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POTENTIAL BARRIERS TO EFFECTIVE ARTIFICIAL INTELLIGENCE (AI) APPLICATIONS IN SPORTS AS PERCEIVED BY COACHES IN TERTIARY INSTITUTIONS IN ENUGU STATE OF NIGERIA

DR. JOSEPH U. EZE
Department of Physical and Health Education
Federal College of Education, Eha-Amufu, Enugu State
sirjoeeze@gmail.com, 07037527770

Abstract

The study investigated the Potential Barriers to Effective Artificial Intelligence (AI) applications in sports as perceived by coaches in tertiary institutions in Enugu State. Five hundred and fifty-two (552) sports coaches constituted the population from whom 257 were selected as the sample for the study using purposive sampling technique. One research question guided the study and one null hypothesis was postulated and tested at 0.05 level of significance. The instrument for data collection was a researcher-designed questionnaire titled "Perceived Barriers to AI Applications in Sports Questionnaire" (PBAASQ). Three experts validated the instrument. A reliability index of 0.75 was determined for the instrument using Cronbach Alpha Statistic. Frequencies and percentages were used for answering the research question and t-test used to test the hypothesis. The findings indicated that coaches perceived economic, ethical, technical, and psycho-philosophical factors as potential barriers to effective AI applications in sports. Additionally, there was no significant difference in the coaches' perception of the factors as barriers based on their institution ownership and location while a significant difference existed based on their institution type. It was recommended amongst others that government at all levels, sports federations, enterprises, sports departments, colleges and universities should provide strong financial support for institution sports and as well organize coaches and other sports officiating experts for purposes of formulating national standards for applications of AI in sports while also use block-chain and other technologies to provide strong protection for AI users privacy rights and intellectual property rights.

Keywords: Artificial Intelligence (AI), economic barriers, ethical barriers, technical barriers, psycho-philosophical barriers.

Introduction

It is in many people's knowledge today that Artificial Intelligence (AI) has entered as a major player in the sports industry and more so, astonishingly in a manner that mimic human intelligence. Sports is an activity that people do to maintain their physical and mental health, socialize, have fun and compete (Kaya, 2023). Regardless of any position from where one views sports, AI has taken it higher to where it would not have been possible without AI. From the bird's eye view according to Kaya (2023), AI is a simulation of human intelligence into machines that do things that we would normally rely on humans. In practical applications, AI now do things on their own more efficiently and methodically than human intelligence as in the case of a self-driving car which by acting through natural language process (NLP) and image recognition algorithms would be able to recognize other cars and traffic rules plus being able to change lanes in order to avoid collisions. This is happening just at the limited memory machine

development stage of AI after the first reactive machine stage where automated Deep Blue IBM's Chess playing AI system by being able to identify its own and the opponent's pieces on the chessboard in making predictions, swiftly beat the chess guru, Garry Kasparov in the late 1990s (Staff, 2023). In the coming days, according to Staff, we would further be introduced to the Theory of Mind and Self-awareness development stages which would be such technological marvels that at the Theory of Mind Stage, AI would have the potential to exhibit relational behaviours with others in a manner that suggests human behavior and at the grand finale self-awareness development stage, it would have an independent sense of conscious understanding of its own existence, predicting other's feelings, and expressing hunger and choice of food.

An attempt at taking head count of AI technologies that are presently applied in various sports would readily reveal a catalogue of them, handy in either hardware or software form. From Computer Vision (CV), Machine Learning (ML), Chartbots, Video Assistant Referee (VAR), Human Pose Estimation (HPE), Hawkeye Tech, Food Visor, as well as wearable software programme, connection kiosk, connected shoes, connected ball software, arcoss caddie, soccer analytics and online tracking (SAOT), stat cast, global scout smart app, and sport smart platforms are a few of such AI. These AI systems are generously applied in all sports performance domains be it in talent identification, coaching and training, athlete diet plans, refereeing, health and safety, sports predictions, sports journalism, fan engagement, ticketing and sport advertising. Notice has consistently been taken as to how such applications of AI in sports have reduced the drudgery of the previous practice and as well, improved the safety and performance of all stakeholders in the sports ecosystem; athletes, coaches, officials, and fans (Eze, 2023). On a second thought, AI may not be an exception among other groundbreaking innovations with loopholes, nonetheless its applications in sports; a claim that resonates with Woods, Araujo, Davids and Rudd's (2021) observation that despite AI's impact in sports, sports scientists and education teams are beginning to ask and reflect on tough questions regarding its overall perfection and infallibility. Such line of enquiry is revealing some economic, ethical, technical, and psycho-philosophical concerns that can potentially form barriers to its applications in sports.

Some AI machines are as large in size as they are costly in price. The hefty price tag is as a result of the production cost as the services and expertise of top-level experts are required. Aside the unit price, the cost of upgrading the AI software and hardware in order to meet the current models and trends in addition to other sundry maintenance costs are added financial burdens. Remittances for the energy consumed as part of the operation cost may also not be ordinary. Moreover, by AI automating every operation in sports, individuals' earnings may be endangered as there is bound to be layoffs. For example, in an instance where scouting and recruitment of players into the team is now based on the AI Data analytics without involving scouts, the scouts would simply be redundant and retrenched. Though for sometime, few teams may use the scouts for recruitment, but as time passes, more teams will replace them with AI leading to what Dane (2023) referred to as workforce disruption where further investment in robust training programs on reskilling and upskilling workers in other jobs is needed. It is based on these financial implications for applying AI systems in sports that European Parliament (2018) emphasized that fund can be a huge barrier for smaller sports organizations and teams.

On ethical ground, leaving most of what happens in sports with AI raises several ethical concerns that may adversely impact motivation for its applications among some sports performance community. Ethics and morality according to Duggal (2024) are important human features that are not in AI systems. By the time AI advances to what Duggal referred to as AI singularity with the lack of morality, AI according to him is feared to grow uncontrollably and eventually wipe out humanity. The ethical principle of fairness and equality is also lacking as the AI systems do not provide level ground for all users of the systems because the data used to train the systems is not always representative of a wide range of athletes in terms of gender, age, racial stereotypes and other demographics. This could have negative impact on diversity and inclusion in sports outcomes because of different training programs for athletes who have access and those who do not have access to those AI-powered training aids. Trusting AI with sensitive personal data such as medical, biometric, and performance information is equally an ongoing challenge. Athletes express less motivation for the trust as a result of probable privacy breaches in forms of unauthorized access, malicious attack, data hacks or theft necessitating litigations ending in no one in particular to be held accountable. As Efe (2023) observed, such privacy breach violates one's privacy and intellectual property rights and as well as impact their health and safety.

The difficulties associated with the structural design and operation mechanism of some of the AI devices could be further AI application bumps in sports. Sharma (2024) referred to AI models, especially Deep learning algorithms as "black boxes" for being commodified in a manner that permits no trace of their thought process leading either to a specific judgment or prediction. Similarly, according to Woods et al. (2021), the use of AI is nothing but a process of machining the mind where information available from the machines and the actions the receivers are allowed to take on the basis of that information, comes increasingly from computers and programs, not through the receivers' own understanding of situations. In this form, the receivers get information only by looking through the AI glass and at times asking "what does the data tell" about the parameter under observation. Such non-interpretability and transparency of AI systems is what Sharma (2024) affirmed to be the first obstacle to AI applications in sports.

As the AI systems prove difficult to understand, so are they vulnerable to providing unexpected or unintended results and consequences that may never had been the intention of the creators. The worse may even occur where robots being vulnerable to the substantivist theory may inadvertently restructure sports into entirely irreversible new pattern (Eze, 2023). This betrays the trust in the system as it limits a coach's ability to adapt to unexpected situations such as when the entire system breaks down or power outage occurs in the middle of important games. More so, top-level operation knowledge and expertise are required in handling most of the AI devices which according to Olowononi and Eletta (2023) are possibly obtainable only by leveraging a diverse tool box encompassing manifold types of neural networks, search algorithms, mathematical operation techniques, and probabilistic data-driven and economic-based methodologies. This knowledge is not common in most developing countries like Nigeria where only few training programs have been offered, and the official takeoff of the AI program courses in the universities being just at the mooting stage. This is currently a crucial challenge and barrier to the AI implementation across national sectors, including sports.

Of equal challenge is the difficulty in creating an effective user interfaces for human experts and some AI systems such as chatbots autonomous cars interactions on shared knowledge. The persistence of this difficulty is due to the AI's lack of emotion, creativity, motivation and ability for personalized feedback. This nurses a sort of skepticism among users who may feel their ingenuity being neglected and hence respond poorly to an AI only coaching approach (Fuentes, 2023). Also for the lack of human touch, the real essence of the game disappears as AI takes the center page in sports. The essence of game built naturally around emotions and unpredictability such that when two teams collide in the field, people watch along, biting their nails and stomping their feet in anticipation of what might happen next according to PMNN (2024) will be no more should people decide to get addicted to AI devices and statistics in preference to in-person action and entertainments.

Beyond the structural and operational barriers associated with AI systems are the psycho-philosophical ones. The psychological and philosophical worth of sport staff and athletes becomes compromised with the AI applications. In particular, self-efficacy and feelings of being in control diminish as a result of the AI compromising an individual's sense of agency that defines the user as a human being with the capacity to be initiator and contributor rather than just a mere product in a task he shares in its success and failure. Shifting the emphasis to just acting on behalf of AI systems in such a manner is tantamount to substituting human skills; a Phenomenon Migle (2020) described as disruptive because it substantially modifies the usual way of operating. This resonates with Ahmed's (2023) argument that such disruption is one most single downside of AI technology that should not be ignored because it undermines the human sense of agency by communicating through direct instructions to human users instead of through symbolic stimulus-response representation. At just its second development stage of limited memory machines, we are already witnessing how AI assists or works on human behalf even when the human is not attending it, such as AI systems in autonomous driving and car races. The introduction of robot into sports is even making the whole situation more critical as according to Mahroun (2020), Robocop, an international research initiative is aiming at developing humanoid soccer-playing robot that can even beat the FIFA World Championship team. Though this remains a concept for the third and fourth stages of AI development but in the unlikely event that it happens, then humans would be reduced to mere spectators in sporting events involving only robots and where fans getting the usual interest and funs in all-human event would remain a difficult experience in the sports industry (Eze, 2023). Nonetheless, some individuals are unsure whether robots will completely replace human referees. Despite using robots to assist in figuring out off-sides and throw-ins, FIFA according to Leung (2023) recounted that the entire replacement of human beings with robots may arise in future, just as Arastey (2021) observed that AI in sports created AI referees that are unquestionably interesting systems that will eventually replace human referees for the purpose of accuracy. Paradoxically, as AI advances to overrun humans in sports, the use of the AI-VAR is already causing some disaffection among big sports clubs such as Manchester vs. Southampton and others in major matches like premier league and world cup where the VAR has made tremendous and irreversible poor match decisions.

Granted that AI is fraught with many challenges including those not captured here, it may however be a mere assumption that they are absolute rather than relative challenges or barriers generalizeable to all users and to all situations. The term barrier in this sense is understood to mean anything, implicit or explicit, capable of causing an impediment to implementing a process, in this case, application of AI in sports. Identifying any or all the challenges as barriers can only be justified in consideration of other factors related to the user's financial disposition, geo-location, and other social and cultural milieu as well as the user personal word views. Against this backdrop, the present study investigated perceived barriers to effective applications of AI in sports among coaches in tertiary institutions in Enugu State of Nigeria.

Statement of the Problem

Under the current reign of AI technology that allows everyone in the sports community to perform at their absolute peak, every country has now devoted premium attention and commitment to adopting and implementing it in all their national sectors, including sports through some strategic programs such as intelligence research scheme as well as development of AI regulatory framework as currently going on in Nigeria (Udezue, 2024). Unfortunately, the probable challenges and barriers to the AI application as perceived by the sports practitioners like the coaches who are the end-users of AI sports is not factored into the programs which is an oversight too significant to overlook. Moreover, generalizing barriers to AI applications to the area of the present study where even similar studies known to the researcher do not exist is unjustifiable and this became the major motivation for this study.

Research Question

The research question that guided the study is: What are the barriers to effective applications of AI in sports as perceived by coaches?

Research Hypothesis

The hypothesis that guided the study is: There is no significant difference in the coaches' perceived barriers to effective applications in sports based on the coaches' institution ownership, type and locations.

Methods

The study adopted descriptive survey research design. The population for the study consisted of 552 sport coaches in tertiary institutions in Enugu State. The sample size for the study was 257 coaches selected using purposive sampling technique based on the pre-determined criterion of having adequate level of awareness and knowledge of AI applications in sports. The instrument for data collection was a researcher-designed questionnaire titled "Perceived Barrier so AI Applications in Sports Questionnaire (PBAASQ)" consisting four clusters of barriers. The instrument was face and content validated by three experts; one in the department of computer science and two in department of Human Kinetics and Health Education; all in the university of Nigeria Nsukka. Reliability index of 0.75 was determined for the instrument using Cronbach Alpha Statistic. The data generated were analyzed using frequencies and percentage to answer the research question while chi-square statistic was used to test the hypothesis at 0.05 level of significance.

Results

Data answering the research questions and data testing the hypothesis were organized and presented as follows:

Research Question One: What are the barriers to effective applications of AI in sports as perceived by coaches?

Table 1: Perceived barriers to effective applications of AI in sports among coaches (n=257)

S/N	Perceived Barriers	F(%)
	(A) Economic Factors	
1.	High production cost of AI systems	198(77%)
2.	High cost of upgrading AI systems	175(68.1%)
3.	High cost of sundry maintenance of AI systems	174(67%)
4.	High incidence of layoffs due to AI Use	181(70.4%)
	Cluster %	**70.8**
	(B) Ethical Factors	
5.	AI lacks ethics and morality (malicious attack)	180(70%)
6.	AI exacerbates pre-existing discriminations	148(57.6%)
7.	AI lends itself to privacy breaches	167(65%)
8.	AI discourages diversity and inclusion in sports	173(67.3%)
9.	AI date not being representative of all uses demographics	175(68.1%)
	Cluster %	**65.8**
	(C) Technical Factors	
10.	AI systems are commodified "black boxes" permitting no trace of their thought process in judging or predicting sports events	160(62.3%)
11.	AI operating AI systems requires top-level expertise	156(60.7%)
12.	AI system can inadvertently restructure sports performance into entirely irreversible new pattern	150(58.4%)
13.	AI systems lack user interfaces for human experts and their (AI) interactions	114(44.4%)
14.	AI systems guarantee no protection against unexpected situations like when they break down or power outrage occurs	164(63.8%)
	Cluster %	**57.92**
	(D) Psycho-philosophical Factors	
15.	AI systems lead to loss of human initiatives	191(74.3%)
16.	AI systems promote loss of feelings of being in control	122(47.5%)
17.	AI systems lead to loss of self-efficacy	125555(48.6%)
18.	AI systems deskill athletes and displace officials	126(49%)
	Cluster %	**54.89**
	Overall %	**62.35**

Data in Table shows that overall, 62.35% of the coaches in tertiary institutions in Enugu State considered the outlined factors as potential barriers to effective applications of AI in sports. Using the cluster percentages, 70.8% of the identified economic factors as barrier: 65.8% opined

that ethical factors are barriers; 57.92% believed technical factors to be barriers; while 54.89% identified psycho-philosophical factors as barriers. Specifically, 198(77%) coaches viewed high cost of AI systems as potential barriers to effective applications of AI systems in sports; 181(70.4%) considered livelihood of high incidence of layoffs due to AI use as a potential barriers; 180(70%) agreed that AI's lack of ethics and morality could be a barrier; 167(65%) were of the opinion that by AI systems being vulnerable to privacy breaches could be a barrier to their use; 175(68.1%) indicated that because data used in training AI may not be representative of all the users demographics could be a barrier; 160(62.3%) identified commodification of AI systems as a barrier; 156(60%) believed that by most AI systems requiring top-level expertise for operating them is a potential barrier; 191(74.3%) indicated that loss of human initiative due to use of AI systems is a barrier to their use in sports; and 125(48.6%) and 126(4.9%) were of the view that loss of self-efficacy and deskilling athletes due to use of AI systems are potential psycho-philosophical barriers to their applications in sports respectively.

Hypothesis 1: There is no significant difference in coaches' perceived barriers to effective applications of AI in sports based on the coaches' institution ownership, type and location

Table 2: Summary of Chi-square Analysis Testing the Null Hypothesis of no significant difference in the proportion of coaches with Perceived Barriers to AI Application based on Institution Ownership, Type and Location

Variables	N	%	X^2	Df	P	Decision
Type of Institution	**257**					
Colleges of education		26.2	24.607	2	. 000	Significant
Polytechnics		17.6				
Universities		46.6				
Institutions Satellite Campuses		9.5				
Ownership of Institution	**257**					
Private		25.8	5.334	2	0.69	Not Significant
State		35.3				
Federal		38.9				
Location of Institution	**257**					
Rural		35.3	1.890	1	.169	Not Significant
Urban		64.7				

Table 2 above shows that there was no significant difference in coaches' perceived barriers to AI applications in sports based on ownership of institution (X^2=5.334, p=0.69) and school location (X^2=1.890, p=0.169) but for the type of institution, there was a significant difference (X^2=24.607, p=.000).

Discussion

The results in table 1 revealed that majority of the respondents indicated that all the items under the four clusters were all barriers to AI applications in sports as shown by their overall percentage of 62.35. On cluster basis, the table further revealed that while economic factor was

perceived by 70% of the coaches as barriers to the AI applications, 65.8%, 57.92% and 54.89% of them perceived ethical factor, technical factor, and psycho-philosophical factor respectively as barriers. Economic factor alone as the highest perceived barrier is not surprising as it aligns with the European Parliament's (2018) emphasis on fund being a very huge barrier to implementing or application of AI systems especially for smaller sports organizations. And the reasons for that are very glaring as the production and procurement costs are as huge as the operation costs in terms of the systems upgrading and other sundry maintenance costs. At present, the country Nigeria like other countries is passing through tough and critical economic crisis such as recessions and inflation at highly unprecedented proportions. As expected, this situation comes with unemployment and disengagement of workers and for the fact that AI systems are naturally known for workforce disruptions including laying off workers, (Dane, 2023), it would reasonably be in the interest of coaches to perceive economic factor as a barrier to the AI applications in sports.

It is equally not surprising for the coaches to have perceived ethical factor as a barrier to AI applications in sports because according to Duggal (2024), ethics and morality as important human features are not in AI systems and are as such feared to grow uncontrollably and may eventually wipe out humanity. Aside the general fear, female coaches and other special population among the coaches in the study may have all expressed ethical factor as a strong barrier for fear of being discriminated against as Dane (2023) noted that data used to train the AI systems is not always representative of a wide range of users demographics such as gender, age, and racial stereotypes. Again, AI is associated with privacy breaches through unauthorized access and data theft which coaches may have perceived as a barrier coupled with the precarious adjudication of cases in the country where such privacy braches do impact people's health and safety necessitating litigations that may eventually end up in no one in particular to be held accountable.

It is little surprising that contrary to the expectation that none of the coaches would perceive any barrier to AI applications in sports given the usual Nigerians euphoria for structured designs and functionalities of technologies, majority of the coaches (57.92%) rather perceived structural designs of AI systems as barriers to their applications in sports. And there are reasons to agree with them. Apart from being designed in a manner that permits no trace of their thought process in judging or predicting sports event, AI systems require top level expertise to operate while also lacking user interfaces for human experts to interact with them, and as well guarantee no protection against unexpected situations. Pockets of AI training programs and few tertiary institutions mounting AI and robotics course programs in Nigeria today are enough reasons to perceive handling or operating AI as a barrier to AI applications in sports. According to Olowononi and Eletta (2023), operating most AI systems requires expertise knowledge in neural networks, search algorithms, mathematical operation techniques, and probabilistic data-driven and economically based methodologies which are still at their infant stage in Nigeria. Also, lack of user-AI interface is a cogent barrier backed by Fuente's (2023) observation that athletes do not respond well to an AI-only coaching approach.

It is equally not surprising for more than half of the coaches to have perceived psycho-philosophical factor as a barrier to AI applications in sports. AI as a system endangers the

psychological and philosophical worth of people by way of subtly subjecting people to passivity in sports by neglecting human sense of agency thereby reducing human to act only on behalf of the system. Robocop, aiming at developing humanoid soccer-playing robot that can beat the FIFA World Cup champions (Mahroun, 2020) sounds like an attempt to replace athletes entirely from sports landscape for which it is reasonable enough for coaches to have perceived psycho-philosophical factor as a barrier to AI applications in sports.

Results in table 2 show that there is significant difference in the way coaches perceived barrier to AI applications in sports based on the coaches institution type (p=0.000) while on the basis of their institution ownership (p=0.69) and location (0.169), there was no significant difference. This implies that difference existed in the way coaches in colleges of education, polytechnics, universities and satellite campuses of the institutions perceived barriers to AI applications in sports. This finding may not be worrisome as access to most institution services and equipment is often lopsided in favour of some tertiary institutions especially universities. The lopsided attention may not have affected the coaches' perception of barriers based on the institution ownership and location, hence the no significant difference observed.

Conclusion and Recommendations

Coaches in tertiary institutions perceived economic, ethical, technical and psycho-philosophical factors as barriers to effective application of AI in sports. There was no significant difference in the coaches' perception of the factors as barriers based on their institution ownership and location while a significant difference existed based on their institution type. Based on the findings and discussion of this study, the following recommendations are made:

(a) Governments at all levels, enterprises, sports departments, colleges, polytechnics, and universities to provide strong financial support for institutions sports to effectively implement AI sports.

(b) Governments and sports federations to organize coaches and other sports officiating experts for purposes of formulating national standards for the applications of intelligent sports, application principles of AI technologies in sports, as well as series of permission requirements.

(c) Governments and institution sports to use block-chain and other technologies to provide strong protection for AI users' privacy rights and intellectual property rights.

(d) Regular interactions and communication between coaches and the AI industry for purposes of delivering uniform standards for sports data that would appropriately be representative enough for all users demographics, for allowing coaches to further understand the importance of scientific applications of AI in sports which would improve their overall quality, and for allowing enterprises and AI professionals obtain more innovative product design inspiration necessary for research and development of AI sports that would enable deep integration between AI and sports.

(e) In-service training for coaches on relevant scientific AI operation proficiency such as neural networks, mathematical operation technology, image recognition, machine learning, search algorithms and other AI knowledge.

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