiths, & Forcier 2016:18). Other ITSs include *Mathia* (Carnegie Learning 2023), *Assistments* (Assistment n.d.), *Knewton Alta* (Wiley 2023), Area9 Lyceum's *Rhapsode* (Area9 2023), *Dreambox* (Dreambox.ai 2023), *Toppr* (n.d.), *Yixue* (Squirrel AI Learning 2023), *Aleks* (Aleks Hammo 2023), *Byju* (Byjus 2022), *Century* (2023), *CogBooks* (2021), *iReady* (Curriculum Associates 2023), *RealizeIt* (2023), *Smart Sparrow* (n.d.), and *Summit Learning* (n.d.).

13 Fine examples of DBTS are *Circsim* by the Illinois Institute of Technology (CIRCSIM-Tutor Project 2015), *AutoTutor* by the University of Memphis (2019), and *Watson Tutor* by IBM (IBM Watson n.d.).

Come 1972 psychiatrist Kenneth Colbe created an AI computer programme, called *Parry* (also called '*Eliza* with attitude'), to replicate the 'thinking patterns of a paranoid schizophrenic' person (Malm 2016). Shortly afterwards, in 1977 Edward Shortliffe designed *Mycin*, which was a knowledge-based computer programme, serving as a 'clinical consultant on the subject of therapy selection for patients' with infectious diseases (Shortliffe 1977:67).

In the 1980s Edward Feigenbaum (with Herbert Simon as his *Doktorvater*), arrived at Stanford University and initiated the development of expert systems (Anyoha 2017). The first system was called *Dendral* and was intended to help chemists to determine organic molecules' structures (Dennis n.d.).

In 1984 the personal computer was launched, which would completely change the scenario of technology, learning, and communication. This year also saw the creation of *Racter* – similar to *Eliza* – by William Chamberlain and Thomas Etter, with the difference that *Racter* did not always act sane. In the same year *Racter* became the first AI programme to author a book, called *The policeman's beard is half-constructed* (Chatbots.org 2023a). In 1995 *ALICE* (Artificial Linguistic Internet Computer Entity), also called *Alicebot*, was incepted by Richard Wallace. She is a 'natural language processing (NLP) chatbot designed to engage in a conversation by reacting to human input and responding as naturally as possible' (Debecker 2017), being inspired by the *Eliza* programme. ALICE is extraordinary, having received three Loebner prizes for AI[14] (2000, 2001, and 2004) for being a top accomplished humanoid and talking robot (Debecker 2017). In both 2005 and 2006 *Jabberwacky* took the Loebner prize (Shah & Warwick 2009:325). This chatbot does not only chat, but it also learns by modelling the way in which humans learn language (Chatbots.org 2023b). It further records every conversation it has with humans. Whereas chatbots are mostly rule-bound and finite, *Jabberwacky* has no hard-coded rules (Chatbots.org 2023b).

14 Hugh Loebner instigated the Loebner Prize in 1990 in order to find the most humanlike chatbot. He awarded a Grand Prize of $100,000 to the person whose chatbot was able to pass the Turing Test which involved visual, textual, and auditory components (Berkeley n.d.).

1997 saw the second example of an AWE, when the Pearson Knowledge Technologies (formerly Knowledge Analysis Technologies) invented a programme called *IEA* (the intelligent essay assessor) that uses LSA (latent semantic analysis) to mark papers. The programme can recognise the meaning of words within their context (Dikli 2006:3; Foltz, Streeter, Lochbaum, & Landauer 2013:68). This year also saw the implementation by Dragon Systems of speech recognition on Windows (Anyoha 2017). Another interesting robot that originated in 1997, is *Kismet*, which is a 'sociable machine [that] can interact with humans in a human-like way via myriad facial expressions, head positions, and tones of voice,' built by Cynthia Breaseal at MIT (Massachusetts Institute of Technology) (MIT 2001).

AI games worth mentioning are IBM's *Deep Blue* chess game that has beaten the chess champion Gary Casparov in 1997 (cf. Haenlein & Kaplan 2019:8), and Google's *AlphaGo* that has beaten the Go champion Ke Jie in 2017 (Meacham 2021). *AlphaGo* was able to achieve this success by utilising a particular kind of ANN (artificial neural network), which is called DL (deep learning). These ANNs are still currently in use, acting as basis for most programmes being labelled as AI (Haenlein & Kaplan 2019:8; Luckin *et al.* 2016). In 2011 *IBM Watson* has beaten the champions in the TV games show Jeopardy (Meacham 2021). This programme can understand human speech and respond to it, thereby 'paving the way for many uses of natural language processing in future applications' (Meacham 2021).

In 2014 a chatbot called *Eugene Goostman* was the first AI to achieve success with the Turing Test. However, having reassessed the answers given, the judges discovered that the AI avoided to answer some of the questions, thereby invalidating the test (Meacham 2021).

From the start of the 21st century, especially the second decade, chatbots increased exponentially, with the recent LLM (Large Language Model) chatbot called *ChatGPT* (Chat Generative Pre-Trained Transformer) taking most of the limelight. Others are *Slack bot* (created in 2014), an assistant that helps the user with specific requests (Pot 2022), *Messenger bots* – specifically created for Facebook, from 2015 (Rosenberg 2016), *Skilla bot*, which is a bot-based talent search platform, founded in 2016 (Tracxn 2023), and *Wordtune*, an AI writer and text generator (Wordtune 2023).

2016 saw the development of *Jill Watson* at Georgia Tech University, which is an ITS or a 'teacher bot' – an exceptionally good example of AIED, using ML to adapt to students' individual learning needs (Hardman 2023). While interacting with the bot, the system gathers data on the student's performance, and with that information the system trains a reinforcement learning algorithm, which can predict the strong points of that specific student with regards to tasks and assignments. In the meantime *Jill Watson* has split into two bots: The one does academic support, while the other one provides social and emotional support to students and helps them to connect to each other (Hardman 2023; cf. Wang, Jing, Camacho, Joyner, & Goel 2020).

In 2019 CMU (Carnegie Mellon University) launched the *OpenSimon* toolkit for educators 'to fuel new advances in student success and learning science. The toolkit is an integrated set of techniques and tools used to drive deliberate, iterative improvements in education. This approach, called Learning Engineering, supports educators as citizen scientists' (CMU 2023). According to CMU (2023), Learning Engineering consists of four phases: Design, develop, deliver, and discover.

There are numerous websites that teach people how to construct a personal chatbot (cf. e.g., a website teaching one how to modify *ChatGPT* for one's personal needs – Chatbase n.d.). As from the end of 2022, the 'new' subset of AI on the market is called Gen-AI (generative artificial intelligence), being capable to autonomously create music, 'audio, videos, images, and even texts' (Ebner *et al.* 2023; cf. Bozkurt & Sharma 2023; Boskurt 2023; cf. Jahic *et al.* 2023:1463). Examples of Gen-AI that are already available, are *ChatGPT* (n.d.), which is an advanced Gen-AI model (Jahic *et al.* 2023:1463),[15] *Bing* (Microsoft Bing n.d.), *Midjourney*

15 According to Ebner *et al.* (2023), *ChatGPT* can currently be used to
- help a student with research;
- generate assessments for a specific subject;
- create curricula and plan courses for students;
- assist students with assessments;

(n.d.), *Jasper Art* (Jasper n.d.), and *Musenet* (OpenAI n.d.). Owan *et al.* (2023:1 of 15) specifically refer to *Bing* and *ChatGPT*, claiming: 'Bing and ChatGPT have been referred to as objects individuals can think with, especially in the teaching-learning situation for learners to enhance their ability to think critically and reflectively, foster creativity, acquire problem-solving skills, and grasp concepts effectively.'

Many of the AI bots being discussed above are chatbots. Chatbots can be divided into two broad categories, namely ruled-based chatbots and AI chatbots (cf. Zendesk 2023). Ruled-based chatbots[16] are the most rudimentary types of bots that communicate through pre-set rules. These bots often supply the user with more than one choice from which they can choose the answer applicable for them – similar to programmed phone menus. AI chatbots (also called visual or contextual chatbots) deliver customer services by using either ML or NLP, both to converse with a user. These bots are learning from their conversations and with time deliver more helpful answers (Zendesk 2023). Examples of these bots are *Dom*, the Domino's ordering assistant bot, preparing pizzas (Adyen 2023), HelloFresh's *Freddy*, preparing food (Chatfuel 2023), and *Ask Benji*, Arixona's FAFSA[17] assistant, helping Arizona students to navigate their financial aid process at FAFSA (AskBenji n.d.).

There is also another category (subset) of AI bots called conversational AI (Zendesk 2023). Whereas the chatbots discussed above only simulate human conversations, while others make use of AI and NLP (deciphering questions and then sending

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- boost critical thinking;
- summarise documents;
- provide a personalised learning experience;
- be a great writing assistant;
- assist in language learning;
- generate and translate codes.

The negative side of *ChatGPT* in education is

- plagiarism concerns;
- a bias based on its restriction to only a limited number of sources;
- 'AI hallucinations;' and
- certain privacy concerns.

16 These bots are also referred to as 'decision-tree, menu-based, script-based, button-based, or basic chatbots' (Zendesk 2023).

17 FAFSA = Free Application for Federal Student Aid.

responses which were previously automated, based on keywords), the conversational AI bots act more as virtual assistants, like *Siri* and *Amazon Alexa* (Zendesk 2023). These bots use ‘data, machine learning...and NLP to recognize vocal and text inputs, mimic human interactions, and facilitate conversational flow,’ either through text messages or as a voice assistant on a (mobile) phone (Zendesk 2023). They are therefore able to interact with their user in a more humanlike way, improving their user’s satisfaction. More examples of conversational AI are *Erica*, the financial assistant of the Bank of America (Bank of America 2023), *Edward*, the virtual host of the Edwardian Hotels in London (Oram 2019), and *Julie*, Amtrak’s virtual travel assistant (Amtrak 2023).

Scientists are also applying AI, together with ML, on mobile devices, with the purpose to ‘enhance computation quality and create possibilities for new applications, such as face unlock, speech recognition, natural language translation, and virtual reality’ (Chen *et al.* 2020a:75267). A good example is the Android NNAPI (neural networks application programming interface – cf. Ignatov, Timofte, Chou, Wang, Wu, Hartley, & Van Gool 2018; Android for Developers n.d.). Architectures (DL models – Löw 2018) like *SqueezeNet*, *MobileNet*, and *Shufflenet* have already been developed for mobile phones (Chen *et al.* 2020a:75267). This technical development of AI helps students to achieve interactive and personalised learning and assess their levels of understanding (Chen *et al.* 2020a:75267).

Looking at all these innovative inventions, the question is not anymore if we should implement them, but rather how (much) and where we should utilise it. The logical question is therefore what the effect of AI will be on the HE environment in the (near) future: Will the educator together with IHEs become redundant in the end (which we do not hope for)? Will our education system become obsolete (which is maybe necessary)? Will an improved form of HE develop (which is imperative)? However, these questions also arose with the dawn of the internet and smartphones – and these two commodities have in the meantime become irreplaceable for most of their users (cf. Ebner *et al.* 2023).

AI and HE[18, 19]

Computers became part of the classroom and presentation of lectures during the later part of the previous century. This 'novelty' developed further with the introduction of the internet, networking, e-learning systems, and the availability of software programmes that made life easier for both educators and students. In most cases the computer has already become indispensable in HE.

The next big step in the process of evolution was the installation and utilisation of AI, Gen-AI, and LLMs. The introduction, proliferation, and advancement of AI presented educators with opportunities to revolutionise various aspects of education, facilitating their work in HE and fostering better effectiveness and efficiency on the level of education, especially during the 21st century (Chen *et al.* 2020a:75264). Timms (2016:702) elaborates that those educators who have already utilised AI, have discovered that it assists them in both global and personalised learning, and the creation of smarter content – with a relatively big contingent of AI not limited to being part of computers anymore. Currently AI is not dependent on computers only, but is also found in machines and robots, also called cobots (colleague robots) or simply bots (cf. Chassignol *et al.* 2018).

As education is for at least the past 30 years very susceptible to AI, it paved the way to refer to it as AIED. AIED[20] can be defined as the development of 'computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving' (Baker *et al.* 2019:10). AI is currently utilised on at least four levels in education: Administration, teaching (instruction), learning, and assessment (Chen *et al.* 2020a:75265). These systems simplify the work of the educator

18 For a bibliometric study on the impact of AI on HE covering the period 2007-2017, cf. Hinojo-Lucena, Aznar-Díaz, Cáceres-Reche, & Romero-Rodríguez (2019).

19 It is for obvious reasons impossible to name 'all' the AI programmes, specifically with relation to education.

20 According to Luckin *et al.* (2016), AIED has already been researched for the past 30 years.

and administrative personnel and assist students in their learning process.

AI in Educational Administration

Admin (administration) in general is time consuming. This also applies to admin for education: The enrolment of students and the processing of marks serve as examples. Here AI already assists by means of AIWBE (adaptive and intelligent web-based educational system) programmes with the enrolment at IHEs as well as the reviewing and grading of portfolio work, and to provide the necessary feedback. Take for instance the student who wants to enrol at an IHE: The AI uses the student's study data that are available, and then facilitates a career path and learning system for the student to improve their personal learning capabilities in specific subjects. After the student has enrolled, AI analyses their thinking capacity and capability, thereby assessing their learning abilities (Chen *et al.* 2020a:75268). This enables the educator to create tailor-made educational strategies for the student. Added to these, are three 'intelligent education technologies[, namely] machine learning, [LA] learning analytics, and [EDM educational] data mining' (Chen *et al.* 2020a:75268).

ML is focused on knowledge discovery, assisting the student to choose a university or to select their educational classes, all based on the student's capabilities and aspirations. Arthur Samuel has coined this term in 1959 (Samuel 1959). Mitchell (1997:2) defines ML, stating that 'a computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E.' This implies that ML, although requiring a huge amount of programming, does not fully rely on algorithms to be programmed what to do, but that it has the ability to learn what to do (Holmes *et al.* 2019:89). For students, ML suggests specific methods which will enable them to learn from data and to make predictions (Chen *et al.* 2020b:4 of 20; Holmes *et al.* 2019:89). ML, being a subset of AIED, is therefore a specific way in which students are trained to complete certain tasks while using much data. Holmes *et al.* (2019:89) describe ML as follows: '[M]achine learning may be considered a three-step process (analyze data, build a model, undertake an action) that is continuously iterated (the outcomes of the action generate new data, which in turn amends the model, which in turn causes a new action).' Applications or programmes that made use of ML include 'natural language processing, self-driving cars, and the Google DeepMind AlphaGo program' (Holmes *et al*. 2019:89). ML can be sub-divided into 1) supervised learning (the most common one) where the AI is provided with large amounts of data that have already been labelled; 2) unsupervised learning, provided with more, but unlabelled data; and 3) reinforcement learning, which is the most powerful. Over against the previous two where a student derives a fixed model, the model in reinforcement learning continuously changes because of the feedback being received (cf. Holmes *et al*. 2019:90-91).

ANNs are AI algorithms that are based on the brains of humans (called biological neural networks), although it is not on the level of the human brain, having only thousands (sometimes millions) of neurons compared to the human brain's billions of neurons. These neurons are not capable of reproducing intelligent data but are rendering statistical phenomena which are merely mathematical incarnations. The algorithms can be applied in all three the subdivisions of ML. An ANN comprises of the following layers: 1) The input layer that uses stimuli called data points or pixels from images, from its surroundings; 2) one or more hidden intermediary layers (being the power of the ANN) doing the processing of the data; and 3) the output layer which presents the result/s. The processing takes place in the form of reinforcement learning (Holmes *et al*. 2019:92).

Added to ML is DL. DL appeared on the scene much later than ML – in 1986, when Rina Dechter introduced it to the ML community (Dechter 1986). Chen *et al*. (2020b:5 of 20) define DL as follows: 'As part of ML algorithms...DL focuses on extracting higher-level features from the inputted data by adopting multiple layers.' Whereas ML is a subset of AI, DL forms a subset of ML (Chen *et al*. 2020b:5 of 20).

LA generates critical data from a student, thereby indicating and predicting the 'critical competencies' that they can pursue, which gives the IHE a good indication on how to act proactively on behalf of the student (Chen *et al.* 2020a:75269). Romero and Ventura (2013:12) define LA as 'the measurement, collection, analysis, and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs.' LA is also instrumental in determining the possibility if the student would be failing or succeeding.

EDM supplies the student with systematic and automated responses to their personal needs. It also improves the 'learning process and knowledge mastery' of the student (Chen *et al.* 2020a:75269), being able to assist them to study in their own time and at their own pace, therefore creating a personalised learning environment for the student. With EDM, an educator analyses various forms of educational data using ML, DM (data mining), and statistical algorithms. By doing this, the educator focuses on educational data, which indicates how a student learns and where they get their data from to understand their educational material better (Chen *et al.* 2020b:5 of 20).

Although there are many similarities between LA and EDM, they differ in the following aspects:

- EDM is more involved with 'clustering, classification, Bayesian modeling, relationship mining, as well as discovery with models' (Chen *et al.* 2020b:6 of 20).
- Whereas LA is more concerned with data and results, EDM would rather describe and compare the DM technologies.

These come to show that AI supersedes our conventional perception of all the different technologies which are implemented to establish it, including 'web-based elements online, distance, and computer-assisted instruction courses and learning' (cf. Chen *et al.* 2020a:75270; Sharma, Kawachi, & Bozkurt 2019).

AI in Teaching (Instruction)

In the past, the development of curricula and assessment took the bulk of an educator's time. With the implementation of AI, this has become a much easier task, making use of VR (virtual reality), AR (augmented reality), web-based platforms, as well as 3-D (three-dimensional) technology, audiovisual presentations, and other forms of robotics, providing the student with up-to-date experiential learning. VR and AR are immersive technologies that can practically demonstrate different materials to students in an interactive way, assisting them with their experiential learning (cf. Owan *et al.* 2023:4 of 15). AIWBEs[21] make the utilisation of the internet much easier. The IALS (individual adaptive learning system) supports individual learning, while the ATS (aided teaching system) assists in the management of the classroom environment, and the IAS (institute administration system) is of assistance in student enrolment (Guan *et al.* 2020:134).

The educator also has access to LMSs (learning management systems), where they are able to 'create, deliver, and manage learning materials, assignments, assessments, and evaluations for students' (Owan *et al.* 2023:4 of 15). On these platforms the educator oversees both online assessments and the progress of their students, while providing feedback on the performance of the students. Examples of LMSs are *Blackboard* (2023), *Canvas* (Canva 2023), and *Moodle* (2023).

IWBE (intelligent web-based education) is a powerful pedagogical tool used for WBE (web-based education). Through implementing AI, communication between the educator and student improve significantly (Chassignol *et al.* 2018:19). Chassignol *et al.* (2018:19) point out that AI is already applied on different platforms, including ILEs (interactive learning environments), acting as a conversation tool between the educator and student, and intelligent student-centred tutoring programmes, including *Mathia* (Carnegie Learning 2023), *ActiveMath* (Melis & Siekmann 2004), *Why2Atlas* (VanLehn, Jordan, Rosé, Bhembe, Böttner, Gaydos, Makatchev, Pappuswamy, Ringenberg, Roque, Siler, & Srivastava 2002), *Comet* (2023), *Viper* (2023), *DeepTutor* (n.d.), and *AutoTutor* (University of Memphis 2019).

21 AIWBEs can be defined as 'the integration of AI principles and technology into web-based learning platforms, which improves the learners' experiences' (Chen *et al.* 2020a:75271).

Robots play a decisive role as educator assistants and cobots, undertaking specific teaching tasks (basic or advanced) (Chen *et al.* 2020a:75272; cf. Timms 2016). Added to these are chatbots ('online computer-based robots with conversational and dialogue abilities to answer routine student queries' – Chen *et al.* 2020a:75272). These bots (ITSs) are equipped with cognitive as well as decision-making abilities, being able to converse with the user in an instructional and pedagogical way. This also includes bots with CALL (computer-assisted language learning) abilities.

A further example of this wide range of ITSs is a programme called *Knewton* that provides a 'platform for feedback to students premised on the interaction on the platforms' (Chen *et al.* 2020a:75271). This is complemented by programmes such as *Turnitin* (on similarity), *Grammarly*, *PaperRater*, and *WhiteSmoke* (all three are assisting with proofreading), *Ecree* (an on-demand writing tutor), and *WriteToLearn* (building writing skills) also assisting the educator and the student). These AI programmes assist educators to focus on their core performance area of teaching, learning, and assessment of students towards graduation.

AI in (Personalised) Learning

Nowadays, intelligent learning systems have many adaptive capabilities (cf. Sharma *et al.* 2019; Pokrivcakova 2019), producing learning plans per student, which are 'based on their learning progress, strengths, and weaknesses' (Owan et al. 2023:3 of 15). Presenting (personalised) material to a student on the internet makes the knowledge available for them wherever they are and whenever they want to utilise it (cf. Gardner, O'Leary, & Yuan 2021:1207) – called 'smart education' by Bajaj and Sharma (2018:840). Smart education is an educational system where a student is provided with personalised learning material and up-to-date technology, wherever they are and at any time (Bajaj & Sharma 2018:840; Demir 2021:3 of 36). To make this possible, an AI system or programme is needed to determine the student's learning style and capabilities, also taking their learning environment into consideration. Based on these data, the programme will determine a specific learning model/s or style/s.[22]

Web-based learning platforms facilitate the process for the student. Should the student be unable to recognise the language, language translation tools are available. In this way AI eliminates many barriers that students used to struggle with. Another ability of AI is to customise and personalise curricula to be in line with the needs, abilities, and capabilities of each learner (Chen *et al.* 2020a:75273; cf. Della Ventura 2017:6 of 9). This includes students with learning or physical disabilities (Chen *et al.* 2020b:2 of 20). Additionally, ITSs are fostering DL, pushing students to explain themselves, and improving their retention of information (Chen *et al.* 2020a:75274-75275).

ELEs (Exploratory Learning Environments)

ELEs act as an alternative type of AIED for ITSs and DBTSs. Whereas ITSs and DBTSs guide a student to become knowledgeable of a specific subject, ELEs are following a constructive approach (within an unstructured environment), encouraging a student to 'actively construct their own knowledge by exploring and manipulating elements of the learning environment' (Holmes *et al.* 2019:120). Examples of ELEs are *Fractions Lab*, facilitating students to experiment with fractions (European Commission n.d.; cf. Mavrikis, Holmes, Zhang, & Ma 2018), *Betty's Brain* by Vanderbilt University, making use of a teachable agent to assist the student (Vanderbilt School of Engineering 2023), and *Crystal Island*, involving and implementing a game in the learning process (Data.ai 2023).

Automatic Writing Evaluation

These programmes assist students in the writing of documents by giving them feedback on both grammatical and semantic

22 Learning theory models/styles include *Felder & Silverman* (The Peak Performance Center 2023), *Kolb's learning theory/style model* (Main 2022), *Honey and Mumford* (G 2020), and *VARK* learning style model (Cherry 2023). Specific AI methods are *Fuzzy Logic systems* (Tutorialspoint n.d.), *Genetic Algorithms* (Turing 2023b), *Bayesian Networks* (Turing 2023a), and *Hidden Markov Model* (Dharaneishvc n.d.).

levels on the documents that they have submitted. There are two overlapping approaches, called formative and summative. The former assists the student before they submit their work, while the later provides the student with automatic scoring (Holmes *et al.* 2019:129). Examples of AWEs are *e-Rater*, *Revision Assistant*, *OpenEssayist*, and *AI Grading*. *e-Rater* is developed by ETS (the educational testing service) (ETS 2023a), using ML to analyse a myriad of linguistic features in a submitted document. *Turnitin* created *Revision Assistant* and *Gradescope*, programmes which are able to supply formative feedback on submitted documents (Turnitin 2023; Gradescope 2023). These programmes use both supervised (utilising similar essays being scored by at least two educators) and unsupervised (using unscored essays) ML. *OpenEssayist*, being developed by both the Open University and Oxford University in England, focuses more on its feedback to the student (Holmes *et al.* 2019:134). *AI Grading* marks essays for students on *edX Mooc* (Electronic Data Exchange massive open online course) (EdX 2023). During the past few years Pearson has incorporated IEA in their product called *WriteToLearn* (cf. Pearson 2023), providing formative feedback to the student, including a summative scoring. By using a supervised ML approach, containing at least 300 matching documents, the programme assesses submitted documents by students.

AI in Assessment

Assessment is some kind of an admin task, but with at least two added instructional features, called feedback and final marks (results). AWE programmes, as discussed above, are very helpful in the evaluation process of students. These programmes are also used to assist with the assessment process. Assessment – in fact evaluation – starts when a student begins with their enrolment process, as their learning abilities are assessed/evaluated to help them choose the right direction with their studies (Chen *et al.* 2020a:75268).

Assessment by AI programmes is done with great accuracy, efficacy, and validity, and with less (educator) bias (Owan *et al.* 2023:1 of 15). According to Gardner *et al.* (2021:1207), the essence of AI related to both formative[23] and summative assessment, 'is the concept of machine "learning" – where the computer is "taught" how to interpret patterns in data and "trained" to undertake predetermined actions according to those interpretations.' Using ML, the computer programme is taught to know both the contents of and quality criteria applicable to each question in a variety of ways, so as to assess the knowledge produced by the student as well as the quality of the work, thereby instilling better outcomes for students (Owan *et al.* 2923:1 of 15).

The two common types of questions asked in assessment papers are essays or short questions, including multiple choice questions, in whichever form. For the first, AES (automated essay scoring) will do the job (cf. Gardner *et al.* 2021:1208), also called automated grading (Owan *et al.* 2923:3 of 15), while for the second type of questioning, CATs (computerised adaptive tests) are applicable. Two successful programmes used for CAT are *GMAT* (the graduate management admission test) (MBA.com 2023) and *GRE* (the graduate record examination) by ETS (ETS 2023b). When it comes to formative and summative assessment, programmes like *Revision Assistant* and *Gradescope* (Turnitin 2023) are well equipped. These programmes supply the student with almost immediate feedback on tasks or assessments, while the educator takes longer to respond.

However, when it comes to assessment, the educator should thoroughly take note of the following: 'The distinction between having knowledge and being able to understand and apply it will not be lost on educators, as it is along this continuum that the capabilities of human judges and machine assessments ultimately part company' (Gardner *et al.* 2021:1208).

CCR (The Center for Curriculum Redesign)

CCR is an international body that creates and overlooks the development of curricula from Grade 1 up to HE. CCR is an international research centre that is redesigning education standards for the 21st century, taking the 4IR and AI into account.

23 Examples of formative assessment tools are *Mentimeter* (n.d.), *Nearpod* (n.d.), and *Socrative* (2023).

In order to reach this goal, this organisation has invited groups with different points of view to partake, like 'non-governmental organizations, jurisdictions, academic institutions, corporations, and non-profit organizations including foundations' (CCR n.d.), 'actively engaging with policymakers, standard setters, curriculum and assessment developers, school administrators, heads of schools, department heads, key [educators], EdTech [educational technology] experts and other thought leaders and influencers to develop a thorough understanding of the needs and challenges of all education stakeholders' (Holmes *et al.* 2019:225). Their aim is to launch meaningful curricula to establish 'sustainability, balance, and wellbeing,' therefore creating a sustainable humanity (Holmes *et al.* 2019:224). They are taking into consideration that information and technology are changing at a phenomenal rate, affecting people's societal and personal needs. By focusing on innovation and synthesis, CCR teaches that students need to be 'adaptive, versatile and wise' (Holmes *et al.* 2019:224).

Conclusion

The use of AI has become imperative for HE. However, HE should not become an education drenched with AI, but rather an adaptive kind of education where AI is utilised where and when needed (cf. Bajaj & Sharma 2018).[24] As Oliver (2019; 2024) has already indicated about serious games,[25] the time has come for the educator to realise their real mission being an educator, i.e., the education of students within a student-centred environment.

However, one may ask: Once AI has been 'fully implemented,' what then? Who will control everything? Haenlein and Kaplan (2019:12) 'naively' ask whether AI 'will allow us' to do certain things. This implies that 'we' will not be in control anymore. Elon Musk once predicted that 'AI could lead' to a next World War (Browne 2017). No more human control? Maybe we

24 Various AI techniques have already been used in adaptive educational systems, like Fuzzy Logic and Decision Trees, as well as Bayesian Networks, Neural Networks, Hidden Markov Models, and Genetic Algorithms (cf. Colchester, Hagras, Alghazzawi, & Aldabbagh 2017).
25 Cf. Oliver 2024.

should stop with all the conspiracy theories and focus on working more intelligently and responsibly with the creation of AI. Then we would not have to worry about what AI will do to us, but how we can develop AI to work with us in a reasonable and innovative way.

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Section 2

Reimagining Higher Education: AI Integration in Teaching, Design, and Assessment

Chapter 4

Working *with* AI: An Integrated, Process-Based Framework for Posthumanist Teaching in Higher Education

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Preface

This chapter explores the potential of integrated learning tasks in view of AI (artificial intelligence) in HE (higher education). AI has democratised content production, but it also poses challenges in distinguishing work done by AI from that done by humans. It suggests that integrated learning tasks can help mitigate these challenges by emphasising the process of writing with AI and focusing on the task rather than the learner. The chapter describes a case study in which students were asked to generate a research topic for themselves and then use ChatGPT (chat generative pre-trained transformer) – a language model AI – to generate prompts for their literature survey. The students then used a spreadsheet to organise their research and a branching tree diagram to form the outline of their literature survey. They used mail merge to extract relevant quotations from their spreadsheets and then used a chatbot to assist them in assembling the final literature survey. We compared the work done by the students in the case study to a group of fifth-year students who did not follow the process and found that the students who used the integrated learning approach had developed an insight in the responsible and ethical use of AI. They also had a much clearer understanding of the research process. In contrast, the fifth-year group simply asked the AI to write the literature survey, resulting in a well-written but vacuous piece of work filled with falsehoods, hallucinations, and fake references. The chapter concludes by pointing out that constructivist learning tasks can help students develop a good understanding of the value of a good prompt and use a step-by-step approach to generate the final project. It suggests that in future, the emphasis should be placed on the process of writing *with* AI, whereas in a posthuman sense, the focus should not be on the student, but on the task.

- In this chapter, you will learn about the potential of integrated process-based learning tasks in the context of AI in HE.
- You will discover how AI has democratised content production, but also poses challenges in distinguishing work done by AI from that done by humans.
- You will explore how constructivist learning can help mitigate these challenges by emphasising the process of writing with AI and focusing on the task rather than the learner.
- You will read about a case study in which students used ChatGPT – a language model AI – to generate prompts for their literature survey, and how they used a step-by-step approach to generate the final project.

Introduction

ChatGPT's launch on 30 November 2022 is probably the biggest disruption of HE since the World Wide Web. Where the Web democratised the acquisition of content, ChatGPT has democratised the production of content. Suddenly, using the same simple text entry box as Google, ChatGPT has allowed anybody to become a writer, a poet, an artist, or even a researcher. The problem driving this research lies in the difficulty to distinguish work that was done by AI from that which is done by humans, and how it affects the way we teach, learn, assess, and do research.

The chapter aims to explore the potential of constructivist learning tasks with a posthumanist approach to AI in HE. Two question drive this study: 1) What are the tenets of posthumanism related to AI in HE? and 2) How does constructivist learning exploit the advantages and mitigate the disadvantages of AI for HE?

Before ChatGPT, there were already many other platforms available that could analyse text, generate graphics, music, and even videos. It is just that the simplicity of ChatGPT made everybody sit upright and take notice of it. Almost immediately schools and universities realised that they had to revisit their policies and task teams, while advisory committees were set up everywhere, conferences and symposia erupted, and experts emerged rapidly with much debate and arguments for and against AI (Baidoo-Anu & Owusu Ansah 2023; Crompton & Burke 2023; Rudolph, Tan, & Tan 2023). Some of these, together with their implications are contained in Table 4.1.

As was the case with the introduction of calculators and later spreadsheets in mathematics and accounting, the initial call was for a total ban, followed by a grudging allowing with conditions, to productive use. This chapter argues for a shift in our thinking about teaching and learning to accommodate the radical change that has been brought about by the rise of AI.

Table 4.1 indicates that the main areas of concern centre around educator autonomy and role redefinition, enhanced teaching and learning, automated grading and feedback, access to vast knowledge resources, research and writing, accessibility and equity, ethical considerations, and a lack of transparency.

AI's main advantages in HE are situated in the redefinition of educator roles to focus on higher-order cognitive skills and human interaction, providing new tools and resources for educators to enhance instruction. It also allows for tailored instruction to individual needs and preferences, enhanced engagement and motivation, timely and efficient feedback, objective and consistent evaluation, 24/7 access to information and resources, personalised recommendations, and content curation, facilitating access to a wider range of information and resources. Additionally, AI enables real-time translation and communication across languages, improved global collaboration and understanding, assistance with writing tasks, brainstorming new ideas, and exploring creative possibilities. It also assists with literature reviews and analyses, data summarisation and interpretation, hypothesis generation, and testing. Moreover, AI

Table 4.1: Advantages and disadvantages of AI in HE

Category	Advantages	Disadvantages	Implications
Teacher autonomy and role redefinition	Redefinition of educator roles to focus on higher-order cognitive skills and human interaction.	May potentially diminish the role of educators and reduce their autonomy in the classroom	Support for educators in adapting to new roles and responsibilities
Enhanced teaching and learning	Provide new tools and resources for educators to enhance instruction. Tailored instruction to individual needs and preferences. Enhanced engagement and motivation.	May require significant time and effort for educators to adapt to and integrate LLMs (large language models) effectively. Potential for bias and discrimination if not carefully designed and implemented. Requires sophisticated algorithms and data collection.	Professional development and support for educators in LLM integration. Careful consideration of equity and inclusion in LLM implementation.
Automated grading and feedback	Timely and efficient feedback. Objective and consistent evaluation.	May not capture the nuances of human judgement. Over-reliance on automated feedback could hinder critical thinking. May diminish the importance of human interaction and nuanced feedback.	Careful integration of LLMs with human educator expertise.
Access to vast knowledge resources	24/7 access to information and resources. Personalised recommendations and content curation. Facilitate access to a wider range of information and resources.	Potential for information overload and misinformation. Requires careful curation and evaluation of resources. May lead to overreliance on LLMs and a decline in critical thinking skills.	Emphasis on developing critical thinking skills alongside LLM use.

Category	Advantages	Disadvantages	Implications
Research and writing	Real-time translation and communication across languages. Improved global collaboration and understanding. Assistance with writing tasks, such as summarising text, generating different creative text formats, and translating languages. Brainstorming new ideas and exploring creative possibilities. Literature review and analysis assistance. Data summarisation and interpretation. Hypothesis generation and testing.	Potential for inaccuracies and misinterpretations. May not capture the full richness and context of human language. Potential for plagiarism and a lack of originality. May not replace human creativity and critical thinking. Ethical considerations regarding data privacy and intellectual property. May reflect and perpetuate biases present in training data.	Develop clear guidelines for the use of LLMs in research and writing. Careful curation of training data and ongoing monitoring for bias. Development of methods to identify and mitigate bias in LLM outputs.
Accessibility and equity	Can provide support for students with diverse learning needs. Can expand access to education for underserved populations.	Ensure equitable access to LLM technology and training.	Bridge the digital divide and address potential inequities in LLM usage.
Ethical considerations and a lack of transparency	Forces us to develop clear ethical guidelines and transparent LLM algorithms.	Raise concerns about data privacy, intellectual property, and accountability.	Public discourse and policy discussions on LLM ethics.

can provide support for students with diverse learning needs and expand access to education for underserved populations. Lastly, it forces us to develop clear ethical guidelines and transparent LLM algorithms.

The key disadvantages of AI in HE are that it may potentially diminish the role of educators and reduce their autonomy in the classroom. It may also require significant time and effort for educators to adapt to and integrate LLMs effectively. There is a potential for bias and discrimination if not carefully designed and implemented, requiring sophisticated algorithms and data collection. Additionally, AI may not capture the nuances of human judgement, while an over-reliance on automated feedback could hinder critical thinking, diminishing the importance of human interaction and nuanced feedback. There is also the potential for information overload and misinformation, necessitating a careful curation and evaluation of resources. Moreover, there is a concern that an overreliance on LLMs could cause a decline in critical thinking skills, resulting in inaccuracies and misinterpretations. LLMs may not fully capture the richness and context of human language and there is a risk of plagiarism and a lack of originality. It is important to address ethical considerations regarding data privacy and intellectual property, as well as to ensure equitable access to LLM technology and training. These concerns also raise questions about data privacy, intellectual property, and accountability.

The key issues around AI in HE are the need to support educators in adapting to new roles and responsibilities, as well as professional development and support for educators in LLM integration. Careful consideration of equity and inclusion is crucial in LLM implementation, along with the careful integration of LLMs with human educator expertise. It is important to emphasise the development of critical thinking skills alongside LLM use. Clear guidelines should be developed for using LLMs in writing and research, while the training data should be carefully curated as ongoing monitoring for bias should be conducted. Methods to identify and mitigate bias in LLM outputs should also be developed. It is essential to bridge the digital divide and address potential inequities in LLM usage. Public discourse and policy discussions on LLM ethics are necessary to ensure responsible implementation.

Learning 3.0

The challenge lies in finding a model that deals with these issues. On his blog on 16 November 2021 Steve Wheeler (2012) presents a compelling argument for a whole new way of learning, based on the technologies of the then near future. He calls it Learning 3.0 (Table 4.2).

Table 4.2: Learning 1.0, 2.0, and 3.0 (Wheeler 2012)

	Learning 1.0	**Learning 3.0**	**Learning 3.0**
Learning Modes	Passive, individual	Active, social, collaborative	Participatory, social, community
Content Organisation	Hierarchy, top down	Hierarchy, bottom up	Networked, multi-nodal, multi-directional
Classification Mode	Taxonomy	Folksonomy	Rhizonomy
Content Provenance	Expert generated content	User generated content	User and machine generated content
Dominant Interfaces	Keyboard, mouse	Keyboard/ mouse, touch screen, voice/ gesture	Voice/gesture, direct implants, biometrics, content aware systems
Construct	Content is king	Context is king	Community is the curriculum
Theories	Behaviourist, cognitivist	Social constructivist	Connectivist, rhizomatic
Data Capture	1D barcodes	2D quick response tags, marker technology	3D holographics, extended marker technologies

Learning 1.0 is a traditional learning model in which students are passive recipients of information from an expert instructor (Wheeler 2012). Content is typically organised in a hierarchical

fashion, with students progressing from simple to complex topics. Knowledge is classified in a taxonomy, with clear distinctions between different subject areas. Content is generated by experts while students are expected to master this content before moving on to the next topic. The dominant interface in Learning 1.0 is the lecture, with students typically using textbooks and notebooks to take notes. The construct of Learning 1.0 is knowledge acquisition, and the educational theories that underpin it include behaviourism and cognitivism. Data capture in Learning 1.0 is typically limited to assessments such as exams and quizzes.

Learning 2.0 is a more social and interactive learning model where learners participate actively in the learning process. Content is typically organised in a less hierarchical fashion, with students able to choose their own learning paths. Knowledge is classified in a folksonomy, with tags and keywords used to describe content. Content is generated by both experts and students while students are encouraged to collaborate with each other and share their knowledge. The dominant interface in Learning 2.0 is the online learning platform, with students using a variety of tools such as discussion forums, wikis, and blogs to interact with each other and with the content. The construct of Learning 2.0 is knowledge construction, and the educational theories that underpin it include social constructivism and connectivism. Data capture in Learning 2.0 is more comprehensive than in Learning 1.0, with data collected from a variety of sources such as online learning platforms, social media, and learning games (Wheeler 2012).

Learning 3.0 is the most recent learning model, and it is characterised by its focus on personalisation, community, and technology. Content is typically organised in a networked fashion, with students able to access and create content from a variety of sources. Knowledge is classified in a rhizomic fashion, with multiple connections between different concepts. Content is generated by experts, students, and machines while students are encouraged to curate and personalise their own learning experiences. The dominant interface in Learning 3.0 is the mobile device, with students using a variety of apps and tools to access and create content, collaborate with others, and learn on the go. The construct of Learning 3.0 is community-based learning, and the educational theories that underpin it include connectivism and rhizomatic learning. Data capture in Learning 3.0 is the most comprehensive of all three learning models, with data collected from a variety of sources such as mobile devices, wearable devices, and the internet of things (Wheeler 2012).

Posthuman Learning

This chapter focuses on the shift towards Learning 3.0 and in particular in content provenance from expert-generated content, through user-generated content, to user and machine-generated content. The combination of humans and machines is known as a cyborg and forms the basis of the discourse on posthumanism. Essentially posthumanism questions the primacy of humans in the world and calls for the integration of humans and non-humans. Non-humans would include all of nature and the human-made environment.

Rosi Braidotti (2019) presents a useful theoretical framework for the critical posthumanities. She draws on Spinoza's concept of 'monism' that argues that the world operates as an interconnected whole without distinct categories and that everything is interrelated.

Another key aspect is transversal convergence, which calls for a synthesis across various points of view, including postcolonial, anti-racist, feminist, queer, and earth studies to generate novel solutions. Braidotti moves from apparent contradictions to integrations. Central to her philosophy is affirmative ethics, drawing inspiration from Spinoza's 'ethics of joy.' She argues that our focus should be on the positive dimensions of human and non-human relationships. Critically, she challenges the notion of human exceptionalism, urging a move beyond the idea that humans hold superior importance without entirely dismissing it. Braidotti calls for an interdisciplinary and postdisciplinary approach, urging the exploration of diverse fields to discover novel solutions and pushing beyond conventional disciplinary boundaries (Braidotti 2006). For Braidotti we are all nomads. We are constantly arriving somewhere, and at the same time we are departing from somewhere. She emphasises embodied and embedded perspectives, encouraging a grounded understanding derived from lived experiences and a discouraging reliance on overarching theories, stressing the importance of embedding posthumanist values within educational institutions. She argues that we should integrate posthumanist thinking and values into educational practices.

In such a fluid environment we need to question our love of binary opposites. One such binary opposition lies in the division between behaviourism and constructivism as learning theories shown in Table 4.3.

Table 4.3. Elements of behaviourist and constructivist instructional design (Ertmer & Newby 2013; Qiu 2020)

Category	Behaviourist	Constructivist
Process	Linear and sequential	Recursive, non-linear, sometimes chaotic
Planning	Systematic, top down	Organic, developmental, reflective, and collaborative
Instructors	Subject matter experts	Facilitators of learning processes
Objectives	Pre-stated and clearly formulated	Outcomes emerge as the process unfolds
Goal	Automaticity of sub-skills	Deep contextual learning
Data	Mainly objective	Often subjective
Evaluation	Summative	Formative

Table 4.3 portrays the characteristics of the two dimensions and indicate that they are mutually exclusive. However, this model cannot leverage the advantages of one dimension to offset the drawbacks of the other. Scholars suggest cognitivism as a middle ground between the dimensions (Ertmer & Newby 2013). Nevertheless, there is a debate among researchers about whether these approaches should be diametrically opposed (Rohlíková 2024; Ahmad, Sultana, & Jamil 2020; Hassad 2011; Rieber

1992; Shabo 1997; Zlatkova-Doncheva 2020). In keeping with Braidotti's concept of transversal convergence and her call for a synthesis across fields (Braidotti 2019), I argue that behaviourism and constructivism are not opposites but distinct philosophical approaches and I suggest an integration by plotting them as orthogonal dimensions, treating them as complementary (Cronjé 2000, 2006).

This integration forms a matrix with four quadrants that I call construction, integration, immersion, and injection. Construction is low in behaviourism and high in constructivism. It fosters students' ability to construct their own meaning. This domain resonates with what Seymor Papert called *constructionism* (Harel & Papert 1991) – a form of learning where students are given a task to construct something, and then once they have constructed it, know they have learnt all the skills required in doing so. Integration blends constructivist exploration with direct instruction, occurring rapidly and seemingly simultaneously, representing the domain of automaticity and expert learning (Bloom 1986). Immersion indicates that one is thrown into the deep end (Cronjé 2019:5 of 19). Injection involves this deep-end immersion. It is the domain of serendipitous learning as well as trial and error. Injection is characterised by high behaviourist elements, resembling classic and operant conditioning with a desire to 'inject' knowledge directly into the brain.

The four quadrants of learning are not mutually exclusive, and effective learning often involves a combination of different approaches. For example, a teacher might use a behaviourist approach to teach students the basic mechanics of a new language, but then use a constructivist approach to help students develop their fluency in using the language in real-world contexts.

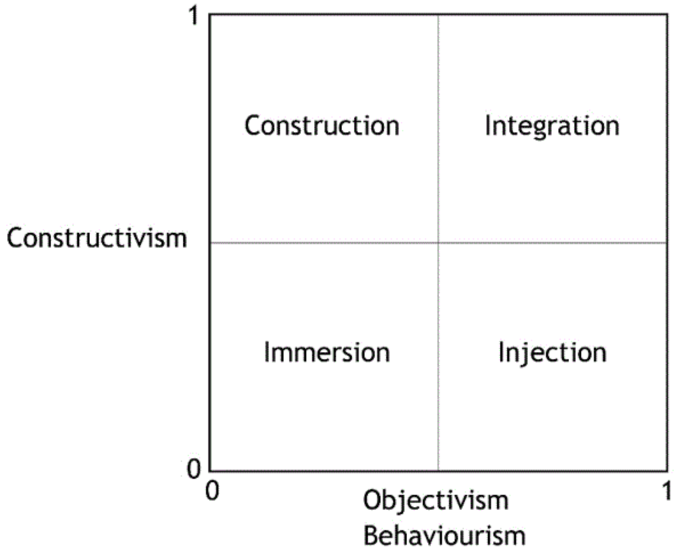

Figure 4.1: Integrating behaviourism and constructivism (Source: Cronjé 2000, 2006)

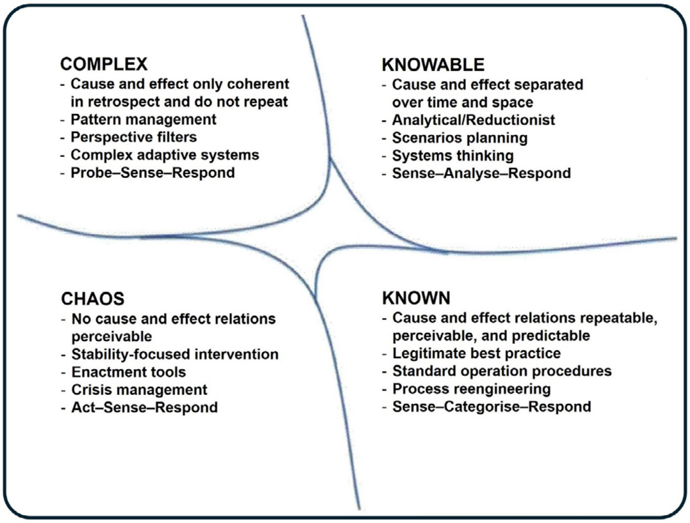

Figure 4.2: The Cynefin framework (Source: Adapted from Kurtz & Snowden 2003)

This four-quadrant model can be mapped directly onto the Cynefin framework (Figure 4.2 above) of decision-making (Kurtz & Snowden 2003). 'Cynefin' is a Welsh term that can be translated with *the place where we belong*, or *habitat*, and was designed to give decision-makers a sense of space in their problem-solving. At the centre of the framework we find the domain of disorder where no sense can be made. From there, depending on the structure of knowledge one moves into one of four domains: Chaos, complex, knowable, or known. The Cynefin framework, developed by Dave Snowden and Cynthia Kurtz, consists of five domains: Disorder, chaos, complex, knowable, and known. The domain of disorder represents a state where you do not know the type of causality that exists. It is a state of confusion where people will not make decisions that take them out of their comfort zones. It is the domain where it is unclear which of the other four domains apply.

In the *known* domain, challenges or problems are well understood, and solutions are evident. It is the domain of best practices, where addressing challenges requires minimal expertise. Issues addressed by help desks often fall into this category. The approach involves sensing the challenge, analysing it, applying expert knowledge, and executing the plan. The *knowable* domain involves challenges where the cause and effect relation requires analysis or investigation. It is the domain of good practices. It requires a greater level of expertise compared to the known domain. The relation between cause and effect in the complex domain is only perceivable retrospectively, not in advance. It is the domain of emergent solutions. The approach involves probing, sensing, and responding, allowing for the emergence of new practices. The *chaos* domain represents situations where, at systems level, no relation is visible between cause and effect. It is the domain of novel solutions. There is an act, sense, and respond approach that allows for the discovery of novel practices. The *chaos* domain represents situations where there is no relation between cause and effect at a systems level. It is the domain of novel solutions. The approach is to act, sense, and respond, allowing for the discovery of novel practices.

The four quadrants can be mapped directly onto the Cynefin framework. Table 4 indicates that in the *known* quadrant, direct instruction suits knowledge with clear cause-and-effect relations. It aligns with the *injection* quadrant, introducing instructor-known material systematically to all students, aiming for standardised understanding and efficient batch processing of learning. In the absence of clear cause-and-effect, the *immersion* quadrant promotes discovery learning, despite seemingly being chaotic. Experiential and incidental learning, apprenticeships, walking and talking, occur here, emphasising apprenticeships, field trips, and incidental learning. The *construction* quadrant, rooted in constructivism, involves students tackling complex tasks to construct solutions, aligning with Papert's 'constructionism.' It encompasses robotics, spreadsheets, and real-world experiences, encouraging pattern recognition by means of group work and reflection. The *integration* quadrant blends drill and practice efficiency with understanding. Educators choose the right mix of instruction and construction for fluency and comprehension of knowable outcomes.

Table 4.4: Mapping the views of Kurtz & Snowden onto Cronjé's paradigms (Aylward & Cronjé 2022:509)

Instructional Design Paradigm	Cynefin Framework	Implications
Injection Direct instruction of known cause and effect relations. High levels of standardisation and regulation of best practice. Drill and practice, standardised tests. Algorithms and recipes. Automaticity, automation.	**Known** Cause and effect relations repeatable, perceivable, and predictable. Legitimate best practice. Standard operating procedures. Process reengineering. Sense-categorise-respond.	This quadrant is where material known to the instructor but not to the student is introduced programmatically through a systematic approach, such as Gagne's events of instruction. The idea is to bring all students to the same standard before progressing.

Instructional Design Paradigm	Cynefin Framework	Implications
Immersion No direct instruction or constructivist scaffolding of relations. Student develops own stability. Iterative cycles. Thrown in at the deep end, trial-and-error, incidental learning.	**Chaos** No perceivable cause and effect relations. Stability-focused intervention. Enactment tools. Crisis management. Act-sense-respond.	Although it may seem that no learning can take place as there is no assistance for learners to make sense of the chaos, much of our experiential learning takes place in this quadrant, such as learning to walk and to talk.
Construction Emphasis on reflection, iterative processes and complex tasks. Fail-safe experimentation. Schema is valued. Group work for multiple perspectives. Complex tasks with multiple solutions. Cognitive scaffolding to support probing, sensing, and responding.	**Complex** Cause and effect are only coherent in retrospect and do not repeat. Pattern management. Perspective filters. Complex adaptive systems. Probe-sense-respond.	This is the quadrant that is high in constructivism and low in behaviourism where students are given complex tasks to construct solutions to learning problems. This is the area of robotics, spreadsheets, and even real experiments. The aim is for students to recognise patterns through reflection and group work.
Integration Systematic learning tasks with increasing levels of complexity. Analysis of learning goals to reduce cognitive load. Students are given clear instruction and then allowed to explore and construct.	**Knowable** Cause and effect separated over time and space. Analytical/ Reductionist. Systems thinking. Sense-analyse-respond.	This is the quadrant that integrates the efficiency of drill and practice with the effectiveness of understanding what you are doing; instructional designers will select the most appropriate blend of instruction and construction to ensure both fluency and understanding.

The theoretical designer framework has now dealt with integrating direct teaching and problem-based learning, as well as considering the knowledge domain. To complete the pedagogical triangle (Houssaye 1988) of educator, student, and content, student competency must be considered. Aylward (2018) proposes a model that fits a learning curve onto the combined model. This results in a taxonomy of learning competence comprising eight levels, as shown in Table 4.5.

Table 4.5: Aylward's levels of competency (Aylward & Cronjé 2022:514)

Level	Name	Description
0	Unaware	Uninformed, unknowing, uneducated, ignorant, or incompetent.
	Rudimentary knowledge	Being informed with limited understanding, no competence, no confidence or even over confidence (Dunning-Kruger). Inchoate.
	Novice I	Limited experience and confidence. Can follow a recipe with the aid of an instructor. Well defined, simple problem or scenario. Rudimentary.
	Novice II	Can follow a recipe with the aid of an instructor. Well defined, simple problem or scenario. Practical application.
	Intermediate I	Can follow a recipe unaided. Well defined, simple problem or scenario. Practical application. Have a working knowledge, basic competence, and confidence.
	Intermediate II	Can follow a recipe unaided. Well defined, medium complexity problem or scenario. Practical application. Has a well based competence and confidence. Competent level.
	Advanced I	Can devise a recipe or algorithm for a broadly defined complex problem and scenario. Master/ed level.
	Advanced II	Can devise a recipe for poorly or ill define problems or scenarios. Expert level.

Progressing through stages of proficiency, an individual starts as unaware, lacking knowledge of the required skill. Moving to rudimentary knowledge, they grasp the basics but lack competence. They might even be overconfident, not knowing what they do not know – the so-called Dunning-Kruger effect. Progressing to Novice I, they can apply the skill in simple situations with guidance. Advancing to Novice II, their application extends to more complex situations with some support. Reaching Intermediate I, they independently handle the skill in complex situations. Finally, at Intermediate II, they not only navigate complex scenarios but can also impart knowledge, teaching others how to master the skill.

Plotting these levels against time, Aylward shows how a learning curve develops with students first struggling to come to terms with new work, and then progressing quickly as their competence increases (Figure 4.3).

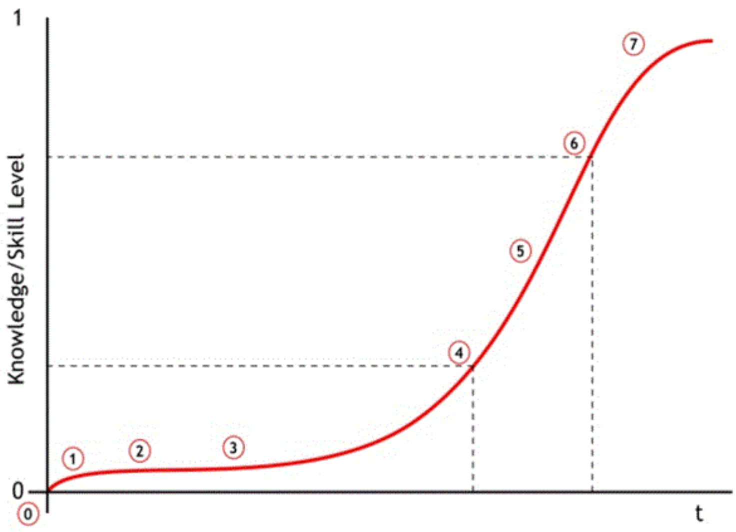

Figure 4.3: Aylward's learning curve (Source: Aylward 2018:1938)

The curve shown above can be turned into a parabola and plotted onto the four-quadrant model.

In the initial phases of learning, the brain processes unfamiliar information within the Cynefin framework's *disorder* domain, represented by the central diamond. Figure 4.4 shows how, depending on the student's knowledge level, from novice to expert, they swiftly move to one of four main domains. Initially, little actual learning occurs as the brain readies itself to assimilate the presented information. Not all learning requires reaching the expert level. Some fields only demand a working knowledge – competence – where one can follow a recipe independently. To achieve this, fundamental knowledge and practice are essential. This occurs in the *injection* domain where an expert instructs the participant primarily through practice, such as explaining steps of the recipe. Certain fields involve applying knowledge and skills practically. Transitioning from the *immersion* domain to the *construction* domain, participants develop their value systems by engaging in discovery and experimentation. Instruction involves a practical application in a fail-safe environment. The highest level of learning occurs in the *integration* domain, where collaboration among peers leads to new knowledge and methods. Instruction involves engaging in debates and projects, pushing boundaries in cross-field integration.

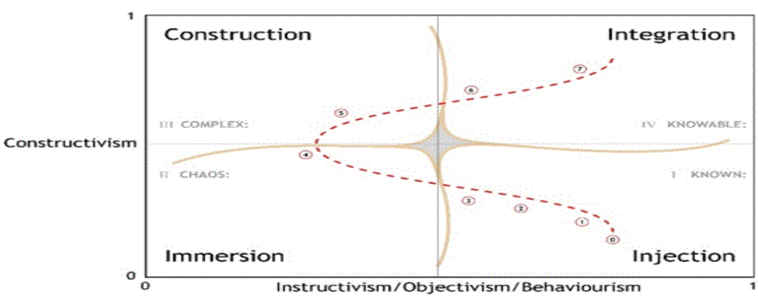

Figure 4.4: The learning curve fitted onto the integrated model (Aylward & Cronjé 2022)

Synthesis

Based on Spinoza's monism we have now created a unified model to integrate teaching, content and the student. In this way we have activated Braidotti's concept of transversal convergence, by creating a synthesis across various points of view, including behaviourism and constructivism, and have moved from apparent contradictions to integrations. Given the nomadic nature of our lives, we must shift from a product-oriented view of learning – where the final outcome is assessed as evidence of learning – to a process-oriented approach that evaluates the entire journey and experience of learning as it unfolds.

The process starts by imparting foundational knowledge to novices. This is most effectively achieved through direct instruction, referred to as injection. Instruction can be provided through formats such as lectures, tutorials, or drills. Lectures may be presented using various methods, including in-person delivery, video recordings, printed books, e-books in PDF format, or other one-way communication channels. While computer-based tutorials enable interactive feedback, similar opportunities can also be included in conventional face-to-face teaching. Students can be encouraged to use AI to simplify complex texts. They could use AI to build tables of comparison between texts, group similar items together, and provide examples and counter examples.

Once students have formed a basic understanding we move into the *immersion* quadrant where they enter the realm of serendipitous learning through experience, encountered in daily life. They can be left to explore various instances of the occurrence that they are studying. This domain aligns with methodologies such as work-integrated learning or field trips. Here students could use AI tools that allow them to explore various activities – tools that build visual representations of knowledge structures.

Intermediate-level students engage with complex knowledge through the approach of construction. This includes engaging in projects, conducting laboratory experiments, and participating in problem-based learning activities designed to match their skill level. This is where students would use Gen-AI (Generative Artificial Intelligence) to do structured tasks in order to construct artefacts that will show that they have mastered the material.

Knowable knowledge falls within the realm of advanced and expert students. Here, an optimal blend of resources essential for effective learning integration is employed. This domain fosters the highest degree of student autonomy, allowing individuals, based on their expertise, to discern and prioritise their learning needs. This is where students will be expected to synthesise all their experiences gained in the process to define their own learning challenge, set their own goals, do their own explorations, construct their own solutions, and perform an evaluation of those solutions. Table 6 provides a synthesis of paradigms, knowledge domains, mastery level, learning tasks and AI platforms that can be used throughout the learning process.

Table 4.6: A framework for designing learning tasks with AI

Paradigm	Knowledge (Kurtz & Snowden)	Mastery Level	Tasks	AI Platform
Injection	Known	0-3 Unaware, rudimentary knowledge	Compare the responses of various AI platforms to the same question. Use AI to simplify complicated texts. Use AI to make tables of comparison. Use AI to group similar items together.	ChatGPT Bard Bing YouChat Perplexity ChatPDF Paper Digest Semantic Scholar
Immersion	Chaos	0-7 All levels, experienced mostly by levels 3 and 4	Determine the leaders in the field. Identify the key debates. Show the relations between elements in the field.	Connected papers Lateral Litmaps Research rabbit

Paradigm	Knowledge (Kurtz & Snowden)	Mastery Level	Tasks	AI Platform
Construction	Complex	4-5 Intermediate	Create a spreadsheet with the key papers in the field. Rank the issues in order of importance to you.	Scispace Elicit
Integration	Knowable	6-7 Advanced	Create a branching tree diagram of your relationship with the field. Write an annotated bibliography of the spreadsheet above. Fill out the branching tree to a fully-fledged paper relating your own experience to what you have learnt.	Voyant Jenni Quillbot Writefull Dall-e Leonardo

After receiving direct instruction of known knowledge, such as watching online videos, novice students can be asked to use AI to assist them with tasks such as comparing responses to the same question, simplifying complicated texts, creating tables of comparison, grouping similar items together. Once they have some grasp of the field, they can be left in the *immersion* quadrant to use AI in determining leaders in the field, identifying key debates, showing the relations between elements in the field. Intermediate students can be asked to use AI in constructing artefacts such as spreadsheets with key papers, ranking issues in order of importance, and creating branching tree diagrams. Advanced students can integrate all their skills and achieve knowable knowledge by using AI in and creating visual representations of the field as it relates to the individual. These technologies can help automate processes, analyse data, and provide insights to support decision-making and learning.

A Worked Example

This case study is a synthesis of various exercises that I have given students over the past year, encouraging them to use AI wherever possible. The case is a fourth-year research methods class for Information Technology students. This is the first time they had to do any research and the aim of the course is to take them through the process of developing a research proposal, executing the research and writing it down. The exercise under discussion was the construction of a literature survey.

Rudimentary, Known, Injection

Students were asked to watch a YouTube video explaining the purpose and process of writing a literature survey. They were then given a multiple-choice test to complete to ensure that they had sufficient knowledge. They could watch the video and do the test as many times as they liked but could only proceed to the next level once they had obtained 75% for the test. Once having reached the 75% grade students were asked to prompt a chatbot of their choice to act as a coach to assist them in finding a suitable research topic for themselves. The topic had to align with their goal with the course they were doing, with their own reality on the ground (their available time, resources, interests, etc.) They had to determine the most opportune field to study, based on their progress in the rest of the course. Finally they had to develop a research plan going forward.

Novice, Chaos, Immersion

Once they had some understanding of the process students were asked to use AI literature search engines to orientate themselves in the field. They had to use two or three different sites, such as Connected Papers, Research Rabbit, and Litmaps to create representations of the field and finally they had to provide the key topics for their own literature outline.

Intermediate, Complex, Construction

Students were asked to use sites such as Scispace and Elicit to make tables that summarise the key elements of concern in their field. They had to make headings such as Title, Abstract, Keywords, Methods, Key Findings, Conclusions, Limitations, and Recommendations for further research. They then had to export these tables to a spreadsheet, cluster the themes according to the graphic representations they had made in the previous phase, and rank them in a logical sequence.

Advanced, Knowable, Integration

The students now had to combine the representations generated in the *immersion* phase with the spreadsheet constructed in the previous phase and generate a branching tree diagram that would form the outline of the literature survey. Having worked with as many as 150 articles they now had a good idea of the structure of a paper, as well as the structure of a literature survey. They were therefore asked to use the tree diagram to develop an outline for their paper, and then to use mail merge to extract relevant quotations from their spreadsheets. Once they had arranged their quotations in a proper sequence, they could decide which they wished to use in inverted commas, and which they wanted to paraphrase and cite. Finally they could use any chatbot of their choice to assist them in assembling the final literature survey. As an appendix to their paper they had to attach a sheet containing every AI that they had used, as well as all the prompts that they put into the AI.

Conclusion

A comparison of the work done by the students in the case study and a group of fifth-year students who did not follow the process showed that they had developed an insight into the responsible and ethical use of AI. They were exposed to many more academic papers than the seniors and had a much clearer understanding of the research process. An analysis of their prompts showed that they had developed a good understanding of the value of a good prompt and used a step-by-step approach to generate the final project. The fifth-year group, on the other hand, simply asked the AI to write the literature survey and the result was invariably a well-written, but vacuous piece of work filled with falsehoods, hallucinations, and fake references.

It is clear that in future the emphasis should be placed on the process of writing with AI. However, in a posthuman sense the focus should not be on the learner, but on the task.

Ethical Use of AI in this Chapter

The following AI platforms were used in producing this chapter: PaperDigest was used for the initial discovery of literature. ChatPDF was used to simplify the highly complex writing style of Braidotti, with the prompt ‘Explain this to a high school learner.’ Bard was used to combine all the resources on advantages and disadvantages of AI for HE and draw up the table of comparison. You.com, Perplexity, and ChatGPT were used to paraphrase, simplify, and expand certain passages, as well as to produce explanations of tables with prompts such as ‘Please rewrite this, grouping similar elements together and putting it in a logical sequence,’ or ‘Please rewrite this bulleted list as a running paragraph,’ or ‘Please convert this paragraph into a bulleted list.’ The abstract was written by ChatPDF. No AI-generated text was copied and pasted without first having been scrutinised, verified, and edited by the author. The author takes full responsibility for the accuracy of the information provided here.

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Chapter 5

Augmented or Automated: Examining the Role of AI in Reimagining Instructional Design in Higher Education

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Introduction

Rapid advancements in AI (artificial intelligence) and big data analytics have ushered in transformative possibilities for HE (higher education) and opened up new possibilities for enhancing teaching and learning. This chapter critically examines the applications of AI in instructional design, assessing current use cases and potential future implementations. It discusses the impact of AI on learning analytics, student modelling, intelligent and adaptive learning systems, AI teaching assistants, and tutors. The analysis aims to identify the trade-offs between augmentation and automation in learning design processes, emphasising the need for ethical and equitable applications. The chapter also explores policy implications to ensure widespread access to beneficial AI technologies. While AI presents opportunities to enhance teaching and learning, the chapter underscores the importance of preserving human expertise and agency in education. However, the rapid development of AI technologies also raises significant challenges, including ethical concerns, integration costs, and the potential displacement of educators' roles. These complexities demand a thoughtful approach that balances innovation with caution. Examples from industries like healthcare and finance demonstrate the potential of AI to revolutionise practices while maintaining human oversight.

Overall, the analysis presented in this chapter aims to shape the discourse on optimising the incorporation of AI capabilities in HE learning design without diminishing the vital role of human expertise and agency. AI and machine learning have emerged as potentially transformative forces in HE. As assumptions about the nature of work, types of careers, and requisite skills evolve rapidly, experts argue that AI will play a pivotal role in building the capabilities of future generations (cf. Joshi, Rambola, & Churi 2021). Harnessing these exponential technologies also represents an unprecedented opportunity to improve how we teach and structure learning. From serving as virtual teaching assistants to providing adaptive curricular pathways, AI-driven tools have already begun reshaping instructional models.

However, to date, the integration of AI in education has been largely *ad hoc* and narrow in scope (Hutson, Jeevanjee, Vander Graaf, Lively, Weber, Weir, Arnone, Carnes, Vosevich, Plate, Leary, & Edele 2022). A more strategic examination is required to determine appropriate and ethical applications that enhance student outcomes without compromising vital human judgement and agency. This chapter analyses the current state and future trajectory of AI in transforming instructional design, exploring trade-offs inherent in augmenting versus automating learning design processes.

AI Driven Learning Analytics and Student Modelling

The advent of big data in HE *via* enterprise systems, online programmes, and learning management platforms means that vast quantities of student data exist that hold potential to inform learning design improvements (Darvishi, Khosravi, Sadiq, & Gašević 2022; Ouyang, Wu, Zheng, Zhang, & Jiao 2023). AI techniques offer new methods to extract actionable insights, predict future behaviours, and personalise learning pathways from this sea of information (Krenn, Buffoni, Coutinho, Eppel, Foster, Gritsevskiy, Lee, Lu, Moutinho, Sanjabi, Sonthalia, Tran, Valente, Xie, Yu, & Kopp 2023).

Several IHEs (institutions of higher education) such as the Open University UK (Boroowa & Herodotou 2022) have already implemented PLA (predictive learning analytics) dashboards that harness natural language processing and neural networks. These PLA systems (cf. Ramaswami, Susnjak, Mathrani, & Umer 2023) analyse real-time streams of student academic and engagement data to flag at-risk students who may require early intervention or support services (Nurhadi, Hussin, & Demon 2021). Automated notifications and alerts enable advisors to connect students with resources like tutoring (Ahmad, Iqbal, El-Hassan, Qadir, Benhaddou, Ayyash, & Al-Fuqaha 2023; Caspari-Sadeghi 2023), counselling (Majjate, Bellarhmouch, Jeghal, Yahyaouy, Tairi, & Zidani 2023), or peer-mentoring (Dede & Lidwell 2023) specifically when they need help. Using PLA for targeted outreach has been found to positively impact student retention and success (Namoun & Alshanqiti 2020; Ifenthaler & Yau 2020). For instance, the Open University UK reported a 15% increase in retention rates after implementing predictive analytics dashboards. However, the effectiveness of PLA depends heavily on the quality and bias of input data. Institutions must adopt measures such as regular audits and diverse data sampling to ensure fair and accurate outcomes.

Recent important developments in the area of AI include improved language technologies like sentiment analysis which are also being incorporated in next generation learning analytics platforms to assess student motivation, confidence, and psychological states by scanning discussion posts, assignment reflections, and advisor meeting notes (Yadav & Vishwakarwa 2020; Kastrati, Dalipi, Imran, Pireva Nuci, & Wani 2021; Shaik, Tao, Dann, Xie, Li, & Galligan 2023). By uncovering affective signals in students' unstructured writings, advisors can identify emerging issues to provide timely assistance. Contextualised insight into the 'whole student' experience allows learning design refinements addressing not just academic but also meta-cognitive and social-emotional development.

Today, developing AI environments that support exploratory learning, particularly in MOOCs (Massive Open Online Course), which require sophisticated student models to provide adaptive support seem to be in vogue (Conati & Lallé 2023). Nevertheless, building adaptive support for open-ended exploratory learning remains a major challenge (Conati & Lallé 2023).

Intelligent and Adaptive Learning Systems

Intelligent tutoring, adaptive learning, and recommender systems are a few notable instances of AI-enabled learning environments. According to Hasanov, Laine, and Chung (2019), an intelligent tutoring system employs AI approaches to emulate a human tutor, hence enhancing learning outcomes through improved student assistance. Recommender systems are defined as ‘software tools that provide suggestions for potentially useful items to someone’s interest based on machine learning and information retrieval techniques’ (Aamir & Bhusry 2015, cited by Syed, Palade, Iqbal, & Nair 2017:1). According to Pliakos, Joo, Park, Cornillie, Vens, and Van den Noortgate (2019), as well as Xie, Chu, Hwang, and Wang (2019), ALSs (adaptive learning systems) are customised learning environments that adjust to students’ learning styles, the order and complexity of the tasks, the feedback period, and their preferences. Through automated feedback cycles built into the systems, these platforms encourage students to keep track of their educational progress.

AI advancements are also enabling more responsive and tailored learning content. On the one hand, intelligent tutoring systems incorporate extensive subject matter expertise to provide personalised guidance scaffolding students from simple to complex concepts (Paladines & Ramirez 2020; Mousavinasab, Zarifsanaiey, Niakan Kalhori, Rakhshan, Keikha, & Ghazi Saeedi 2021). These AI systems assess individual student needs, dynamically adjust activities to address knowledge gaps and supply real-time hints during problem solving. Research indicates that such adaptive learning technologies enhance concept retention and reduce attrition for diversified students, including low-performing students (Akyuz 2020).

On the other hand, AI techniques like natural language generation and information retrieval as well as ALSs (Kabudi, Pappas, & Olsen 2021) facilitate the automated curation of customised course learning materials from existing repositories (Tlili, Zhang, Papamitsiou, Manske, Huang, Kinshuk, & Hoppe 2021). Text and data mining methods help assemble relevant exercises, readings, videos, and cases into unique sequences meeting defined learning outcomes. Automating the indexing, recommendation, and assembly of personalised content modules based on parameters like learning preference, prior learning and/or mastery and target competencies, stands to make course creation more scalable while providing a tailored learning path (Osadcha, Osadchyi, Semerikov, Chemerys, & Chorna 2020).

However, despite promising applications, many intelligent and ALSs remain narrow in scope, supplemental rather than core to learning experiences. One notable challenge is the scalability of these systems, particularly for resource-constrained institutions. The infrastructure required for ALSs, including advanced computing systems and continuous updates, often limits their adoption. Moreover, the unequal distribution of resources can create disparities in access to these personalised learning tools, further widening the digital divide. Truly personalised, responsive platforms enabling student agency and control and positively impacting on learning outcomes remain rare (Bernacki, Greene, & Lobczowski 2021). Similarly, a meta-analysis by Major, Francis, & Tsapali (2021) indicated that technology-supported personalised learning resulted in significantly positive learning outcomes for school-aged children in low- and middle-income countries. Correlations have also been identified between the use of personalised and responsive e-learning platforms and students' performances (Mustafa 2021). A study by Leem (2023) highlights the significant positive effect that personalised and responsive online learning platforms have on learning outcomes, which underscore the importance of considering the interaction between content, teaching, and platform design to enhance student engagement and achievement. AI tools, such as cognitive tutors and adaptive learning systems, provide personalised learning paths, improving student engagement and academic performance (Bilad *et al.* 2023; Legowo *et al.* 2024).

Further research has delved into specific factors such as student-to-student dialogue, course structure, and technology quality, which are found to positively impact student satisfaction, which in turn is correlated with e-learning outcomes. These improvements suggest solutions like enhancing the teaching platform and course design, as well as a careful selection of software and teaching aids (My, Tien, My, & Le Quoc 2022). Moreover, individual student support systems and adaptive pedagogical approaches within personalised and responsive platforms are posited to potentially impact learning outcomes in online education (Singh & Alshammari 2023). Another perspective offered by Seo, Tang, Roll, Fels, and Yoon (2021) focuses on the impact of AI systems on student-educator interaction in online learning, discussing concerns such as agency and surveillance. The paper recommends that AI systems should prioritise explainability and human-in-the-loop design to positively support these interactions.

Implementing platforms such as arabi.id – a personalised and responsive LMS (learning management system) – proved to have a statistically significant positive impact on the language skills of non-native Arabic students (Ismail, Mun'im Ahmad Zabidi, Paraman, Mohd-Yusof, & Rahman 2023). Similarly, engaging with educational resources like podcasts in a personalised manner has been found to positively influence students' learning outcomes (Facer, Abdous, & Camarena 2009).

The benefits of these platforms do not preclude challenges, however. Adaptations can include embedding feedback systems developed through a participatory design with both students and educators to mitigate the risks associated with the adoption of such personalised tools. The complexity of replicating dynamic educator-student interactions makes automating comprehensive course experiences elusive. Ethical issues around data privacy, uneven access and overreliance also give pause. Yet the trajectory toward augmented, if not fully automated course assembly is clear.Top of FormBottom of Form

AI Teaching Assistants and Tutors

As AI capabilities advance, one emerging application is AI teaching assistants that support routine instructional tasks and augment human teaching staff. Chatbot technologies allow customised student queries about assignments, deadlines, and course logistics to be addressed 24/7 without overburdening faculty (Tian, Risha, Ahmed, Lekshmi Narayanan, & Biehl 2021). A systematic review of chatbot applications in education found that chatbots can provide instant responses to students, improve student engagement, and enhance learning outcomes. Tegos, Demetriadis, and Tsiatsos (2014) found that conversational agents can trigger productive dialogue among students, leading to improved learning outcomes. Additionally, AI chatbots have been used to provide personalised support for students, including pre-enrolment requirements, university-class schedules, and assessment timetables. These technologies have also been employed to facilitate practice and thus enhance specific communication skills, such as motivational interviewing skills and workplace communication for health workers (Kuhail, Alturki, Alramlawi, & Alhejori 2023). Here real-time personalised feedback sharpens performance. Automating the answering of repetitive questions enables teaching staff to focus on higher value instructional duties. Over and above this, studies indicate that AI teaching assistants can match human teaching assistants in terms of response speed and helpfulness, particularly in programming education (Lee, Myung, Han, Jin, & Oh 2023). AI teaching assistants have been effective in guiding novice learners through complex tasks by breaking them down into manageable subgoals, demonstrating their potential in structured learning environments (Lee *et al.* 2023).

AI teaching assistants leverage data mining, speech recognition, and natural language processing to assess open-ended verbal student responses, either correcting errors or indicating gaps for educators to discuss (Paladines & Ramirez 2020). However, the absence of EI (emotional intelligence) in AI remains a critical limitation, as these systems cannot interpret non-verbal cues or provide empathetic support. Institutions should implement blended models where AI handles routine tasks, enabling educators to focus on mentorship and complex teaching interactions. This approach ensures that students benefit from efficiency gains without losing the human connection vital for holistic education. For high-enrolment foundation courses, automating basic content comprehension checks and written feedback remarking saves faculty grading time to concentrate on advancing conceptual mastery (Çekiç & Bakla 2021). Sophisticated neural networks have achieved sufficient semantic understanding abilities to provide scoring agreements with instructors above 90% across various subjects (Ariely, Nazaretsky, & Alexandron 2023).

ITSs (Intelligent tutoring systems) have been shown to improve learning outcomes by providing tailored feedback and support, thus enhancing the overall educational experience (Bilad, Yaqin, & Zubaidah 2023). However, while AI tutoring assistants effectively supplement teaching, fully replicating deeper instructor roles remain improbable in the foreseeable future. The need for emotionally supportive, dynamically sensitive human engagement constitutes one constraint, especially for younger students (Akyuz 2020). Most significantly, the ingenuity gap of creatively inspiring students or customising personal growth pathways eludes the existing AI. At best teaching assistants provide task augmentation, however, there are also some noteworthy risks. First, an increased use of AI systems may lead to reduced student interaction with real humans, potentially impacting social connections and EI. Second, even though this is improving, AI's lack of EI and the inability to read and perceive unspoken signals such as tone and body language may hinder effective communication and teaching (Luong, Sivarajah, & Weerakkody 2021), emphasising the need for human input in conjunction with AI, rather than as a sole replacement for educators. Third, an overreliance on AI can potentially reduce students' capacity for independent thought and critical thinking, as they may become increasingly reliant on the software, impacting their learning outcomes (Kamalov, Santandreu Calonge, & Gurrib 2023). Then there is the fact that AI algorithms may struggle to provide the same level of innovative and creative approaches that human educators can offer, potentially impacting the overall engagement and effectiveness of educational materials (Qadir 2023). AI models may struggle with individualised learning needs and perpetuate biases if trained on biased data, leading to potential gaps or inaccuracies in the educational content (Schwartz, Vassilev, Greene, Perine, Burt, & Hall 2022; Hagendorff, Bossert, Tse, & Singer 2023).

Challenges and Considerations for Implementation

Despite burgeoning investment, adopting AI-based instructional enhancements face barriers concerning system biases, equitable access, changing staff roles, and ethical data usage that warrant consideration. One concern around increasingly data-dependent academic decision-making involves issues of fairness, transparency, and accountability (Nassar & Kamal 2021). Analytics predictions informed by datasets with hidden biases may scale systemic disadvantages rather than foster inclusivity (Archer & Prinsloo 2020). Interpretability around AI recommendations requires improvement to avoid an overreliance on algorithms lacking explanatory audit trails.

Unequal access and affordability issues also persist regarding new technologies, potentially exacerbating achievement gaps (Deganis, Haghian, Tagashira, & Alberti 2021). Students lacking home broadband (Hampton, Fernandez, Robertson, & Bauer 2020) or sufficient digital literacy skills (Reisdorf & Rhinesmith 2020) could remain excluded despite an institutional adoption of AI innovations. Disparities between well-resourced early adopters actively prototyping applications and smaller colleges also seem likely absent deliberate effort. These dynamics emphasise the necessity of equity-centred design and deployment policies promoting responsible innovation (Hendricks-Sturrup, Simmons, Anders, Aneni, Clayton, Coco, Collins, Heitman, Hussain, Joshi, Lemieux, Novak, Rubin, Shanker, Washington, Waters, Harris, Yin, Wagner, Yin, & Malin 2023).

Further tensions stem from AI's impact on educator job roles and a sense of professional purpose, should automation limit specialised expertise application while prioritising efficiency (Zawacki-Richter, Conrad, Bozkurt, Aydin, Bedenlier, Jung, Stöter, Veletsianos, Blaschke, Bond, & Broens 2020). To address these challenges, institutions could establish cross-disciplinary committees that include educators, technologists, and ethicists to oversee AI implementation. Additionally, policies must prioritise inclusivity by offering subsidies for underprivileged students and ensuring that AI platforms are accessible to users with disabilities. These measures can help bridge the gap between well-resourced and resource-constrained institutions, fostering equitable access to AI benefits. Faculty adoption pivots on maintaining educator agency over tools intended to augment and not prescribe practice. Insufficient communication around evolving AI capabilities and participatory decision-making risk alienating stakeholders within complex political university environments wary of disruptive technologies. Transforming organisational culture to balance innovative experimentation with core values of openness, academic freedom, and humanistic education stands critical (Bozkurt, Junhong, Lambert, Pazurek, Crompton, Koseoglu, Farrow, Bond, Nerantzi, Honeychurch, & Bali 2023).

Ethical Frameworks for AI in Higher Education: Augmentation vs. Automation

The distinction between AI as a tool for augmentation versus automation in HE lies at the heart of developing ethical frameworks. Augmentation refers to AI enhancing human capabilities, such as improving educators' efficiency or providing personalised support for students, while automation entails the replacement of certain human functions with AI systems. Ethical considerations for these two paradigms differ but are deeply interconnected, as both approaches aim to maximise the benefits of AI while minimising potential harms.

In the context of augmentation, ethical frameworks must focus on supporting human agency. When AI is used to assist educators, such as through intelligent tutoring systems or AI teaching assistants, its role should be to empower rather than replace. For instance, AI can provide personalised feedback to students on routine tasks, enabling educators to focus on higher-value activities like fostering critical thinking and mentoring. However, if augmentation is poorly implemented, there is a risk of over-reliance on AI, leading to a deskilling of educators and diminishing their professional judgement. Ethical frameworks must thus include provisions for capacity-building, ensuring educators to have the skills to effectively use and supervise AI tools. Transparency in how AI generates recommendations or performs tasks becomes crucial in these scenarios to maintain educators' confidence and control over the process.

When AI is applied for automation, such as in grading or administrative tasks, ethical concerns shift towards accountability and fairness. For example, automated grading systems might inadvertently disadvantage students whose work does not align with the algorithm's design, such as creative or unconventional approaches to problem-solving. Ethical frameworks must mandate regular evaluations of such systems to detect and mitigate biases and inaccuracies. Additionally, clear protocols for redress must exist, ensuring students to contest automated decisions. This is particularly important in high-stakes applications like admissions or predictive analytics for at-risk students, where automation could amplify systemic biases if not carefully monitored.

Inclusivity is a cornerstone for both augmentation and automation. Augmented systems should cater to diverse learning preferences, enabling equitable access to personalised education. Meanwhile, automated systems must be designed to accommodate students with disabilities or varying levels of digital literacy. For instance, an automated learning analytics platform that identifies students needing extra support should ensure that these insights are accessible and actionable for both students and educators, regardless of technological proficiency. Adaptive learning technologies represent a significant advancement in personalised education, leveraging sophisticated algorithms to tailor learning experiences to individual student needs. Systems like AutoTutor exemplify this approach, using adaptive algorithms to customise content based on learners' existing skills and knowledge. This ensures that students are challenged appropriately while receiving the support necessary to progress effectively (Lippert, Gatewood, Cai, & Graesser 2019; Shi, Wang, Zhang, Shubeck, Peng, Hu, & Graesser 2021). Moreover, AutoTutor incorporates six major learning affordances that facilitate the mastery of complex material, an essential feature for students with low literacy skills, enabling them to overcome significant educational barriers (Lippert *et al.* 2019; Shi *et al.* 2021).

The user-centred design of adaptive learning systems further enhances their efficacy, focusing on creating simple and intuitive interfaces that reduce cognitive load. These accessible designs cater for learners with diverse technological proficiencies, ensuring broader adoption and usability (Shi *et al.* 2021). Additionally, these systems often integrate conversational agents and interactive elements to boost engagement and motivation. For adult learners, who may face challenges in traditional educational settings, these features can significantly enhance self-efficacy and drive, making education more accessible and impactful (Hollander, Sabatini, & Graesser 2021; Shi *et al.* 2021).

Finally, the principle of human-in-the-loop emerges as a vital ethical safeguard bridging augmentation and automation. The principle of HITL (human-in-the-loop) in education underscores the collaborative interaction between humans and AI to enhance learning experiences. This approach emphasises the importance of human oversight, critical evaluation, and empathy, ensuring that AI systems align with human values and educational needs. HITL fosters a partnership between educators and AI systems to create adaptive learning environments, where AI analyses student data and identifies patterns while humans provide contextual understanding and emotional support. This synergy enables personalised learning experiences that address both cognitive and affective dimensions of education (Tong & Lee 2023).

The HITL model also addresses ethical concerns by ensuring that human judgement remains integral to decision-making processes in AI applications. By positioning humans as 'fellow workers' who interpret and validate AI outputs, the approach enhances the ethical legitimacy of AI in educational settings. This safeguards against the risks of biased or inappropriate decisions, as educators retain the authority to evaluate and contextualise AI recommendations (Salloch & Eriksen 2024).

Furthermore, HITL encourages interdisciplinary integration, drawing on insights from diverse fields such as psychology, computer science, and pedagogy to improve AI technologies in education. This cross-disciplinary collaboration is critical for developing AI systems that are not only technically robust but also empathetic and responsive to the nuanced needs of learners (Hutson & Plate 2023).

While the HITL principle offers significant advantages by balancing the strengths of human and machine intelligence, it also raises concerns about a potential over-reliance on AI, which could diminish human agency in learning processes. Striking the right balance between technological innovation and human input remains a critical challenge, requiring ongoing evaluation and adaptation of HITL frameworks to ensure they serve educational goals without undermining the central role of educators and learners. Whether AI augments or automates processes, human oversight should always remain integral to decision-making. This ensures that ethical judgement, empathy, and contextual understanding – currently, qualities uniquely human – are not overshadowed by efficiency gains. For example, while an AI system might recommend interventions for struggling students, educators must have the final say, informed by their personal interactions with students.

In short, ethical frameworks must be tailored to reflect the dual role of AI as both an augmentation and an automation tool in HE. By addressing issues of transparency, accountability, fairness, and inclusivity, these frameworks can guide institutions in leveraging AI responsibly while preserving the essential human elements that define education. This balance ensures that AI enhances the teaching and learning process without compromising the values and agency integral to HE.

Discussion, Recommendations, and Conclusion

The pace of advancement in AI will constantly accelerate, making proactive yet judicious integration into instructional systems imperative. From learning analytics to intelligent tutors and automated content creation, AI offers enhancements that could enrich HE. However, we must equally guard against over-exuberance where embedded biases, unequal access, deskilling or dehumanising effects arise from an uncritical adoption of AI.

The transformative potential of AI in HE is evident across various dimensions, from learning analytics to ITSs. The integration of AI into instructional design holds promise for enhancing personalised learning experiences and optimising educational outcomes. However, the current landscape reveals a somewhat fragmented implementation of AI technologies in education. While PLA and ALSs showcase significant advancements, there remains a need for a more cohesive and strategic approach to leverage the full potential of AI.

The emergence of AI-driven tools for student support, such as chatbots and predictive analytics dashboards, signals a shift toward more proactive interventions. These technologies enable a timely identification of at-risk students, facilitating early intervention strategies and support services. The ALS showcases a move towards personalised education, addressing individual student needs and dynamically adjusting content based on performance. Despite these advancements, the discussion also acknowledges the current limitations, emphasising the importance of striking a balance between augmentation and automation. The complexities of replicating dynamic educator-student interactions and the need for emotionally supportive, human engagement remain crucial considerations.

Moreover, challenges related to system biases, equitable access, and changing staff roles need careful attention. The potential benefits of AI should not exacerbate existing inequalities and strategies, for responsible innovation must be integrated into the implementation process. Ensuring transparency, fairness and accountability in AI-driven decision-making becomes paramount.

With all these in mind, there are some recommendations I would like to put forward. The first one relates to policy and strategy. Institutions should develop clear metrics to evaluate AI's impact, such as student engagement rates, retention improvements, and equity benchmarks. Additionally, AI policies must be dynamic, allowing for periodic review and adaptation to incorporate technological advancements and evolving educational needs. Long-term strategies should focus on building partnerships with AI developers to co-create tools tailored to HE's unique requirements. Institutions need to adopt a strategic and cohesive approach to integrating AI into instructional design, aligning technology implementation with educational objectives. As such, content developers and policymakers should prioritise equity-centred design principles to ensure that AI applications do not exacerbate existing disparities in access and outcomes. To make this a reality, educational institutions have to implement comprehensive faculty development programmes to enhance educators' understanding and utilisation of AI technologies, fostering a balance between human expertise and technological augmentation. Further, there is a need to foster a collaboration between educational experts, technologists, and ethicists to ensure a wholistic approach that addresses the social, ethical, and educational implications of AI in HE.

Finally, while AI presents an immense potential for transforming HE, a careful consideration of ethical, social, and pedagogical dimensions is essential. A strategic and collaborative approach, coupled with ongoing research and dialogue, will be instrumental in harnessing the benefits of AI to enhance learning outcomes without compromising the essential role of human agency in education. The journey towards an optimised integration of AI in HE requires a balance between innovation and preservation of core educational values. Moving forward, a guiding perspective should emphasise AI as enhancing educator capabilities rather than replacing teaching roles. Implementation policies must promote ethical data usage, systemic inclusivity, and faculty autonomy. Beyond functionalist lenses and narrowly defining measurable analytics improvements, we need wholistic assessments weighing social, emotional, and civic growth central to HE's formative mission, yet less quantifiable. Ultimately by foregrounding cooperation, wisdom, and responsibility as educational values no less important than efficiency or personalisation, IHEs can fruitfully pioneer AI systems harmonising automation with our deepest humanity.

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Chapter 6

Intelligent Frameworks for Assessment in AI-Enhanced Learning Environments

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Introduction

Nowadays several critical challenges, opportunities, and trends in learning must be considered in the development and implementation of new learning environments. These include encouraging lifelong learning, valuing both informal and formal learning, addressing the open and social dimensions of learning, and recognising the different contexts where learning takes place. It is also crucial to address what today's students need. We observe, however, that during the last years, knowledge acquisition and learning have been distributed and continue to occur in a world without boundaries. Students are collaborating more than ever beyond classroom boundaries, which become more and more irrelevant within formal settings. Moreover, the openness of knowledge resources and the social nature of the web through the participation, voting, collaboration, aggregation, and distribution it enables, are leading to a new generation of students, driven by openness, networking, and sharing. Considering the new requirements in terms of learning also raises challenges with regard to the assessment of learning. Student-centred and networked learning require new assessment models that address how to recognise and evaluate self-directed learning achievements.

We need to put the student at the centre of our focus and give them the control over the learning experience. We also need to help students to operate in decentralised and open environments, and provide them with different kinds of assessment according to their needs. Assessment is an integral part of instruction, as it determines whether the lesson's educational goals and standards are being met (Marshall, Zhang, Chen, Lally, Shen, Fox, & Cassel 2003). In the literature, researchers distinguish between different kinds of assessment. The main difference between the different concepts of assessment is the usage of data in the diverse assessment activities. When we consider the one kind of assessment, data are used to decide the direction for action in the learning process. In another kind of assessment, data are used to determine the extent to which an action was successful (Secolsky & Denison 2017).

Our research has specifically looked into assessment mechanisms. One way of increasing the efficiency of assessment is to allow students to assess themselves or each other. In addition, and within the continuously advancing domain of educational technology, the incorporation of AI (artificial intelligence) into the realm of assessment methodologies is increasingly recognised as a critical factor in enhancing and personalising educational experiences. ML (machine learning), a fundamental subdivision of AI, endows systems with the capability to autonomously learn from data. This function is essential for tailoring educational content and assessments within adaptive learning frameworks.

This chapter presents an overview of the specificities related to the deployment of technology-enhanced assessment, and the different forms of assessment that could be deployed using technologies. A special focus is on the semantic web which provides a framework for interoperability of data through various environments and possibilities for personalisation and adaptation for the students. The challenges related to the deployment of assessment in AI-supported learning environments are presented. In particular, we will focus on collaborative intelligent assessment, where we present a case study related to the deployment of our intelligent assessment framework and the results obtained.

Evolving Educational Challenges and Opportunities

During the educational process, the dynamic character of the area of education is continually confronted with new obstacles and possibilities since education is not a static entity but rather an ever-changing environment influenced by many elements. This is evident from the research of Kayembe and Nel (2019) that social issues, inequality, and the marginalisation of socioeconomic groups are all representations of the difficulties that the educational system faces, whereas the opportunities that affect the educational systems are promoting innovation and creativity, partnerships and collaboration, and technology as a bridge for social inclusion.

Amidst this ongoing evolution, the educational sector faced an unprecedented hurdle in the form of the COVID-19 (Coronavirus disease of 2019) pandemic. Sadjadi (2023) explains the education system’s challenges and opportunities during COVID-19, which are uncertainty in academic semesters, digital transformation of educational programmes, online education, capacity building, skill mismatch, and access to learning opportunities, whereas the opportunities that affect the educational systems are digitalisation, smart working, equality in digital access to education, long-term planning for capacity building, value creation, and relationship strengthening. From these opportunities, it becomes clear that the educational system can adapt, innovate, and create value in response to challenges like the COVID-19 pandemic. Neuwirth, Jović, and Mukherji (2021) highlight some of the challenges that faced the educational systems during the COVID-19 pandemic: The transition to virtual classrooms, maintaining normalcy, psychosocial factors, diversities, and the inequitable distribution of resources. However, despite these challenges, they present opportunities for the educational system during and post COVID-19, such as unique learning opportunities, building resilience, and transferable skills.

Bonfield, Salter, Longmuir, Benson, and Adachi (2020) discuss the potentially disruptive technologies that present challenges and advantages to established pedagogies and course design. They also mention the need for IHEs (institutions of higher education) to redesign curricula to support lifelong learning, online learning, and developing skills for future employment. This underscores the importance of research and reflection to inform strategic conversations about the future role and importance of E4.0 (Education 4.0).

Moreover, that clears up the evolving educational challenges and opportunities, and explains the need for faculty and students to collaborate and adapt to the new virtual learning environment while also addressing the psychosocial factors and challenges.

The Rise of Open and Social Learning

The current educational environment is experiencing a notable shift, characterised by the increasing prominence of open and social learning. Open and social learning approaches emerge as a critical factor as established educational paradigms undergo a major upheaval. The driving forces behind this paradigm change are technological breakthroughs, evolving student preferences, and a worldwide transition towards collaborative and inclusive learning experiences. The intersection of open educational resources, social media platforms, and collaborative online spaces signifies a shift away from conventional, exclusive educational approaches.

A study conducted by Hew and Cheung (2014) explores the rise of MOOCs (massive open online courses), a popular form of open and social learning, and highlights challenges in teaching such as student reaction, fast feedback, assessment difficulties, and instructors who are facing challenges like time and resource demands. The opportunity to teach MOOCs includes the value of the diverse perspectives and resources generated by MOOCs, motivations like curiosity, and personal challenges faced by students and instructors. The rise of open and social learning, particularly through MOOCs, has therefore sparked significant interest and debate among educators, researchers, and students.

Veletsianos and Shepherdson (2016) discuss the rise of open and social learning in education. This includes the use of MOOCs, OERs (open educational resources), social media, collaborative and networked learning, inclusivity, and accessibility. The research explores the impact of open and social learning on equity, access, and participation in education, as well as the challenges and opportunities it presents for educational institutions, educators, and students. Issues such as quality assurance, accreditation, business models, and the evolving role of educators are addressed. The emergence of open and social learning reflects a shift in educational practices driven by technology and learner needs. Ongoing research continues to explore the implications and effectiveness of open and social learning in education.

The emergence of open and social learning therefore reflects a paradigmatic shift in educational practices brought about by technological advancement, shifting student needs, and the desire for more adaptable, inclusive, and collaborative learning experiences. Ongoing research and scholarly inquiry continue to explore the implications, effectiveness, and future directions of open and social learning in education.

The Need for New Assessment Models

Academic literature emphasises the need for new assessment models that go beyond traditional academic knowledge. Scholars argue for assessing a wider range of skills and competencies, including psychological constructs like personality traits and EI (emotional intelligence). The increasing number of publications in this area shows a growing recognition of the importance of re-evaluating assessment practices. The use of digital technologies has also sparked interest in more innovative approaches. There is therefore a commitment to developing more effective and comprehensive assessment models.

Wafubwa (2020) indicates that the assessment models have limitations in accurately measuring student learning and achievement, including limited scope, standardisation, reliability and validity, time constraints, pressure and stress, and bias. These limitations can negatively impact students' performance and the quality of their education. To address these issues, educators and policymakers should develop more inclusive, reliable, and valid assessment models that include multiple methods, accommodate diverse students, and ensure fairness and unbiasedness. Coiro (2021) points to the limitations of current assessment models in digital literacy and reading. It suggests a need for a more comprehensive approach that considers more than just comprehension. He emphasises the importance of the authentic assessment of comprehension and learning in complex digital spaces. Current models often focus on comparing reading on paper and digital screens, neglecting the complexities of readers engaging with diverse digital texts.

Wiliam (2011) explains why we need to shift to competency-based assessment, which is very important because current assessment models have flaws like putting too much emphasis on standardised tests, not being useful in the real world, not measuring non-cognitive skills well enough, and possibly being biased. This transition necessitates comprehensive, student-centred approaches and continual professional development for instructors. Nadelson, Heddy, Jones, Taasoobshirazi, and Johnson (2018) mention that the use of multiple assessment methods, such as concept maps, exploratory factor analysis, confirmatory factor analysis, item response theory, and Rasch modelling, is crucial for a comprehensive understanding of conceptual change in science teaching and learning. This approach helps educators and researchers to gain a complete understanding of the factors influencing conceptual change, leading to more effective teaching strategies and interventions.

Due to the significant role of educators, it is crucial to enhance assessment without compromising its proficiency in utilising this technology during instruction and subsequent procedures. Opfer, Nehm, and Ha (2012)test developers have been urged to use an "assessment triangle" that starts with research-based models of cognition and learning [NRC (2001 argue that the educator's professional development in assessment should focus on understanding assessment principles, designing effective assessments, data analysis, differentiation, feedback, and grading, using formative assessment techniques, integrating technology for assessment purposes, and considering ethical and legal considerations. These components help educators to design assessments that align with learning objectives, interpret data, differentiate between students, provide constructive feedback, use formative assessment techniques, integrate technology for data management, and ensure ethical and legal considerations. By addressing these areas, professional educator development can improve assessment practices and enhance student learning outcomes.

Over all, academic literature highlights the need for new assessment models, focusing on a broader range of skills and competencies, while considering psychological constructs and digital technologies. The call for competency-based assessment addresses flaws in current models, such as standardised tests and bias. The professional development of educators is crucial for aligning assessments with learning objectives and leveraging technology for improved outcomes. Collective efforts to reform assessment practices are vital for a more comprehensive and effective educational system.

New Forms of Assessment

During the last few years, we have observed that both lifelong and informal learning are becoming important themes due to the ubiquitous delivery of information and knowledge. Much of the academic learning happens beyond the formal institutional education systems. It comes from different informal channels on the web. It is also crucial to address what today's students need. As stressed in the Leuven/Louvain-la-Neuve Communiqué of

Bergan and Matei (2020), '[s]tudent-centred learning requires empowering individual learners, new approaches to teaching and learning, effective support and guidance structures and a curriculum focused more clearly on the learner.' This implies a need for new learning and assessment models that

- foster lifelong and informal learning perspectives;
- support a wide variety of learning experiences within and beyond the institutional boundaries;
- put the student at the centre and give them control over the learning experience;
- recognise the social and network aspect of learning, and put a strong emphasis on knowledge creation and sharing within a social context; and
- operate in decentralised and open environments.

Student-centred and networked learning models are best represented by PBL (project-based learning) approaches. In PBL, students can generate new knowledge and acquire new skills based on their previous knowledge and experiences when they carry out a project. PBL is also a good way for students to solve practical problems in an open environment using an interdisciplinary approach. The shift to new learning models raises challenges in the assessment of learning. Student-centred and networked learning require new assessment models that address recognising and evaluating self-directed, informal, and networked learning achievements. We need to think about new criteria for assessment that bring together educator assessment, peer-assessment, self-assessment, intelligent feedback, and group assessment.

Assessment constitutes an important part of the learning process. Assessment methods are shaped by mainly two factors: The type of assessor and the type of assesses. The assessor is the actor who performs the correction, i.e., evaluates the student's contribution to generate feedback. Four main types of assessors can be distinguished: Educator (educator assessment), peers/network (peer/network-assessment), self (self-assessment), and computer (automatic assessment). The students who are assessed and evaluated by the assessor are known as assesses. There are two main types: Individuals (individual assessment) and groups (group assessment). Assessment is considered to be an important aspect of both distance and face-to-face education. We can distinguish three main categories of assessment that can be used in any education programme:

- *Diagnostic assessment* provides an indicator of a student's aptitudes and preparedness for a course.
- *Formative assessment* provides feedback to students on their progress but does not contribute to the overall assessment.
- *Summative assessment* provides a measure of achievement or failure in a student's performance concerning the programme of study.

At the beginning of a learning process, it would be good to use diagnostic assessment to find out which prerequisite competence and knowledge students have, to be able to organise student groups and provide appropriate resources and activities to each student according to their profile. At the end of the learning process, a summative assessment would be fitting to provide information to the students about progress and achievement. This form of assessment can be qualified as an 'assessment of learning,' and would enable one to check whether the learning objectives have been achieved. The last type of assessment is formative assessment, which is used to identify the development of students' skills and knowledge. On the one hand, it is considered an 'assessment for learning,' since the assessment activity can be considered a learning activity and an integral part of the inquiry process. On the other hand, formative assessment can be characterised as 'assessment as learning,' in order to give students information on their own learning and assessment and to develop and support meta-cognition for students. All of these forms of assessment are essential to an understanding of what students learn during a learning activity. Researchers have also identified another category of assessment that can be considered transversal to the three categories presented: Authentic assessment. Authentic assessment is related to the assessment of students' skills and competencies in real-world contexts.

The challenge is to provide a thorough assessment of the learning experience, which combines different assessment forms. These include the following:

- *Educator assessment*: Formal learning scenarios are often characterised by a specific separation of students and educators. These roles are often adapted directly, meaning that both educators and students are assessors. The advantages of this method are that the educators' professional expertise as well as their routine practice with assessment, facilitate high-quality feedback with ensured reliability.
- *Peer/Network assessment* involves students making judgements about other students' work. Using peer assessment with essays is useful and highly informative for the student and the tutor and it can be used at various points in the learning and assessment process to give feedback before completing the final piece of work for submission. Peer assessment can be divided into peer-review and peer grading (Gušić, Cardeña, Bengtsson, & Søndergaard 2016). The process of providing elaborated formative feedback to review the performance of other students is called peer review. Peer grading emphasises the process of providing summative feedback or rather grades for peers' work.
- *Self-assessment* involves students judging prerequisites to their work. Reflecting and assessing their performance support self-critical thinking.
- *Automatic assessment/Intelligent feedback* aims to provide students with individualised, dedicated feedback based partly upon an analysis of the procedures followed by the user, which may provide some assistance on how the user should progress.
- *Group assessment*: An approach to reduce the workload for correction is the arrangement of groups to cooperatively work on activities. A more important objective of group assessment is to improve learning success for all group members. Additionally, group assessment provides opportunities to strengthen soft skills like communication skills or conflict management.

- *Mobile assessment* can be defined as an assessment that is facilitated and enhanced by the use of digital mobile devices such as smartphones and tablets and that can be characterised by a rapid and continuous change of context. In particular, mobile and personalised assessment provide efficient and personalised routes for establishing the proficiencies of students. This type of assessment offers students the possibility to maintain and expose their competency profile to multiple learning and assessment environments throughout their lives.
- *Assessments based on* OSRQs (open short response questions) are issues for which the student must provide a short answer, which can be composed of a few words or sentences, not exceeding five lines. The fact that it only requires a single piece of information as a response sets it apart from short development questions in particular. This type of question is easy to produce, provided that it is well constructed and allows for the evaluation of the ability of problem analysis. Intelligent feedback provides interesting information that is generated based on data about the user's interests and the learning context.

Technologies used to facilitate assessment can be split into three categories:

- *Technologies for aligned assessment*: These technologies allow the alignment of assessment with the intended learning outcomes by making possible scenarios in which students can demonstrate the competencies they have developed in authentic contexts (Aguirre, Grau, Eckert, Euzenat, Ferrara, Van Hague, Hollink, Jiménez-Ruiz, Meilicke, & Nikolov 2012). This is facilitated by advanced learning technologies including digital games, mobile technologies, and pervasive learning scenarios.
- *Technologies for embedded assessment*: These technologies enable the integration of assessment activities into learning flows, where the result of the assessment may condition the following learning activity to be presented to the students (Villasclaras-Fernández, Hernández-Leo, Asensio-Pérez, &

Dimitriadis 2013). Technologies supporting personalisation or adaptive learning, the use of interoperability specifications, and standards can offer relevant approaches for embedded assessment.

- *Technologies for scalable assessment*: These technologies are especially critical in courses with no constraints on class size (e.g., MOOCs). Assessment technologies supporting feasible assessment in massive online environments include quizzes embedded in videos, as well as self-assessment and peer assessment systems (Kay, Reimann, Diebold, & Kummerfeld 2013).

Self-Assessment and Peer Assessment

Self-assessment and peer assessment are increasingly recognised as essential tools for nurturing responsible, critical, and reflective professionals within HE (higher education). Recent research underscores the efficacy of these methods when conducted anonymously *via* online platforms, surpassing the effectiveness of traditional lecturer assessments. For instance, a study conducted at the Universidad de Vigo in Spain (Iglesias Pérez, Vidal-Puga, & Pino Juste 2022) found a robust agreement between peer and lecturer assessment, indicating that students possess the capability to evaluate their peers effectively with both validity and reliability.

Topping (1998) and the theoretical underpinnings of the method are discussed. A review of the developing literature follows, including both process and outcome studies. This indicates that peer assessment is of adequate reliability and validity in a wide variety of applications. Peer assessment of writing and peer assessment using marks, grades, and tests have shown positive formative effects on student achievement and attitudes. These effects are as good as or better than the effects of teacher assessment. Evidence for such effects from other types of peer assessment (of presentation skills, group work or projects, and professional skills offers a comprehensive typology of peer assessment methods, laying the theoretical groundwork for their implementation. Stelmakh, Shah, and Singh (2021) address the detection of strategic behaviour in peer assessments, developing a statistical framework to counter manipulation. Double, McGrane, & Hopfenbeck (2020) and Li, Xiong, Hunter, Guo, and Tywoniw (2020) demonstrate that peer assessment significantly improves student performance, a benefit further enhanced by rater training. The role of peer assessment in fostering self-assessment is underscored by To and Panadero (2019) who have found that peer interactions enhance self-assessment capabilities. Exploring another facet of peer assessment, Zhou, Lin, and Zhao (2022) highlight the importance of respect and constructive feedback in peer assessment, linking them to students' emotional responses and satisfaction. Zheng, Zhang, and Cui (2020) have established that technology-facilitated peer assessment markedly improves learning outcomes, especially when combined with additional support strategies. In this context, Chien, Hwang, and Jong (2020) explore the impact of SVVR-based (scientific visualisation and virtual reality) peer assessment for EFL (English as a foreign language) students, noting improvements in language skills, motivation, and critical thinking while reducing learning anxiety.

Turning to the realm of self-assessment, recent studies have shed light on its dynamics and implications. Yang, Chen, Flanagan, and Ogata (2022) found a positive correlation between frequent self- assessment engagement, and HE scores. However, they also noted that not all active engagement in self-assessment leads to improved learning outcomes, highlighting the complexity of student engagement and behaviour in the self-assessment process.

Further expanding the scope, Surahman and Wang (2022) have conducted a comprehensive literature review focusing on AD (academic dishonesty) and TA (trustworthy assessment) in online education. Findings underscore the necessity for educators to adapt their teaching and assessment methods in the digital age, suggesting the potential of AI, ML, and LA (learning analytics) as pivotal tools in mitigating academic dishonesty and enhancing the trustworthiness of assessments. In a related vein, Darvishi, Khosravi, Sadiq, and Gašević (2022)some common concerns and criticisms are associated with the use of peer assessments (eg, scarcity of high-quality feedback from peer student-assessors and lack of accuracy in assigning a grade to the assessee underscore the potential of AI and analytical methods in augmenting the reliability and efficiency of peer assessment procedures. This perspective is corroborated by the research of Swiecki, Khosravi, Chen, Martinez-Maldonado, Lodge, Milligan, Selwyn, and Gašević (2022) as well as Hooda, Rana, Dahiya, Shet, and Singh (2022), who simultaneously acknowledge the intricate challenges introduced by the integration of AI in assessment processes and its capacity to yield innovative and efficacious solutions. Collectively, these scholarly insights accentuate the escalating significance of AI in redefining assessment practices, enhancing their dependability, and ensuring their congruence with the requisites of modern education.

Project-Based Learning Assessment

PBL represents a student-centred teaching approach that empowers students to engage collaboratively in authentic projects rooted in real-world scenarios, to develop knowledge and skills relevant to the practical application of the subject matter (Chen & Yang 2019). These projects should be complex assignments that extend beyond textbook content, requiring students to explore, collaborate, and apply new knowledge (Apeanti & Odei-Addo 2024).

In the realm of PBL, students actively participate in the analysis of a given project and the quest for potential solutions, typically tied to the practical aspects of the course material. Marsiti, Santyasa, Sudatha, and Sudarma (2023) elucidate the advantages of incorporating PBL within blended learning frameworks. Their research highlights the substantial role this approach plays in augmenting academic achievements and nurturing creativity among learners. In a related investigation, Umar and Ko (2022) have conducted an in-depth analysis of the synergistic interplay among PBL strategies, the dynamics of team cohesion, and the principles of flipped learning. Their study focuses on understanding the cumulative effect of these educational components on the efficacy and engagement levels of student learning. Additionally, in an endeavour to expand the application scope of PBL, Susanti, Rachmajanti, Suryati, and

Astuti (2023) undertook a study in the domain of English language instruction. Their research was primarily aimed at enhancing the development of critical thinking abilities within online learning platforms.

The PBL setting offers learners a collaborative and context-driven learning experience (Amamou & Cheniti-Belcadhi 2018). Research conducted by Mhlongo, Oyetade, and Zuva (2020) indicates that PBCL (project-based collaborative learning) has a positive impact on students' overall academic performance and the development of their skills. This approach contributes significantly to boosting students' self-confidence as it allows them to engage in collaborative work, explore new concepts, and apply their knowledge in innovative ways.

Collaborative learning represents a multifaceted educational approach that intricately combines individual and group efforts. As highlighted by Johnson and Johnson (2009), it places significant emphasis on two critical aspects: Individual accountability and positive interdependence. In this approach, students' success is not solely reliant on their personal learning but is also intricately linked to the accomplishments of their peers. It is imperative to stress the necessity of a comprehensive assessment of each facet of collaborative learning to effectively cultivate successful collaboration.

Lifelong and Informal Learning Assessment

Research on lifelong learning and informal learning assessment emphasises the significance of acquiring knowledge beyond formal schooling and day-to-day encounters. Informal learning, especially in situations that are abundant in technology, is associated with the development of problem-solving abilities. The implementation of a lifelong learning explorer framework facilitates the delineation of courses and the assessment of methodologies. Harrison, Villalba-Garcia, Brown, and Richardson (2022) mentions that evaluating and assessing lifelong and informal learning is an essential component of both educational and professional growth as it involves recognising and evaluating the knowledge, skills, and competencies gained through nonformal and informal experiences. The process entails the identification, documentation, assessment, and certification of certain learning outcomes and competencies. The EU (European Union) advocates for the recognition of non-formal and informal learning, highlighting the importance of offering many learning routes that do not lead to dead ends. Authenticating these experiences can result in complete or partial certifications, which can have a favourable influence on professional opportunities, personal growth, and overall welfare. Research on lifelong learning and informal learning assessment emphasises the significance of acquiring knowledge beyond formal schooling and everyday experiences. Informal learning, especially in situations that are abundant in technology, is associated with the development of problem-solving abilities. The implementation of a lifelong learning explorer framework aids in the establishment of a curriculum and the assessment of methodologies.

The 21st century has significantly impacted education, emphasising lifelong learning and self-realisation, and exploring the concept of lifelong learning through various scales and assessments (Eskici & Özkır 2023). These include the contribution of local newspapers to lifelong learning, employee attitudes towards lifelong learning, lifelong learning competency scales, and informal learning scales. These assessments assist in guiding educational policies and practices, ensuring individuals' motivation and self-directedness, while learning outcomes are effectively measured and assessed.

Nguyen and Walker (2016) emphasise the importance of preparing students for future learning without compromising their ability to meet present needs. They mention that sustainable assessment is crucial for lifelong learning, aiming to align assessment practices in universities to support students' development as lifelong learners, and this approach goes beyond improving HE to prepare students for future learning, including informal and lifelong learning. Nguyen and Walker (2016) add that new assessment methods are being used to incorporate lifelong learning into Australian education. These methods, including action research, portfolio assessment, and peer assessment, put the student first, focus on learning development, and try to make assessment more natural in the learning environment, showing how lifelong learning is being put into practice.

Both lifelong and informal learning assessment are critical for educational progress, as they encourage knowledge acquisition outside of formal education. Sustainable assessment approaches integrate universities with lifelong learners, promoting both professional and personal growth. Australian teacher education uses innovative assessment methods to ensure seamless integration.

Challenges in New Assessment Models

The concepts of lifelong learning and informal learning assessment are closely connected, requiring the development of creative methods for assessment. Considering the increasing complexities of the 21st century, it is essential to modify assessment model frameworks to maintain education as a catalyst for personal development and societal adaptability. If we would like to modify the new assessment model frameworks, we need to identify the challenges that face them.

Toomey, Chapman, Gaff, McGilp, Walsh, Warren, and Williams (2004) explain the challenges facing the assessment, especially for the Australian Faculty of Education, which faces several challenges, including resistance, marginalisation, student attitudes, time constraints, a lack of communication, regulatory constraints, and philosophical differences. These factors prevent the adoption of novel assessment methods because colleagues frequently find them impractical. Additionally, both time and structural constraints make it difficult to reform assessment systems. Furthermore, philosophical differences within faculties and across campuses further complicate the process.

Guangul, Suhail, Khalit, and Khidhir (2020) explain that the shifting to remote assessment during the COVID-19 epidemic posed difficulties such as infrastructure issues, breaches of academic integrity, student dedication to submitting assessments, and guaranteeing accurate assessment of module learning results. According to them, sufficient infrastructure, encompassing internet connectivity and suitable gadgets, is considered vital for students and faculty. They mention the imperative to prioritise academic integrity in remote assessments due to the potential of cheating and fraud in the absence of physical supervision. Furthermore, it is essential to address the level of dedication that students have towards participating in online lectures and completing assessments to successfully achieve the desired learning outcomes of the module in a remote learning setting.

Serutla, Mwanza, and Celik (2024) mention that the primary obstacle associated with online assessments pertains to their reliability and authenticity, which is a major challenge because of the prevalence of cheating and impersonation. The issue of technological proficiency poses a significant challenge and a substantial obstacle, impacting the capacity of both students and educators to actively participate. Also, the proctoring tools and monitoring technology give rise to concerns over privacy. Resource limitations, educational adaptation, and interoperability therefore all present difficulties. Personalised feedback and policy frameworks are crucial for the efficacy of online examinations. After all these challenges, the scholars point out that providing personalised feedback and establishing policy frameworks are essential for the success of online assessments.

The interrelated notions of both lifelong learning and informal learning assessment require the use of new assessment methods. To effectively navigate the challenges of the modern day, it is essential to make a significant change in the frameworks used for assessing educational models. This change is necessary to ensure that education continues to promote personal development and the ability of society to adjust to new circumstances.

Semantic Web for Intelligent Assessment

The semantic web is a framework designed to enable data to be shared, to be interconnected and reused across diverse applications. It provides structured data formats and ontologies that facilitate interoperability between systems, especially useful in educational settings where adaptive, personalised learning experiences are key. In an AI-driven educational environment, the semantic web supports advanced content recommendation, learning analytics, and adaptive assessments by establishing a shared data language and linking data to create meaningful connections. The semantic web offers tools and infrastructure for semantic representation employing ontologies. It provides a common framework allowing data to be shared and reused across applications, enterprises, and communities (Berners-Lee, Hendler, & Lassila 2023). In the past few years, the relevance of semantic web technologies for developing e-learning systems has been supported by several research efforts (Bittencourt, Isotani, Costa, & Mizoguchi 2008). Semantic web technologies have been increasingly used as a tool for generating, organising, and personalising e-learning content, including e-assessment (Cubric & Tosic 2011). The use of ontologies for context modelling in many research works explores the relation between semantic web technologies and context modelling. In practical settings, ontologies have become widely used for mobile context modelling since they are reusable and sharable. In Yu, Zhou, and Nakamura (2008), a context-aware ubiquitous learning infrastructure called semantic learning space is proposed. The infrastructure leverages semantic web technologies to support explicit knowledge representation, flexible context reasoning, and adaptive content recommendation. Semantic web technologies, especially ontologies, have also been used as an efficient modelling approach to propose an exhaustive learner model called 'learner context' (Laroussi 2012).

To deal with these challenges, it is necessary to retrieve relevant data for learning and assessment activities from different tools. Unfortunately, social media applications are data silos – only people may have access to data, not computers. The reuse and exchange of data among social tools are only possible using the API (academic performance index). The semantic web provides a common framework that allows data, information, and knowledge to be shared and reused across applications. Linked data describes a method of exposing, sharing, and connecting data, information, and knowledge on the web (Bojārs, Breslin, Finn, & Decker 2008; Gruber 2008). It provides a standardised, uniform, and generic method for data discovery, distributes queries against several data repositories, integration, or semantic mash-up, and uniform access to metadata, data, information, and knowledge.

Ontological Models for Technology-Enhanced Assessment

To ensure interoperability at the semantic level, it is necessary to use common vocabularies among web tools. These vocabularies can be semantic models necessary to design technology-enhanced learning systems. In previous work, we described the required semantic models for the description of Assessment (Cheniti-Belcadhi, Henze, & Braham 2008).

According to Baker (2000), the models indicate three main roles in educational processes in AIED (artificial intelligence in education) research. These models could be the following components as ontologies:

- Models as scientific tools: A model used as a means for understanding and predicting some aspects of an educational situation.
- A model as a component: A computational model, corresponding to some aspect of the teaching or learning process, used as a component of an educational artifact.
- A model as a basis for design: A model of an educational process, with its attendant theory, forming the basis for the design of a computer tool for education.

In TEA (technology enhanced assessment), we recall the following models that can be components as ontologies: Learner models, tutor models, assessment models, context models, adaptation models, and recommendation models. The semantic web approach enables us to meet the challenge of finding information by avoiding polysemy and reducing the number of results. The semantic web offers tools and infrastructure for semantic representation employing ontologies. The latter fosters interoperability at the semantic level because it provides a unique meaning for a concept and a relation in ontology. In TEA, the objective is to facilitate assessment and additional potential benefits associated with semantic web technologies. Indeed, ontologies can provide a precise semantic for the assessment domain, the assessment activities, the different categories of stakeholders, the assessment content that is collected and produced, the assessment context, and all peer assessment activities and components (e.g., criteria and grid).

Personalisation and Adaptation in AI Assessments

Within the continuously advancing domain of educational technology, the incorporation of AI into the realm of assessment methodologies is increasingly recognised as a critical factor in enhancing and personalising educational experiences. ML, a fundamental subdivision of AI, endows systems with the capability to autonomously learn from data. This function is essential for tailoring educational content and assessments within adaptive learning frameworks. Personalisation with AI in learning environments is mainly related to the ability of AI systems to personalise learning processes and provide recommendations to individual students based on their preferences, behaviour, and context. The goal is to improve the learner experience, engagement, and effectiveness by delivering relevant and targeted learning content or services.

Adaptive assessments have emerged as a valuable tool in educational research, offering several advantages. These assessments dynamically adjust their difficulty levels based on students' responses, resulting in more precise knowledge measurements. Consequently, students benefit from tailored feedback, which in turn leads to enhanced performances. Furthermore, adaptive assessment, which is intricately designed by AI, proficiently modulates assessment content, pacing, and complexity in response to the unique performance metrics of each student, thereby ensuring a deeply individualised assessment trajectory. Additionally, ITSs (intelligent tutoring systems), utilising AI, are adept at providing personalised instruction and feedback, effectively mirroring human tutoring approaches.

In the sphere of data analysis, the utilisation of AI in assessment analytics is instrumental in deriving significant insights from assessment data, consequently enhancing the precision and effectiveness of assessment procedures.

The principle of personalisation, lying at the heart of these technological advancements, guarantees that the assessment journey is meticulously aligned with the distinct needs and capabilities of each student.

Frameworks for AI-Driven Assessment

The educational landscape has witnessed a significant transformation, predominantly propelled by the integration of technology into pedagogical settings. This integration has led to remarkable enhancements in the delivery and assessment modes of education, challenging and reshaping traditional educational frameworks. A significant innovation in this domain is the advent of the intelligent assessment framework or framework for AI-driven assessment. It represents the forefront of innovation by integrating educational technology with advanced AI, signifying a departure from conventional assessment approaches.

Developing and Implementing AI Assessment Frameworks

The intelligent assessment frameworks are uniquely dynamic and conceptualised to cater to the individualised learning requisites of each student (Rivera Muñoz, Ojeda, Jurado, Peña, Carranza, Berríos, Molina, Farfan, Arias-Gonzáles, & Vasquez Pauca 2022). These frameworks are proficient in the real-time processing of performance data, enabling modifications in aspects such as question difficulty, content type, and overall assessment strategies. Such adaptability ensures that each assessment is not only rigorous but also aligns with the individual needs and capabilities of each student (Hill, Overton, Kitson, Thompson, Brookes, Coppo, & Bayley 2020). These frameworks can instantly process and adapt to performance data, which change different aspects of assessment. This ensures that each assessment is not only difficult but also directly related to each student's specific needs and skills (Conati & Merten 2007).

The impact of these intelligent assessment frameworks in the modern educational paradigm is noteworthy, marking a substantial progression in the approach toward learning and assessment. They tackle some of the major hurdles in e-learning, including the need for personalised learning, engagement, and effective assessment of learning outcomes (Zhang, Zhang, Fang, Wan, Tao, & Sun 2020). As educational landscapes continue to change and diversify, particularly with the growth of online and remote learning formats, the importance of such intelligent systems in delivering high-quality, individualised education on a large scale becomes even more crucial.

Case Studies of Framework Implementation

This section presents two case studies, each exemplifying the integration of AI in distinct educational assessment frameworks. These studies highlight how AI technologies are being leveraged to transform and enhance assessment methodologies in various learning environments.

Case Study: Application of AI in the Collaborative Assessment Analytical Framework in Project-Based Collaborative Learning

Framework Overview

This case study by Hadyaoui and Cheniti-Belcadhi (2022) examines CAAF (the collaborative assessment analytical framework), highlighting its integration of AI in the realm of PBCL. This framework represents a sophisticated approach to assessing student collaboration and interaction in real-world project scenarios, particularly in the context of computer science education.

CAAF is an innovative framework that incorporates AI to enhance the assessment of group dynamics and performance in PBCL. It focuses on real-world problems in programming courses, leveraging AI to analyse and predict student engagement and performance.

Framework Implementation

- *Framework design*: CAAF is designed to assess skill mastery through collaborative projects. AI is utilised to analyse a series of sub-objectives and corresponding assessment activities, addressing the complexities of group work assessment.
- *AI in formative assessment*:
    - *Self-group assessment*: AI algorithms analyse feedback and interactions within discussion forums, providing insights into individual contributions and the effectiveness of internal group feedback.
    - *Peer-group assessment*: AI is used to evaluate interactions in peer-group assessment sessions held in chatrooms. It assesses the quality of peer feedback and its impact on the group's project, influencing the final grading.

- *Data analytics and predictive modelling*: The framework of CAAF employs AI-driven data analytics to organise and interpret assessment data. This includes:
    - *Predicting group disengagement*: AI models predict potential disengagement within groups, allowing timely interventions by educators.
    - *Performance analytics*: The framework uses supervised learning methods to analyse forum contributions and chatroom interactions, generating predictive models of group performance.
- *AI's role in enhancing learning outcomes*:
    - *Educator feedback and decision making*: AI analytics provide educators with comprehensive data, aiding in informed decision-making and targeted feedback.
    - *Student engagement and skill development*: The AI-driven insights assist in enhancing student engagement and developing critical collaboration skills.

The integration of AI into the framework of CAAF marks a significant advancement in educational technology, particularly in PBCL environments. By harnessing the power of AI for data analysis and predictive modelling, CAAF provides a robust, efficient tool for educators to assess and improve group dynamics and individual performance in collaborative projects. This case study showcases the potential of AI to transform educational assessment methodologies, making them more adaptive, insightful, and effective in addressing the challenges of modern collaborative learning settings.

Case Study: AI-Driven Intelligent Collaborative Assessment Framework in e-Learning Environments

Framework Overview

In this case study by Hadyaoui and Cheniti-Belcadhi (2023), we examine ICAF (the intelligent collaborative assessment framework), a cutting-edge construct developed to redefine assessment practices and collaborative learning within e-learning platforms. This framework is distinguished by its integration of AI technologies, aimed at refining online learning assessments with a nuanced approach.

Structure and Functionality of ICAF

- *Framework composition*: Central to ICAF's efficacy is the integration of AI and ML algorithms. These advanced technologies are pivotal in providing personalised feedback and supporting interactive learning activities among students.
- *Modules of assessment and collaboration*: ICAF encompasses two principal modules: The first is an assessment module utilising AI algorithms to deliver tailored feedback to students; the second is a collaborative module designed to facilitate group activities and peer-to-peer learning, thereby augmenting the interactive dimensions of e-learning.

Target Audience and Operational Environment

- *Intended user demographics*: ICAF is primarily designed for use by educators, instructional designers, and professionals in the field of e-learning. It additionally offers advanced collaborative assessment tools and personalised feedback options for students.
- *Application context*: Tailored for digital e-learning environments, ICAF is adept at navigating the unique challenges and leveraging the opportunities inherent in these settings.

Implementation and Application of the Intelligent Collaborative Assessment Framework

- *Role in assessment process*: ICAF operates across various stages of the assessment cycle. It transcends traditional roles of administering and scoring assessments by also contributing to the formulation of assessment tasks, delivering nuanced feedback, and monitoring student progression.
- *Ongoing assessment and feedback*: The framework is designed for continuous assessment, providing perpetual feedback to students. This aligns with the iterative nature of the learning process, ensuring consistent engagement and development.

Purpose and Advantages of the Intelligent Collaborative Assessment Framework

- *Objective*: ICAF's primary objective is to address the limitations found in conventional e-learning assessment methods. It aims to streamline and elevate the assessment process, integrating AI to foster both collaborative and personalised learning experiences.
- *Benefits*: Employing an AI-driven methodology, ICAF enhances the efficiency and student-centricity of assessments. It stimulates active participation and tailors educational experiences to individual student needs.

Impact of AI on the Intelligent Collaborative Assessment Framework

- *Personalised feedback*: AI's application within ICAF allows for the provision of customised feedback, adapting to the unique learning styles and requirements of each student.
- *Supporting collaborative learning*: AI algorithms are utilised within the framework to analyse group dynamics, significantly contributing to effective peer learning and collaborative engagement.

This case study elucidates the transformative capability of AI integration in modernising traditional assessment methods, rendering them more adaptive, engaging, and suitable for current e-learning scenarios. With its emphasis on personalisation and collaboration, ICAF establishes a new standard in the application of AI in educational technologies.

Generative AI and its Impact on Assessment

In the dynamically advancing domain of e-learning, the advent of Gen-AI (generative AI) has been recognised as a pivotal development. Scholarly research, like that of Liao, Lu, Fei, Gu, and Huang (2024)including inefficient design processes, limited data reuse, and the underutilization of previous design experience. Generative artificial intelligence (AI has been instrumental in delineating the capabilities of Gen-AI in the sphere of structural design, especially in its application to generating innovative concepts by analysing complex structural drawings and amalgamating various knowledge sources. Concurrently, Chiu (2023) has undertaken an in-depth analysis of the ramifications of Gen-AI tools like ChatGPT (Chat Generative Pre-Trained Transformer) on conventional educational paradigms, elucidating both the potentialities and challenges inherent in their deployment.

In the current academic conversation, which is mostly about making policies and finding good ways to grade students, there is a big gap in research about how HE will change in the future when AI is involved. To bridge this gap, a qualitative investigation has been conducted, focusing on student perceptions regarding the influence of Gen-AI within the HE sector. This study, predicated on a systematic literature review for the development of a conceptual framework, engages in a thematic analysis of inputs by 51 students. This analysis has unearthed three principal themes alongside 10 subthemes that comprehensively encapsulate the dualistic nature of opportunities and challenges presented by AI in the educational sphere. The findings of this study advocate for a transformative shift in HE, gearing it towards equipping students for a workforce increasingly reliant on Gen-AI.

In a related vein, the research conducted by Miyazaki, Murayama, Uchiba, An, and Kwak (2024) focuses on ChatGPT, a renowned component of the GPT (generative pre-trained transformer) series, acclaimed for its sophisticated intelligence and conversational proficiency. Their study, which encompasses an analysis of three million Twitter posts from January 2019 to March 2023, underscores a burgeoning interest in Gen-AI across a diverse array of professional fields, extending beyond the confines of information technology. Notably, the general sentiment towards AI has been observed to be positively inclined, correlating directly with the degree of AI exposure, although concerns have been raised by illustrators regarding the unethical application of AI in creative domains.

Furthering this discourse, Baidoo-Anu and Owusu Ansah (2023) have identified ChatGPT as a prominent Gen-AI instrument within the educational arena, acclaimed for facilitating personalised learning experiences, generating stimuli for formative assessments, and providing continuous pedagogical feedback. However, they also delineate certain limitations of ChatGPT, including the potential for disseminating erroneous information, inherent biases in data training, and privacy issues. They posit that a concerted effort involving policymakers, researchers, educators, and technology specialists is imperative to navigate the safe and constructive utilisation of Gen-AI instruments like ChatGPT in educational contexts. Additionally, their reference to a survey on unsupervised generative models for data analysis and representation learning further enriches the discourse on this emergent technology.

Expanding upon the established corpus of research that delineates both the possibilities and limitations inherent in the application of Gen-AI within educational and evaluative frameworks, our study endeavours to deepen this comprehension through empirical investigation. To achieve this objective, a thorough survey has been executed, purposed to collate a wide array of viewpoints regarding the influence of Gen-AI on assessment methodologies. This survey extensively explores the varied applications, advantages, and potential pitfalls associated with the use of Gen-AI across different domains.

Analysis of 'Generative AI in Assessment' Survey

Within the sphere of educational technology research, the 'Gen-AI in assessment' inquiry was rigorously structured to capture a broad spectrum of viewpoints on the influence of Gen-AI on modern assessment techniques. This extensive study traversed various professional sectors, thoroughly examining aspects such as demographic profiles, the degree of awareness and understanding of Gen-AI, its practical applications in assessment processes, and the perceived advantages and challenges linked to its deployment.

Demographic Analysis

The demographic composition of the study's participants was notably varied, covering a wide range of ages, gender identities, and professional fields, including education, technology, business, and healthcare. This heterogeneous mix provided a solid analytical base, with diverse experiences in AI technology adding depth to the research findings.

Awareness and Interpretation

The research revealed a range of levels in terms of awareness and comprehension of Gen-AI among the study's participants. Varied sources, including academic publications, digital courses, and diverse media platforms, contributed to shaping the participants' perceptions and attitudes regarding the integration of AI in assessment contexts.

Implementation in Current Assessments

The gathered data pointed to an emerging yet non-uniform incorporation of Gen-AI within current assessment methodologies, with its usage visible in forms like multiple-choice examinations, essay compositions, performance-related tasks, and peer assessments. This trend suggests a progressive, intermittent assimilation of AI technologies into assessment protocols.

Perceived Advantages

There was a consensus among participants on the potential of Gen-AI to significantly augment the precision, efficiency, and impartiality of assessment procedures.

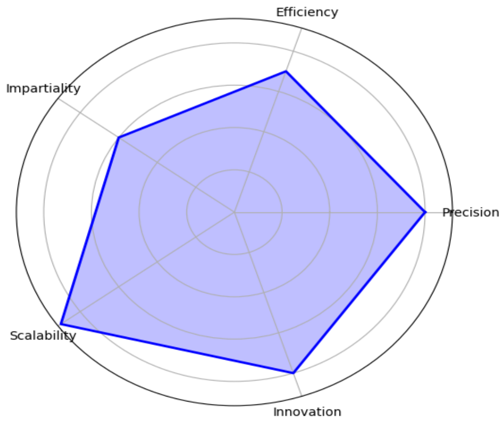

Figure 6.1: Perceived advantages of generative AI in assessments (Personal archive)

The chart, as depicted in Figure 6.1, includes five key aspects: Precision, efficiency, impartiality, scalability, and innovation. Each aspect is rated on a scale of one to 10. These characteristics underscore AI's transformative capacity to transition towards more dependable and equitable assessment methodologies.

Ethical and Operational Challenges

The study underscored significant ethical dilemmas, alongside concerns about the accuracy and dependability of AI and the possible hazards of its misuse or excessive dependence. These findings highlight the critical need for ethical foresight and operational prudence in AI's application within educational frameworks.

Future Orientation and Attitudinal Trends

Participant responses regarding future applications and the assimilation of AI in assessment practices were largely positive, reflecting a general optimism about the progressive role of AI in reshaping assessment techniques. Nevertheless, apprehensions about its impact on established assessment methods were observed, indicating the necessity for a judicious and balanced approach to AI adoption.

Additional Insights and Future Research Directions

The participants offered significant additional insights and put forward suggestions for future research and practical implementation. These inputs are crucial in guiding forthcoming policy development and in fostering the creation of more efficient and innovative assessment methodologies in the context of Gen-AI.

Challenges and Ethical Considerations in AI Assessments

Investigations into Gen-AI within the field of educational assessments shed light on a scenario characterised by both promising innovations and the need for meticulous deliberation. The blend of affirmative attitudes toward future AI integration, coupled with a recognition of the challenges, suggests that while the potential of Gen-AI is recognised, its application in education warrants a careful, ethically grounded approach. This study plays a pivotal role in informing subsequent research directions and policymaking in the rapidly evolving domain of AI-enhanced educational assessments.

Challenges in AI Assessments

The integration of AI into the assessment process represents a noteworthy departure from traditional methodologies, ushering in a more efficient, objective, and personalised approach to measuring students' knowledge and skills.

AI has firmly established itself as a central element within educational environments, ushering in a transformation in the dynamics of teaching and learning. This section delivers an extensive overview of AI's deployment in educational contexts, unveiling specific instances that illustrate its potential for a profound change in the assessment process. Table 6.1 serves as a succinct guide to the myriad applications of AI in education, delineating the purpose of each application alongside its corresponding use case, thereby spotlighting AI's capacity to revolutionise teaching and learning across a spectrum of scenarios.

Table 6.1: AI applications in assessment

Application of AI in Education	Description	Use Case
Personalised Assessment	AI-driven platforms adapt content, pace, and difficulty based on individual student needs and preferences.	Students receive customised assessment experiences, enhancing engagement and knowledge retention.
Automated Grading	AI-powered systems automatically assess and grade assignments, quizzes, and exams using ML.	Educators save time on manual grading, and students benefit from quicker feedback, promoting timely improvements in their work.
Intelligent Assessment Systems	AI algorithms create and administer assessments that adapt to each student's proficiency level.	Assessments become more precise and fair, providing tailored challenges to each student, and promoting deeper learning.
Language Learning Support	AI applications assist language students with pronunciation, grammar, and vocabulary through interactive exercises.	Language students receive immediate feedback and targeted practice, accelerating their language acquisition.

Application of AI in Education	Description	Use Case
Predictive Analytics for Student Success	AI-driven predictive analytics analyse student data to identify those at risk of falling behind and suggest interventions.	Educational institutions can proactively support struggling students, increasing overall student success rates.
Educational Chatbots	Chatbots with AI and natural language processing capabilities provide students with instant answers to queries and guidance on academic matters.	Students receive immediate support outside regular office hours, fostering a responsive and supportive learning environment.
Virtual Labs and Simulations	AI-driven virtual labs and simulations create interactive, hands-on learning experiences for science and engineering subjects.	Students gain practical experience in a safe virtual environment, enhancing their understanding of complex concepts.
Assessment Content Recommendation	AI algorithms recommend additional assessment resources based on a student's current assessment progress and interests.	Students discover supplementary materials that check their understanding and cater to their evolving interests.
Adaptive Textbooks	AI-powered adaptive textbooks provide tailored content and practice exercises based on individual learning patterns.	Students receive targeted support and practice materials that align with their strengths and weaknesses.
Proctoring and Anti-Plagiarism Tools	AI tools monitor online exams, ensuring academic integrity by detecting plagiarism and unauthorised assistance.	Educators can conduct secure online assessments, maintaining the credibility of the assessment process.

As e-learning environments continue to transform, the role of AI in assessment is poised for increased prominence, contributing significantly to the development of intelligent and adaptable learning experiences. Table 6.2 serves as an illuminating resource, shedding light on AI's transformative potential in the assessment landscape. It succinctly outlines the critical facets of AI in assessment and assessment within e-learning environments, emphasising the advantages and benefits inherent in AI-driven assessment tools and personalised assessment methodologies.

Table 6.2: Transforming assessment and feedback with AI advancements

Aspect	**AI in Assessment and Assessment**
Automated Grading and Feedback Generation	Efficiency and timeliness in grading and feedback provision. Consistency and objectivity in assessment outcomes. Scalability for handling large volumes of assessments. Generation of specific feedback and improvement recommendations.
Personalised Assessment	Adaptive assessments tailored to individual proficiency levels. Individualised assessment pathways based on strengths and weaknesses. Support for both formative and summative assessment approaches. Continuous assessment for ongoing feedback and growth opportunities.

Ethical Implications

There are specific ethical issues with the use of AI tools in student assessments. The two most important ones are justice and bias. Biases in training data may be reflected in students' assessments. Ongoing efforts should be made to detect and lessen these prejudices in order to guarantee justice. Understanding the foundation for assessment depends on the AI's decision-making mechanisms being transparent. As assessment personalisation relies mainly on student data, ethical considerations related to privacy and security become important and crucial. Indeed, we need to ensure and guarantee that the personalised assessment process is conducted in a responsible and transparent way.

Ethical Issues in the Use of Student Data

The utilisation of student data in personalised assessment necessitates a careful balance between enhancing educational processes and protecting privacy. The ethical dimension of this balance demands rigorous attention. To this end, this discourse advocates for the strict enforcement of data protection measures, emphasising the critical importance of maintaining student confidentiality and building trust within educational paradigms. The safeguarding of sensitive student data is not merely a regulatory requirement but a fundamental aspect of ethical educational practice.

Ensuring Responsibility and Transparency

The ethical integrity of personalised assessment processes hinges on their accountability and transparency. This chapter underscores the need for establishing clear, robust norms and standards to govern the use of AI and data analytics in educational contexts. These standards are designed to ensure that the personalisation of learning and assessment adheres to ethical principles, encompassing fairness and impartiality. The goal is to create a framework where personalised assessments are not only effective but also ethically sound and respectful of student privacy and rights.

Frameworks for Ethical Data Governance

Addressing these ethical concerns requires more than *ad hoc* measures; it calls for the development of well-structured data governance frameworks. Such frameworks should encompass recommendations for regular audits, ensuring transparency in algorithmic decision-making, and facilitating the involvement of a broad range of stakeholders in oversight roles. The objective of these frameworks is to establish a system where ethical considerations are ingrained in every aspect of personalised assessment, from data collection to the application of AI-driven insights.

In addition, Remian (2019) offers a thorough examination of the ethical factors associated with the integration of AI in education and explores a range of obstacles and moral considerations, such as privacy, security, prejudice, impartiality and equality, verification of knowledge, openness, manipulation of people, preservation of cultural values, human control, ownership of ideas, and reliance on technology. These factors are of utmost importance when integrating AI into educational environments to guarantee ethical and efficient support for both students and educators.

Future of AI in Educational Assessment

The educational landscape is currently undergoing a significant transformation, driven by the integration of AI. This shift heralds the transition towards educational experiences that are increasingly personalised, ethically grounded, immersive, and collaborative. In these realms, AI is fundamentally reconfiguring the way in which education is perceived, delivered, and experienced. Furthermore, the emphasis on lifelong learning accentuates AI's pivotal role in fostering environments conducive to sustained education and skill development, a critical aspect in the context of a rapidly evolving global milieu.

Considering assessment can automate the assessment data collection and analysis process, giving educators more time to concentrate on instruction and intervention. AI is also capable of personalising diagnostic and formative assessment by offering personalised, real-time feedback tailored to each student's particular learning requirements. Concerning summative assessment, with AI this type of assessment becomes more reliable. AI can be used, for example, to mark essays, eliminating the subjectivity and inconsistent nature of human grading.

Within this transformative landscape, Gen-AI emerges as a key agent of change, redefining educational experiences to meet the demands of a digitally focused society. This development surpasses mere technological progression, indicating a profound shift in educational philosophies and methodologies. Consequently, the future of education is contingent upon the integration of Gen-AI's technological prowess with the core pedagogical objectives of the educational sector. This integration ensures that these advanced systems are ethically robust, universally accessible, and in alignment with the requisites of a digital era.

As Gen-AI continues to advance and become more ingrained in educational infrastructures, it is imperative for stakeholders to critically engage with these technologies. This engagement involves not only comprehending the capabilities and prospects of Gen-AI but also addressing the ethical nuances and ensuring equitable access across the board. Such engagement is fundamental in the development of educational practices and assessment methods that are not only effective and inclusive but also adaptable and forward-thinking. These practices and methods are designed to cater for the dynamic requirements of students in a global landscape characterised by rapid change and technological evolution.

Conclusion

After analysing the role of AI in assessments within AI-enhanced learning environments, it is clear that integrating AI into educational assessment mechanisms brings about a major shift in the educational framework. AI has the potential to greatly improve the accuracy, customisation, and efficiency of assessments, leading to a more adaptable, inclusive, and effective era in education.

The shift towards learner-centred educational models, highlighted by the growing prevalence of open and collaborative learning platforms, has necessitated a thorough reassessment of conventional assessment methods. Utilising AI tools, the incorporation of student self-assessment, peer-assessment, project-oriented learning assessments, and assessments of informal learning experiences serve to address the diverse skill sets needed in the modern era. Additionally, this approach fosters a more comprehensive and continuous learning process.

It is anticipated that the utilisation of AI in the realm of educational assessment will experience substantial growth in the coming years. However, AI assimilation and processing of educational data pose major dangers to the privacy and integrity of such sensitive information, making student data privacy a critical problem. An effective resolution of ethical concerns requires collaboration among professionals from diverse fields such as technology, education, ethics, and policymaking. Our objective is to develop and apply ethical norms and standards for instructional AI. This collaborative and multifaceted strategy ensures that AI technologies are used responsibly and effectively to improve educational outcomes while keeping to the highest ethical standards.

The integration of AI into educational assessment is currently in its early stages. As advancements in these technologies continue, we are at the forefront of an educational revolution that promises to provide tailored, captivating, and effective learning experiences for a wide range of students.

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Section 3

Wholistic Transformations in Higher Education: Bridging AI and Contemplative Approaches

Chapter 7

Dimensional Approach for a Digital Transformation Process in Higher Education

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Introduction

Technology has evolved over the last few decades and the development of new technologies are growing at an alarming rate. Digital transformation activities are prominent (critical) to ensure that all business sectors incorporate and integrate new technologies to ensure viable business modules. Our business sector with digital transformation, which includes AI (Artificial Intelligence) adoption, is vital and ready to be integrated with the educational sector. This integration is not optional but vital for the survival and thriving of IHEs (institutions of higher education).

The research focus of this chapter is on HE (higher education) sectors, and more specifically universities. This research proposes a multi-dimensional approach to enhance the digital maturity of a university to be at the forefront of technology development and integration. The research utilises a systemic literature review to identify critical contributions to digital transformation (dimensions) within the HE sector.

The integration of digital elements into HE impacts all role-players within IHEs, from the student and educator to the ICT (information and communication technology) department and management. AI integration should be a wholistic approach with the buy-in from all custodians (role players) to ensure all aspects are aligned to the vision and mission of the institution.

The research has identified three dimensions that have a direct impact on a university's digital transformation maturity namely custodians, processes, and AI drivers. In a technology impacted educational environment, technology has become a driver to reshape HE around the world. Educational spaces are being transformed and morphed into a hybrid collaboration between humans and technology. This transformation speaks to the changes from traditional educational pedagogies to technology based educational pedagogies (Okagbue, Ezeachikulo, Akintunde, Tsakuwa, Ilokanulo, Obiasoanya, Ilodibe, & Ouattara 2023). There is a global drive towards the 4IR (fourth industrial revolution) and 21st-century learning skills. With global digital drivers, quality education needs to adopt new technologies brought in by digital transformation (Shenkoya & Kim 2023).

The goal of this chapter is to create a narrative of existing and published concepts and frameworks, and the underpinning that contributes to understanding the digital transformation as well as AI within IHEs. The first part of the research consists of a systemic literature review of published information on digital transformation and AI in HE that concludes with key factors and drivers from both the digital transformation and AI spheres. The second part of this research utilises the factors and drivers to propose a step-oriented approach to AI integration that can assist IHEs to increase their digital transformation maturity levels.

One of the most recent impact drivers is AI and it has the potential to transform HE through digital transformation (Spada, Chiarello, Barandoni, Ruggi, Martini, & Fantoni 2022; Mukul & Büyüközkan 2023; Pereira, Falcão, Costa, Lunn, Pêgo, & Costa 2023). Digital transformation through AI should be integrated into all levels of education focusing on strategic and institutional pedagogies, platforms, and implementation strategies. Digital transformation can be described as the integration of digital technology (in this research, AI) into an educational space (HE) that will change the operational drivers to add value, quality, and support to students. AI integration impacts not only the activity driven aspects, for example teaching and learning, but extents into management aspects, for example policies, to behaviour aspects including plagiarism and academic writing. AI can be regarded as both a disruptor and an enabler. Both viewpoints (disruptor and enabler) should be taken into account when IHEs plan, design, implement, and monitor transformation activities that link to AI. The combination of both will provide a stage approach to ensure that AI integration is managed to the desired outcome of an IHE. This research will investigate which drivers (both disruptors and enablers) must be in place to address AI within a digital transformation process in HE. The focus of the research is on a multi-dimensional approach that will include 1) AI drivers; 2) custodians; and 3) process phases to ensure the integration of AI into the HE space.

Digital Transformation in Education

Digital transformation is based on technology (usually new technology) and the blending of technology with people towards a specific outcome (Zarifis & Efthymiou 2022). According to Alenezi (2021:1 of 13), digital integration speaks to the 'evolutionary process' that impacts and involves both people and organisations. Alenezi (2021:10 of 13) adds that digital transformation in HE speaks to adapting and updating current methods and practices to address the HE mission.

According to Zarifis and Ethymiou (2022:1868), focusing on AI and digital transformation is key when universities create and implement their own plan of action (a 'roadmap'). Fernández, Gómez, Binjaku, and Meçe (2023:12351) state that IHEs are adopting new digital models to become digital universities. Digital transformation (especially focusing on AI integration) is no longer a luxury within the HE space, but rather a necessity to ensure continuation that includes income, student participation, and service delivery. AI is transforming education landscapes and impacts teaching and learning through digital transformation and competences focusing on 21st-century learning skills (Kuka, Hörmann, & Sabitzer 2022). Kuka *et al.* (2022:551) are referring to a few emerging subject areas in AI transformation that are impacting HE. These emerging areas include VR (virtual reality), AR (augmented reality), virtual laboratories, and AI for student assessment. It is critical to note that AI can be regarded as the underpinning factor of digital transformation. AI driven technology is mainly linked to digital development due to the large data volumes created by digital transformation which acts as the contributing factor to AI being a critical aspect to take note of (Aldoseri, Al-Khalifa, & Hamouda 2024).

Integrating AI into education is a global challenge in terms of educational elements to meet instructional and learning needs of students (Xu & Ouyang 2022). This is supported by Zawacki-Richter, Victoria, Bond, and Gouverneur (2019:1) who identify AI in education as an emerging field in educational technology in HE. The combination of new and existing technologies within digital transformation is critical. Incorporating old technologies with new technologies (for example, AI) is vital to the digital transformation process (Zarifis & Efthymiou 2022).

HE spaces, specifically university spaces, have a different path to digital transformation than industries. Universities have a different relationship with their students than industries have with customers (Zarifis & Efthymiou 2022). One of the most important tasks of universities is to ensure student-centred learning (Yuliana 2022). Part of student-centred learning includes teaching methods, student service delivery, and technology stable environments created through digital transformation. A pedagogical change in digital transformation is occurring due to the morphing of a pedagogical shift from educator-led teaching and learning towards student-centred methods (Øvrelid, Bygstad, Ludvigsen, & Dæhlen 2023). This shift towards incorporating technology in teaching and learning has a direct impact on any university’s infrastructure, culture, and digital competencies (Pinheiro, Tømte, Barman, Degn, & Geschwind 2023). The impact of digital transformation is not only focused on teaching and learning but ripples through the management, ICT, and service providing infrastructure of any IHE. One aspect that is critical within the HE space is knowledge generation that contributions to a wide range of bodies of knowledge. IHEs should always strive to protect the integrity, validity, availability, and accuracy of these new aspects, for example plagiarism. Using AI software incorrectly can become a knowledge risk and can harm the reputation of any educational institution.

All universities must have a real and clear vision of how to digitally transform a university (Fernández et al. 2023), especially focusing on AI integration. This transformation must align with student needs in the given HE space. The alignment of the digital transformation vision is the responsibility of leaders within the university. Ultimately the university must strive for digital maturity (Fernández et al. 2023). For digital maturity, leadership is a key aspect of the success of digital transformation (Schatsky & Gurumurthy 2019). The leaders of digital transformation in universities may differ from those in industries, just like these leaders may vary from academics (university faculty) to business consultants and technology experts with the same vision and driving force for the university (Zarifis & Efthymiou 2022).

A critical aspect to note is that digital transformation does not only include a top-down (management) approach but also a bottom-up approach, both of which are equally important (Øvrelid et al. 2023). A bottom-up approach addresses all role-players and different levels within the university – examples include ICT personnel, academic, and support staff. It is therefore critical to obtain buy-in from all role-players within an IHE. Digital transformation is not only about digitising education platforms (Díaz-García, Montero-Navarro, Rodríguez-Sánchez, & Gallego-Losada 2022) but should include all stakeholders, management structures, and policies that lead to an organisational and cultural change. Digital transformation is based on three categories: Technology, process, and people (Zarifis & Efthymiou 2022; Lakshmi, Kumar, Kumar, Patel, Lokesh Naik, & Ramesh 2023). Gkrimpizi, Peristeras, and Magnisalis (2023:15) expand on these three categories and include environmental, strategic, organisational, technological, people-related, and cultural aspects.

In the past, digitalisation (including AI) originated from computer science and engineering but now covers a multiple of disciplines including philosophy, cognitive science, neuroscience, economy, and more (Zawacki-Richter et al. 2019). One pedagogical environment where digital landscapes have a significant and disruptive impact is the education landscape. Digital transformation within education links directly to the foundational aspects of how educational methods are designed and implemented for students. According to Bisri and Putri (2023:169), reasons for implementing digital transformation include accessibility by society, increased business profit and customer satisfaction, a growing organisation performance, productive efficiency and quality of education, and improving the student experience.

It is therefore important that within any educational environment, digital transformation must be regarded as a multiple disciplinary and dimensional activity that includes all aspects of HE. The transformation to a digital AI space is critical to be competitive with other IHEs across the globe. The next two sections (3 and 4) will provide a brief overview of digital transformation and the critical focus of AI within digital transformation.

Educational Based Digital Transformation Frameworks

This section investigates factors and indicators that address digital transformation within the educational environment. Table 7.1 depicts factors relating to digital transformation in education within three published frameworks that include the Microsoft Education Transformation Framework for HE (Microsoft 2024), Google, KPMG (Klynveld, Peat, Marwick, and Goerdeler) framework (KPMG 2020). and the Deloitte viewpoint to digital maturity. The terms in BOLD in Table 7.1 depicts the main categories within the motioned documents and the rest, subcategories relating to digital transformation.

Table 7.1: Industry oriented frameworks for digital transformation

Microsoft	Google	KPMG	Deloitte
Leadership	Vision	Critical capabilities	Flexible, secure infrastructure
Vision	Learning	Insight driven	Cloud infrastructure
Inclusion	Culture	Innovative products	Agile DevOps (development operations)
Accessibility	Funding and sustainability	Innovative services	Technology platforms
Partnership	Professional development	Experience centricity by design	Security (cyber)
Capacity building	Technology	–	Data mastery
Strategic Planning	Community	Integrated partners	Data analytics
Immersive experience	–	Responsive supply chain	Digitally savvy, open talent networks
Teaching & Learning	–	Responsive operations	Training/Digital competencies
Educator development	–	Seamless interactions	Talent identifying
Personalised learning	–	Aligned workforce	Ecosystem engagement
Wellbeing	–	Technology blueprint	External partners
Quality assurance	–	Actors	Intelligent workflow
Curriculum	–	Access	Recalibrating process (human/ technical)
Assessment	–	Interaction hubs	Unified customer experience
Technology Blueprint	–	Organisational capabilities	Business model adaptability
Operation management	–	Process	New models to meet needs

Microsoft	Google	KPMG	Deloitte
IT (information technology) management	–	Changed advances	–
Collaborative learning	–	Cyber security and privacy	–
Data driven	–	IoT (internet of things)	–
Devices for learners	–	Enterprise data store	–
Intelligent environment	–	Middle and front business practices	–
Purpose driven access	–	Data analytics	–
Sustainability design	–	Digital technologies and process advances	–
Facilities management	–	Enterprise support	–
–	–	Enterprise technology	–
–	–	Enterprise	–
–	–	Customers	–
–	–	Communication	–
–	–	Strategy	–
–	–	Core business practices	–
–	–	Advanced data and analytics	–
–	–	Enabling business practices	–

According to Quy, Thanh, Chehri, Linh, and Tuan (2023:5), the main focus of digital transformation in organisations is to improve research, to increase competitiveness and scalability, to improve service experience, to increase productivity, and to increase revenue. According to Díaz-Garcia, Montero-Navarro, Rodríguez-Sánchez, and Gallego-Losada (2023:2), factors impacting digital transformation include the learning process, internal communication, culture, data driven decision making, leadership, and people management.

Artificial Intelligence

AI has had an impact on many sectors across the globe, for example smart machines, industrial automation, agriculture, healthcare, transportation, ecosystems, warfare, business, and education (Hossain 2023). A wide range of digital tools and technologies have been developed according to the needs of students within the educational system (Alenezi 2021). According to Shenkoya and Kim (2023:11), digital transformation should enhance the concepts of E4.0 (Education 4.0). E4.0 is directly linked to the 4IR which is highly impacted by digital transformation (Quy et al. 2023). One subset of digital transformation that has a huge impact on education is AI (Quy et al. 2023; Shenkoya & Kim 2023). AI has been impacting on the education field and is changing the nature of educational instruction (Zhang & Aslan 2021; Zhang, Schießl, Plößl, Hofmann, & Gläser-Zikuda 2023). With the rapid development of AI tools and processes, AI is affecting not only how we teach but the whole educational process at large. According to Dokthaisong and Pinyonatthagarn (2021:11004), it is critical to address human capital development when dealing with AI.

The integration of AI with IHEs should be on both technical and human-related platforms. Most of the AI impact underpins and impacts almost all factors of digital transformation. It is therefore vital that when an IHE adopts a vision of digital transformation, the impact of AI must be understood. There are also a wide range of challenges with AI and digital transformation in education. According to Zhang and Aslan (2021:7 of 11), some challenges include cost, scalability, ethics, privacy, a lack of AI expertise, a lack of AI guidelines of a legal basis, changing thinking and management capacity, IT, infrastructure, skills, and access of the capability of IT (Quy et al. 2023).

The growing impact of AI is a catalyst for worsening digital poverty, outpacing national regulatory adaptation, the use of content without consent, and unexplainable models used to generate outputs (UNESCO 2023). UNESCO (United Nations

Educational, Scientific, and Cultural Organisation) continues and states that AI generated content is polluting the internet that leads to a lack of understanding of the real world as well as reducing the diversity of opinion, generating deeper deepfakes. AI adoption is no longer a 'futurist idea' but rather an inevitable reality with far-fetched implications for all technology users. A critical aspect to take note of is that AI is every changing, adapting, and re-transforming element to be in a continued state of flux. The technological growth of the 4IR has made inroads into IHEs, forcing them to deal with the digital transformation in all of its dimensions (Alenezi 2023). The 5IR (fifth industrial revolution) encompasses the notion of harmonious human-machine collaborations, with a specific focus on the wellbeing of the multiple stakeholders (Nobel et al. 2022). The goal of the 5IR is to address the inconsistencies discerned in the foregoing 4IR.

The 5IR has brought in an era of technological advancements, transforming various sectors tremendously, including education, and has brought with it a transformative shift to education in general with an emphasis on digitalisation, AI, automation, and the IoT. The 5IR is characterised by a synergistic integration of humans and technology (Moola et al. 2024). There is a renewed focus on the role of humans in an era of rapid technological innovation.

Curriculum 5.0 is a state-of-the-art curriculum that matches the demand of future jobs and the 5IR environment. Barrot (2023) explains the context of curriculum 5.0 and why there is a need to adopt such a curriculum innovation, as well as comprehensively discusses the principles and key features of curriculum 5.0. The 5IR can make our students ready for the future and is an opportunity to make HE more relevant.

The COVID-19 (Coronavirus disease of 2019) pandemic has had a significant impact on IHEs worldwide, accelerating the use of digital tools in education (Rampersad, Maynard do Lago, & Fernandes 2024). In fact, it is being said that COVID-19 has been observed as 5IR, which has naturally advanced education five/10 years ahead of digitalisation (Makumane, Khoza, & Zuma 2022). The article is situated in the 4IR to adopt the policies and procedures to guide IHEs in the present – this can be the short-term plan of action with a focus on the 5IR as a long-term plan for positioning IHEs to be relevant and value adding in the future.

Research Method

This research follows a quantitative approach by means of a systematic literature review based on the PRISMA (preferred reporting items for systematic reviews and meta-analyses). The PRISMA approach assists research to analyse published research (Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow, Shamseer, Tetzlaff, Akl, Brennan, Chou, Glanville, Grimshaw, Hróbjartsson, Lalu, Li, Loder, Mayo-Wilson, McDonald?, McGuinness, Stewart, Thomas Tricco, Welch, Whiting, & Moher 2021).

The research focused on 2022 and 2023 and used the ScienceDirect Database with a focus on research (review) articles in journals within the ScienceDirect Database. The literature search included the following keywords: ('higher education') AND (AI OR 'artificial intelligence' OR 'machine learning') AND ('digital transformation') AND/OR ('driver' OR 'factor' OR 'indicator'). The preliminary result indicated 189 relevant articles. From the 189 articles, 50 were identified to be included in the analysis that focuses on either digital transformation or AI within HE. The article focused on a systematic approach but with the aim to understand the articles used to identify needed concepts in the topic area. After the articles were selected, the research used Atlas.ti (a qualitative analysing software tool) to analyse the published articles. Atlas.ti was used within this research study to analyse the 50 articles obtained by the PRISMA approach. Figure 7.1 depicts keywords from the articles.

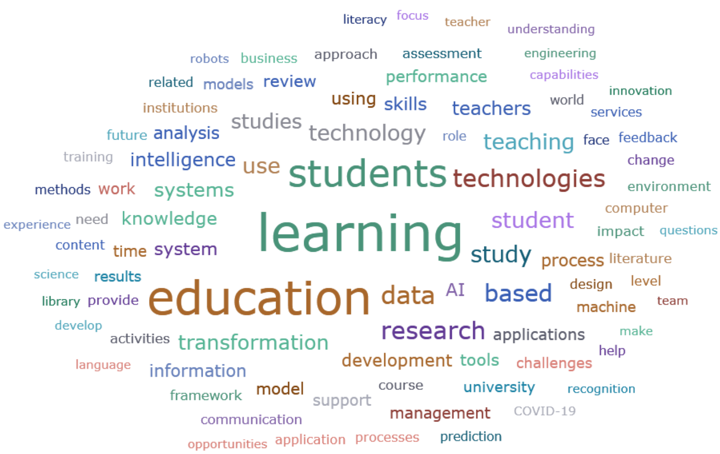

Figure 7.1: Keywords from literature review (Personal archive)

From the literature review, several AI drivers were identified as having a growing and critical impact on academic spaces. These include AI writing detection, formative course support, student risk analysis, virtual learning, personalised learning environment, integrated AI support, AR, real time feedback, data analysis, gamification, curriculum design, and automation. These examples of AI drivers are only a short list and can be extended (cf. Table 7.2). This research proposes a multidimensional framework where these AI drivers are linked to custodians and implementation processes to ensure a growing AI maturity over time.

Proposed Framework

The proposed framework combines a wide range of the digital transformation and AI factors and indicators that are needed to be integrated within an IHE. The framework proposes a multidimensional approach to incorporate AI into the existing learning environment.

The first dimension of the proposed framework includes the process phases which are 1) commit, 2) strategise, 3) test (and develop), 4) implement, and 5) evaluate. The second dimension reflects on the role players/custodians of the AI integration. The custodians for this approach were derived from the literature review and include 1) leadership, 2) AI management, 3) technology department, 4) academics, and 5) students. The third dimension is the set of AI drivers that are required to ensure the AI maturity of a university. Note that students were added as part of the custodians of AI as students have a large role to play within the AI maturity of a university. Note the input of the students will differ from the other custodians.

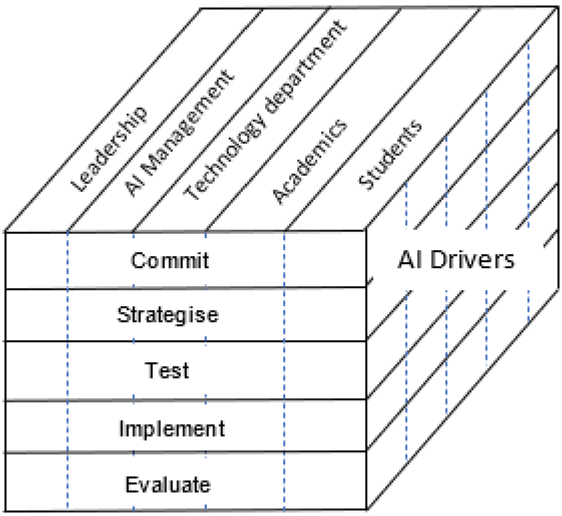

Figure 7.2: Proposed framework (Personal archive)

It is critical to note that the planning of the AI space within an educational area must have short-term goals (those that have to be implemented within a year or two) and long-term sustainable goals that will allow the educational space to grow with new technologies and developments in the future. This is where the adoption from the 4IR to the 5IR will be incorporated and implemented. Both approaches of short-term and long-term planning are to ensure a rigorous design, implementation, testing, and measuring phases including all relevant role-players (and custodians) within the IHE. One of the factors that will determine the success of the integration of AI into IHEs is the buy-in and commitments from the different custodians. Only if all the custodians support this approach will the AI integration be success within the environment. However, this is important to note that one of the most difficult aspects of reinventing HE spaces is the human factor.

The systemic literature review identified the tasks (AI drivers) that are critical to be addressed by different custodians. AI drivers can be linked to a custodian as a point of reference. However, this research identified several AI drivers (not an exhaustive list) that are directly linked to all custodians as depicted in Table 7.2.

Table 7.2 provides the AI drivers that are linked to the custodians of AI integration within a university. Most (if not all) of the AI drivers will expand over all the process phase dimensions (which include the process phases 'commit,' 'strategise,' 'test,' 'implement,' and 'evaluate'). For each of these phases, the custodians should create and implement short-term and long-term plans to ensure that the university grows in AI maturity over time. Focusing on both a bottom-up and top-down approach (between different custodians) is critical to ensure that everyone within the university has a mindset of digital transformation.

A critical aspect of integrating AI (or any digital transformation approach) is transparency to all the relevant stakeholders. The IHE must have the needed digital transformation policies and procedures approved and available. This will ensure that students understand the 'rules and regulations' of what is acceptable during their studies and what will be a violation of the policies. The research proposes that all IHEs provide an MOOC (massive open online course) that is compulsory for all students to complete. Such a MOOC will explain the university's digital transformation policy and process as well as guide the student to what is acceptable in their studies and what activities are against the policies.

A similar proposal for an internal course for all faculty members is equally important to ensure that they (the role-players) understand the vision of the university and their

Table 7.2: Task for each layer in proposed framework

Leadership	Management	ICT	Academics	Students
Vision	Governance	Data analysis	Student support	Awareness
Alignment 4IR	Digital strategy for policies	Measurement instruments	Curriculum development	Compliance
Sustainability	AI readiness	New advances	Assessment	Participation
Community enrichment	Integrated teaching and learning plan	Transparency	Grading	–
Culture creation	Global/social change	Accountability (audit process)	Personal learning spaces	–
21^{st}–century learning skills	External collaboration	Support process	Gamification	–
E4.0	Resources	Monitoring	Feedback	–
Long-term planning	Equity and inclusiveness	Professional development	Tutoring	–
–	National/ International standards	Security/privacy/ accessibility	–	–
–	Implementation planning	Academic student support	–	–
Ethics policies	Ethics policies	Ethics processes	Ethics teaching	Ethics participation
Wellbeing opportunity	Wellbeing opportunity	Wellbeing environment	Wellbeing participation	Wellbeing participation

Leadership	**Management**	**ICT**	**Academics**	**Students**
Culture building	Culture building	Culture infrastructure	Culture participation	Culture participation
Student-centredness	Student-centredness	Student-centredness	Student-centredness	-
QA (quality assurance)	QA	QA	QA	-

role and responsibility to assist the university in this digital transformation process.

Contribution

The contribution (in the form of a literature matrix and proposed framework) of this chapter is to propose a possible AI transformational process for IHEs. Atlas.ti was used as a qualitative data analysis method to obtain the coding structure, relationship links, and the network diagram to provide a clearer understanding of the interlinking of the AI transformational indicators. The hierarchy between the dimensions, custodians of AI, and AI drivers is mapped. This proposed mapping of the different dimensions will provide HE with a roadmap that can be used as a guide to incorporate AI correctly, ethically, and institutionally into their academic curricula and qualifications. The proposed contribution of the research will be in the form of a guideline that can be used by IHEs to assist with digital transformation, including AI. The research provides a starting point to assess the maturity of digital transformation that is directly linked to the digital student-centred culture of the university.

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Chapter 8

When Artificial Intelligence Meets Contemplative Studies: Toward a Wholistic Human Augmentation for Collective Wellbeing

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Introduction

In the late 2010s, HE (higher education) leaders, practitioners, and researchers began to discuss how AI (artificial intelligence), as part and parcel of the 4IR (fourth industrial revolution), might transform IHEs (institutions of higher education) (Aoun 2017; Gleason 2018; Peters & Jandrić 2019). As they enthusiastically embraced the 4IR, however, their discussions tended to focus on how IHEs should actively adapt to the AI-driven economy without critically reflecting on how IHEs might intervene and reshape the trajectory of the 4IR itself. In this regard, their mode of thinking was rather reactive (Saito 2022).

Although this reactive mode of thinking remains dominant, critical reflections also have gained ground since the launch of ChatGPT (Chat Generative Pre-Trained Transformer) in 2022 (UNESCO 2023a, 2023b), consistent with the growing discourse of the 5IR (fifth industrial revolution), Industry 5.0, and Society 5.0 that foreground the importance of wellbeing *vis-à-vis* the potential negative externalities of technological development (Cabinet Office 2024a; European Union 2021). Take, for example, *Generative AI and the future of education* published by Stefania Giannini, assistant director-general for education at UNESCO (United Nations Educational, Scientific, and Cultural Organisation) (Giannini 2023). In this document, Giannini defines the essential function of education as 'to help us make informed choices of how we want to construct our lives and norms' and adds:

> The central task for education at this inflection moment is less to incorporate new and largely untested AI applications to advance against the usual targets for formal learning. Rather, it is to help people develop a clearer understanding of when, by whom, and for what reasons this new technology should and should not be used. *AI is also giving us impetus to re-examine what we do in education, how we do it, and, most fundamentally, why* (Giannini 2023:8; emphasis added).

This chapter builds on such a critical impulse to fundamentally rethink and reimagine HE *vis-à-vis* AI. To this end, I will first summarise a dominant approach to AI among HE leaders, practitioners, and researchers. Essentially, the dominant approach proposes to use AI to complement human capabilities as an instrument for maximising work-related performance for the economy. In contrast with the dominant approach, I articulate an alternative, *wholistic* approach by illustrating how AI might connect with the incipient growth of contemplative studies in IHEs to help students augment their human capabilities, such as metacognition, empathy, and compassion, for transforming both inner and outer worlds in the direction of *collective wellbeing*. Despite the potential dangers of AI to hack human minds (Harari 2018:ch.19) and harm wellbeing through manipulation, surveillance, and exploitation (Feldstein 2019:122; Zuboff 2019:ch.16), I argue that it is also possible to use AI for *wholistic human augmentation* toward the flourishing of humanity and their fellow beings on Earth.

The Dominant Approach: AI-Human Collaboration for Peak Economic Performance

While HE research on AI had been sparce before the 2010s, the sea change began with the publication of *The fourth industrial revolution* by Klaus Schwab (2016), the founder of the WEF (World Economic Forum). For Schwab, AI was one of the main technological drivers of the 4IR, 'fundamentally changing the way we live, work, and relate to one another' (Schwab 2016:7). Following Schwab, Joseph Aoun (2017:xxi, 22), president of Northeastern University, published *Robot-proof: Higher education in the age of artificial intelligence*, calling on HE leaders and policymakers to rebalance curricula to 'ensure that graduates are "robot-proof" in the workplace' and reform their institutions to 'master the economic and societal challenges brought on by robots, AI, and advanced machines.' Similarly, Nancy Gleason (2018:5), then director of the Centre for Teaching and Learning at Yale-NUS, edited *Higher education in the era of the fourth industrial revolution*, to urge IHEs to adapt their curricula and pedagogies to prepare graduates for the 'automation economy,' in which '[n] early everyone will work with artificial intelligence.'

Whereas HE leaders, practitioners, and researchers began to discuss how IHEs should adapt to the AI-driven economy in the context of the 4IR, business leaders and policymakers, especially in Western Europe, started talking about the 5IR or Industry 5.0. This was because they felt that

> the Industry 4.0 paradigm, as currently conceived, is not fit for purpose in a context of climate crisis and planetary emergency, nor does it address deep social tensions. On the contrary, it is structurally aligned with the optimisation of business models and economic thinking that are the root causes of the threats we now face. The current digital economy is a winner-takes-all model that creates technological monopoly and giant wealth inequality' (European Union 2021:5).

As an alternative to the 4IR, they propose the Industry 5.0 paradigm, 'a more transformative view of growth that is focused on human progress and well-being based on reducing and shifting consumption to new forms of sustainable, circular and regenerative economic value creation and equitable prosperity' (European Union 2021:6). To be sure, the discourse of the 5IR is rather continuous with that of the 4IR in the technological dimension, for both discourses essentially draw on the same set of technologies, including but not limited to AI, the IoT (internet of things), robotics, and biotechnology. Nevertheless, the 5IR adds to the 4IR the strong emphasis on the ethics of human centricity and sustainability for mobilising AI and other technological advances to enhance the wellbeing of workers, customers, societies, and, ultimately, the planet while making the world a more humane, equitable, and sustainable place (European Union 2024; Noble, Mende, Grewal, & Parasuraman 2022; Xu, Lu, Vogel-Heuser, & Wang 2021).

Despite the discursive shift toward the 5IR among business leaders and policymakers, the HE discourse on AI maintained and even consolidated its reactive mode of thinking. In 2019, for example, UNESCO organised the 'International Conference on Artificial Intelligence and Education' in Beijing and published the *Beijing consensus* to offer recommendations regarding the use of AI for multiple aspects of education, including but not limited to management and delivery, teaching, learning assessment, and preparation for life and work. Two of the recommendations specifically targeted HE, focusing on the economic implications of AI as follows:

> Be mindful of the systemic and long-term transformation of the labour market, including its gender dynamics, due to AI adoption. Update and develop mechanisms and tools to anticipate and identify current and future skills needs in relation to AI development, in order to ensure the relevance of curricula to changing economies, labour markets and societies (UNESCO 2019:6).

These recommendations were consistent with the dominant HE discourse that accepted AI, or any other technological innovation, as the external imperative to which IHEs must adapt for their economic survival.

Then, the COVID-19 (Coronavirus disease of 2019) pandemic accelerated the development and deployment of AI systems worldwide, as researchers created new software applications in disease detection and contact tracing, diagnosis and treatment, vaccine development, and so on (Arora, Banerjee, & Narasu 2020; Chang, Zhan, Zhao, You, Liu, Yan, Fu, Liang, & Zhao 2021). Concurrently, UNESCO elaborated on its AI-related guidelines for policymakers. Again, UNESCO (2021a:36) focused on the economic implications of AI for HE and recommended that policymakers '[s]et up plans to help higher education and research institutions build or enhance programmes to develop local AI talent...Develop executive master programmes to reskill engineers in AI, and incentivize engineering companies to invest in retraining their workforces in AI.' Furthermore, UNESCO (2022) emphasised that IHEs also had an important role to play in facilitating the use of AI in K-12 education with the provision of AI concepts and pedagogy in initial educator training and ongoing support for in-service educators.

Finally, the HE discourse on AI exploded in 2023 in response to the rapid popularisation of ChatGPT and other AI tools. Writing for the WEF, Aoun (2023) shared his perspective on the 'generative AI revolution' to reiterate the importance of creating a curriculum for the AI-driven economy and urged HE to place lifelong learning 'at the forefront of its mission, serving nontraditional learners with customized programmes tailored to changing professional needs.' Similarly, Sean Hughes (2023), academic programme manager of the Minerva Project, called for 'a new model of learning...grounded in learning science and primarily focused on teaching students "how to think" through the cultivation of "durable skills"...to cultivate highly effective learners who can transfer skills from the classroom to the real world.'

The Minerva Project (2023:25), which had partnered with Keck Graduate Institute to launch Minerva University in 2013, further elaborated as follows on the importance of 'durable skills' in the AI-driven economy:

> Examples include critical thinking, problem-solving, communication, emotional intelligence, and collaboration.

> Durable skills are transferable, adaptable, and highly resilient against AI advances because they represent many of the tasks that AI systems currently struggle with. Students with durable skills are highly sought after by employers and will find themselves to be 'AI-resilient' in the workforce relative to their peers who don't learn these skills.

Thus, while recognising the continuing relevance of uniquely human skills, the dominant HE discourse on AI ultimately defines these skills as a means for achieving peak economic performance. This focus on the economy is so strong that even those who wish to mobilise AI to provide 'learning that fosters agency, awareness…connectedness, and well-being [end up encouraging] educators, students, parents, and policy-makers to come together to consider what skills our students really need to…shape meaningful futures *in a changing economy*' (Kopp & Thomsen 2023; emphasis added).

This dominant HE discourse is perhaps best summed up by Karim Lakhani (2023), a professor at Harvard Business School, who stated, 'AI is not going to replace humans, but humans with AI are going to replace humans without AI.' Hence, IHEs must educate students-*cum*-future-workers to learn to collaborate with AI for greater economic performance. Here, the dominant HE discourse risks legitimating 'reverse adaptation' through which, 'instead of machines being designed to support human ends, humans are enlisted to do whatever is necessary to augment and adapt to the machine's abilities' (Vallor 2024:88) in facilitating the smooth functioning of the economic system.

The Critical Approach: Addressing the Challenge of AI-Human Bias

While adopting this dominant, economy-focused orientation, UNESCO has also voiced critical concerns about the potential risks and challenges of AI in HE. Because UNESCO supports the use of AI in the pursuit of SDG (sustainable development goal) 4 – equitable and inclusive education and lifelong learning for all – it duly pays attention to how AI might undermine SDG 4 by exacerbating inequalities and exclusion.

Take, for example, the UNESCO publication *ChatGPT and artificial intelligence in higher education: Quick start guide* (UNESCO 2023a). On the one hand, the publication explains a wide range of roles that AI might play to enhance the quality of teaching and learning: Socratic opponent, collaboration coach, guide on the side, personal tutor, co-designer, exploratorium, study buddy, motivator, and dynamic assessor (UNESCO 2023a:8-9). On the other hand, it critically appraises the potential negative effects of ChatGPT, as well as other AI tools, on academic integrity, privacy, cognitive bias, gender quality and diversity, and accessibility, among other things (UNESCO 2023a:10-11). Similarly, when UNESCO subsequently published *Harnessing the era of AI in higher education: A primer for higher education stakeholders* (UNESCO 2023b), it critically gestured beyond the economy-focused use of AI:

> Now equipped with further knowledge and understanding [of how AI is shaping higher education], the next step is to ask how higher education could or should shape future AI, and the role that higher education could play, together with other stakeholders, in shaping a future that systematically addresses the digital and connectivity divides, as well as the challenges of data bias (UNESCO 2023b:79).

Indeed, *bias* is a key thread in UNESCO's critical discourse on AI. In both the *Quick start guide* and *A primer* (UNESCO 2023a, 2023b) ,UNESCO elaborates on cognitive bias as a main challenge in the educational use of AI: Because any AI system 'collects information from the databases and texts it processes on the internet [and] also learns any cognitive bias found in that information' (UNESCO 2023a:11), it has the power to reinforce 'bias and stereotypes in and beyond data' (UNESCO 2023b:79) as a root cause of gender, racial, economic, and other forms of inequality in society. As political philosopher Mark Coeckelbergh (2022:40) puts it, the challenge is not just that 'a particular AI algorithm is biased in a specific case and has particular consequences...rather the main problem is that these technologies interact with, and support, existing hierarchical structures in society.'

These critical concerns about bias can also be found in the wider policy discourse on AI. Since algorithms and datasets are known to be biased and capable of perpetuating, amplifying, and disseminating cognitive biases among humans on a global scale (European Union Agency for Fundamental Rights 2022; IBM 2023; Schwartz, Vassilev, Greene, Perine, Burt, & Hall 2022), policymakers and researchers have proposed various strategies for mitigating AI biases by, for example, institutionalising open data science to include data on underrepresented groups and creating an organisational culture that incorporates multiple perspectives and expertise in diverse subjects (especially in the humanities and social sciences) in the development and management of AI systems (Ammanath 2021; Haas School of Business 2020; Seneor & Mezzanotte 2022). Ultimately, all these strategies emphasise the essential role that only humans can play in ensuring accountability, equity, inclusiveness, and transparency of AI systems (UNESCO 2023c), which in turn requires humans to become more aware of their own cognitive biases (McKinsey Global Institute 2019).

It is challenging for anyone, however, to become aware of their own cognitive biases. This is because cognitive biases are mostly 'implicit,' operating at the unconscious level (Greenwald & Banaji 1995; Greenwald & Lai 2020), and hence capable of evading the reinforcement of AI-related ethics, policies, and regulatory frameworks. Take, for example, the EU's (European Union's) so-called AI act. Provisionally agreed in early December 2023, Title 2 of the act prohibits the manipulative or exploitative use of AI systems causing physical or psychological harm to specific individuals and groups. This prohibition extends to 'the social score leading to…detrimental or unfavourable treatment of certain natural persons or whole groups thereof that is unjustified or disproportionate to their social behaviour or its gravity' (European Commission 2021). Any judgement of what is 'unfavourable' or 'unjustified,' however, always presupposes human cognition, which can never be completely free from implicit biases.

To be sure, these cognitive biases might be made conscious with the help of AI tools capable of identifying how an individual's speech and behaviour are patterned in a certain way without their knowledge. Nevertheless, the question remains: Once made aware of their own cognitive biases, how can an individual transform them, especially when they are emotionally invested? In fact, the unwillingness to acknowledge and transform one's own cognitive biases has been the source of polarisation and discrimination around the world (Nichols 2017:40-69), which can be exacerbated by none other than AI's algorithmic biases (Lambrecht & Tucker 2019; Obermeyer, Powers, Vogeli, & Mullainathan 2019).

This critical discussion of bias in both AI and humans illustrates that the former is ultimately a 'mirror' of the latter, as AI ethicist Shannon Vallor (2024) observed. If AI is biased against certain groups of people, that is because humans already are. In this regard, the effort to fix biases in AI systems cannot but presuppose the effort to confront biases in humans themselves, for it is up to the latter to decide what counts as a bias and what needs to be done about it. Put another way, an answer for the question, 'What more could AI and other technologies do for us – or rather, what more could we do for each other with them[?]' (Vallor 2024:210) depends fundamentally on our self-definition of who we are as human beings and what future we want collectively. Only when it is thus recognised that AI is merely a tool for our collective self-actualisation, the real work can begin: How might we notice and transform our own biases in the direction of greater equity, solidarity, inclusiveness, and other ideals that we cherish, and how might AI tools assist us in this endeavour?

Turning to Contemplation as an Internal Technology for Wholistic Human Development

A first step for answering this question, I suggest, can be found in the incipient worldwide movement to promote contemplative studies in HE (Barbezat & Bush 2014; Eaton, Hughes, & MacGregor 2017; Palmer, Zajonc, & Scribner 2010). Simply put, this movement combines the third- and first-person investigations of both religious and nonreligious practices, ranging from chanting and meditation to music and dance, to explore how contemplative states of consciousness might be attained (Hart 2004:29-30; Roth 2006:1789). The movement envisions HE to be more wholistic in the sense of recognising not only scientific modes of knowing but also non-scientific ones that are grounded in one's inner experience, traditionally known as 'wisdom.'

Today, this vision of more wholistic HE embracing multiple modes of learning about the world *vis-à-vis* oneself is gaining momentum, as evinced by an increasing number of centres and programmes at IHEs that explore the integration of scientific and contemplative investigations – to name but a few, the Contemplative Studies Initiative and Concentration at Brown University, the Center for Contemplative Science and Compassion-Based Ethics at Emory University, the Graduate School of Advanced Integrated Studies in Human Survivability at Kyoto University, the Contemplative Studies Centre at the University of Melbourne, and the Contemplative Sciences Center at the University of Virginia.

While these centres and programmes are located mostly in North America, researchers in European IHEs have also formed a network called 'Mind & Life Europe.' Moreover, even though not using the term 'contemplation,' the Sweden-based initiative 'IDGs' (inner development goals) shares with the contemplative-studies movement the following observation on the importance of the inner world:

> Although we have accumulated much knowledge about the climate crisis, poverty, public health, and other social ills communicated in the SDGs, we seem to lack the inner capacity to deal with our increasingly complex environment and challenges...Fortunately, modern research shows that the inner abilities we require to complement and accelerate our external approaches can be developed (IDGs 2024).

Put another way, if AI is an external technology that enhances human performance, contemplation is an internal technology that cultivates uniquely human capabilities to gain wisdom or insight through one's own experience. However, how might such an internal technology help to address the issue of AI-human bias? To answer this question, I propose to focus on *mindfulness practice*, partly because its implications for cognitive bias have been extensively documented by researchers in neuroscience, medicine, and psychology (Creswell 2017; Kabat-Zinn 2013; Tang, Hölzel, & Posner 2015), and partly because it is arguably the most commonly used contemplative intervention in HE (Bush 2013; Shapiro, Brown, & Astin 2011).

First and foremost, mindfulness practice is found to improve *metacognition* – the ability to monitor one's thoughts with a degree of psychological detachment. For example, because mindful individuals with higher levels of metacognition can observe their inner experiences non-judgementally or non-reactively, they are less susceptible to stress, depression, and anxiety and obsessive-compulsive disorders (Giluk 2009; Hargus, Crane, Barnhofer, & Williams 2010; Solem, Thunes, Hjemdal, Hagen, & Wells 2015). Given the power of mindfulness to strengthen such metacognition, mindfulness practice has been incorporated into cognitive therapy to help patients change maladaptive thought patterns (Gu, Strauss, Bond, & Cavanagh 2015; Segal, Williams, & Teasdale 2018:44-62). Mindfulness-based interventions have also been developed to help non-clinical populations to reconstruct their thought patterns to create more positive interpersonal relationships (Reb, Allen, & Vogus 2020; Young 2017:ch.1). This growing body of research indicates that mindfulness practice makes it easier for people to recognise their own cognitive biases – specific thought patterns regarding gender, race, politics, and other issues in the world – and reconstruct them.

The benefits of mindfulness practice go beyond improved metacognition. As the UNESCO International Commission on the Futures of Education (UNESCO 2021b:124-125) argues, 'Cognition is not the only way that we learn...As highlighted in earlier chapters on pedagogy and curricula, the complexity of education derives from the fact that it intersects inseparably with all aspects of the world, including its social, economic, environmental, material, and spiritual dimensions.' Indeed, mindfulness practice offers another major benefit that goes beyond the cognitive dimension of the human mind: An increased level of perspective-taking, active listening, empathy, compassion, and prosocial behaviour (Cheang, Gillions, & Sparkes 2019; Luberto, Shinday, Song, Philpotts, Park, Fricchione, & Yeh 2018). This benefit is reportedly produced by two different kinds of mindfulness practice: Loving-kindness meditation that sends love and positive thoughts to others, and focused breathing that directs attention to bodily sensations, even though not directly concerned about others (Hafenbrack, Cameron, Spreitzer, Zhang, Noval, & Shaffakat 2020). This means that focused breathing, perhaps the most foundational method of mindfulness practice to improve metacognition, also facilitates the cultivation of prosocial emotions and behaviours toward different individuals and groups who hold diverse opinions, beliefs, values, and worldviews.

In this regard, contemplation, exemplified by mindfulness practice, makes a vital contribution to the mission of UNESCO that continues to resonate today: 'Since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed' (UNESCO 2023d). Here, the worldwide movement for contemplative studies in HE shows the potential to facilitate the wholistic cultivation of the inner 'defences of peace,' encompassing cognitive, affective, and behavioural dimensions – and these inner defences of peace are also likely to be effective against AI-human biases.

Indeed, I argue that contemplation and AI are not incompatible but can be combined to create the effective 'defences of peace' against AI-human biases and even help make humans become more fully human. If contemplation as an internal technology and AI as an external technology work together in augmenting humanity, it might become possible to provide positive answers to the following questions: 'Could AI support our capacities for justice in solidarity with one another, even with other planetary life and future generations? Could AI enrich, rather than replace or diminish, our own humane practices of social care, even love?...Could AI one day not merely reflect our intelligence, but enable our *wisdom*?' (Vallor 2024:64; original emphasis). In fact, such a possibility is already emerging in HCI (human-computer interface) that aims to augment the mind and body with computers, machines, and other relevant technologies (Engelbart 1962; Inami, Kitazaki, Miyawaki, Gowrishankar, Iwata, Sugimoto, Kasahara, & Uriu 2021).

Toward the AI-Assisted Augmentation of Human Capabilities for Collective Wellbeing

Today, the field of HCI is expanding due to rapid advances in neuroscience, AI, metaverse, and wearable devices, as well as the international movement to accelerate the 5IR. To date, much of existing HCI research and technology has been geared toward a 'man-computer symbiosis' (Licklider 1960) and recently, a 'human-AI symbiosis' (Jarrahi 2018), to augment work-related performance – for example, the autopilot on an aircraft, marine craft, and spacecraft, level-3 driving automation, and powered exoskeletons for medical, industrial, and military uses. In this symbiotic HCI, humans and computers or machines remain essentially separate, but they cooperate to perform tasks at a higher level than humans alone can achieve.

While such symbiosis risks exploiting human capabilities for peak economic performance, some of the HCI research and technologies are geared toward 'self-actualisation' rather than symbiosis. The focus of this self-actualising HCI is to help humans become able to do things that they could not do before (e.g., due to injuries or a lack of mastery), so that they can feel happy with their own accomplishments and hence gain the feelings of self-efficacy and self-esteem (Rekimoto 2018:457-459).

In this regard, HCIs have the potential to augment inner human capabilities, such as metacognition and prosocial emotions and behaviours that are conventionally cultivated by contemplation. Take, for example, 'body-sharing' in which people can share their experiences (e.g., bodily sensations), whether synchronously or asynchronously, through wearable devices that recreate similar stimuli in the brain and other parts of the body (Tamaki 2022:ch.2). While the metaverse already allows people to virtually experience the world from the perspectives of others who are different in terms of gender, race, class, and other social dimensions, body-sharing can make this virtual experience feel more visceral and vicarious. In theory, then, body-sharing enables a person to 'jack-in' (Kasahara & Rekimoto 2014) to other people's bodies and hence augment their perspective-taking, empathy, and even compassion to counteract various biases that they hold toward certain groups – body-sharing therefore advances self-actualising HCI in the direction of collective wellbeing.

In Japan, the government has joined this effort to develop HCIs for collective self-actualisation with its Society 5.0 plan to create 'a society that is sustainable and resilient against threats and unpredictable and uncertain situations, that ensures the safety and security of the people, and that individual to realize diverse well-being' (Cabinet Office 2024a). For example, one of the sub-programmes of the Society 5.0 plan is to create 'a mentally healthy and dynamic society' by developing 'science and technology that enhances human communication and sharing of emotions, and to develop mental support services that enhance the empathy, stability, and creativity of groups' (Cabinet Office 2024b:1-2). Another sub-programme has a more daring goal to create 'cybernetic avatar technology' that would enable people to overcome 'the limitations of the human "body," "brain," and "space and time" [and] apply their capabilities anywhere in the world where such capabilities are needed' (Cabinet Office 2024c:4, 8). Although these sub-programmes are not free from the risk of reverse adaptation of human capabilities to work-related performance, they are in theory oriented toward the full realisation of human potential.

Specifically, VR (virtual reality) space, whether inside or outside of the metaverse, can be used to amplify the effect of contemplation on prosocial emotions conducive to collective wellbeing. Particularly relevant contemplative practices here can be found in the Vajrayāna or tantric lineage of Buddhism that is currently practiced in Tibet, Japan, and elsewhere. Take, for example, Tibetan Buddhism, which inspired the creation of SEE (social, emotional, and ethical) learning at Emory University (CCSCBE 2023). The Tibetan tradition teaches a method of contemplation that combines the visualisation of Avalokiteśvara, the bodhisattva of compassion that is believed to incarnate in the Dalai Lama, with chanting of mantras that describe the aspirations and virtues of the bodhisattva. This method enables a practitioner to mentally simulate, becoming one with the bodhisattva and embodying infinite compassion toward all beings (Kunchok, Sonam, & Saito 1995:chs.4-5).

The Shingon tradition in Japan, which established Koyasan University in 1926, also teaches another tantric method of contemplation called 'Ajikan' that combines the vocalisation and visualisation of the first vowel of Sanskrit 'a,' symbolic of the cosmic buddha Vairocana. In this contemplation, the practitioner imagines the cosmic buddha as a ball of light and mentally simulates becoming one with it, expanding infinitely to embody oneness with the entire universe encompassing all beings (Oshita 2021). Here, virtual reality space provides fertile ground for augmenting contemplative practices that aim to cultivate compassion and the feeling of oneness, which in turn can facilitate other-oriented behaviours promoting collective wellbeing.[1] Indeed, researchers in the US (United States of America) and elsewhere have begun to mobilise VR space, wearable devices, and other relevant technologies to 'support intimacy, empathy, and enlightenment' at both individual and collective levels (Wildman & Stockly 2021:246). One of these 'spirit tech' innovations deploys VR space for participants to experience the feeling of oneness with other beings and the universe. Another innovation joins 'neurofeedback with advancing knowledge of the physiology of meditation…to guide – and yes, speed up – our meditation practice' (Wildman & Stockly 2021:58).

Importantly, these HCI innovations can be combined with AI to enable the individual optimisation of contemplative training. In Catholicism, Buddhism, and other religious traditions, monastics as well as laypeople typically spend many years training in prayers, chanting, and meditations to attain higher levels of consciousness filled with empathy, compassion, love, and wisdom. This training takes time partly because trainees must learn to calibrate standardised sequences and combinations of training methods according to the unique characteristics of

1 These methods of contemplation can be practised in AR (augmented reality) as well, as the educational use of AR is growing worldwide (Geroimenko 2020).

their minds and bodies. Here, AI and wearable devices can be used to individually optimise standardised training programmes, on the one hand, by creating a data lake that correlates trainee characteristics, a variety of contemplative methods, and their sequences and combinations, and neurological, psychological, and physiological effects, among other things and, on the other hand, by offering synchronous and continuous feedback to trainees.

These potential benefits of AI-assisted augmentation of inner human capabilities for collective wellbeing, however, are accompanied by various ethical questions. For example, how much should humans rely on AI and other relevant technologies to enhance their inner capabilities? Should humans be required to augment their capabilities that are deemed essential for collective wellbeing? The weight of these questions will only increase in the future: While the foregoing discussion has assumed HCIs to be non-invasive (i.e., detachable from the brain and the body), the latest scientific research and technological innovation points to the development of invasive BMIs (brain-machine interfaces) that permanently augment human capabilities through direct modifications of the brain and the body (Konno & Ikegaya 2021; Lebedev & Nicolelis 2017; Musk & Neuralink 2019). To say the least, any BMI research and innovation should be maximally cautious about their unintended consequences, for modern history is rife with cases of scientific and technological 'progress' that produced harmful side-effects to humans, animals, and environment (Beck 1992; Latour 1993).

Equally important, the possibility that 'the brain and the mind aren't the same' (Harari 2018:317) should be taken seriously. In fact, a sizable number of researchers point out a disjunction between neural networks and subjective feelings, reject the transhumanist belief that the mind can be uploaded to machines, and caution against the industry's hype over AGI (artificial general intelligence) becoming more intelligent than humans (Herzfeld 2023; Lennox 2020; Narayanan & Kapoor 2024; Vallor 2024). After all, Rudolf Steiner and other advocates of wholistic education (Japan Holistic Education Society 2005; Miller 2000; Miller, Karsten, Denton, Orr, & Kates 2005) may be right that the working of the mind ultimately eludes and escapes scientific investigations and technological interventions because it is connected with the spirit or the soul that is believed to exist beyond the empirical dimension. Thus, no matter how much progress AI, HCI, and BMI might make in the future, I suggest that humans trust their own wisdom when deciding how to use these technologies.

Conclusion and Future Directions

To summarise my argument in this chapter, I will offer the following reflections on Yuval Noah Harari's *21 lessons for the 21st century* (Harari 2018). When commenting on the future of education, Harari (2018:268) suggests,

> If, however, you want to retain some control of your personal existence and of the future of life, you have to run faster than the algorithms, faster than Amazon and the government, and get to know yourself before they do. To run fast, don't take much luggage with you. Leave all your illusions behind. They are very heavy.

As a meditator himself, Harari knows well how contemplative practice can help people let go of their 'illusions.' While I fully agree with Harari about the promise of contemplative practice, I also wonder whether we need to 'run faster than the algorithms.' To be sure, we want to run faster than the algorithms intended to hack, manipulate, and exploit our minds, but I believe that some algorithms – and other technologies like self-actualising HCIs – can help us 'run faster' toward wisdom, compassion, and wellbeing.

Put another way, it is always up to humans to decide how to use AI in HE as well as in the wider society. As I have argued, the currently dominant approach does not seem to serve the best interest of humanity because it focuses too narrowly on the economic implications of AI. In fact, the economy-driven use of AI might well harm humanity and their fellow beings on Earth, as indicated by a growing number of studies showing its negative impacts on worker dignity and wellbeing, democracy, and environment (Bashir, Donti, Cuff, Sroka, Ilic, Sze, Delimitrou, & Olivetti 2024; Marcus 2024; Schaake 2024).

The alternative approach that I have briefly sketched above, by contrast, expands the use of AI to facilitate wholistic human development through the augmentation of such capabilities as metacognition, perspective-taking, empathy, compassion, and prosocial behaviours as the preconditions of collective wellbeing. Here, Vallor (2024:219) is right to observe that 'AI is neither replacement nor guide for humanity, but a surplus.'

At first glance, this wholistic approach may seem to have affinity with another alternative approach anchored in liberal arts education that the ancient Greeks developed. The classical liberal arts approach to AI posits that, just as the Greeks did not need to work because their work was done by slaves, future generations may not need to work because their work will be done by AI (Araya & Marber 2023:6). In such a 'post-work' society, according to American philosopher Jon Burmeister (2023), liberal arts education will free humans, not only from the manipulative and exploitative algorithms by helping them acquire self-knowledge and self-regulation, but also toward atelic pursuits in which humans enjoy activities for their own sake, such as contemplation on truths for its own sake, as the highest form of human flourishing.

Nevertheless, this utopian vision risks legitimating post-work society to be 'one based on slavery, albeit one in which the slaves are artificial' and hence perpetuating hierarchical social structures (Coeckelbergh 2022:24). By contrast, the wholistic approach proposes to go beyond simply using AI to replace human labour and allow humans to enjoy atelic activities; rather, it aims to augment humanity itself in the service of greater equity, solidarity, freedom, and inclusiveness, and accelerate learning and flourishing toward collective wellbeing.

Of course, the wholistic approach still needs to be accompanied by laws regulating the use of AI: The internal cultivation of positive human capabilities through AI must be coterminous with the external regulation of negative ones that might be amplified through AI. Nonetheless, as the latter has already been a focal point of extensive policy debates and public discussions around the world, I hope this chapter offers a refreshing perspective on the former, perhaps the most virtuous contribution that AI might make – to help humanity fully and wholistically actualise their potential.

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Chapter 9

Artificial Intelligence In Education: Africa's Prospects and Challenges

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Introduction

The application of AI (artificial intelligence) in education is not something new as it might appear to be because it has already been integrated in learning and education services for several decades. During COVID-19, Africa, like the rest of the world was faced with challenges associated with the emergence of the pandemic, such as lockdown and social distancing imposed by the WHO (World Health Organisation) to contain the spread of the disease. The lockdown and social distancing resulted in the closure of social spaces such as education institutions and public places. To counter these measures brought by the COVID-19 pandemic and to ensure that businesses continue, organisations immediately turned to remote working using the power of AI tools (UNICEF 2022). In fact, this was the first evidence of a mass application of AI tools to ensure that learning continues in both developed and developing economies (cf. Georgescu & Popescu 2015).

However, though the world adopted AI tools to deliver services for the purposes of business continuity, one notable thing that has not been explained is whether such application of AI tools in learning institutions, specifically IHEs (institutions of higher education) were uniformly successful in achieving the purpose of education delivery without compromising quality and inclusivity *vis*-à-*vis* exclusivity in the rural parts of the world and explicitly in Africa where the infrastructure of ICT (information and communication technology) is still in a poor state. For education to benefit society, it must be delivered to the whole population without compromising the quality and accessibility. COVID-19 exposed the world's preparedness regarding the application of AI tools in delivering services to populations remotely, and this did not even spare the developed world.

Education is a human right and any application of AI tools should ensure that no one is excluded. AI is an interdisciplinary field of knowledge that was initiated in the 1950s and combines the achievements of computer science, cognitive science, and logic (UNESCO 2021a; UNICEF 2022; Wójcik 2021:437). AI is an umbrella term for various methodologies that are designed to provide computers with human-like abilities of hearing, seeing, reasoning, and learning (Güngör 2020:72). It aims to solve complex problems that are beyond the scope of simple algorithms, and it strives to reproduce and refine the functions of the human mind (Wójcik 2021:438). According to studies, some types of AI have been with humans for quite some time, such as Google search, reading our e-mails, scheduling a doctor's appointment, asking for driving directions, or receiving movie and music recommendations. People are constantly using the application of AI and its assistance in their daily lives (Akgun & Greenhow 2022:439). Similarly, several studies (Akgun & Greenhow 2022:439; Fernández-Batanero, Montenegro-Rueda, Fernández-Cerero, & Menéses 2023:297; Remian 2019) agree that the application of AI in education has substantial benefits to both students and educators. AI, for instance, has a wide range of algorithmic applications in education, including personalised learning systems to encourage student learning, automated assessment systems to assist educators in assessing what students know, and facial recognition systems to provide insights into students' behaviours or identities.

The advancement of ICTs has created chances to increase educational quality and employ various modes of learning, such as blended learning, which combines face-to-face and online learning, or fully online learning (Rugube, Mthethwa-Kunene, & Maphosa 2020:4). Online learning, also known as e-learning, is dependent on the availability of the internet and electronic devices such desktop computers, laptops, tablets, and smartphones. However, some of the main AI tools are not within the reach of most of the population in Africa. The use of computer technology for e-learning has widened access to education while also improving its quality. However, several questions remain unanswered regarding the much-acclaimed improved quality of education because of the application of AI tools to deliver education to students. Taking the application on its face value ignores the fact that AI tools can also open an avenue for misuse or abuse that can circumvent the very purpose of education (Veintimilla, Ulloa, & Veintimilla 2018).

Education is a human right for every child and adult through lifelong learning (Rugube *et al.* 2020:5). As a result, improving access to education opens opportunities for many people who would otherwise have been denied of it. The implementation of e-learning has become necessary, particularly in the wake of the COVID-19 pandemic, which has driven educational institutions to provide remote learning (Rugube *et al.* 2020:7; UNESCO 2021a; UNICEF 2022).

African Context

With around 1.5 billion people residing in its 55 countries, the African continent makes almost 20% of the world's land area and is home to nearly 18% of the globe's population (Worldometer 2024). While 50% of people worldwide reside in rural areas, the percentage is closer to 70% in Africa. With a median age of 19.7 years, Africa is now the youngest continent in terms of population (UN 2022). In SSA (Sub-Saharan Africa), high fertility rates combined with declining infant mortality have led to fast population increase. The emergence of an SSA urban structure and a drastic change in its agriculture are two significant effects of the region's rapid population expansion. This indicates that

Africa will continue to have a high demand for AI technologies and education.

With EdTech (educational technology) solutions, the continent is already utilising digital technology's potential to transform education for kids. The $1 XPRIZE winner RoboTutor, an open-source android tablet programme from Carnegie Mellon University, serves as an illustration of this. It helps youngsters aged seven to 10 who have limited or no access to schools and teachers to learn the fundamentals of reading, writing, and maths without the help of an adult (XPRIZE 2019). Tanzania is currently testing a Swahili version of the AI-enabled RoboTutor, which tackles the severe teacher shortage in developing nations. Although RoboTutor provides amazing prospects for learners who have access to it, it is also important to consider the limitations that might keep some kids from using it and the potential risks of it escalating inequality (Booyse & Sheepers 2024; Bu 2022). Todino, Desimone, and Kidiamboko (2022:240) opine that the governments of the countries of the Global South know that, for example, distance education is the facilitating tool *par excellence*, promoting access to education and ensuring social balance by providing educational content relating to each institution. In addition, there are some critical issues related to teachers' digital skills. Due to a lack of updating in teachers' digital training courses, they are not really prepared to face these new challenges. On the other hand, as the European institutions have repeatedly requested, it is necessary that schools are globally renovated both from a structural and a content point of view.

AI has the potential to expand applications and enhance and expedite procedures. When implementing AI solutions in the real world, the chance for failure must be weighed against the many benefits of the technology (De Klerk & McLean 2024). Inadequate models, flawed datasets, and a lack of time to test and evaluate AI solutions could harm the field's reputation (cf. Grama & Vogel 2016). Among the challenges already associated with AI are the spread of false information and biased scoring and grading of members of minority groups (Dixit, Stefańska, Musiuk, & Singh 2021; Svärd, Guerrero, Balogun, Saurombe, Jacobs, & Henttonen 2024; UNESCO 2021b). Therefore, the moment is right to think about AI's ethics and how it will affect the lives of various social groups in addition to its crucial role in providing individualised education to ensure that everyone has equal admission to it (Willcocks 2024).

Politicians, corporate executives, and regulators must make difficult choices as they embrace AI's immediate potential while taking society's long-term effects into account. It is hoped that many negative effects can be avoided, and that AI can be used for the greater good by preparing educators and students in the field with a deeper awareness of the risks (Chatelier & Voicu 2018). With a population of about 1.5 billion, Africa accounts for a sizeable share of the global population and ICT is an essential instrument for unleashing the knowledge and creative potential that are ingrained in her people.

In the following section, the prospects of AI tools in Africa's education systems are discussed. The subsequent paragraph begins with prospects and winds up with strategies to overcome the challenges that confront the continent's readiness and ability to roll out and implement AI tools in the delivery and management of education in Africa.

Prospects of AI in Education in Africa

Table 9.1 presents a snapshot of the benefits that AI applications in education can offer to both students and educators, besides other uses. Table 9.1 does not offer exhaustive AI features that are currently in use. As AI keeps evolving every day, it becomes unpredictable to what the next day would be regarding its application with consequences on the users (Meunier, Pikhart, & Klimova 2022).

Table 9.1: Summary of AI technologies currently in use for learning and educational service (UNESCO 2021a; Roschelle, Lester, & Fusco 2020)

AI technologies	**Applications**
NLP (Natural Language Processing)	For the use of AI to automatically interpret texts, including semantic analysis used in translations, and for generating texts of learning contents, and supporting personalisation processes.
Speech recognition	Covers the application of NLP to spoken words, including smartphones, and provides AI personal assistants within games and intelligent tutoring systems, and for conversational bots on learning platforms.
Image recognition and processing	Employs AI for facial recognition (e.g., for electronic documents and processes in classroom situations), handwriting recognition, text analysis (e.g., to detect plagiarism), image manipulation (e.g., for recognising deepfakes), and for autonomous scoring and grading.
Autonomous agents	Use AI in computer game avatars, software bots, virtual learning spaces, and smart robots.
Affect detection	Employs AI to analyse sentiment in text, behaviour, and faces.
AI underlying	Data mining algorithms for predictive learning diagnoses, progress forecasting, socio-emotional wellbeing analysis, financial predictions, and fraud detection.
Artificial creativity	Uses AI in systems that can create new kinds and exemplars of photographs, music, artwork, or stories.

In the following paragraphs, we will underscore some of the prospects of AI tools in education systems that African countries could capitalise on to promote and deliver education to the marginalised communities. The summary of these prospects is already highlighted in Table 9.1.

Personalised Learning

AI can tailor educational content to individual students' needs, helping them to learn at their own pace and with their personal style, supporting the very essence of the ODeL (open distance e-learning) philosophy. In an ODeL institution, students are utilising online classes because they want personalised and customised learning, the reason being that each student learns at a different rate and seeks personalised sessions in which they work at their own pace. As a result, e-learning systems can employ AI chatbots to resolve students' course-related enquiries with their recognised educators in real time (Einarsson, Lund, & Jónsdóttir 2024; Ellikkal & Rajamohan 2024). Hence, students have the freedom to speak up, obtain a better understanding, and learn at their own pace. This can aid in ODeL delivery specifically for students who are slow at learning or suffer from dyslexia.

Evidence suggests that AI can help tailor learning in a variety of ways to deliver education to all students from diverse backgrounds (Pedró, Subosa, & Rivas 2019:1579; Kabudi, Pappas, & Olsen 2021:7 of 12). AI assists in creating a better professional atmosphere for instructors to work with students who are struggling. Tutors devote a significant amount of time to routine and administrative duties such as creating assignments and answering frequently requested inquiries in educational settings (Gray, Alma Rahat, Crick, & Lindsay 2024; Kabudi *et al.* 2021:10 of 12). A dual-tutor model, which includes an instructor and a virtual teaching assistant who can take over mundane tasks for the educator, frees up the educator's time, allowing them to focus on student supervision and one-on-one contact (Hidayat-ur-Rehman 2024; Isiaku, Muhammad, Kefas, & Ukaegbu 2024). Tutors have already begun collaborating with AI assistants to achieve the best results for their students.

Furthermore, AI can assist in mapping each student's specific learning plans and directions as well as their strengths and weaknesses – subjects that are more expensive but quickly assimilated or taught – and learning preferences and activities (Jacobs 2024). AI can customise learning and increase possibilities for students by using algorithms to help students navigate diverse topic paths with the assistance of their instructors and classrooms. According to recent assessments, intelligent tutoring systems are part of the new technical options for expanding educational learning in the Global South (Pedró *et al.* 2019; Ouyang & Jiao 2021:5 of 6). In addition, given the enormous amount of time spent on grading tests and homework, AI as an assessment tool can be used to learn how an educator grades, freeing up the latter's time. AI is being utilised not only to evaluate multiple-choice examinations but also to grade essays (Jina, Yana, Echeverriaa, Gaševića, & Martinez-Maldonadoa 2024). These opportunities are beginning to materialise in the industrialised countries of the Global North. A plethora of applications are now being tested in both public and private enterprises (Pedró *et al.* 2019).

Improved Efficiency

Administrative tasks like enrolment, grading, and scheduling can be automated, saving time and resources. The crucial aspect of having a successful ODeL institution is helping students through the enrolment process. Because the process differs from university to university, it gets cumbersome for candidates. Every student wants easy and quick answers. An AI-powered chatbot that has been 'educated' and set to learn a prospect's admission cycles effortlessly simplifies the admission experience (Kajiwara & Kawabata 2024; Kumar, Kumar, Bhoyar, & Mishra 2024). These chatbots give an admission exam, follow students' performances, shortlist those who qualify, notify them about the next steps and course selections, and answer all their enquiries without requiring human participation (Fleckenstein, Meyer, Jansen, Keller, Köller, & Möller 2024; Kabudi *et al.* 2021:11 of 12). This expedites the procedure by eliminating the customary waiting period required by a human agent.

Enhanced Research

AI assists researchers in data analysis, pattern recognition, and simulations, advancing scientific discoveries. AI can be used in information retrieval for librarians using augmented intelligence solutions, which allow an increase in their natural capabilities in the acquisition, analysis, and processing of information in meeting users' information needs (Kabudi *et al.* 2021:8 of 12; Wójcik 2021:442). The application of augmented intelligence increases the speed and accuracy of the process of retrieving information, missing bibliographic data, or the provenance of information that is necessary for the precise description of resources (Maniyan, Ghousi, & Haeri 2024; Wójcik 2021:442). Using this feature of AI can enhance the way in which ODeL is delivered to remote and rural areas where physical libraries are, hence assisting in the promotion of teaching and learning. Moreover, AI tools such as chatbots, ChatGPT 3 (Chat Generative Pre-Trained Transformer 3), NOVA AI, IZI AI, ChatGPT 4, and many others have all revolutionised how education can be delivered to the students in real time (Kajiwara & Kawabat 2024; Kumar *et al.* 2024). Chatbots are regarded as one of the most significant advances in the field of AI that can be harnessed to deliver and promote learning to students (Knoth, Tolzin, Janson, & Leimeister 2024; Svärd *et al.* 2024). Currently, these AI chatbots may be found in practically every service; they are present in every field, always assisting in some way – education is one of them.

The majority of AI-powered chatbots in education help students and educators with a variety of duties, including answering questions, offering study materials, measuring progress, and much more. These chatbots can be implemented into educational platforms and learning management systems for student support, tutoring, and overall learning experience enhancement (Kabudi *et al.* 2021:8 of 12; Lee & Kwon 2024). Through the integration of natural language processing and machine learning capabilities, these educational chatbots can converse with students and provide personalised real-time support (Lee, Latif, Wu, Liu, & Zhai 2024; Mitha & Omarsaib 2024). These chatbots are designed to comprehend the user's inquiries and respond with relevant and helpful information (Kabudi *et al.* 2021:9 of 12). Educational chatbots can give answers to questions, study materials, feedback, and even assist in personalised coaching. They make studying more enjoyable and interactive for students and can help educators save time by automating tedious tasks.

Accessibility

AI-driven tools can make education more accessible to students with disabilities, providing them with customised support. Assuring inclusive and equitable educational quality and encouraging possibilities for lifelong learning for all are the objectives of ODeL. Most people in the countries of the Global South still live in isolated, rural settings with little to no infrastructure supporting AI (Lundall & Howell 2000). These people are therefore marginalised (Pedró *et al.* 2019). AI integration in ODeL, however, can give marginalised individuals and communities, refugees, individuals with disabilities, out-of-school individuals, and residents of remote areas access to suitable learning opportunities. Telepresence robots, for instance, enable students with special needs to continue their education during catastrophes or crises or to attend classes from home or the hospital. It can therefore promote universal access and inclusion for all (Aly 2022; Pedró *et al.* 2019). AI chatbots can be integrated in ODeL education to aid students 24/7 with personalised learning, rapid feedback, cost-effectiveness, accessibility, stress reduction, and enhanced student engagement (Kabudi *et al.* 2021:10 of 12; Nemorin, Vlachidis, Ayerakwa, & Andriotis 2022). As technology improves, AI chatbots will become an increasingly significant element of the educational setting, supplying students with the tools they need to achieve their academic goals and flourish in their chosen areas (Kabudi *et al.* 2021:9 of 12).

Predictive Analytics

AI can predict students' performances and identify those at risk of dropping out, enabling early intervention. While IHEs are hoping for increased efficiency, productivity, and performance because of the use of such advanced technology, both the need for shifting skill sets and a shortage of personnel are frightening the public, which leads to strong opposition to the AI implementation process. Furthermore, the complete adoption of AI in IHEs in developing nations like Africa is being hampered by a lack of experience and exorbitant costs (Mukherjee 2022:161). Communication procedures between students and educational providers are a part of any training and education, and it is crucial to discover which communication modalities are best suited for a given teaching and learning process (Ammah, Lütge, Kriebitz, & Ramkissoon 2024; Frans & Pather 2021). According to Frans and Pather (2021), technologies are becoming increasingly important in helping educational providers, especially with their daily management and administration. One of the most important ways that technology may help with training and education is by facilitating the transmission of educational resources, specifically course materials (Nemorin 2024). Course materials are a crucial component of the teaching and learning process in all forms of education and training, whether they are delivered in-person or virtually.

As there is much technology that could help with different teaching and learning methods, some of these, like whiteboards or overhead projectors, can be used universally in any kind of educational or training programme, while others like language labs or woodworking equipment may be referred to as specialised technology (Frans & Pather 2021:1580). Once more, this group covers a wide range of technology, from the most basic – like pen and paper – to the most advanced, like computerised simulations. Individual interaction between educators and student groups, as well as in certain cases, between students and their educators, is made possible *via* face-to-face contact (Frans & Pather 2021:1584). Additionally, it enables students to be transported to other sites where the learning environment is centred around the group's immediate surroundings. Examples of these instructional uses include field trips and excursions. When used effectively, human interaction is its strongest point. Contact sessions allow for social engagement, which is often outside the purview of the course subject. During sessions, social interactions and associated learning experiences can be observed, and instructional design can be promptly modified as needed (Frans & Pather 2021). It is possible that both educators and students can sense how a scenario is developing and decide to step in during class. Face-to-face interaction makes it relatively easy for educators to keep an eye on their students' attitudes, involvement, attendance, and engagement levels (Frans & Pather 2021). There are two kinds of technologies:

- *Asynchronous*: Technologies known as asynchronous (or postponed time) do not require participants to be present at the moment of presentation. Postal correspondence, electronic mail, and computer conferences are a few examples.

- *Synchronous*: Technologies, often known as real-time technologies, necessitate simultaneous interaction between users and are typically planned. Multi-user object-oriented environments like MOOCs (massive open online courses), video conferencing, audio-graphic conferencing, telephony, and audio-conferencing are some of these technologies.

The studies above present several prospects of AI tools in education that policymakers and educators need to be realised. From the literature there is no doubt that AI tools have the potential to address several challenges in African education today. However, in the following paragraph, we will present some of the challenges that currently face the continent's ability and readiness for the roll-out of the AI tools for innovative teaching and learning practices, and finally accelerate the progress towards SDG (sustainable development goal) 4.

Challenges

The concept of AIED (artificial intelligence in education) includes everything from AI-driven, step-by-step personalised instructional and dialogue systems, through AI-supported exploratory learning, the analysis of student writing, intelligent agents in game-based environments, and student-support chatbots, to AI-facilitated student/tutor matching that puts students firmly in control of their own learning process. It also includes students interacting one-on-one with computers, whole-school approaches, students using mobile phones outside the classroom, and much more (De Klerk & McLean 2024; Holmes, Bialik, & Fadel 2019). In Table 2 we highlighted some of the applications of AI in education against the possible challenges and their vulnerability in the society that needs to be addressed wholistically for a smooth implementation. These are challenging issues that require the commitment of everybody involved, as AI is going to stay with humanity.

The present transition from I4R (industry 4.0) to I5R (industry 5.0) is one example. While I4R began in Germany in

2011, I5R began in Japan in 2019. A development of I4R and I5R blends the efficiency, intelligence, and accuracy of robots with the inventiveness of human specialists (Xu, Yuqian, Vogel-Heuser, & Wang 2021). For instance, the world is currently moving forward with I5R, including E5.0 (Education 5.0), which is an advancement over I4R. The inconsistencies found in the previous I4R were the impetus behind the creation of I5R (Breque, De Nul, & Petridis 2021; Moola, Dhurumraj, & Ramaila 2024). The idea behind I5R stems from the observation or presumption that I4R has put more emphasis on digitalisation and AI-driven technologies to increase production efficiency and flexibility than it did on the original principles of sustainability and social justice (Breque *et al.* 2021; Xu *et al.* 2021).

To support the industry in its long-term service to humanity within planetary bounds, the idea of I5R offers a distinct focus and point of view and emphasises the significance of research and innovation. There are several obvious distinctions between I4R and I5R, even though both promote the use of AI-related technology in businesses. I5R, for instance, aims to allay concerns that were connected to the use of AI in education in I4R. It puts equal emphasis on human expertise and technical inventiveness, emphasising sustainability and coexistence (Ajani, Tella, & Oladokun 2024; Moola *et al.* 2024). With human values at the centre of education, I5R has now made it necessary for educators and students to collaborate, think critically, think analytically, and be creative. Thus, E5.0, where technology is seamlessly integrated to tailor and improve learning experiences, is ushered in by I5R. With a focus on creativity, critical thinking, and adaptability, an educator can provide students with the tools they need to succeed in a world that is increasingly driven by technology (Moola *et al.* 2024) – hence, the rise of digitally enabled human-to-non-human connectivity exchanges as well as cooperative human-to-machine interactions utilising AI and machine interfaces. The goal is to establish a synergy that uses digital technologies and data-driven insights to address difficult social issues while promoting economic success through technical developments (Breque *et al.* 2021; Moola *et al.* 2024). These components of I5R have the potential to improve Africa's chances of advancing education through teaching and learning.

Arakpogun, Elsahn, Olan, and Elsahn (2021:375) contend that while AI capabilities offer Africa some significant advantages, there are several potential drawbacks and unforeseen repercussions that policymakers should be aware of. These issues vary from the risks of automation and job displacement that could impact numerous industries to structural inequality brought on by digital gaps and the low level of digital skills across a sizable section of the African population (Africa Union 2024). Due diligence is therefore required to take these issues into consideration. For instance, this can be done by concentrating on AI technologies that can empower rather than replace workers (educators) and by creating programmes that aim to close the digital divide in African economies (De Klerk & McLean 2024). Additionally, the necessity for a workforce with digital skills is the foundation for AI advancements – hence, closing the digital divide is essential if African nations are to be better positioned to gain from these innovations.

The first challenge is creating a wholistic perspective on AI-related public policy for sustainable development. The intricate technological environment required to progress in this subject necessitates the cooperation of numerous entities and elements. The establishment of an AI ecosystem that supports sustainable development requires collaboration between national and international public policy (Arakpogun *et al.* 2021:380). Creating a sustainable AI connection is included and equitable in education as the second challenge. With the emergence of AI, the least developed nations should see new technological, economic, and societal divides. Establishing the prerequisites for putting novel tactics that use AI to enhance learning into practice requires overcoming certain major challenges, such as the need for fundamental technology infrastructure (Arakpogun et al. 2021:385).

Table 9.2: Concept matrix of the five AI trust challenges and the respective vulnerabilities each creates for stakeholders (Adopted from Lockey, Gillespie, Holm, & Someh 2021:5468)

AI trust challenges	Domain experts	End-users	Society	Overcoming challenges
Transparency and explainability	Ability to know and explain AI output and provide human oversight: Manipulation of erroneous explanations.	Ability to understand how decisions affecting them are made: Ability to provide meaningful consent and exercise agency.	Knowledge asymmetries: Power imbalance and centralisation; Scaled disempower-ment.	Diverse participation from different segments of the communities at the development of stage of the AI tools.
Accuracy and reliability	Accountability for accuracy and fairness of AI output: Reputational and legal risk.	Inaccurate/harm-ful outcomes: Unfair/discrimina-tory treatment.	Entrenched bias/inequality: Scaled harmed to select populations.	Inclusive of diverse race, ethnicity in the development of the AI tools.
Automation	Professional over-reliance and deskilling: Loss of expert oversight; loss of professional identity; loss of work.	Loss of dignity (humans as data points; de-contextualisation; loss of human engagement; over-reliance and deskilling.	Scaled deskilling: Reduced human connection; scaled technological unemployment; cascading AI failures.	Retraining and development of employees.
Anthropo-morphism and embodiment	Professional over-reliance: Psychological wellbeing.	Manipulation through identification: Over-reliance and over-sharing.	Manipulation through identification: Human connection and identity.	Policy to restrict the users.
Mass data extraction.	Accountability for privacy and use of data: Reputational and legal risk.	Personal data capture and loss of privacy: Inappropriate re-identification and use of personal data. Loss of control.	Inappropriate use of citizen data: Mass surveillance; loss of societal right to privacy; power imbalance and societal disempowerment.	Privacy laws on the use of personal data.

Lack of Infrastructure in General and Network Infrastructure

Notably, the adoption of the AI ethics frameworks, the desire to adopt AI technologies, and the awareness of AI ethics issues are all influenced by a variety of factors, including aspects as commonplace as access to electricity, civil and political stability, internet penetration, and quality education (Ruttkamp-Bloem 2023:18). Africa is struggling with other basic and pressing issues affecting its population which made the investments and financing of AI infrastructure roll out nearly impossible.

According to David and Grobler (2020:1415), most African nations have poor fixed line and internet access telecommunications penetration rates. While internet penetration is higher in Algeria, Botswana, and South Africa respectively, fixed line telecom penetration is higher in Mauritius, Libya, and Egypt (David & Grobler 2020:1415; Patel & Ragolane 2024; Roschelle *et al.* 2020). The slope of the curves showing the relation between ICT penetration, economic growth, and development in Africa indicates that, overall, the CIT (computers and information technology) – a measure of ICT penetration – has a positive impact on economic growth and development in Africa (Owusu-Agyeman 2024). However, the positive impact is greater in economic growth than in economic development (David & Grobler 2020:1415).

It is necessary to spend more in fixed line and internet access telecommunications because these services are not widely available in most African nations. This will increase fixed line and internet access subscriptions to lower the cost of electronic communication and advance Africa's digital economy (David & Grobler 2020:1415). In addition, Ade-Ibijola and Okonkwo (2023:110) believe that the deployment of AI technologies in Africa is beset by other obstacles, including a lack of technical expertise, uncertainty, structured data, government regulations, ethics, and user attitudes (Table 2). According to Asongu and Le Roux (2017), AI can increase educators' efficiency in the classroom while also helping them to stay competitive and learn more about their students. Today, Africa has the lowest ICT usage rate globally, although SSA has the highest ICT growth rate. Our findings consolidate the need to promote ICT penetration and/or the adoption of more inclusive development. While the findings of this inquiry demonstrate the relevance of ICT for socio-economic benefits, we concede that the affordability and lack of relevant infrastructure constitute substantial barriers to access (cf. Asongu & Le Roux 2017:47). The governments of sampled countries should formulate and implement policies that enable universal access mechanisms via low pricing and sharing schemes and increase the infrastructure needed for ICT penetration (Asongu & Le Roux 2017:48).

Of all the continents, Africa has the youngest population. It is also the second largest and second most populous continent in the world. A younger population means greater potential for innovation and economic progress as well as a larger future workforce (Africa Union 2024). Therefore, it is essential that every nation has the AI skills necessary to prepare people for workplaces where human-AI collaboration is the norm (Africa Union 2024; Sanusi, Oyelere, & Omidiora 2021:5 of 10). The factors listed below in sections, prohibit South African schools from utilising computers for instruction and learning (cf. Lundall & Howell 2000).

Insufficient Funds

The educational and nonformal educational systems in Africa would have to be more generously funded and managed by people who understand how technology can be applied the best at minimal costs, since many African countries are still struggling in terms of national incomes (Oduaran 2019:35). Adult and distance learning in Africa would have to drift more rapidly towards ensuring that the continent has an easier penetration of technology into what is existing now. The personnel who plan and manage this goal would have to be provided with better equipment and technology in many parts of Africa (Oduaran 2019:38).

An Insufficient Number of Computers

Education challenges are mounting in Africa. These include limited access to quality education, language barriers, skills gaps, gender disparities, a lack of investment, political instability, brain drain, and global economic disparities (Adediran, Adedeji, Nwosu, Nwugo, & Nnamani 2023). In African countries one finds a limited adoption of technology in the education sector (Adeniran *et al.* 2023; UNESCO 2015). For instance, EdTech initiatives deployed by the Kenyan government largely exclude marginalised and vulnerable groups (Ngware & Ochieng 2020). This is attributed to the high number of students residing in rural areas without electricity or internet connection. This is a common experience in several countries in SSA. The effectiveness of EdTech for improving learning largely depends on supporting infrastructure, political commitment, digital literacy, and educator training. EdTech adoption is facilitated by the presence of key infrastructure, such as electricity and internet coverage.

While there has been progress in electricity coverage over the past two decades, less than half of the population in SSA is connected to an electricity supply, with lower rates in rural areas. For instance, only 47.7% of the population in Africa were connected to the electricity grid in 2018 (Ibrahim Forum Report 2021). Additionally, access to the internet and digital devices is also low on the continent (World Development Indicators 2022; UNICEF 2022). About 89% of learners in SSA do not have access to computers in their households, while 82% lack internet access, and around 20 million live in areas without mobile network coverage (Ibrahim Forum Report 2021). Consequently, innovation in EdTech is likely to have limited impact, especially among vulnerable groups (poor households and rural dwellers), since a greater fraction of these groups lack electricity and internet access.

There were several obstacles to overcome while using technology for online and technology-enabled learning (Song, Weisberg, Zhang, Tian, Boyer, & Israel 2024). The obstacles impede the thorough investigation and utilisation of technological prospects. Across nations, infrastructure, expenses, and a lack of technological expertise and abilities for both teachers and learners seem to be the most prevalent issues. In public institutions with inadequate physical facilities and infrastructure, this kind of bad infrastructure is typical.

Lack of Computer Literacy among Teachers

A common fact is that there are not enough individuals with the necessary expertise and abilities to operate AI tools. To develop an AI technology with good content, system, and service qualities, one needs a solid skill set; to implement the technology effectively, one needs sufficient product knowledge. These abilities go beyond fundamental technology understanding and could help with other issues like inadequate managerial expertise or even the creation of business concepts. According to Ade-Ibijola and Okonkwo (2023:111), AI tools need regular upkeep and upgrades, which necessitate specialist programming skills.

The lack of ICT literacy among most African educators makes the roll out of AI in education more difficult beside other factors. Teachers and learners are unable to produce data that are used to create and validate algorithms that inform instruction and other decisions when a sizable portion of them lack the hardware, software, and connectivity required to access and interact with digital learning platforms. There is a representational gap since those learners are from vulnerable groups (such as low-income households, learners with special needs, and learners from remote areas).

Insufficient Training for Subject Teachers to Include Computers in Classrooms

According to Lukose, Kantore, and Fosu (2023), one of the characteristics of the global information-intensive era of the 21st century is the incorporation of technology in the HE (higher education) teaching and learning environment. This has made technological skills, or e-skills, an implicit prerequisite for participation in the teaching and learning environment in IHEs. Access to the internet and technological devices are two of the major enabling factors for learners' e-readiness in embracing e-learning as an attractive tool. These abilities go beyond fundamental technology understanding and can help with issues like inadequate managerial expertise or even the creation of company concepts. According to Ade-Ibijola and Okonkwo (2023:111), AI tools need regular upkeep and upgrades, which necessitates specialist programming skills. Put another way, a business that wants to adopt AI technologies must have an internal engineer or a reliable supplier for upkeep and servicing. Therefore, to adapt, learn, govern, and use the technology in their respective fields of work, education leaders, other stakeholders, and members of the public who may be involved in the deployment and usage of any form of AI must acquire the necessary fundamental skills (Frans & Pather 2021). Teachers are also identified as influential others in the lives of respondents. Teachers in this context refer to those in the education profession who have contributed positively to the choices made by the young individuals during their schooling years. Accordingly, the evidence shows that teachers could substantially influence the decision-making of learners to adopt ICTs at school level.

Ruxwana and Msibi (2018) have assessed the readiness of South African universities to adopt BYOD (bring your own device) for education and have identified technological and organisational readiness factors as the major influencers for BYOD adoption. Once all the relevant sub-factors of technological and organisational readiness have been identified and assessed and are all in sync with the objectives of BYOD in education, an institution will be ready to adopt BYOD. Based on the outcome of the findings, there is only a partial readiness in South African universities to adopt BYOD, as notable barriers such as a lack of comprehensive policies for mobile device use, a lack of supporting infrastructure, and unclear strategies and support from top management are still lingering. It is imperative therefore that those universities consider these factors to be ready to adopt and implement the best BYOD policy successfully. In a similar study, Krönke (2020) who did research on open, distance, and e-learning in Kenya identified instructors’ lack of skills to teach online, insufficient electronic content, limited access to computers and the internet, and frequent electricity blackouts as common obstacles to distance and remote learning. Moreover, approaches to technology enhanced learning in HE have been slow to change and must often play catchup with emerging technologies used by learners, even in some of the continent’s wealthiest nations such as South Africa.

According to Tsegay (2016), education is a process of changing the behaviour patterns of learners. This implies using behaviour in the broad sense to include thinking and feeling as well as overt action. It is through this personal development that HE affects the national and global awareness of citizens. Despite many challenges, currently the situation is changing as many countries are focusing on ICT as a main tool of progress and an effective and efficient delivery of services in many sectors including education. Nonetheless, access to ICT and its integration in education differ from country to country and within the different regions and socio-economic statuses of the people. Rural areas and people with low socio-economic status have lower access than urban areas and the rich. Moreover, schools use ICT to supplement the teaching-learning by finding some materials mainly from the teacher's side. The study discovered that there is a mixed perception among people whether Africa could ensure all learners to have access to connected digital devices and a relevant and responsive digital learning environment by 2030. The situation is a challenge for many countries with the current level of progress, while many of the challenges which are critical for ICT development such as electricity will not fully be achieved by 2030. Tsegay (2016) found that the level of ICT in education in SSA is much lower than in the developed world. Besides, there are various issues such as food and other basic social services that the least developed countries have not yet fulfilled.

The Lack of Adequately Designed Computer Skills Education Curricula

Most African countries are struggling to develop curricula to teach the basic computing skills to both teachers and learners. According to studies, universal and equitable access for learners and teachers has not yet been achieved in both developed and developing nations (cf. Dieterle, Dede, & Walker 2022). This falls short of the objective of educational equity, which states that all learners should have access to the resources they require regardless of their gender, race, ethnicity, language, disability, sexual orientation, family background, or family income. Furthermore, the digital divide, which includes unequal access to technology and the internet as well as a gap between the 'haves' and ‘have nots,’ hinders learners’ and teachers’ abilities to collaborate and access information over time and distance. It also makes it harder for them to build social capital and get ready for success in a knowledge-based economy (Dieterle *et al.* 2022). This type of scenario represents most of if not the entire continent’s reality regarding technological developments (Dieterle *et al.* 2022). It must be noted that most African countries are still in need of basic requirements meeting the demand of education to their population, yet they are expected to embrace technologies which do not fall under their priority lists. This questions their readiness in implementing AI tools in their education systems.

Exorbitant Phone and Internet Bills

Software acquisition, installation, and replacement come at a high cost (Krönke 2020). Along with the lack of appropriate spaces or buildings to house the technology, most African nations still lack a dependable supply of electricity, telephones, internet services for online education, and access to computers in communities, schools, and universities (cf. Krönke 2020). It is not just difficult but nearly impossible to create AI apps for workplaces and schools that are equally comprehensible and accessible. Although it may be theoretically feasible, AI applications do not consider cultural differences, specific needs, or alternative learning paths because they are based on the data of the average learner (Kousa & Niemi 2022; Krönke 2020).

Limited Expertise and ICT Skills Levels

These skills go beyond fundamental technology understanding and can help with issues like inadequate managerial knowledge or even the creation of company concepts. This suggests that everyone involved, including the government, should create a system for training individuals from the very beginning of primary school until the professional level. Technology adoption and utilisation are hampered by a lack of technical expertise (Ade-Ibijola & Okonkwo 2023:111). There are several ethical issues with the use of AI technologies, especially when it comes to role, privacy, transparency, trust, personality, and culture. It is crucial to take user privacy into account when integrating AI tools into any area of life. Therefore, it is best to let people know if an intelligent machine is AI-capable so they may decide how to engage with the system.

The human-to-human interaction is not the same as the human-machine relationship. Users will understand and trust an AI system more if they are aware of its nature. When designing and developing AI technologies, it is important to consider the needs of various user groups, users, interests, characteristics, and contexts (Ade-Ibijola & Okonkwo 2023:111). Culture is a significant factor in ethics. It focuses on how people behave in social situations in a particular location. The multilingualism and cultural diversity of African countries may influence their adoption of technological innovation (Ade-Ibijola & Okonkwo 2023:111). Governments ought to accelerate the development of their infrastructure and network connectivity, particularly in Africa's rural areas. In addition, to guarantee appropriate AI system development, deployment, and acceptance in Africa, African governments and stakeholders – including the African mobile ecosystem – must set up well-organised rules and policies (Ade-Ibijola & Okonkwo 2023:111). For instance, the continent's digital literacy rate is 31%, according to the Afrobarometer (Krönke 2020), whereas its digital non-readiness score is 56.6%. The marginalisation of some demographic groups is another feature of the continent's low adoption of EdTech projects. In their research of ICT use in HE in India, Dixit *et al.* (2021) identified the main obstacles as ICT infrastructure, language and content, a lack of funding, and a shortage of qualified professional educators because most of the population lacked technological expertise.

Lack of an Enabling Policy Environment

When rolling out AI tools, policy becomes imperative to guide its implementation. The absence of any sound policy may jeopardise the whole process. Ethically, AI tools have been criticised for intruding into people's private lives (cf. UNESCO 2021a). In Africa where the literacy level is low compared to other continents, the application and the implementation of AI tools in education without a sound policy to protect the end-users may put both the teachers and learners at risk (König, Karrenbauer, & Breitner

2023). However, it should be mentioned that governments, academics, and students are begging for greater data privacy to receive less advertising. In practice, this means that users need to be urged to act responsibly and consider disclosing their personal information (König *et al.* 2023).

This section highlighted the challenges that currently face the continent's readiness for AI tool application in educational systems, specifically in schools. The following section offers possible solutions to those challenges identified above that Africa needs to tackle to realise the full potential provided by AI tools in education systems.

Overcoming Challenges

Investment in ICT Infrastructure

It is proposed that policymakers should focus their efforts on improving the continent's ICT capabilities, accessibility, and adoption. This can be achieved if entities engaged in the SSA agenda for prosperity, such as the ADB (African Development Bank) and the World Bank (2022) provide the support needed to complement different governments' efforts in advancing ICT penetration in the continent. Additionally, legislative actions are needed to help grow the continent's tech hubs to aid in the marketing of high-tech products, as well as to help establish patents so that the continent's young and innovative population may help build the continent (Africa Union 2024; Al-Maskari, Al Riyami, & Ghnimi 2023; Roger, Shulin, & Sesay 2022:12 of 17).

Literature suggests that both ICT development and innovation diffusion would foster sustainable economic growth in Africa. ICT development, innovation diffusion, and sustainable growth reinforce each other, and compared to innovation diffusion, ICT development is more effective in driving sustainable economic growth in SSA. Considering progress made by most Western and East Asian countries in recent times through ICT development and innovation, diffusion can offer and sparks confidence in promoting collective prosperity in Africa (Roger *et al.* 2022:12 of 17). First, ICT can offer policymakers concerned with the growth agenda of African countries, convincing means of addressing challenges associated with ICT infrastructural development to induce sustainable growth through enhanced ICT access, use, and skills. Innovation diffusion and ICT development show that making shared prospects in Africa may not just be about improving infrastructural investment, but an innovative ICT infrastructure that gears toward sustainable growth and transformation in the continent's education sector (Roger *et al.* 2022:12 of 17).

Gaffley, Adams, and Shyllon (2022) argue that the development of ethical principles and guidelines governing the usage of AI technologies that are formulated based on African values and standards may generate responsible AI perspectives that extend beyond common understandings of fairness, transparency, and accountability, to address the specific AI-related challenges experienced on the continent. Mangundu (2023) asserts that an AI embedment in HE's information systems is on the rise, leading to an improved provision of HE services. However, for its benefits, AI brings with it risks that need to be governed. The study further recommends an establishment of AI governance structures, processes, and mechanisms. By improving AI governance maturity levels, IHEs can manage AI risks and ensure that AI aligns to university strategies.

Training and Development

Despite the numerous efforts to promote diversity in the field of STEM (science, technology, engineering, and mathematics), African people are still under-represented in these fields. According to a report by the National Science Foundation (2017), only 13.4% of African people in the USA earned bachelor's degrees in STEM fields in 2017. This lack of representation has serious consequences, as it limits the pool of talent available in these fields and reinforces societal inequalities (Mbalaka 2023:382). IHEs face a challenge in adopting training and professional development, but these institutions and their professionals must be committed to integrating these resources into the classroom and supporting digital training for educators to equip them to take on complex IoT (internet of things) projects that will drastically alter the teaching-learning model to be more creative and in line with students' new realities. To guarantee the efficient and moral application of IoT in HE, these issues need to be proactively and thoroughly addressed. By conquering these challenges, educational establishments may utilise the IoT's potential to enhance instruction, learning, and the general student experience. This would help the African continent to prepare for the full introduction and integration of AI tools into their educational systems.

Building prediction models that recognise employment and skill patterns and provide retraining programmes for workers in jobs at risk from AI automation is advised (UNESCO 2021a). African countries are still struggling with providing quality education and employment creation for their youthful population; hence, the continent's readiness for AI technologies needs to be approached cautiously. It is necessary to determine the social costs of job automation and raise public awareness of the ensuing changes in the need for skills on a national and international level to benefit from AI tools in providing education to its population (UNESCO 2021a). Therefore, to deal with the methodical and long-term restructuring of the labour market, African governments must set a national priority on improving future-proof skills at all educational levels, offer choices for reskilling routes, and foster workforce resilience. According to UNESCO (United Nations Educational, Scientific, and Cultural Organisation) (UNESCO 2021), older workers should have extra protection because they could have a harder time picking up new skills and adjusting to new work settings. This involves encouraging training programmes to include a focus on how AI will impact every facet of the profession (cf. Soja & Soja 2020).

African governments must strive to harmonise their education and training and networks. The pace of the development of technologies is so fast, for instance, the time between the two generations of technology is much shorter than that for human life – recently, the switch from paper to digital technology, and from analogue phones to smartphones. Therefore, citizens and workers must adapt positively to these technological challenges. This means investment in continuous learning while creating social awareness about the importance, risks, and perspectives of new technologies (Molfino, Cepolina, Cepolina, Cepolina, & Cepolina 2023).

AI Ethics and Governance

What are the obstacles for IoT integration in HE? IoT technology adoption occurs when many elements are somehow in harmony with one another. To put it another way, integrating IoT can offer a lot of advantages, but there are also issues that must be resolved. Some of the elements or obstacles affecting the adoption of IoT in HE have been identified by this study.

The use of IoT technology in education has created a new learning environment that necessitates the integration of several technical resources in terms of infrastructure and connectivity. However, one of the biggest challenges for HE is that there are not enough smart devices in HE, which makes it difficult for them to create innovative and high-quality education (Veintimilla *et al.* 2018). IoT applications in HE have also brought additional security and privacy-related issues. As more smart devices are networked, institutions are more vulnerable to cyberattacks (Georgescu & Popescu 2015), which prompts the adoption of cybersecurity measures. The educational community is concerned about identifying who owns the data created, who uses it, and how they use it because many of the linked devices will gather student data, including their movements (Grama & Vogel 2016). As a result, a transparent privacy policy that outlines the collection, storage, and use of data obtained from IoT devices should be put in place.

Inclusive AI Policy Development

The inclusive AI policy development could help overcome the issues such as privacy invasion and mass data extraction that are synonymous with the application of AI tools in education. It is in the public domain that most of the African countries are yet to be included in the development of AI tools, which has hampered the continent's contribution to these technologies. AI tools are developed by multinational organisations based in the Western countries with no participation from Africa, whereas Africa forms a larger part of those multination's customer base. Anshari, Hamdan, Ahmad, Ali, and Haidi (2023) advise that organisations should apply the stakeholder theory which involves the relations between a business, individuals, and groups of people who can affect or are affected by the decisions. All stakeholders must be treated fairly. Hence, this theory would address challenges such as understanding the potential harms and benefits for groups or individuals, the effective management of stakeholder relationships that helps the survival or thriving of the business, as well as to create value and prevent moral failures in the case of AI tools in HE.

Development of AI in Curricula

Perhaps, this could be another factor worth considering that African governments should look at. First and foremost, HE curricula must incorporate AI-tools skills to implement the essential adjustments to educate students and educators for the future, guaranteeing their relevance to changing labour markets, economies, and societies across a range of disciplines and competencies (UNESCO 2021a). The African education sector must create programmes, courses, and credentials that offer knowledge and proficiency in the areas of AI creation, ethics, and technology operation.

However, African participation in both the design and development phases of technologies at international level has not been realised given that the multi-national companies who happen to own the technologies are home-based in the Global North (Western countries). Despite these obstacles, Africa should encourage the creation of educational resources based on good techniques and pedagogical research on AI (UNESCO 2021a). Due care though is needed when Africa develops such tools, first for the context for which such technologies will be developed, and second, their cultural and religious beliefs should form part of the development to avoid a possible backlash. Africa is home to millions of ethnicities with distinct characteristics and practices, a myriad of religions and cultures, which should not be ignored in the design and development phase of the AI technologies that can work for the continent's needs.

To develop local AI potential, HE and research institutions should receive support. A gender-based pool of experts with the know-how to design AI systems from a variety of socioeconomic backgrounds must be established, policies must be put in place to support HE and research institutions, and programmes to cultivate AI talent must be developed or improved (UNESCO 2021a). To encourage engineering firms to invest in retraining their employees in AI technology, the continent should think about creating executive master programmes. With potential protection against regional disparities in pay and benefits, AI companies should be encouraged to locate locally. By offering engaging intellectual challenges and a healthy work-life balance, as well as by 'incorporating fundamental concepts of data science and the ethics of data acquisition; using real-world data sets that require students to address privacy, fairness, and legal issues while developing AI solutions,' AI professionals can be retained. delivering ethics-related instruction in a variety of formats and at various times; 'ethics across the curriculum' serves as a model for doing this, but the idea is to consistently emphasise the importance of ethics, even in 'technical' courses (Borenstein & Howard 2021:64).

Developing Expertise and ICT Skills Levels

People should improve AI literacy in all spheres of society by implementing institutional measures; giving all Africans access to basic AI education will be necessary to prepare the continent's educational system. This education will teach people to think critically and responsibly about their rights, privileges, and choices considering AI and how it affects their daily lives (UNESCO 2021a). They ought to be educated on how to safeguard their privacy and manage their own information and choices. The continent may need to educate the populace about AI's limitations and the distinctions between it and human intellect to debunk the myths and hype surrounding the technology. Furthermore, new AI literacy abilities must be carefully incorporated with already-established fundamental abilities like media and information literacy. To avoid overburdening the curricula, it is also necessary to determine how the many necessary literacies can emerge.

Educators should experiment with and expand evidence-based approaches to using AI in the classroom. The first step in implementing AI in education is to support pilot testing and evidence-based informed adoption of technologies, such as chatbots, augmented and virtual reality tools, learning network orchestrators, dialogue-based tutoring systems, exploratory learning systems, automatic writing evaluation systems, language learning tools, AI-based artwork, music generators, and AI-based learning models (UNESCO 2021a). Adoption of AI tools that support diverse and open-ended exploratory learning settings must also be encouraged. As opposed to short-term or *ad hoc* plans, the use of AI in education must be integrated into long-term pedagogical plans to foster broad, transferrable abilities such as socio-emotional skills, meta-cognition, collaboration, problem-solving, and creativity (Gwagwa, Kraemer-Mbula, Rizk, Rutenberg, & De Beer 2020; UNESCO 2021a).

In the following section, we summarise the themes of this chapter based on the review of the related literature. As AI technologies keep on evolving, it is very difficult to precisely predict with certainty how the next new technologies will unravel educational systems on a global basis. For example, take the leap that the world is taking to I5R and E5.0, which is an improvement from I4R. Therefore, this chapter only highlights the current prospects of AI, with much speculation about its future application in the workplace, specifically education delivery and management. This is because much of the literature is based on secondary data, with just a few empirical studies available as the field of AI technologies still evolves.

Conclusion

The chapter highlights the prospects of AI tools in education, discussing the challenges and the strategies that African governments should consider implementing AI technologies in their education systems. The literature points out that AI tools can address the most complex public challenges facing society today including education, health, public infrastructure, agriculture, and security, all of which requires rigorous oversight from public officials procuring such solutions, as well as public transparency and accountability. Africa cannot afford to be left out in the race to apply AI tools in educational systems, therefore, it is imperative for the continent to acts with caution when embracing the technologies.

In this chapter we have summarised some of the notable prospects of AI tools in education as follows: First, that African governments should tap in on natural language processing which uses AI to automatically interpret texts, including a semantic thematic analysis used in translations, and for generating texts of learning contents, and supporting the personalisation process (Tables 1 and 2). The future world is predicted to be more complex on a technological level, hence the utilisation of AI tools in education not only provides students with personal experience, but also exposes them to the reality of the workplace requirements now and in the future. For AI to support education to fully realise sustainable development, all the possible prospects of the tools need to be identified and leveraged, and the risks acknowledged and mitigated (UNESCO 2021a). These AI tools can assist the continent to deliver and manage education to its youthful population.

Second, speech recognition covers spoken words and provides AI personal assistants inside games and intelligent tutoring systems, and conversational bots in learning platforms. Third, AI tools aid the delivery and management of education; learning and assessment; empowering teachers and enhancing teaching; and promote lifelong and life-wide learning in several ways. However, it should be noted that these prospects highlighted in this chapter are exhaustive enough as AI technologies evolve every day of our lives, hence its utilities cannot be based on what the current literature provides. We still expect both prospects and challenges of its application to educational systems to unravel in Africa.

Notwithstanding the prospects of the application of AI tools in the delivery of education and management, Africa must contend with the reality that such benefits come at a cost. First, AI tools require heavy investment in ICT infrastructure for its benefits to be fully realised and utilised for education in Africa.

However, this heavy investment in AI tools in Africa's educational systems may not be one of the continent's priorities. Second, the African development agenda priority is to provide health facilities, basic education, and clean safe drinking water to the continent's growing population. Third, with a very youthful population in the world, having an average age of 19 years, the continent needs to shift its attention to the provisions of essential amenities which may not fall within ICT's infrastructure.

The challenges concerning the application of AI tools in education in Africa are identified as low literacy rate, poor infrastructure, poor internet penetration, poor electricity supply, corruption, poor governance, among others, while other impediments are insufficient funds, insufficient numbers of computers, reliance on donor funding for almost every capital expenditure, a lack of computer literacy among the educators, a lack of subject educators to integrate computers into learning areas, an absence of properly developed curricula for teaching computer skills, limited expertise and ICT skills levels, high costs of telephone and internet, and a lack of enabling policy environment.

Many of the challenges highlighted above are found in most countries on the continent and seem to be similar if not the same. The continent needs to overcome these impediments before realising the full benefits of AI tools in education. Therefore, to overcome these challenges, we propose the following as suggested in the literature: Investment in ICT infrastructure, which includes internet penetration, a constant supply of electricity or alternative use of solar power in the remote areas, an increase in the broadband lines, training and development of both educators and students on the awareness and potential of AI tools in education, a formulation of AI ethics and governance, inclusive AI policy development, and a full-time availability of funds.

Following the discussion and issues raised in this chapter concerning Africa's readiness for AI tools in education, it becomes apparent that the prospects' weightage of the issues raised outweighs its benefits, hence making it difficult to tell with certainty the continent's ability as the AI technologies are not available in the continent of Africa. Therefore, this chapter summarises its case by cautioning educators and policymakers to pay due care before rushing to implement AI tools in education. Several claims are made by the advocates of AI tools about the potential of AI in education based on conjecture, speculation, and optimism (Nemorin 2021; Nemorin *et al*. 2022). AI is likely to create more inequities on how education will be delivered and managed, due to regional disparities within a member state country and inter-states, given that most of the countries have common challenges and a reliance on external funding for most of the continent's capital expenditure. Despite these challenges, Africa cannot sit back and watch others advancing but must strike a balance between various competing interests concerning other developments and the implementation of AI tools in their education systems.

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Chapter 10

Artificial Intelligence in Open Distance e-Learning Institutions in Sub-Saharan Africa: Quality Assurance Opportunities and Challenges

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Introduction

This chapter critically reviews the literature on the use of AI (Artificial Intelligence) with specific reference to ODeL (open distance e-learning) institutions in SSA (Sub-Saharan Africa). A critical review of the literature was conducted on works that explored the application of AI in education through the search of popular databases on previously published works. These were carefully evaluated, synthesised, and evaluated for their fitness, and then systemically presented. The chapter highlights the various quality benefits accrued from the application of AI applications in education. The integration of AI in ODeL systems is linked to quality assurance challenges and the integrity of assessments, and poses significant new challenges to research, policy-making, and institution governance. It also provides implications to researchers, businesses, politicians, and all users, including educators and other education stakeholders.

AI is a term that was predominantly used in science fiction but has recently found a space in our daily lives. UNICEF (United Nations Children's Fund) adopted the definition used by the OECD (Organisation of Economic Cooperation and Development), indicating that AI refers to machine-based systems that, given a set of human-defined objectives, make predictions, recommendations, or decisions that influence real or virtual environments (Penagos, Kassir, & Vosloo 2020:3). Soori, Arezoo, and Dastres (2023:54) consider AI as a branch of computer science that combines machine learning, algorithm development, and NLP (natural language processing). In basic terms, AI is the science of making machines that think like humans, but unlike humans, AI technology can process large datasets that surpass human capabilities (Collins, Dennehy, Conboy, & Mikalef 2021:11 of 17).

Akgun and Greenhow (2021:432) regard AI as the ability of a digital computer or computer-controlled robots to perform tasks commonly associated with intelligent human beings. It is thus a process of using computers and machines to mimic human perceptions, decision-making, and other processes to complete a task. Humans have been using machines to augment their capabilities for a long time, so it is only natural that humankind has arrived at a point where we are looking to replicate our cognitive processes in some of those machines. According to Sarker (2021:1 of 21), AI is a field of science that combines computer science to enable problem-solving. AI enables adapting machines to the student learning process (Kabudi, Pappas, & Olsen 2021:2 of 12). It assists in finding out what students do and do not know about their personalised study schedule considering the knowledge gaps. In this way AI tailors studies according to students' specific needs, increasing their efficiency (Seo, Tang, Roll, Fels, & Yoon 2021:2). In education, AI enhances learning outcomes and provides more engaging learning experiences (Kumar 2023:154). Although AI has recently become a buzzword, its impact on education is just beginning to be realised. It has now been positioned as a powerful tool to deliver knowledge that is organised and packaged by educators (Li, Bastone, Mohamad, & Schiavone 2023:2 of 8).

Pantelimon, Bologa, Toma, & Posedaru (2021:2 of 10) claim that the idea of using AI in education is not new, as the first AI programme in education was written in 1951. The tutoring systems that aimed to adapt to the needs of students was initiated in 1991 with a focus on teaching computers (Pantelimon *et al.* 2021:3 of 10). Though AI in education has become more popular during the last 10 years, this phenomenon has already started in the 1970s (Guan, Mou, & Jiang 2020:135). Even though AI is yet to be a standard cult in IHEs (institutions of higher education) it has been accepted to have the potential to be the next big thing in teaching and learning within universities (Chen, Chen, & Lin 2020:75270). Its impact will start from early childhood education to HE (higher education) up to corporate training (Tuomi 2018). It is expected that AI will yield positive results in improving students' experiences by offering them opportunities to create adaptive learning features such as personalised learning tools.

The use of AI in education allows for the application of technologies such as automated classroom classification, discussion robots, and NLP which help in improving feedback from educators through enhanced feedback (Martínez-Comesaña, Rigueira-Díaz, Larrañaga-Janeiro, Martínez-Torres, Ocarranza-Prado, & Kreibel 2023:97). The use of virtual tutors which is an AI development has ensured that students receive feedback quickly and adequately. For e-learning institutions, incorporating AI in e-learning offers enhanced accessibility and personalisation of education like streamlining grading processes, supporting instructors, and identifying potentially at-risk students. In the e-learning environment, AI refers to the use of trained models that can analyse student learning processes, recognise learning difficulties, and adjust course content accordingly (Kamalov, Santandreu Calonge, & Gurrib 2023:20 of 27). These models can also answer questions or provide learning materials in a variety of languages. The integration of AI into learning ranges from adaptive learning platforms that modify themselves to suit individual students, to chatbots that are available to answer questions around the clock.

AI-enabled online learning platforms can analyse individual student data including patterns, preferences, and strengths (Tapalova & Zhiyenbayeva 2022:640). With abundant AI options institutions must adopt appropriate ones that address their students' needs. AI inevitably spurs innovation thus making countries competitive (Holmes, Chakroun, Miao, Mendes, Domiter, Fan, Kharkova, Orr, Jermol, Issroff, Park, Holmes, Crompton, Portales, Orlic, Rodriguez, Kaur, & Assouline 2019:8), and when it comes to education it creates room for cooperation through information sharing (Akinwalere & Ivanov 2022:15). New digital technologies are creating a great revolution by transforming all aspects of education in teaching, learning, assessment, and feedback (Janardhanan, Rajamohan, Manu, & Rangasamy 2023:30).

AI in Africa

The quality of education is a concern for Africa, with many educational institutions experiencing a lack of basic amenities like libraries, laboratories, and computers. Musau (2018:10) laments that it is widely accepted that most of Africa's education and training programmes suffer from low-quality teaching and learning as well as inequalities and exclusion at all levels. Moreover, in most parts of Africa, there is an evident use of outdated teaching methods and curricula which block the development of critical thinking and problem-solving competencies among African students. The rapid uptake of disruptive technologies in Africa prompted speculations about whether AI applications will take root on the continent since many African countries lack the statistical capacity, infrastructure, and good governance needed for AI to take off.

As the world has produced the 4IR (fourth industrial revolution), AI as a technology within that space is expected to impact Africa in several ways (Neupane & Sibal 2021). For many African countries, the prospects of AI are thrilling since AI carries with it a keen anticipation of new technology and innovations (Onaolapo & Onifade 2020:8 of 9). For African countries, AI has the potential to usher in innumerable positive things. However, the dawn of AI in these countries carries fears of falling behind more developed economies than the eager anticipation of new technology. Against this backdrop, Africa is embracing AI uniquely realising that it has the potential to transform many of its key sectors such as health, education, and agriculture, among others. In Africa, many people are already utilising AI, developed in social networks, businesses, and health care (Okolo, Aruleba, & Obaido 2023:50). If meticulously planned AI can leverage African countries' economies by hinging on workers' productivity. For instance, in the era of AI, machines can be equipped to perform complex tasks rather than to rationalise several employees.

In the African educational space, AI can facilitate the access of students to educational resources and materials. Using online platforms and digital libraries powered by AI algorithms, students can have access to a wealth of educational content regardless of their geographical location. This means that AI systems can be beneficial to remote area students who lack access to physical libraries and learning materials. AI is not a panacea to all educational challenges faced by African countries but has the potential to address many of them by providing personalised learning experiences, improving access to educational resources for students, and supporting educators to provide quality education. As Holmes, Persson, Chounta, Wasson, & Dimitrova (2022:10) note, AI is increasingly having an impact on education, bringing opportunities and challenges.

AI and Quality Assurance in an Open and Distance e-Learning Space

During the 4IR era, online learning has increased the participation rate in HE (Penprase 2018:979), QA (quality assurance) is an important component of any educational institution's operations. Over the years QA practices have evolved from manual processes to incorporate dedicated software solutions. The invention of AI necessitated the revolutionisation of QA practices to achieve accuracy and efficiency, since with the utilisation of AI systems institutions can expedite several quality processes through reduced time. In reaction to both modern society and advances in technology, distance education has been provoked to rethink its educational programmes and provide innovative approaches to its teaching and learning practices by including cutting-edge technologies in educational environments as supporting tools in teaching processes in digital interactions (Jamalova, Aymatova, & Ikromov 2022:600).

Online learning is expected to offer significantly increased access to HE at a reduced cost. Despite the expected gains from online education quality remains a concern. QA in online learning is a highly strategic issue (Pannen 2021:122). In open and distance e-learning QA has become a universal concern to those involved in aspects of teaching and learning. By leveraging AI, institutions can uncover critical areas for improvement and enhance overall performance. In education, continuous improvement is a critical process that helps to ensure that students receive the highest quality education possible. AI-powered systems foster a culture of continual improvement through the collection of feedback from students. AI-powered chatbots offer a valuable tool for continuous improvement in education through the utilisation of data analytics. By analysing the data collected, IHEs can identify patterns, trends, and areas needing attention.

Innovative Applications of AI in Quality Assurance

According to Zawacki-Richter, Marín, Bond, and Gouverneur (2019:5), AI applications in education have been on the rise in the last 10 years, which made them attract a lot of attention. According to Yufei, Saleh, Jiahui, and Abdullah (2020:555), the typical scenarios in AI applications used in education include automatic grading systems, intelligent tutoring, adaptive learning, chatbots, NLP, and Chart GPT AI (chart generative pre-trained transformer artificial intelligence). AI's potential in QA extends beyond traditional assessment methods and curriculum design.

A critical advantage of AI-powered applications is how they democratise education by making better education available to more students thereby increasing social mobility and equity (Saltman 2020:200). With the use of AI in education high-quality learning resources are no longer confined to affluent schools and privileged students (Luckin, Holmes, Griffiths, & Forcier 2016:23).

AI applications enable inclusive and equitable access by offering standard and quality education to students irrespective of their location or financial status (Milanez 2023:78). AI applications offer personalised study materials, interactive lessons, and doubt-solving platforms. In this chapter, the following applications have been handpicked: NLP, automated grading system, ITSs (intelligent tutoring system), and ALSs (adaptive learning systems).

Natural Language Processing

NLPs are part of AI that leverages concepts and techniques from computer science and computational linguistics to cognitive psychology (Tyagi & Bhushan 2023:860). NLPs are used to enable computers to interact with human language more naturally and intuitively (Khan 2023:5). It encompasses various activities such as language translation, text classification, sentiment analysis, named entity recognition, and speech recognition. NLPs aim to develop models and algorithms that can understand and generate human language in a way that is accurate and contextually relevant (Otter, Medina, & Kalita 2020:610). NLP algorithms can process large amounts of data, including students' performance data, and find patterns that might improve students' learning efficiency. Through data analysis using NLP algorithms, educators can learn about areas where students need more help and create lessons to address those needs. NLP algorithms can be used to analyse assignments and written essays by providing valuable insights, critical thinking, coherence, and language proficiency. NLPs are useful tools for improvement by transforming the feedback process into an art by offering an in-depth analysis of students' textual data (Bauer, Greisel, Kuznetsov, Berndt, Kollar, Dresel, Fischer, & Fischer 2023:1230).

One technology that is gaining popularity in the education sector is chatbots. They constitute intelligent conversational agents capable of delivering adaptive learning experiences through NLP dialogues (Zhang, Fleyeh, Wang, & Lu 2019:239). Chatbots are AI-powered programmes that can converse with humans, providing them with information and assistance on a variety of issues. One of the most advanced chatbots currently available in Africa is ChatGPT (chat generative pre-trained transformer), which is an application that has been trained to generate human-like responses to questions and prompts (Naidu & Sevnarayan 2023:9 of 12). ChatGPT offers a variety of benefits to students.

At many IHEs chatbots support students by responding to inquiries, connecting students to course information and student services including sending out reminders (Essel, Vlachopoulos, Tachie-Menson, Johnson, & Baah 2022:15 of 19). The technology is always available to provide support and guidance to students (Lopez & Qamber 2022:18). It uses a machine learning algorithm to analyse student learning history and provide them with personalised recommendations based on individual student needs. The system has been designed to provide quick and accurate answers to student questions.

Automated Grading System

The impact of AI technology is pervasive in the ever-changing educational landscape, particularly with the development of applications that can automatically grade students' work and provide them with objective scores (Bozkurt, Karadeniz, Baneres, Guerrero-Roldán, & Rodríguez 2021:4). An automated grading system is designed to grade student's assignments, exams, and essays in a scientific computing way (Ramesh & Sanampudi 2022:2496). Through this system, a grade for a correct solution is automatically recorded. A student can also use this system to check the correctness of their programme assignments. An automated grading system uses machine learning to recommend grades for students, thereby automating grading and freeing academics so that they can focus on other duties (Weegar & Idestam-Almquist 2023:267).

The significance of AI-graded assessment in the education sector cannot be overstated. According to Kaipa (2021:20), traditional methods of grading where educators have to manually evaluate piles of assignments and exams have been a staple of educators for many centuries. However, with the new evolving technology, AI is poised to revolutionise this fundamental process by automating it, expediting the evaluation process and providing fast individualised feedback (Kamalov *et al.* 2023:14 of 27). AI-graded assessment is built on the principle of utilising AI algorithms to evaluate and grade assignments, tests, essays, and even open-ended questions (Owan, Abang, Idika, Etta, & Bassey 2023:4 of 15). AI-graded systems can streamline the grading process by providing instantaneous feedback, thereby improving the overall efficiency of assessments (Grivokostopoulou, Perikos, & Hatzilygeroudis 2017:220). These automated grading systems have considerably enhanced educational efficiency and consistency by giving students timely feedback and lowering educators' workload (Gordillo 2019:3 of 24). By automating grading, planning, and administrative work, AI systems can free up time for educators to concentrate more of their time on interaction with students.

The versatility of the automated grading system and its adherence to set criteria lead to a fair and standardised assessment. The incorporation of AI technology into the grading process is one of the many revolutionising innovations that stand out for their remarkable successes in altering the traditional assessment practice (Adiguzel, Kaya, & Cansu 2023:6 of 13). A whole new grading system has emerged because of the development of AI. An automated grading system powered by AI is positioned to overcome the drawbacks of the traditional grading system. This contribution to rethinking conventional approaches for evaluation and assessment of student performance provides a wealth of benefits to students and educators. AI-powered grading systems are altering how quickly examinations are graded.

Adaptive Learning Systems

Educational technology like adaptive learning platforms can customise learning activities and content in real-time. They constitute a broad paradigm aimed at tailoring educational experiences to optimise engagement, effectiveness, motivation, and access (Shah 2023:5 of 8). They are utilising intelligent technologies leveraging machine learning, AI, and advanced analytics. The concept of adaptive learning revolves around the idea that students have diverse backgrounds, learning preferences, and cognitive abilities (Kerr 2016:89). It personalises learning by continuously evaluating each student's performance in real-time, and ever-changing student learning paths directed by machine learning, thus increasing student engagement and satisfaction (Taylor, Yeung, & Bashet 2021:25). ALSs support students in acquiring knowledge and skills in a particular domain. The system enhances student learning to their comprehension speed, accuracy, quality, and quantity of learning (Wu, Chen, & Chen 2017:910). With an ALS, students can choose the speed and pace at which they work, hence they become more motivated to complete their work. An ALS uses data-driven instruction to adjust and tailor experiences to meet the individual needs of each student (Gligorea, Cioca, Oancea, Gorski, Gorski, & Tudorache 2023:5 of 27). They are capable of tracking student data such as their progress, engagement level, and performance and use that data to provide personalised learning experiences. The adaptive learning platforms analyse solutions to problem-solving tasks or even observe students while they interactively generate problem solutions. ALSs have been developed as a response to the recognition that students learn differently and that their comprehension of concepts varies. ALSs address differences in learning abilities by targeting teaching practices (Wang, Christensen, Cui, Tong, Yarnall, Shear, & Feng 2023:800). The use of ALSs ranging from technological programmes to intelligent systems can be used in a traditional classroom. Because of the customised nature of learning when using adaptive learning platforms students tend to feel that they have more control over their learning and therefore persevere in the programme tasks. Students also grow in confidence and show less academic dishonesty in their academic work. An ALS can allow students to either advance or remediate, and this capability makes it reputed for its potential to accord students' learning mastery (Dziuban, Moskal, Johnson, & Evans 2017:27). Because of its responsiveness, adaptive learning enables universities to accommodate demographically diverse student cohorts potentially levelling the education field (Dziuban, Moskal, Parker, Campbell, Howlin, & Johnson 2018:20). When using an ALS, underachievers gain the most from the supportive nature of the model and succeed in their learning to achieve their education goals. This is possible due to the personal learning plan offered by the adaptive learning programme. In this programme, students begin to realise control over their learning and authority over tasks (Kem 2022:387).

AI Powered Learning Games

The concept of game-based learning is that principles and game characteristics are associated with learning community prospects (Utsler 2021:186). Learning in the form of a game is one of the oldest and most useful pedagogical ideas that has been applied throughout the history of humankind (Ferreira, Gouin-Vallerand, & Hotte 2016:8 of 8). This activity promotes student involvement and engagement in the learning domains (Wagan, Khan, Chen, Yee, Yang, & Laghari 2023:7 of 12). Game-based learning refers to the use of videos and elements related to games, reading, content, and images in the educational process (Ge & Ifenthaler 2018:10). Educators have long recognised the value of play-based learning and have used it in computer games to stimulate and deliver targeted learning.

McLaren and Nguyen (2023:440) conceive AI-powered learning as a digital learning game which is an interactive, computer-based system in which users (players) engage in artificial activities involving fun, challenge, and fantasy where instructional and entertainment goals are part of the system. AI-driven gamification elements can transform learning into an interactive and enjoyable experience by incorporating game-like features such as rewards, achievements, and leaderboards. With the increased popularity of video games across all ages, digital-based learning can prove to be a valuable tool in energising students and encouraging active learning in the classroom (Nadeem, Oroszlanyova, & Farag 2023:4 of 23). However, Liu, Shaikh, and Gazizova (2020:55) note that game-based learning has limitations which include the complexity and labour intensiveness during its development and the difficulty of integrating the games into the learning process.

Intelligent Tutoring Systems

ITSs are emerging as a powerful tool in education, employing the capabilities of AI to provide personalised learning experiences. According to Lin, Huang, & Lu (2023:3), ITSs can be defined as computer-based educational systems that have independent databases or knowledge bases for educational content in addition to teaching strategies and aim to use conclusions about students' abilities to understand topics and identify their strengths and weaknesses. From this analysis, they can adapt the learning process dynamically (Chen *et al.* 2020:75265).

These are complex computer systems designed to provide immediate and customised instruction feedback to students without requiring instruction from a human educator. The software application tracks students' work, adjusting feedback, and providing hints along the way. ITSs are often dedicated to a single subject or language. They are designed to help students master difficult knowledge and skills by implementing powerful algorithms that adapt to the student at a fine-grained level and that instantiate complex principles of learning (Guo, Wang, Gu, Li, Wang, & Zhou 2021:450). They simulate the one-on-one experience of working with a human tutor. It has a common goal of enabling learning in a meaningful and effective manner by using a variety of computing technologies. It is an educational software tool that has an AI component in it (Alshaikh & Hewahi 2021:410). The AI component allows it to model students' psychological states such as motivation, emotion, and cognition, as well as their prior knowledge skills and preferences.

According to Li *et al.* (2023:2 of 8), ITSs can also monitor students' progress, provide feedback, hints, and scaffolding, and select appropriate problems or tasks for students to practise. Students who use ITSs have been found to perform better than those who use conventional methods of learning. This is because an ITS uses advanced algorithms to provide customised learning techniques for various students according to their needs and capacities (Akyuz 2020:954). They are developed and based on the notion that customised learning is more effective than traditional classroom teaching and learning.

Benefits of AI for QA in ODeL Institutions

The inclusion of AI in ODeL teaching and learning has attracted much interest, particularly the belief that AI has the potential to improve the quality of education in IHEs. AI has positively impacted the quality of curricula, teaching and learning, the quality of evaluations, and feedback from students and educators.

AI and Curriculum

Curriculum development is the backbone of the educational process, as it determines what students learn, how they learn it, and how their learning is ultimately evaluated (Haque & David 2023:10). It is imperative to ensure the quality and effectiveness of the curriculum in the rapidly evolving education landscape, as the advent of AI possibilities for enhancing QA in education has emerged. AI offers educators the opportunity to create and develop high-quality learning materials (Khosravi, Denny, Moore, & Stamper 2023:3 of 20).

By analysing vast amounts of data AI algorithms can identify knowledge gaps, update curriculum content, and recommend resources for teachers (Southworth, Migliaccio, Glover, Glover, Reed, McCarty, Brendemuhl, & Thomas 2023:4 of 10). This capability ensures that curriculum design adheres to accurate and up-to-date information, enabling educators to provide students with the most relevant and comprehensive learning materials. Curriculum creation and development used to be a tedious and time-consuming exercise, however, with AI entering the field of play, the situation has been upended. AI algorithms can continuously monitor and analyse educational data in real time. Using AI to track students' performance, engagement, and feedback can identify areas where the curriculum may be lacking or need updating (Owan *et al.* 2023:3 of 15).

AI can be used in the curriculum to provide opportunities for enhancing the evaluation of the quality of courses for their effectiveness. AI's predictive and analytic capabilities can be harnessed to inform curriculum design and decisions thereof (George & Wooden 2023:6 of 20). The other significant advantage of AI is its ability to tailor the curriculum according to the specific needs of each student. AI algorithms can analyse student data including learning preferences, strengths, and weaknesses to develop personalised learning paths for them (Seo *et al.* 2021:6).

AI and Accreditation

Accreditation is a formal recognition and approval granted by an authorised body or agency to an institution, programme, or organisation (Duarte & Vardasca 2023:3 of 19). It is an assurance that the institution entity meets specific standards and criteria set forth by the accrediting body. Accreditation is thus an acknowledgment of an educational institution's ability to carry out required educational tasks according to the set prerequisites by a regulatory authority. The purpose of accreditation in HE is to improve the quality of programmes and services and to assure public accountability (Van Jaarsveldt, De Vries, & Kroukamp 2023:47). Using AI, learning programmes and courses can be evaluated against international and national standards in preparation for their accreditation. Given the lengthy process of accreditation and the number of programmes including courses submitted for consideration to an accrediting body, the use of AI can expedite and simplify the process significantly. In the same way peer reviewers are trained on curriculum evaluation, AI systems are designed using data elements, evidence, rubrics, and decisions made by past reviewers to conduct accreditation assessments.

AI can be a transformative tool for institutions in managing the accreditation of programmes through automation. The integration of AI into programme accreditation offers an exciting frontier for IHEs. By harnessing the power of AI IHEs not only improve their operations but also elevate the quality and relevance of their programmes. Using AI the evaluation of courses and programmes according to international and national standards can be significantly simplified and expedited. For instance, the process of validating external education units for certification requires manual work, which is both expensive and time-consuming. Institutions can streamline this process by employing AI tools to automate key steps of the certification process. The use of AI in the certification process eliminates the need for manual review while saving a considerable amount of time and resources. AI algorithms can analyse the curriculum, assess its alignment with the accreditation requirements, and provide reports with detailed areas of compliance and those needing improvement.

The use of AI in accreditation assessment not only saves time and resources but also ensures a more objective evaluation process. AI can also be valuable in maintaining compliance when standards are strict. Through continuous monitoring and analysis, AI systems can ensure that programmes consistently meet the required standards (Brey & Dainow 2023:7 of 13). They can provide real-time feedback on compliance issues, helping institutions address potential gaps before they become significant challenges.

Personalised Learning

Personalisation is one of the biggest trends in education. Personalised learning is, however, not a new concept in education. According to Bhutoria (2022:2 of 18), the concept has been used interchangeably with terms such as matching or tailoring to recognise the heterogeneity of students with special challenges. Personalised learning is an educational approach that aims to customise learning for each student's weaknesses, strengths, skills, and interests (Shemshack & Spector 2020:8). This requires tailoring learning according to individual needs and prior experiences to allow every student to realise their maximum potential through customised instruction (Bernacki, Greene, & Lobczowski 2021:1682). It requires a digital learning environment to be adaptive to individual knowledge, experience, and preferences for it to be supportive of desired student outcomes.

Personalised learning is therefore a way of using AI that focuses on training that fits the needs of each student. With the use of AI, students have personalised approaches to learning. Traditionally it has followed a 'one-size-fits-all model' where all students were expected to learn in the same way and at the same pace. However, it is a known fact that students learn differently and at different paces. AI is very handy in circumstances like these as it bridges the gap by providing students with adaptive personalised learning experiences. AI-powered adaptive learning platforms can collect and analyse data about students' learning styles, progress, and performances (Akavova, Temirkhanova, & Lorsanova 2023:3 of 34). Based on such data the platform can adjust the content and develop methods that suit each student's needs, preferences, and their pace of learning. The major result of personalisation in education is the maximisation of motivation and creativity of students and educators alike through the implementation of individualised programmes, learning goals, and methods (Makhambetova, Zhiyenbayeva, & Ergesheva 2021:10). Personalised learning helps students to learn more efficiently and achieve better learning outcomes.

Access to Vast Resources

The use of digital technologies in education holds significant promise. When AI is applied to education, they have the potential to improve the quality and equity of learning by providing learners with limitless access to information resources (Božić 2023:9). Easy access to vast amounts of information reduces students' need for rote memorisation of facts and figures as they can readily access and retrieve such information. In the past students were often limited to materials that were made available in their institutions' libraries. However, with the advent of digital technologies students can now access a vast array of educational resources from anywhere in the world. AI-powered search engines such as ChatGPT help students to quickly and easily find relevant and high-quality educational content on a wide variety of topics (Javaid, Haleem, Singh, Khan, & Khan 2023:5 of 12).

Assistive technology, powered by AI can help students with special needs and educational requirements by offering them personalised resources and interventions to aid their learning. AI-embedded platforms can bridge the learning gap by providing educational resources to students in remote and underserved areas (Olanrewaju, Adebayo, Omotosho, & Olajide 2021:3 of 10). These tools offer access to a wide range of learning materials and courses thereby democratising education whilst promoting learning. Addressing the issue of inclusivity and equity through AI-powered systems creates and ensures an inclusive learning environment and equal opportunities for students' academic success (Abbasi, Davis, Heredia, & Camacho 2024:3).

Automated Evaluation and Feedback

Feedback has been recognised as a vital element of learning at all levels (Wisniewski, Zierer, & Hattie 2020:2 of 14). In addition to its potency feedback is also one of the mechanisms in courses that tailors what is a common programme to the needs of each student (Buckingham Shum, Lim, Boud, Bearman, & Dawson 2023:40 of 42). Automated evaluation is the ability of computer technology to evaluate and score written tasks. It is the feedback that is generated by AI-based software and delivered to students upon completion of a written task (Fleckenstein, Liebenow, & Meyer 2023:2 of 11). It provides immediate scoring and feedback on students' work (Zhai & Ma 2022:2820). Automated feedback addresses mechanical and structural elements like citation, academic style, grammar, and structure leaving educators to focus on high-order cognitive skills like comprehension and argumentation of concepts. It therefore focuses on low-order concerns making personalised feedback possible even for a large student cohort. The use of AI-powered systems is enabling the ease of collection of big data. The sophistication found in learning analytics provides just-in-time information (Atherton, Shah, Vazquez, Griffiths, Jackson, & Burgess 2017:123). This allows data from digital teaching and learning experiences to provide valuable insights for prompt and accurate decision-making (Martínez-Comesaña *et al*. 2023:95).

AI-powered assessment tools provide numerous benefits, including improving the accuracy and efficiency of assessments and generating personalised feedback for students (Owan *et al*. 2023:13 of 15). The generation of automated assessments and feedback enables educators to adapt their teaching strategies to meet the needs of students. AI algorithms can also automate the evaluation of programmes and courses thereby reducing the time needed for educators and administrators to undertake such exercises. Depending on the configuration of the automated evaluation system it can support teaching and learning by enabling interactions between the technology, students, educators, and peers (Wilson & Roscoe 2020:89). It encourages students to participate in the active-reflective process in which they actively improve their work instead of relying on the tool to correct their work (Cherepinsky 2011:298).

AI and Predictive Analytics

AI is very effective at performing predictive analytics because it collects, organises, and analyses data quickly. AI predictive models can generate solutions to challenges or tasks using complex algorithms within a matter of minutes. It provides foresight and vision for the future that can help to improve learning effectiveness and prompt remedial, timely, and appropriate actions (Sghir, Adadi, & Lahmer 2023:8300). Predictive analytics is a branch of advanced analytics that makes predictions of outcomes using historical data combined with statistical modelling, data mining, techniques, and machine learning (Kumar & Garg 2018:31). It is used to predict future events.

IHEs use predictive analytics to find patterns in the data to identify tasks and opportunities. In IHEs predictive analytics can be used to predict learning behaviours or performances based on past patterns and trends (Sghir *et al.* 2023:8310). Consequently, educators can provide timely and precise interventions, potentially averting academic setbacks, and fostering more supportive learning environments (Ifraheem, Rasheed, & Siddiqui 2024:255). Predictive analytics can be used to build predictive models that forecast student success and retention (Essa & Ayad 2012:62). If the platform notices a trend that could indicate a student is at risk, it notifies the student support team. Predictive analytics can help educators to streamline grading and assessment processes, saving time, and allowing the educators to focus more on their research (Igbokwe 2023:303). It can also assist educators in analysing data to make informed decisions about their teaching and students learning. This predictive analytic capability is critical in helping students improve their academic performance by providing them with personalised learning experiences. This can make students learn more effectively and efficiently, leading to student engagement, motivation, and ultimate satisfaction.

As an important component of AI, predictive analytic models and providing feedback to the instructors and students have become critical (Ouyang, Wu, Zheng, Zhang, & Jiao 2023:5 of 23). For example, AI-powered systems can identify at-risk students at an early stage of their learning and suggest the needed support systems and intervention strategies they might require (Baneres, Rodriguez-Gonzalez, & Serra 2019:255). Traditional methods of addressing effective student retention have limitations in the early identification of at-risk students and in providing effective interventions (Villegas-Ch, Govea, & Revelo-Tapia 2023:15 of 20). AI has been used to analyse large-scale data sets to identify at-risk students and to provide personalised interventions (Ikram, Fiaz, Mahmood, Ahmad, & Ashfaq 2021:2 of 12).

Challenges Posed by AI for QA in ODeL Institutions

Integrating AI in education has sparked a dynamic discussion about potential gains and drawbacks (Viljoen 2023). Challenges posed using AI may emanate from privacy concerns, ethical considerations, and AI's potential to preserve existing biases.

Ethical Concerns

Another important challenge that is encountered when implementing AI in the educational system is the issue that concerns ethics and transparency in data collection and use. The advent of AI has heightened concerns about data protection and privacy. Aldoseri, Al-Khalifa, & Hamouda (2023:15 of 33) notes that as explainable AI technologies become more advanced, there is a risk of generating explanations that may be misleading and biased leading to potentially harmful consequences. The use of AI in IHEs requires the collection and analysis of student data. While the benefits of AI are promising, students and instructors may perceive an indiscriminate collection and analysis of their data as an invasion of their privacy (Seo *et al.* 2021:15). The integration of AI in education raises ethical concerns as AI relies on data for it to function effectively. Holmes *et al.* (2022:506) also note that as with any transformative technology, some AI applications are bound to raise ethical and legal questions related to liability or potentially biased decision-making. AI has the potential to infer sensitive information such as student location, habits, and preferences and it poses a risk of unconsented data dissemination (Manheim & Kaplan 2019:120).

The use of AI in learning raises ethical issues that must be addressed. Bias in algorithms used by AI systems is a significant concern as programming can result in biased outcomes or the promotion of certain ideologies without transparency (Silva & Kenney 2018:13). When educators and students interact with generative AI systems their conversations and personal information might be stored and analysed, posing a serious risk to their privacy. With public AI systems educators should refrain from submitting sensitive details about their colleagues or students including but not limited to private communication, personal identifying information, health records, academic performances, emotional wellbeing, and financial information (Chen, Wu, & Wang 2023:8 of 33). The deployment of AI in education also raises concerns about accountability (Memarian & Doleck 2023:5 of 12). For instance, it might be unclear why an AI system has made specific recommendations, how it arrived at a certain decision, and a particular assessment result. This makes it difficult to hold the system accountable for its actions and decisions. Educators and policymakers must carefully consider these concerns when implementing AI in teaching and learning. Students must be fully informed about the data being collected, how it is used, and who has access to it.

Academic Integrity

As technology continues to evolve, the use of AI in academic settings has become increasingly common. According to Kier and Ives (2022:1 of 19), maintaining academic integrity has always been a critical concern for educators and instructors, but in a digital atmosphere where digital technologies are being used, this challenge has since multiplied. The concerns with academic integrity increased since the shift to online learning that was necessitated by the advent of the COVID-19 pandemic (Ives & Cazan 2024:120). This is so because of the ease of accessing information and the apparent availability of various AI applications.

Nilsson (2016:5) contends that with the advent of digital technologies, cheating, plagiarising, and colluding students are attracting a lot of attention. Technology is thus acting as a double-edged sword since it aids learning but at the same time promotes cheating (Zainuddin 2024:2). AI in education can lead to unintended consequences, making the bad worse and the good better. Some of the AI-powered applications can inadvertently perpetuate behaviours that compromise academic integrity technologies like ChatGPT that can generate text that closely mimics human-generated content. Students may use these convenient technologies to complete assignments, essentially outsourcing their thinking process to a machine. It is therefore important to establish guidelines and mechanisms for ensuring that the use of AI is both ethical and effective. This is important because information generated by AI can be inaccurate or misleading, a fabrication of research, faking sources, and not attributing work to their authors. AI can thus obscure the students' lack of comprehension of a particular subject matter. In response to this challenge, solutions are being developed to safeguard academic integrity. The development of tools to detect AI-generated content has become an urgent need in many fields including education (Uzun 2023:45).

There are available AI tools used for preserving the sanctity of student assignments by monitoring remote student work closely. Such tools enable educators to assess student assignments with their rubrics online. The instructor can keep track of both analytics and student engagement, and answer any questions that may arise (Owan *et al.* 2023:4 of 15). The AI-generated content detection tools will ensure the authenticity and credibility of the content and that issues about plagiarism and academic integrity are addressed (BaHammam, Trabelsi, Pandi-Perumal, & Jahrami 2023:155). Therefore, while AI poses a challenge concerning academic integrity it can also be an integral part of the solution (Cotton, Cotton, & Shipway 2023:5 of 12). For instance, plagiarism software can evolve to identify AI-generated content by analysing patterns, syntax, structures, and other unique markers. Parallel to fighting the ills of AI in academic integrity could be continuous education on academic integrity by emphasising the value of original thinking and creation and speaking against an undue reliance on AI.

Balancing Automation with Human Interaction

AI has revolutionised humans' interaction with technology, making their lives more efficient, convenient, and even more interesting (Füller, Hutter, Wahl, Bilgram, & Tekic 2022:1 of 22). In an era marked by rapid technological innovations, the juxtaposition of AI and human interaction is a prominent subject of discussion (Lee, Kavya, & Lasser 2021:5). As IHEs continue to adopt digital information, they must find a balance between automation and the human touch for optimal results. While AI offers efficiency it cannot replace the invaluable human interaction provided by educators, therefore striking a balance between technology and personal interaction is crucial for a well-rounded education.

There is much more to consider on the human side of digital transformation and automation than simply implementing new software and its associated processes. Achieving harmony between AI, automation, and human interaction requires a strategic approach and an adaptive mindset (Davenport, Guha, Grewal, & Bressgott 2020:26).The key to harnessing the full potential of AI while preserving the value of human interaction lies in striking a balance between the two. This can be achieved by, among others, using AI-powered applications whilst preserving human support for complex and emotionally sensitive issues. AI can also be designed and encouraged to handle repetitive tasks while humans focus on innovation, creativity, and tasks requiring EI (emotional intelligence) (Nandan, Arya, Binjola, & Chaudhary 2023:458). The other way to achieve a balance or harmony between automation and human interaction is by combining the data analysis capabilities of AI with human expertise to make well-informed decisions (Trunk, Birkel, & Hartmann 2020:883). This goes to show that AI and human interaction are not necessarily opposing forces but can complement each other to create a harmonious digital environment.

High Costs of Implementation

Implementing AI is an ambitious undertaking with serious financial implications for the institution. While AI systems are beneficial to the organisation it is critical to consider expenses associated with its adoption. The maintenance of technological devices employed in AI can be very expensive (Sjödin, Parida, Palmié, & Wincent 2021:577). There are many costs associated with implementing AI tools. These costs include hardware and software costs, labour costs, and training and maintenance costs. Adopting AI technologies can be very expensive in terms of initial investments or ongoing maintenance. One of the expenses in implementing AI is the cost of acquiring the necessary technology and infrastructure (Mun, Housel, Jones, Carlton, & Skots 2020:85).

Moreover, customisation and integration costs may rise when adapting AI systems to fit an institution's specific needs. The implication of integrating AI into the education system means that the budget for the institution must increase. Institutions that cannot cope with the costs will be left behind and will lose the opportunity to adopt the use of AI to enhance their operations and their teaching and learning (Ahmad, Han, Alam, Rehmat, Irshad, Arraño-Muñoz, & Ariza-Montes 2023:6). IHEs often need to allocate significant resources to integrate AI effectively, which can be challenging for those with smaller or limited budgets. The high cost of deployment and a lack of skilled workforce are some of the key factors hindering the implementation of AI in education (Abioye, Oyedele, Akanbi, Ajayi, Delgado, Bilal, Akinade, & Ahmed 2021:5 of 13). Employees need to be trained on how to effectively use AI systems and integrate them into their workflows.

Limited Ease of Accessibility

AI-powered education technology has the potential to improve access and inclusivity for students with disabilities or other learning needs. However, there is a risk that AI-based systems in education will not be accessible to all students which could potentially contribute to already existing inequalities (Williamson 2023:3 of 8). AI systems can adversely impact students' abilities to access educational services because not all students have access to computer devices and the internet. This imbalance could accelerate the gap between students from different economic backgrounds.

Moreover, if AI algorithms are biased their decision-making processes may inadvertently discriminate against certain individuals or groups (Varsha 2023:3 of 9). For instance, if an AI-powered system used for admissions is designed and trained on biased historical data it may disadvantage students from under-represented backgrounds or those attending IHEs with fewer resources. This can perpetuate inequities or hinder social mobility (Zajko 2022:5 of 16). Furthermore, in developing countries, resources that are utilised in the implementation of AI are scarce or not easily available. There is a huge concern regarding the availability and reliability of internet connections in the developing countries. Additionally, modern-day gadgets and devices that support the effective functioning of AI applications such as smartphones are not readily available. The resource constraints experienced by many African countries act as a detrimental factor to the adoption of the necessary AI needed to enhance the quality of education (Jaldi 2023:20 of 25). This means that AI systems can contribute to limiting access to educational opportunities for students in different geographical locations.

Educators' Digital Competencies

The term 'digital literacy' denotes a set of skills needed for one to live, learn, and work in a society where people need to communicate and access information through digital technologies such as internet platforms, social media, and mobile devices. Since its inception, AI, as well as its development and integration have been concentrated within the Global North (Acosta, Riordan, & Jarrín 2023:7). This concentration has created a disparity that has limited the ability of AI applications to be effective and not being able to operate in a functional manner that does not compound existing inequalities (Okolo *et al.* 2023:40).

Digital skills literacy is a significant barrier to the adoption and implementation of AI in Africa. It must be stated that in developing markets such as Africa, AI-ready workers are scarce, posing a major issue (Ade-Ibijola & Okonkwo 2023:106). According to the IFC (International Finance Corporation) LEK (Lawrence, Evans, and Koch) Consulting (2019:36), globally SSA has the lowest percentage of citizens equipped with digital skills equalling to about half of the average level of digital adoption status globally. According to Falloon (2020:2451) as well as Dwivedi, Hughes, Ismagilova, Aarts, Coombs, Crick, Duan, Dwivedi, Edwards, Eirug, Galanos, Ilavarasan, Janssen, Jones, Kar, Kizgin, Kronemann, Lal, Lucini, Medaglia, Le Meunier-FitzHugh, Le Meunier-FitzHugh, Misra, Mogaji, Sharma, Singh, Raghavan, Raman, Rana, Samothrakis, Spencer, Tamilmani, Tubadji, Walton, & Williams (2021:9 of 97), although institutions implementing AI claim to provide training to their employees, a shortage of appropriate skills remains a major barrier to AI adoption. AI skills are more difficult to master and there is undoubtedly a demand-supply imbalance in the market (Jaldi 2023:7 of 25).

A major part of educators' responsibilities is to create meaningful learning environments to deepen students' learning experiences and boost their capabilities. However, some educators may not be digitally ready to use AI-driven educational applications for teaching and learning purposes (Ally 2019:303). They may not be familiar with these novel technologies to facilitate aspects of their teaching, in terms of technical and other broader aspects such as communication, collaboration, and other multidisciplinary skills (Ng, Leung, Su, Ng, & Chu 2023:141).

Reduction of Staff

AI's ability to complete routine tasks raises worries about job displacement for occupations previously deemed impervious to automation. The potential of AI in education is exciting but also poses significant challenges for the future of the teaching profession. According to Tuomi (2018:2), as educational systems tend to adapt to the requirements of the industrial age, AI could make some functions of education obsolete and emphasise others. For example, as AI becomes more advanced the role of educators will shift. Educators will become more focused on high-level tasks such as lesson planning and student engagement, while AI systems will proceed with the administrative and grading tasks.

As AI becomes sophisticated it could potentially replace human labour in a range of sectors leading to job losses (Khogali & Mekid 2023).

AI has the potential to automate various tasks, which can lead to business efficiency but also to job cuts (Dwivedi, Kshetri, Hughes, Slade, Jeyaraj, Kar, Abdullah, Baabdullah, Koohang, Raghavan, Ahuja, Albanna, Albashrawi, Al-Busaidi, Balakrishnan, Barlette, Basu, Bose, Brooks, Buhalis, Carter, Chowdhury, Crick, Cunningham, Davies, Davison, Dé, Dennehy, Duan, Dubey, Dwivedi, Edwards, Flavián, Gauld, Grover, Hu, Janssen, Jones, Junglas, Khorana, Kraus, Larsen, Latreille, Laumer, Tegwen Malik, Mardani, Mariani, Mithas, Mogaji, Nord, O'Connor, Okumus, Pagani, Pandey, Papagiannidis, Pappas, Pathak, Pries-Heje, Raman, Rana, Rehm, Ribeiro-Navarrete, Richter, Rowe, Sarker, Stahl, Tiwari, Van der Aalst, Venkatesh, Viglia, Wade, Walton, Wirtz, & Wright 2023:5 of 63).The use of AI can lead to job losses for educators who could be replaced by automated systems and robots. The use of robots can therefore result in a decrease in jobs available for qualified educators. While AI has the potential to enhance productivity and create new job opportunities it also poses challenges and causes disruptions in the labour force (Zirar, Ali, & Islam 2023:10 of 17).

With the automation of tasks, there is a possibility of humans being replaced by machines and robots (Acemoglu & Restrepo 2018:5). The use of AI technologies will impact jobs soon as most jobs get automated especially when humans will be expected to work together with robots in ways that were never imagined before (Poba-Nzaou, Galani, Uwizeyemungu, & Ceric 2021:65). Although AI can automate certain administrative tasks and provide personalised learning experiences, it cannot replace human qualities. According to Haladjian and Montemayor (2016:215), despite their breathtaking capabilities, AIs cannot replicate the attributes of emotion, compassion, and ethical judgement. AI lacks the depth of emotional understanding and subjective interpretation of human beings concerning their subjective endeavours. According to Kerasidou (2020:246), in the realm of human touch where the ability to incorporate diverse perspectives are intrinsic to artistic expression are emphasised, AI is found wanting. Therefore the notion that AI will completely replace educators needs to be approached with scrutiny and analysis (Ghamrawi, Shal, & Ghamrawi 2023:4).

Algorithmic Bias

The term 'algorithmic bias' has been applied to a variety of unfairness in automated systems (Baker & Hawn 2021:3). According to Gaskins (2023:418), algorithmic bias refers to algorithms that produce results that are systemically prejudiced due to erroneous assumptions in the machine learning process. It stems from biases held by people who design or train AI, and machine learning systems (Idowu 2024:3). While the design and training can increase the unfairness, biases often come from the data itself capturing historical prejudices, cultural stereotypes, or demographic disparities (Yu, Li, Fischer, Doroudi, & Xu 2020:298).

AI systems are not immune to bias, and they can perpetuate or amplify existing social inequalities (Igoe 2021:10). Algorithmic bias is the discrimination of one group over another due to recommendations or predictions of a computer programme. According to Jimenez and Boser (2021:4), bias occurs when students' inputs are misinterpreted and in turn misevaluated and then scored differently. Given how fast computer programmes operate they can apply bias more quickly and efficiently than humans can. Since AI is trained on data, the underlying data could be implicitly or explicitly biased (Marinucci, Mazzuca, & Gangemi 2023:748). If data contains biases the results will also contain biases. Algorithmic biases have been detected and documented in situations ranging from the prediction of student dropout rates (Anderson, Boodhwani, & Baker 2019:490) to the prediction of students failing a course (Hu & Rangwala 2020:435; Kizilcec & Lee 2022:178). In the face of algorithmic bias, organisations can make attempts to mitigate this bias through a variety of ways. They can promote an awareness and educate designers and users about the implications of bias in technology. The creation of more education and awareness about algorithmic bias can effect necessary change. Furthermore, organisations can actively work towards inclusive data collection, ensuring that diverse perspectives are represented, and data are thoroughly evaluated for potential bias. Regular audits and assessment of algorithms can serve as a tool in identifying and rectifying biases.

Assessment Change

AI not only introduces opportunities but also challenges assessment practices (Swiecki, Khosravi, Chen, Martinez-Maldonado, Lodge, Milligan, Selwyn, & Gašević 2022:2 of 10). A primary challenge that needs attention before educators can apply AI in assessment is their lack of knowledge and skills relevant to AI techniques as well as their access to big data (Su, Ng, & Chu 2023:6 of 14). Just like all technologies, AI-based systems suffer from technical difficulties and glitches. These may disrupt the education process, causing students to lose valuable learning time. When it comes to assessments, if an AI system crashes during a crucial examination slot, it could result in impacting negatively on the student's performance and their grades.

In the present and emerging AI context, the allocation of marks and grading in both formative and summative assessments are becoming increasingly challenging. There is only a limited collaboration and transparency between educators and students, as well as among students mutually. The rise of AI has prompted IHEs to depart from traditional assessment practices to online and automated assessment methods. Such a transition affects the quality of assessment. The use of AI applications may cause a significant risk if used by students completing their qualification assessment. Applications such as chatbots may produce answers that seem correct but are incorrect and biased (Kooli 2023:11 of 15). AI applications have been found to produce not only biased answers but harmful and dangerous answers to questions and can also produce fake references to books and articles by real or fake authors.

AI-generated text provides quick solutions to assessment-based questions. However, an overreliance on this easy way of completing assessments can negatively impact students' high order thinking capabilities (Farhi, Jeljeli, Aburezeq, Dweikat, Al-shami, & Slamene 2023:6 of 8). It can also hinder the development of other important competency skills such as critical thinking, problem-solving, and other essential skills. At present technology-based assessments provide immediate and precise descriptive feedback relating to student performance, enabling both diagnostics and differentiation of instruction (Bulut, Cutumisu, Aquilina, & Singh 2019:3 of 16). However, the usual concern with technology-based assessments is that they can be done by other sources rather than by the students themselves, and the use of AI takes this concern to a different level.

Opportunities Created by AI for QA in ODeL Institutions

Assessment

AI in assessment is transforming education by automating grading and feedback processes. In the world of education where innovation is key to staying ahead, AI-powered tools for e-learning are emerging as transformative forces in the field of assessment (Pratama, Sampelolo, & Lura 2023:353). One such area experiencing changes is in e-learning assessments. AI-based techniques have been developed to automate parts of the traditional assessment practice partially or fully. AI has the potential to improve the way students receive assessment feedback by bringing a new level of authentic assessment, accessibility, inclusion, and automation (Richardson & Clesham 2021:5). AI can generate assessment tasks, find peers to grade work, and automatically grade student work. These techniques offload work or tasks from humans to AI making assessment practices more feasible to maintain (Swiecki *et al*. 2022:4 of 10).

AI-driven assessment ensures that students are evaluated based solely on the quality of their work, fostering a more equitable learning environment. AI systems can identify individual student strengths and weaknesses and tailor feedback to address specific areas needing improvement (González-Calatayud, Prendes-Espinosa, & Roig-Vila 2021:5 of 15). AI systems render more accurate, unbiased, and constructive feedback which can lead to more effective learning, motivation, and growth in the mindset of students.

Increase in Productivity and Efficiency

The gradual integration of AI technologies into complex tasks has the potential to significantly impact productivity across a wide range of activities (Gao & Feng 2023:4 of 21). AI technologies use the power of automation to enhance productivity and improve efficiency. The integration of AI into HE offers promising outcomes, including personalised education, automation of administrative tasks, and improved efficiency. By automating time-consuming tasks institutions can free their employees from the menial administrative tasks so that they could focus on more critical and strategic aspects of their jobs. According to Czarnitzki, Fernández, & Rammer (2023:190), the pace and scope of a groundbreaking development in AI technology can substantially change organisations' production methods thereby affecting their productivity. With AI individual students' needs can be addressed leading to increased efficiency in the education system. AI technologies can gather and process large amounts of institutional data thus generating wholistic insights from these data points.

Promotion of Inclusivity and Accessibility

AI has emerged as a powerful tool for making online content accessible and inclusive. It can help remove many of the barriers that people with disabilities face, allowing them to easily and freely access information and ideas. AI technologies can create inclusive and accessible educational materials, platforms, and tools for individuals with disabilities, ensuring equal access to education and promoting an inclusive learning environment (Salas-Pilco, Xiao, & Oshima 2022:8 of 17). The field of AI is continuously advancing, with researchers and developers exploring new ways to leverage AI to improve accessibility for individuals with disabilities.

Designing inclusive experiences is essential to building a user-centric and fair society in the modern-day digital era

(Apostolidou & Fokaides 2023:5 of 16). AI technology is rapidly advancing, creating new opportunities for improving accessible technology and diversity design. There are AI technologies developed specifically to enhance accessibility for individuals with disabilities. One such technology includes speech recognition software which converts spoken language into written text, allowing individuals with mobility impairment or conditions such as dyslexia to interact with computers through speech (McCollum, Nation, & Gunn 2014:11 of 13) and a screen reader which uses AI algorithms to convert on-screen text into synthesised speech or braille output (Mukhiddinov & Kim 2021:6 of 31). They enable individuals with visual impairment to access digital content. These are just a few of the technologies that enhance accessibility, particularly for students with disabilities. These technologies aim to provide equal opportunities and improve the quality of life of people with disabilities. AI is used to promote inclusion rather than reinforcing existing disparities and inequalities. By leveraging AI capabilities IHEs can create inclusive environments and provide equal opportunities for everyone irrespective of their abilities.

Research Support

The role of AI in academic research has garnered attention from the information community in recent years (Collins *et al.* 2021:2 of 17). This transformative technology powered by machine learning algorithms and data analytics is revolutionising the research landscape. By using AI for research purposes both students and academics will find the information they need for their studies quickly with abundant data, thus enriching the quality of their research output (Crompton & Burke 2023:4 of 22). AI tools can be used to sift through large data sets to identify patterns, build models, recommend articles, and prepare manuscripts for publication (Sarker 2021:4 of 21).

AI can assist researchers in the discovery and synthesis of information from vast amounts of existing research papers and patents, finding relevant literature and other academic sources. This can help to identify research gaps and relevant literature and generate new insights. AI has the potential to accelerate the pace of scientific discovery and enhance the quality of research outputs by enabling researchers to process vast amounts of data, extract meaningful insights, and automate repetitive tasks. As AI evolves, researchers need to adapt and embrace this powerful tool while also being mindful of its limitations and ethical considerations. By striking a balance between automation and human ingenuity researchers can unlock new possibilities, advance scientific knowledge, and contribute to the transformative potential of AI in the realm of academic research.

Over the years the ability of researchers to generate and store data has increased tremendously causing data deluge (Munshi & Mohamed 2017:370). Sometimes this made it difficult for researchers to analyse this vast amount of data for patterns and insights (Sivarajah, Kamal, Irani, & Weerakkody 2017:265). Given the deep learning techniques, AI algorithms play a critical role in making research work easy for data collection and analysis (Soori *et al.* 2023:56). The use of AI algorithms is applied to analyse large amounts of data sets and identify patterns, correlations, and trends that may not be easily recognisable by humans alone. According to Malik, Pratiwi, Andajani, Numertayasa, Suharti, Darwis, & Marzuki (2023:3 of 11), AI algorithms can help suggest relevant research papers, conferences, or potential collaborations in academia based on researchers' interests and previous work.

Reduction of Teaching Load

Reducing the teaching load for academics has been a long-lasting challenge for educationists, hoping to achieve more effective teaching in the classroom by empowering and having them focused more on teaching than the surrounding activities (Chaudhry & Kazim 2022:160). With the emergence of focus on online learning education and the emergence of new tools to facilitate online learning, there is a need for educators to adapt their teaching strategies to these new changes. Celik, Dindar, Muukkonen, and Järvelä (2022:620) assume that a reduced teaching load is another advantage brought about by the emergence of AI systems in education.

Educators could benefit from AI tutors thereby saving them time for other activities. AI can therefore be utilised to reduce educators' workload and allow them to focus more on interacting with their students in several ways. This is achievable since AI has the potential to automate tasks that would traditionally be performed by educators such as grading assignments and providing feedback to students. The integration of AI into the educational system has altered the way in which educators deliver content and how educational institutions function (Kamalov *et al.* 2023:2 of 27). The utilisation of AI systems frees educators so that they can meaningfully focus on the curriculum and interact closely with students.

Conclusion

AI technology evolved and developed predominantly in the Global North, but its growth and application has since permeated the entire globe. This digital technology has caused people to rethink how to integrate information, analyse data through the use of machine technology, and use the resultant information. AI is now being applied across all sectors of health, agriculture, engineering, and education. In education AI is instrumental in addressing issues related to assessment, tutoring, grading, and feedback. Information collected using AI platforms in education has contributed to improvements around inclusivity and the general quality of education due to enhanced curriculum and AI aided teaching and learning methodologies. However, the adoption of AI technology has raised a lot of debates and controversies emanating from ethical concerns.

Despite the challenges and ethical concerns that surround the use of AI in open and distance e-learning the benefits of this technology far outweigh the challenges that are posed by its usage. Amidst the problems and challenges it has become acceptable that AI plays a significant role in enhancing student learning experiences and teaching and learning in general. AI is also critical in improving the use of technology, particularly in enhancing efficiency and providing inclusivity and accessibility. It is thus important for IHEs to carefully plan how to integrate AI systems and processes responsibly to ensure their equitable use. By harnessing the power of AI and other new technologies, institutions can create better learning environments that are inclusive, flexible, and responsive to students' needs.

AI technology will never terminate education services but will generate opportunities for accelerating transformation in education. Open and distance institutions should therefore strategise on how to leverage AI and new technologies to enhance efficiency, encourage learning, and foster creativity while ensuring fairness and equity. AI has emerged as a transformative force across various sectors revolutionising processes and enhancing efficiency. In the field of education, AI holds an enormous potential to reshape students' experiences, enhance assessment, streamline administrative tasks, and even personalise learning for students.

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1 No initials are provided for this author.

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