AI-DRIVEN HEALTHCARE: ASSESSING THE IMPACT OF ARTIFICIAL INTELLIGENCE IN HEALTH EDUCATION, HEALTH PROMOTION AND HEALTH MANAGEMENT OF ATHLETES

Okanlawon, A.J*., Moronkola O.A. and **Iyanda A.B**
*National Institute for Sports, Surulere, Lagos.
**Department of Health Education, University of Ibadan, Ibadan.

Abstract
Artificial intelligence is reshaping every industry, including healthcare, health education, health promotion and sports. With advancements in AI technology and its integration into routine tasks, the field of healthcare, health education, health promotion and sports is rapidly evolving. It is important for healthcare professionals including health educators to have a basic understanding of what AI is and how it works. The study examined the use of AI in health education and health promotion, exploring its application and impact on health education and health promotion. This paper also reviewed the proactive approach of AI in managing athletes' health. The paper also delved into the use of AI in healthcare and the benefits it brings to athletes in terms of health management, injury prevention and performance optimisation. Additionally, this paper explored the future of AI in health education, health promotion and sports and discussed AI ethics in health education and health promotion.

Introduction

The fusion of artificial intelligence (AI) into the health sector has revolutionised the landscape of healthcare, health education and health promotion, transforming the way we learn, interact and engage with health information. AI is influencing almost every sector and including the healthcare sector. With its unparalleled ability to personalise learning experiences, analyse large amount of data and quite reliably predict health outcomes, AI is transforming health education and promotion into a smarter, more effective and life-saving endeavour. AI-driven health education is bridging the gap between health knowledge and behaviour change so important to healthcare professionals, especially health educators, who are more interestrd in empowering clients with evidence based facts for adoption of healthy behaviour for better health outcomes.

Also, AI is transforming the sports industry by enhancing athletic performance and managing athletes' health. Health management and injury prevention are critical aspects of sports where AI is making significant strides. Athletes' careers can be severely affected by injuries, and AI offers a proactive approach in managing athletes health. By continuously monitoring athletes through wearable devices, AI systems can detect early signs of fatigue or stress, predicting potential injuries before they occur. This allows for timely interventions, such as adjusting training intensity or providing targeted physiotherapy, thereby reducing the incidence of injuries and ensuring athletes maintain peak performance levels (Wei Wei, 2019).

The role of AI in health management of athletes is important, as it brings a multitude of benefits and advancements to various aspects of athlete performance analysis, injury prevention, and strategic decision-making. By leveraging AI technology, sports scientists, coaches, trainers and healthcare professionals can gain deeper insights into athlete performance, optimise health, and improve overall sports performance (Teachflow, 2024). The paper explored the use of this cutting-edge technology in healthcare, specifically examining its use and application in health education, health promotion and health management of athletes.

Understanding artificial intelligence (AI)
Artificial intelligence (AI) is a branch of computer science. However, there is no universal definition of AI, and that is because the field is constantly being redefined as new topics and uses emerge. A common definition is that AI is a field that focuses on creating machines and systems capable of performing tasks that normally require human intelligence. These tasks include learning from experience, interpreting complex data, recognizing patterns, understanding spoken or written language, and making decisions (University of Florida, 2024). AI refers to the development of computer systems that can perform tasks that typically require human intelligence, such as perception, reasoning, and decision-making (Dave and Patel, 2023). Artificial intelligence (AI) generally applies to computational technologies that emulate mechanisms assisted by human intelligence, such as thought, deep learning, adaptation, engagement, and sensory understanding (Tagliaferri et al., 2020). Some devices can execute a role that typically involves human interpretation and decision-making (Panch, Szolovits and Atun, 2018). There are seven branches of AI, and they include machine learning, neural networks or deep learning, natural language processing, expert systems, computer vision, robotics, and fuzzy logic (University of Florida, 2024).

AI in healthcare
Healthcare refers to taking care of people and nursing them back to full health. It also involves taking measures to prevent diseases from occurring and spreading (St. Patricks, 2024). AI is quickly transforming health care, public health, health education, and behavioural health research. From diagnosing diseases to predicting health outcomes, from personalizing patient care to revolutionizing public health interventions, AI is reshaping these sectors in numerous ways.

AI in healthcare refers to the use of machine learning, natural language processing, deep learning and other AI technologies to enhance the experiences of both healthcare professionals and patients (Daley, 2024). Healthcare professionals study, diagnose, treat and prevent human illness, injury and other physical and mental impairments in accordance with the needs of the populations they serve. They advise on or apply preventive and curative measures, and promote health with the ultimate goal of meeting the health needs and expectations of individuals and populations, and improving population health outcomes (World Health Organisation, 2013). Healthcare professionals

include health educators, medical doctors, nurses, pharmacists, physiotherapists, amongst others.

University of Florida (2024) noted that artificial intelligence can be applied in healthcare in the following ways.

1. Disease diagnosis: Sophisticated AI models can analyze medical images, such as X-rays, MRIs, and CT scans to identify and diagnose medical conditions. For example, AI-based algorithms can detect early signs of breast cancer in mammograms with greater accuracy than human radiologists.
2. Predictive analytics: AI is being used to analyze large data sets from electronic health records to identify patterns and trends that can inform clinical decision making. For example, AI can be used to predict which patients are at the highest risk for readmission to the hospital based on their medical history.
3. Robot-assisted surgery: AI is being used to guide robotic surgical systems to perform complex procedures with greater accuracy and precision. For example, AI-based algorithms can help surgeons to identify and avoid critical structures during surgery.
4. Patient monitoring: AI is being used to monitor patients' vital signs and identify potential health risks. For example, wearable medical devices can detect irregular heartbeats and alert patients and health care providers.
5. Natural language processing: AI is being used to analyze and understand natural language, which can improve communication between patients and health care providers. For example, AI-based chatbots can provide patients with personalized health advice and support based on their symptoms and medical history, and this can be done in different languages.

University of Florida (2024), went further to affirm that the application of AI in public health include:

1. Disease surveillance: AI is being used to monitor disease outbreaks and predict the spread of infectious diseases. For example, AI algorithms can analyze social media data to identify potential disease outbreaks and track the spread of the disease in real time.
2. Vaccine development and distribution: AI is being used to accelerate the development and distribution of vaccines. For example, AI algorithms can help researchers identify the most promising vaccine candidates and predict the effectiveness of different vaccine formulations.
3. Environmental monitoring: AI is being used to monitor environmental factors that can impact public health, such as air quality and water contamination. For example, AI algorithms can analyze satellite data to identify areas with high levels of air pollution and develop targeted interventions to reduce exposure.

AI in health education and health promotion
Health education is the process by which people acquire knowledge, attitudes, and behaviours that promote their health and help them make decisions directed at solving personal, family, and community health problems (Moronkola, 2007). Health education can be seen as a concept, discipline, course of study, approach, or method through which accredited health information is made available to people with the aim of simultaneously stimulating positive health-related attitudes and practices that promote personal and community health (Moronkola, 2002). Health promotion is the process of enabling people to increase control over, and to improve, their health. It moves beyond a focus on individual behaviour towards a wide range of social and environmental interventions (World Health Organisation, 2024).

Health education is a critical pillar of public health and healthcare systems. Health educators work in a variety of settings to educate and empower individuals, families, and communities to live healthier lives. Health educators do this by promoting healthy behaviours, creating and disseminating tailored messages, developing, implementing, and evaluating health programmes, advocating for policies that improve health outcomes for all, researching ways to improve health and prevent diseases, and using the latest technologies to improve health outcomes. The demand for certified health education specialists and the overall employment of health education specialists and community health workers is expected to grow by 12% from 2021 to 2031. So that requires 21st century skills for the new job market. This include learning skills, (such as critical thinking, creativity, collaboration, and communication) literacy skills (such as information, media, and technology) and life skills (such as flexibility, leadership, initiative, productivity, and social skills) The high ownership of digital devices, wider access to broadband internet, and an influx of AI tools require today's health education specialists to be literate and competent in AI. According to the 2021 National Security Commission on Artificial Intelligence Final Report, human talent is the most conspicuous AI deficit and the single greatest inhibitor to AI-enabled technologies for national security purposes. (University of Florida, 2024).

AI applications in health education and health promotion include:
1. Personalized education: Health educators can use AI to develop and disseminate tailored health education materials based on demographic characteristics, literacy levels, health status, and learning styles.
2. Plan and evaluate health programmes: Health educators can use AI to plan and evaluate health programmes. For example, natural language processing and sentiment analysis can analyze social media data and identify the health needs and preferences of different populations. AI can also be used to analyze feedback to improve programme effectiveness.
3. Advocate for special population groups: Health educators can use AI to advocate for special population groups by identifying and addressing health disparities. For example, they can analyse health data and identify disparities in health outcomes among different populations.

4. Predictive modeling: Health educators can use AI to anticipate health behaviour changes in response to interventions, improving programme effectiveness.

5. Develop health policy: Health educators can use AI to inform the development of health policy by providing data-driven insights into health needs and trends. For example, they can use algorithms to analyse health data and identify gaps in health policy and areas for improvement.

6. Real-time health monitoring: Health educators can use AI to analyse data from wearable devices to provide immediate feedback and adjust education goals.

7. Health education chatbots: Health educators can use AI to provide timely health information, reminders, and follow-ups, thus increasing the effectiveness of health communication efforts.

8. Virtual assistants: AI-powered virtual assistants can provide guidance and support to individuals as they navigate health education and behaviour change interventions, providing a more personalised and responsive experience.

9. Telehealth: AI-powered telehealth solutions can help expand access to health education and behaviour change interventions, especially in rural or underserved areas. (University of Florida, 2024).

Types of AI tools used in health education and health promotion

Teachflow (2023) noted that AI tools come in various forms and can be utilised in diverse ways to facilitate health education, especially in schools. Some commonly used AI tools include:

1. Virtual Reality (VR) and Augmented Reality (AR): VR and AR technologies provide immersive experiences that enable students to explore and interact with health-related concepts and scenarios. For example, students can virtually visit the human body, observe the effects of unhealthy habits, or simulate emergency situations to develop problem-solving skills.

2. Intelligent Tutoring Systems: These AI-powered systems act as virtual tutors, providing personalized feedback, guidance, and support to students. They adapt to each student's progress, addressing knowledge gaps, and offering additional resources or explanations as needed.

3. Natural Language Processing (NLP): NLP allows computers to understand and interact with human language. AI-powered chatbots equipped with NLP capabilities can engage with students, answer their health-related questions, and provide accurate information and guidance.

4. Gamification: AI can be used to gamify health education, making it more interactive and enjoyable for students. By incorporating game elements such as challenges, rewards, and leaderboards, AI-powered gamification motivates students to actively participate in their health education journey.

AI brings unique advantages to health promotion efforts in the community. By analysing large datasets and identifying patterns and trends, AI can provide valuable insights into individual's health behaviour, risk factors, and needs. It can also tailored health messages,

recommendations, and resources that increases the relevance and effectiveness of health promotion efforts, as people are more likely to engage with information that is specifically tailored to them.

Some AI technologies that are effective and engaging people:

1. Chatbots: AI-powered chatbots can provide people with instant access to reliable health information and guidance. People can ask questions, seek advice, and receive personalised recommendations related to their health concerns. Chatbots can also assist in tracking progress and offering support for behaviour change.
2. Wearable Devices: AI can be integrated into wearable devices such as fitness trackers or smartwatches to monitor people's physical activity levels, sleep patterns, and other health-related metrics. These devices can provide real-time feedback, set goals, and motivate students to adopt healthier lifestyles.
3. Mobile Applications: AI-powered mobile applications can offer interactive and engaging platforms for health promotion. These apps can provide educational resources, track behaviours, send reminders, and offer personalised recommendations for healthy habits.
4. Data Analytics: AI-powered data analytics tools can analyse large datasets to identify trends, risk factors, and priorities for health promotion. This information can inform the development of targeted interventions and enable government to allocate resources effectively. (Teachflow, 2023)

Health management and injury prevention in athletes

Health management of athletes encompasses the holistic care and development of an athlete's career, health and well-being (Catapult, 2023). It is the process of ensuring the health and well-being of athletes to help them perform at their best and achieve their goals. AI's contribution to health management and injury prevention is one of the most promising applications in sports. By continuously monitoring athletes' biomechanical and physiological data, AI systems can predict potential injuries and suggest preventive measures. This proactive approach can significantly reduce the incidence of injuries and extend athletes' careers (Najjar, 2023). AI plays a crucial role in health management and injury prevention, which are vital for maintaining athlete wellness and prolonging careers, in the following ways:

Injury Prediction: AI systems analyse biomechanical and physiological data to predict potential injuries. For example, in football, AI can detect patterns in player movements that indicate a high risk of injury AI systems can analyse data from wearable devices to monitor athletes' physical conditions continuously, enabling early detection of signs of fatigue or stress (Rahmani et al., 2024).

Recovery Monitoring: AI aids in recovery management by tracking rehabilitation progress and providing personalised recovery plans. Wearable devices collect data on heart rate, sleep patterns, and physical activity, which AI algorithms analyse to optimise recovery protocols. AI-driven health management systems are becoming indispensable tools for

sports teams, ensuring athletes recover fully and return to peak performance levels safely (Rahmani et al., 2024).

AI algorithms can identify potential risk factors for injuries for coaches and trainers to develop personalized injury prevention programs and make necessary adjustments to training techniques. AI algorithms is useful in extracting meaningful patterns and trends. Coaches can then use this information to identify areas of strength and weakness in individual athletes or teams, allowing them to devise strategies to exploit opponents' weaknesses. AI-powered performance analysis tools provide coaches with valuable information to make informed decisions during training and competition, ultimately leading to improved performance outcomes (Teachflow, 2024).

Future of AI in health education, health promotion and sports
The increasing use of AI in health education, healthcare, public health, and other fields is creating new career opportunities for health educators who are AI literate and competent. The future is great and the possibilities are endless for health education specialists. Examples of AI job market for health educators include health data analyst, health technology specialist, content specialist, developer for chatbots, virtual assistants, and apps, health policy analyst, science and tech writer, telehealth educator counselor, and entrepreneur (University of Florida, 2024).

The World Health Organisation is embracing generative AI with its Smart AI Resource Assistant for Health (S.A.R.A.H.), a leap in health education accessibility. This digital assistant breaks down language and digital literacy barriers by offering immediate, tailored health conversations in eight languages. S.A.R.A.H.'s mission is to level the informational playing field, ensuring that quality health advice is merely a click away for everyone. Given the habit of turning to the internet for health and medical guidance, S.A.R.A.H. fills a crucial gap with interactive discussions on a wide spectrum of health issues, including disease prevention and lifestyle modifications. WHO's initiative with S.A.R.A.H. points to a bright future in public health engagement and education through advanced AI (Kaiserle, 2024).

The future of AI in sports holds exciting possibilities. Developing real-time feedback systems that provide instant analysis and recommendations during training can further enhance athlete performance. Integrating AI with the Internet of Things (IoT) can enable continuous data collection and analysis, offering deeper insights into athlete performance and health (Pottala, 2018). As AI technology continues to evolve, its impact on sports is expected to grow, bringing innovative solutions and improvements across all aspects of the industry.

Ethical principles of AI in health education and health promotion
There are nine ethical principles of AI that are relevant to health education and health promotion. They are autonomy, beneficence, non-maleficence, confidentiality, privacy, and trust, justice, fairness, and equity, transparency and explicability, accountability, sustainability, and solidarity.

1. Autonomy focuses on the rights of individuals to make their own choices. AI must protect and enhance autonomy, preserve a user's ability to make decisions, and choose between alternatives. And AI tools should not make decisions for patients without their informed consent. Furthermore, patients must be informed about how AI is used in their care, given the ability to consent, and maintain the right to override AI decisions.

2. Beneficence implies acting in the best interest of others. An AI tool should benefit the user, with minimal or no harm. For example, an AI system that uses machine learning to predict health risks must be accurate and reliable, as faulty predictions could harm patients. AI should also benefit humanity, society, and the environment.

3. Non-maleficence means to do no harm. AI systems should not harm users, intentionally or unintentionally. For example, if an AI system misinterprets data and provides incorrect health information, this could cause harm. Thus, AI systems need to have tools and techniques to ensure compliance with norms and standards.

4. Confidentiality, privacy, and trust: Confidentiality involves respect and privacy and keeping personal information secure. Privacy is both a value to uphold and a right to be protected. For example, if an AI system doesn't have proper data security measures, it can breach confidentiality. Also, there is the need to use trustworthy design principles and to build and sustain a culture of trust.

5. Justice, fairness and equity: The principle of justice requires fair, equitable, and appropriate treatment. AI technology should be accessible to all, not just a privileged few. For instance, if an AI application is only available to certain demographics, this violates the principle of justice. Thus, AI systems need to be accurate, complete, and trained on diverse data.

6. Transparency and explicability: AI systems must be understandable, explainable, explicable, predictable, and transparent. A lack of clarity about how an algorithm makes decisions undermines trust. So to promote transparency, clear information about source codes, data use, limitations etc. should be disclosed to users and stakeholders in non-technical language.

7. Accountability involves taking responsibility for the consequences of actions. Thus, developers, users, and regulators should have clear guidelines and must share responsibility for the ethical implications of using AI. For example, if an AI system delivers inaccurate medical results leading to faulty conclusions, accountability needs to be established.

8. The principle of sustainability is closely related to beneficence. AI systems should be designed, used, and managed to promote sustainability, increase energy efficiency, and minimize their ecological footprint.

9. Solidarity: AI should work with humans rather than against them. AI also should complement rather than replace the labour force. And there is a risk that AI will widen the digital divide and economic development between more and lesser technologically advanced countries.

It is important to note that there are about 84 ethics guideline for AI from different countries, national organisations and industry (University of Florida, 2024)

Strategies to overcome challenges in use of AI in health education and health promotion
According to Teachflow (2023), the following strategies can be implemented to overcome challenges in use of AI in health education and promotion.

1. Ethical Frameworks: Establish ethical guidelines for the use of AI in health education and promotion. Ensure transparency and accountability in algorithm development, address bias, and prioritise the well-being and autonomy of people.
2. Privacy and Security: Implement robust data protection measures, obtain informed consent, and ensure compliance with privacy regulations. Be transparent about data collection and use, and educate people and educators about privacy safeguards.
3. Training and Support: Provide comprehensive training programmes to health educators on AI technologies, their applications, and best practices for integration. Offer ongoing support, resources, and opportunities for collaboration and professional development.
4. Equitable Access: Advocate for policies and initiatives that promote equitable access to AI tools and technologies. Seek partnerships and funding opportunities to ensure that everyone, regardless of their resources, can benefit from AI in health education and promotion.

Conclusion
The integration of Artificial Intelligence (AI) in healthcare has the potential to revolutionise the way in which healthcare professionals, including health educators, are trained. Health educators need to stay informed about the latest developments in AI and be knowledgeable about the potential benefits and challenges associated with its use. By doing so, they can leverage AI to improve health outcomes for individuals and communities. However, the successful adoption of AI in health education and health promotion hinges on addressing critical challenges such as ethics, bias and privacy concerns. It is imperative that healthcare professionals, especially health educators, collaborate to harness AI's potential in health education and health promotion. By doing so, health education and health promotion can be revolutionalised and a smarter and healthier world for all can be created. Conclusively, AI is revolutionising the sports industry by providing advanced tools and technologies that enhance every aspect of sports, from athletic performance to health management. The integration of AI in sports is creating a more dynamic, engaging, and fair sporting environment, benefiting athletes, coaches and healthcare professionals. As AI technology continues to evolve, its impact on the sports industry is expected to grow, bringing even more innovative solutions and improvements.

References

Asim, J. (2024). From sweat to success: The game-changing role of AI wearables in athlete recovery. https://kodexolabs.com/the-role-of-ai-wearables-in-athlete-recovery/

Catapult. (2023). Introduction to athlete management. https://www.catapult.com/blog/5-steps-to-success-athlete-management#

Daley, S. (2024). AI in healthcare: Uses, examples and benefits. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

Dave, M. and Patel, N. (2023). Artificial intelligence in healthcare and education. *British Dental Journal*, 234(10), 761-764.

Kaiserle, J. (2024). Is S.A.R.A.H. the future of AI-driven health education?https://healthcarecurated.com/tech-and-innovation/is-s-a-r-a-h-the-future-of-ai-driven-health-education/

Moronkola, O.A. (2002). Health Education or Health promotion, what is in a name? In Z.A. Ademuwagun, J.A. Ajala, E.A. Oke, O.A. Moronkola and A.S. Jegede (Ed.), *Health Education and Health Promotion,* Ibadan: Royal People (Nigeria) Ltd.

Moronkola, O.A. (2007). Multicultural health education curriculum for social transformation of young people in multi-ethnic Nigeria. In Nwazuoke, I.A., Okediran, E.A., Moronkola, O.A. (Eds.), *Education for social transformation.* Faculty of Education, University of Ibadan, Ibadan: Nigeria, pp 88-97.

Moronkola, O.A. (2007). The development of the school health policy and curriculum in Nigeria. DOI:10.1007/978-94-6091-876-6_12

Najjar, M.C. (2023). Legal and ethical issues arising from the application of data analytics and artificial intelligence to traditional sports. *Albany Law Journal of Science and Technology*,33, 51.

Panch, T., Szolovits, P. and Atun, R. (2018). Artificial intelligence, machine learning and health systems. *Journal of Global Health*, 8(2), 020303.

Pottala, M. (2018). Artificial intelligence: Artificial intelligence in sports. https://www.theseus.fi/handle/10024/151574

Rahmani, M., Majedi, N., Hemmatinejad, M. and Jamshidi, A. (2024). Application of artificial intelligence in the sports industry: A review article. *AI and Tech in Behavioral and Social Sciences*, 2(2), 20-27. https://doi.org/10.61838/ kman.aitech.2.2.4

St. Patricks. (2024). What is the role of healthcare professionals? https://www.st-patricks.ac.uk/blog/posts/2019/april/what-is-the-role-of-healthcare-professionals/

Teachflow. (2024). The role of AI in school physical education and sports science. https://teachflow.ai/the-role-of-ai-in-school-physical-education-and-sports-science/

Teachflow. (2023). AI and school health education and promotion. https://teachflow.ai/ai-and-school-health-education-and-promotion/

University of Florida. (2024). AI in health education and health promotion. Office of Professional and Workforce Development. https://ufl.instructe.com/courses/498617

Wei Wei, W.W. (2019). Research progress on virtual reality (VR) and augmented reality (AR) in tourism and hospitality: a critical review of publications from 2000 to 2018. https://doi.org/10.1108/JHTT-04-2018-0030

World Health Organisation. (2013). Transforming and scaling up health professionals' education and training: World Health Organization guidelines 2013. https://www.ncbi.nlm.nih.gov/books/NBK298950/

World Health Organisation. (2024). Health promotion. https://www.who. int/westernpacific/about/how-we-work/programmes/health-promotion