Blueprint of Higher Education Delivery in Remote Areas of Pakistan through AI-Integrated Technologies

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by

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Introduction

From Plato's garden of higher education, 'The Academy,' to the halls of modern day 'Universities', the purpose has remained the same—to cultivate intellectual minds and foster a deep understanding of knowledge. The contemporary model of higher education finds its roots in the 'Humboldt model', given by Wilhelm von Humboldt.[1] The model was adopted worldwide to promote research-based education, encouraging the formation of well-rounded individuals, capable of critical thinking; ethical reasoning, and participation in society as informed citizens. Developing critical minds has been the foundational goal of higher education.

Pakistan's higher education statutory body Higher Education Commission (HEC-) is an autonomous, and constitutionally established institution of funding, overseeing, regulating, and accrediting the higher education efforts in the country. It has served the educational domain by producing researchers in the country.[2] However, its scope has been limited in promoting higher education only in the universities situated either in urban or suburban areas.

Pakistan's population consists of approximately 37-40% urban residents and 60-63% rural residents, with literacy rates of 66% and 42%, respectively.[3] Despite having a large

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[1] Bongaerts, Jan C. 2022. "The Humboldtian Model of Higher Education and Its Significance for the European University on Responsible Consumption and Production." BHM Berg- Und Hüttenmännische Monatshefte 167 (10): 500–507. https://doi.org/10.1007/s00501-022-01280-w.

[2] News HEC Signs Contract to Automate Pakistani Universities with TMC." 2024. Hec.gov.pk. 2024. https://www.hec.gov.pk/english/news/news/Pages/HEC-signs-contract-with-TMC.aspx.

[3] "Gul Rind, and Kathleen Knight Abowitz. 2022. Review of Education Reforms and Democracy in Pakistan: The Problem of Privatisation Education Reforms and Democracy in Pakistan: The Problem of Privatisation. November 8, 2022. https://www.researchgate.net/publication/365211092_Education_reforms_and_democracy_in_Pakistan_the_problem_of_privatisation_Education_reforms_and_democracy_in_Pakistan_the_problem_of_privatisation.

population, the rural areas have been deprived the most. Education as a public good has
been neglected since Pakistan's inception. It continues to fall short of providing quality
and equitable education for all. Given the scenario, access to higher education has been a
distant dream for many in Pakistan.

Since technology has been impacting every aspect of human life for a long time, the
provision of education has been getting easier. However, with the advent of AI, the realm
of education is being revolutionized all over the world. Artificial intelligence will set
education and students free from the boundaries of a physical classroom, not only at the
basic level but on higher level too. It has the potential to transform remote areas by
making higher education accessible to rural and economically depressed communities in
Pakistan. It will not only reshape the social fabric of the country but also the economic
one. Graduates will be able to secure jobs worldwide. Employability will be increased.

Curriculum, Pedagogy, Scope and Limitations of Pakistan's Higher Education System

The higher education system in Pakistan continues to face challenges in terms of
curriculum, pedagogical approaches and scope.

Curriculum Patterns

Pakistan's higher education curriculum is often criticized for being outdated. It is
primarily theoretical, emphasizing rote memorization rather than critical thinking and
problem-solving skills. Ultimately, one must ask: what does the "quality" of higher
education mean? Equivalently, how may one differentiate between HE institutions on the
basis of quality? This then translates into measuring "real access" to higher education and
separating it from mere enrolment. [4] Moreover, the curriculum lacks practical
components and does not serve the purpose of equipping students with skills required in
the workforce.

Existing Pedagogical Regime in Higher Education

Pedagogy can be simply described as 'the science and art of teaching. The Oxford
Dictionary of English defines pedagogy as 'pedagogy is the method and practice of
teaching especially as an academic subject or theoretical concept: the relationship
between applied linguistics and language'. Alexander classifies teaching method and
student as the two sides of pedagogy.[5]

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[4] Pakistan's Higher Education System—What Went Wrong and How to Fix It on JSTOR." 2024. Jstor.org. 2024.
https://www.jstor.org/stable/41261335?read-now=1&seq=5#page_scan_tab_contents.

[5] Malik, Ali, and Muhammad Yasir Chaudhry. 2014. "Intersection of Pedagogy and Emerging Technologies to Enhance Student-
Centred Learning in Higher Education." *ResearchGate* 34 (2): 397–407.
https://www.researchgate.net/publication/274961361_Intersection_of_Pedagogy_and_Emerging_Technologies_to_Enhance_St
udent-Centred_Learning_in_Higher_Education.

Pedagogical approaches in Pakistan's higher education are predominantly teacher-centered. This method does not help students' engagement and active participation. It rather limits opportunities for collaborative learning. In addition to that, the teachers do not possess a higher level of research skills.

Scope

HEC's endeavors are remarkable in the realm of higher education. It regulates 262 Public and private universities for various Undergrad, Grad and PHD programs. These universities are either located in urban or suburban areas of the country. However, provision of higher education to distant areas has been out of the scope of HEC. With emerging technologies in the 21st century, it can be possible for HEC to go beyond its limited scope and bring higher education to the doorsteps of students residing in remote areas.

Limitations

Despite the opportunities, the higher education sector in Pakistan faces significant limitations. Funding is a critical issue, as many public universities rely heavily on government support, which is often inadequate. This financial constraint hampers infrastructure development, research activities, and the recruitment of qualified faculty.

Furthermore, there are disparities in access to higher education, particularly for women and marginalized communities. Socio-economic factors, cultural norms, and inadequate infrastructure in rural areas hinder the enrollment of underrepresented groups. Quality assurance remains another major challenge, with a lack of effective accreditation processes leading to variability in educational standards across institutions. As a result, employers often express concerns regarding the employability of graduates, who may lack the necessary skills and competencies.

This policy brief intends to find ways to make higher education provision possible in far flung areas of Pakistan by examining the role of AI technologies in various educational institutions and online platforms around the world.

AI in Education

AI in education refers to the application of artificial intelligence technologies to enhance teaching and learning processes. It acts as a virtual teaching assistant, offering personalized learning experiences tailored to individual students' needs. AI-driven systems can adapt world-class pedagogy by differentiating instruction, allowing students to engage in active learning based on their pace and learning style. By analyzing data, AI can identify areas where students struggle and offer targeted interventions, bridging the gap that might otherwise be left to fate.

Artificial Intelligence (AI) has the potential to address many of the challenges facing higher education by transforming various aspects of learning, teaching, administration, and research.

Comparative Analysis of Existing AI Integrated Educational Institutes and Platforms

AI adoption is taking place among almost all educational institutions, including top-ranked universities and online platforms. From Massachusetts Institute of Technology () and Stanford to Arizona State University (ASU), the University of Tokyo, and platforms like Khan Academy and Coursera, they are already imparting education through AI-integrated technologies. These institutes are striving to bring education at every student's doorstep across the globe.

Institution	Functions	Features	Tools Used	Design Approach
Arizona State University (ASU)	• Enhances creativity and problem-solving • Supports personalized learning and research	• AI Innovation Challenge • Collaborative projects with OpenAI • Focus on ethical AI practices	• *ChatGPT Edu:* Educational version of ChatGPT • *Google Gemini:* Natural language processing • *Microsoft 365 Copilot:* Productivity assistance • *Adobe Express:* Graphic design tool • *Zoom AI Companion*: Meeting enhancement	• Emphasizes Principled Innovation • Ethical guidelines for AI use • Community engagement for feedback and development

Institution	Functions	Features	Tools Used	Design Approach
University of Tokyo	• Research and development in AI applications	• Collaboration with industry for technology advancement	• Specific tools not detailed, but known for strong partnerships in AI research	• Focuses on interdisciplinary collaboration in AI research
Massachusetts Institute of Technology (MIT)	Interdisciplinary projects addressing complex problems	Hands-on learning with real-world applications	Various AI tools integrated into curriculum (specific tools not detailed)	Emphasizes practical applications and innovation in education
Khanmigo (Khan Academy)	Personalized tutoring and interactive learning experiences	Simulates interactions with historical figures and promotes critical thinking through guided discovery	Khanmigo: AI-powered tutor for personalized learning experiences	Focuses on user engagement and privacy in educational technology

The table highlights diverse approaches of educational institutes to integrate AI in education. Each institution's unique strategy reflects its educational goals and values in the AI landscape.

Blueprint of AI Adoption in Higher Education across Remote Areas of Pakistan

1. World Class Pedagogy

"World-class pedagogy" refers to teaching practices, strategies, and methods that are recognized globally for their effectiveness in fostering deep learning, critical thinking, and overall academic success. It aims to prepare students to thrive in a rapidly changing, interconnected world. Several key features typically characterize world-class pedagogy:

a. ***Inquiry-Based and Critical Thinking Approaches***: This approach encourages students to ask questions, explore problems, and think critically about solutions rather than just memorizing facts.

b. ***Personalized Learning***: AI tutors can personalize and customize coaching, as well as adapt to an individual's needs while hovering beside our learners as they work. Even more impressive, this technology teaches our learners to be better thinkers by engaging them in Socratic questioning. [6]

c. ***Global Competence***: Emphasizes understanding and appreciating different cultures, viewpoints, and perspectives, preparing students to engage with global issues.

d. ***Teacher Professional Development***: It also ensures that teachers are continuously improving their skills, keeping up-to-date with educational research, and engaging in reflective practices.

e. ***Adaptive Learning***: AI systems can adjust the pace and complexity of lessons based on individual student performance, ensuring that no one is left behind. It can also recommend supplemental materials tailored to each student's learning style.

f. ***Active Learning***: Active learning focuses on engaging students actively in the learning process, typically through discussions, problem-solving, or hands-on activities. AI can enhance this by:

- ***Simulations and Virtual Environments***: AI can power realistic simulations or immersive virtual environments (e.g., VR/AR), allowing students to actively participate in problem-solving and decision-making in dynamic, real-world scenarios.
For Example, Sal khan discusses about teaching through simulation and how 'khanmigo'-Gen AI is trained to help students: Teachers could assign this type of thing for homework: "Debate with Khanmigo as to whether the United States should have dropped nuclear bombs on Japan to end World War II." But it can go even further. Not only does Khanmigo let users chat with literary characters, they can also chat with historical figures—anyone from Benjamin Franklin to Cleopatra to Rembrandt.[7]

- ***AI-Powered Gamification***: Games integrated with AI can adapt to the learner's skill level and provide challenges that promote active engagement.

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[6] Khan, Salman. 2024. *Brave New Words*. Penguin.

[7] Ibid.,65

These games often include problem-solving tasks and promote collaboration or competition, both of which engage students actively.

2. Curricula: Content Creation and Curation

a. **Lesson Planning and Content Delivery:** AI tools can help teachers create or recommend high-quality learning resources, lesson plans, and multimedia content tailored to the needs of individual students or entire classes.

b. **Outcome-Based Education (OBE)**: AI systems can track and measure learning outcomes in real-time, helping educators adjust teaching strategies to ensure that students achieve specific competencies and learning objectives.[8]

c. **Competency-Based Education (CBE)**: AI-powered learning platforms can allow students to progress at their own pace, advancing once they demonstrate mastery of required skills. Personalized learning paths can be developed to cater to individual student needs.

d. **Interdisciplinary and Multidisciplinary Programs**: AI can recommend course combinations from different disciplines to promote a holistic understanding of complex issues. It can also support critical thinking and problem-solving skills by integrating knowledge from various fields, making students better prepared for roles across multiple industries.

e. **Industry-Academia Collaboration**: AI can facilitate closer collaboration between academia and industry by identifying relevant internship and job opportunities for students based on their skills. It can also help align curricula with current market demands, ensuring that students are prepared for the evolving job market.

f. **Employability Focus**: AI systems can emphasize 21st-century skills—like communication, collaboration, creativity, and critical thinking—through personalized and project-based learning. These systems can also track student progress in developing these competencies and offer tailored resources to enhance employability. [9]

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[8] Wang, Xia, and Liyan Yang. 2024. "Application of Outcome-Based Education Instructional Theory Based on Artificial Intelligence in the Design and Practice of Research Curriculum." *International Journal of E-Collaboration* 20 (1): 1–16. https://doi.org/10.4018/ijec.356498.

[9] Wu, Ying, Lin Xu, and Simon P. Philbin. 2023. "Evaluating the Role of the Communication Skills of Engineering Students on Employability according to the Outcome-Based Education (OBE) Theory." *Sustainability* 15 (12): 9711. https://doi.org/10.3390/su15129711.

3. Global Access

AI-powered online learning platforms (like MOOCs and adaptive learning systems) can expand access to quality education globally. Students in remote areas can benefit from AI-guided resources without the need for physical access to universities.

4. Funding and Financial Sustainability

Technology has generally lowered the cost of access to world-class tools and learning. Our mission of free, world-class education for anyone, anywhere would have seemed delusional without computers and the internet. AI is going to be the next technological wave that empowers future creatives in art and science. [10]

Operational Efficiency: AI can optimize university operations, reducing administrative costs and improving financial sustainability. For example, AI can automate routine administrative tasks such as admissions, course scheduling, and student tracking.

5. Research and Innovation

AI is significantly transforming research and innovation by automating processes and enabling deeper insights. It accelerates research by speeding up data collection, analysis, and literature reviews, allowing researchers to focus more on creative and strategic work. AI also enhances collaboration, as tools can suggest relevant collaborators and research areas based on trends in global datasets, supporting international cooperation. Additionally, AI systems excel at synthesizing vast academic literature, making it easier for researchers to stay current with scientific advancements and identify new opportunities. [11]

6. 24/7 Availability

Sal khan, the founder of Khan Academy, writes in his book that --- After all, a student might engage a human tutor for a few hours a week, but they have access to Khanmigo 24/7, and Khanmigo can report back to the human tutor what it's been working on with the student to allow the human tutor to go deeper and further. Some students might even feel more comfortable asking certain questions to an AI, because they would have less fear of being judged or wasting the human tutor's precious (or expensive) time. [12]

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[10] Khan, Salman. 2024. *Brave New Words*. Penguin, 63

[11] Chubb, Jennifer, Peter Cowling, and Darren Reed. 2021. "Speeding up to Keep Up: Exploring the Use of AI in the Research Process." *AI & SOCIETY* 1 (37). https://doi.org/10.1007/s00146-021-01259-0.

[12] Khan, Salman. 2024. *Brave New Words*. Penguin, 43

7. Supporting Teachers

- **Teacher's Assistant:** AI can handle administrative tasks like grading, managing schedules, and organizing lesson plans, allowing teachers to focus on more personalized interactions with students.

- **Professional Development:** AI systems can also support teachers by providing real-time feedback on teaching methods and suggesting improvements.

8. AI Technologies in Various Fields of Study

Artificial Intelligence (AI) technologies are being applied across a wide range of fields, providing novel methods to simulate real-world environments, analyze data, and foster deeper learning experiences. The following are some AI-driven technologies and how they contribute to various fields:

- **Virtual Labs**: These digital platforms allow students, particularly in fields like medicine, engineering, and the natural sciences, to conduct experiments and explore complex phenomena without the need for physical equipment. **Labster**, for example, provides medical students with a safe and immersive lab experience where they can conduct experiments virtually.

- **Simulation and Modeling**: AI-powered tools like **COMSOL MultiPhysics** and **Ansys** simulate real-world scenarios in physics and engineering, enabling students to model complex systems and analyze their behavior in a controlled environment. These technologies are used widely in engineering, medical, and scientific research to predict outcomes and test hypotheses without needing physical prototypes.

- **Data Analysis**: Across disciplines, from economics to social sciences, AI tools help researchers sift through large datasets. AI-driven platforms such as **MATLAB** and **Simulink** are particularly useful for engineering and scientific fields, enabling users to model, analyze, and visualize data in real time.

- **Visualization and Augmented Reality**: Augmented Reality (AR) is increasingly used in fields like medicine and engineering to provide immersive, hands-on learning experiences. **VisualDx** is an AI-powered diagnostic tool that uses AR to help healthcare professionals visualize patient symptoms and provide more accurate diagnoses.

- **Assessment and Grading**: AI tools are increasingly being integrated into the education system for automating assessment and grading, especially in fields with large datasets or objective criteria like engineering and mathematics. Tools like **IBM Watson** are used for complex assessments, offering more personalized and insightful feedback than traditional methods.