

Towards Authentic Digitalised Delivery Learning Modes in Physical Education in Zimbabwean Institutes of Higher Learning

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ABSTRACT

Pedagogical practices constitute the pinnacle to architectural delivery learning modes in education, globally. This study explored the use of ICT as a critical delivery mode to Physical Education (PE) teaching in selected Tertiary Learning Institutions of Zimbabwe. The Technology Pedagogical Content Knowledge (TPACK) Framework underpinned this study. The study used a descriptive cohort design anchored on the quantitative approach. A sample of 30 university lecturers and students were chosen for the study. Informed consent was obtained from study participants. Purposive sampling was used to select the study respondents. Cronbach Alpha was used to test reliability of the instruments. Pilot-tested questionnaires were used as data collection tools for the study. Data presentation was performed using frequencies and presented on tables. Emerging findings revealed ICT to be an efficient meta-cognitive tool to authentic PE teaching and learning. The study findings established that an in-depth technologically-oriented pedagogical expertise base is still lacking among PE lecturers, and that theoretical and practical knowledge development gaps that enhance students' physiological and socio-psychological existed from insufficient ICT pedagogically-oriented approaches. Stimulative ICT-oriented teaching approaches and learning environments are critical in developing students' meta-cognitive competencies in PE. Theoretical and practical knowledge development gaps for students should be plugged through integration of knowledge-incurring ICT assistive devices during PE lectures. Lecturers need regular upgrading development clinics to boost their ICT technical skill resource bases aligned to existing technologically-oriented teaching modes in Physical Education.

Key Words: *meta-cognitive; technology; digital literacy; pedagogy; Physical Education*

INTRODUCTION

The development of technologies has seen a tremendous leap-frog in the expansion of digital transformation systems in the 21st century (Arfeli et al., 2025, Mwakapina, 2024). In the context of these transitions, universities have substantially been hooked in this rapidity of the digital transformation era (Pado et al., 2025). Multiple changes in educational, pedagogical, communication and administrative processes have necessitated tertiary institutions to re-assess existing educational models to align with the modern technological drift (Pado et al., 2025) and the transformative potential of ICT in education (Mwakapina, 2024). Meaningful lesson delivery is borne out of the delivery modes chosen by the instructor. While the major purpose of teaching lies in ascertaining learner behavioural change following learning episodes, not all chosen pedagogical approaches have the same efficacy on learners' achievement needs (Gareto, 2025). Heterogeneous teaching abilities during lesson delivery could generate depressive learning environments with subsequent impact on learning outcomes. Yet the psychomotor and meta-cognitive elements applicable to authentic learning, if not well attended to, could easily compromise life-long learning processes. Keeping track with the fast-growing ICT pedagogical modes often present some serious challenges to classroom practitioners (Gareto, 2025). Hence the need for ICT use. This article is intended to plug this pedagogical ICT knowledge gap given the potential to expand the number of digital natives as tertiary students, via appropriately designed technologically-mediated learning modes in Physical Education.

RESEARCH QUESTIONS

1. Do technologically-mediated pedagogical approaches effectively enhance learners' metacognitive dimensions?
2. Are lecturers knowledgeable with instructive digital modes that enhance Physical Education teaching?

LITERATURE REVIEW

This section explores literature on the pedagogical implications of technology on learners' meta-cognitive dimensions. It presents the theoretical framework that underpinned the study and then landscapes pedagogical models and digital framework transitions in Physical Education. Clinical ICT pedagogical tools that develop learners' metacognitive dimensions in PE engagements are explored. Key factors that influence ICT adoption by users and consumers are highlighted.

THEORETICAL FRAMEWORK

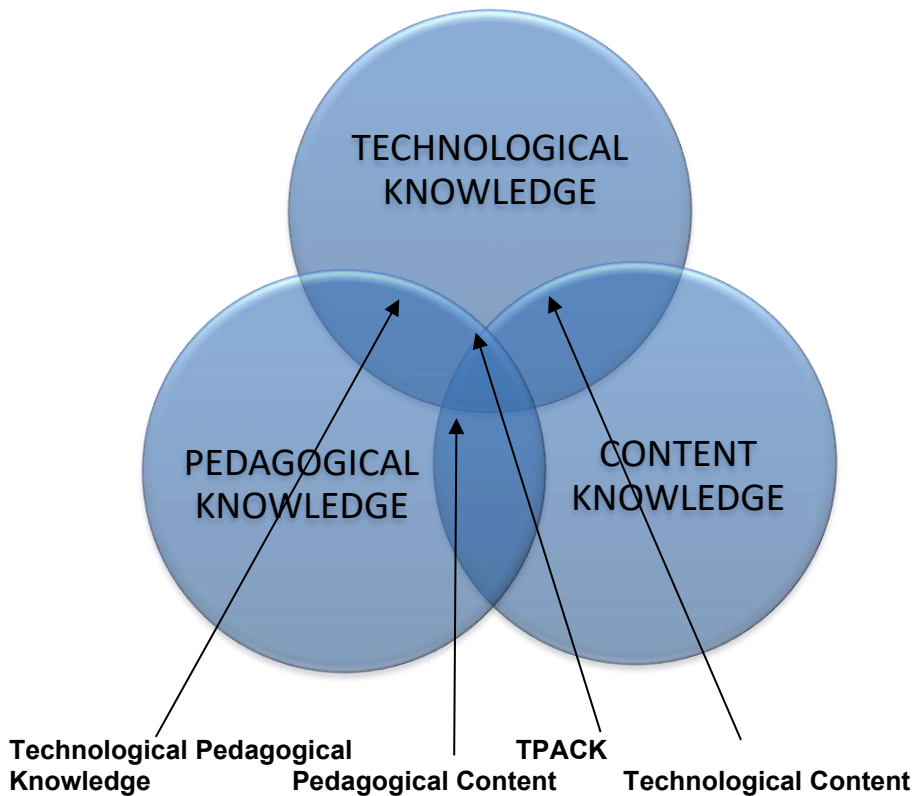


Figure 1: The Technology Pedagogical, Content, Knowledge (TPACK) Framework (Mishra & Koehler 2006). **Source:** (Trabelsi et al., 2021)

This study was underpinned by Mishra & Koehler's (2006) Framework that hinged on 3 knowledge types of Technological, Pedagogical and Content Knowledge (TPACK) illustrated in Figure 1. The framework explicates that effective technological integration requires an established expertise on the lecturer or teacher. Content knowledge entails the need for an in-depth knowledge of the subject area (concepts, theories, rules, internal logic) whereas Pedagogical Knowledge centres on how best to deliver Content Knowledge using appropriate pedagogical tools that meet students'

requirements regarding lesson design. Technical Knowledge concerns availability of Digital Technology for the lecturer/teacher to adequately handle and align with the pedagogical tools available (Mishra & Koehler, 2006). With a minimum knowledge base in each aspect effective technologically-enhanced teaching/learning could be operationalised (Koehler & Mishra, 2009). A blend of these knowledge types provides a pathway to understanding how the integration of the various ICTs into teaching can be applied in different educational settings. Knowledge deficiencies regarding the 3 components makes it more difficult for the lecturer/teacher to interconnect them in Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge and subsequently the TPACK and ICT infusion (Koehler & Mishra, 2009). Thus, the lecturer's knowledge on how the 3 knowledge types is integrated and interrelated is crucial as they provide them with basic understanding of constructively presenting concepts using technology during content delivery. Further, the lecturer needs to have requisite knowledge on how technology can plug gaps students encounter and have the technical skill sets to use technology to extend students' existing knowledge (Koehler & Mishra, 2009).

Pedagogical Impact of Technology on Learning Outcomes and Learner Meta-Cognitive Parameters

Information and Communication Technology is a powerful enabler of pedagogical innovation that has inexorably transformed the contemporary landscape of Physical Education (Komar et al., 2022; Casey et al., 2017). It provides novel platforms that instil critical aspects of objectivity, efficiency, consistency and analytical aptitudes (Rahaya, 2023) fostering conducive teacher-student communication and collaboration (Muresan, 2023). Its extensive potential in enhancing personalised learning during instructional strategies (Sangheethaa & Korath, 2024), makes it a significant mode worth exploring in contemporary teaching practice. Despite the extensive global use of ICT, reports indicate substantial technical and pedagogical deficiency gaps in the field of PE (Varea & Gonzalez, 2020; Koh et al., 2020; Sargent & Casey, 2020; Legrain et al., 2015). Desired educational goals can be achieved through integration of ICT tools and digital competences (Casey et al., 2017) which constitute the pinnacle of the 21st century skills of communication and critical thinking (Mwakapina, 2024; Roure et al., 2019). If the education 5.0 mantra is anything to write home about in PE Higher education learning, then embracing the use of ICT becomes a golden tenet to learners' lifelong meta-cognitive development processes. Hence considering what amounts to the desired combination for effecting use of ICT in PE is of significance (Tou et al., 2020).

Landscaping Pedagogical PE Models with ICT

ICT interconnects multiple Physical Education pedagogical teaching models. Taking a case in point, The Teaching Games for Understanding (Comprehensive Teaching of Sports Initiation) is a game-centred model that focuses on technical, tactical and execution aspects involving competition-simulated situations and sport-specific game modifications (de Medeiros et al., 2017). Infusing ICT enables students to comprehend authentic game versions through practical applications in various sport games. Games constitute a cultural aspect that embeds testing of skills, competition and entertainment across all ages, and video games have transitioned into a developing market in a digital society that has attracted \$184.4 billion worldwide among 3.2 billion players in 2022. Their artistic nature arouses and connects users (learners) to their inner dynamics of cognition, affective and emotional parameters (Galli et al., 2025) making them critical mediators of the learning environment (del Moral, 2014). In a study of 303 Argentinean undergraduate university students in Computer Science, Galli et al. (2025) observed that 89% played video games in their leisure time with the rest being reported from education-related degrees. This may indicate less utilisation in Physical Education learning modes.

The Sport Education model is a pedagogical scientific instructional model that seeks to develop enthusiastic, competent and motor-literate athletes, immersing them in a sports culture that

stimulates their emotions (Siedentop, 2019). Its application from an ICT viewpoint triggers students' psychomotricity dimensions translating theoretical elements into reality during their practical engagements. On the other hand, the use of a Gamification pedagogical model further expands these theoretical and practical elements making it easy to switch practical game elements in order to modify students' behaviour. This motivates learners psychologically and sharpens their critical thinking skills (Ceker & Ozdamli, 2017). For instance, making a push pass in soccer requires precise mental engagement first so that the combination of body appendages for skill execution receives timely and correct instruction from the CNS synergy executive programme to act accordingly. Similarly, the use of Active Video Games (Exergames) extends students' motor skills since they create motivational environments through practical scientific engagements (Osterlie et al., 2023). The Ludo-Technical Approach, like the Teaching Games for Understanding model, has a technical approach to various sports and involves serially modified games with game-oriented rules aligned to sport techniques.

Moving further afield, the Motor Literacy/Physical Literacy model puts emphasis on the development of physical motor competence knowledge for application in practical situations (Choi et al., 2022). Similar elements are replicated in the Practice-Based/Movement-Oriented Practicing Model where goal-directed practice constitutes the pinnacle to standards of brilliance through video use within sport systems in-school and out-of-school (Arufe-Giraldez et al., 2023). Flipped Classroom is a practical pedagogical approach based on constructive teacher-driven lessons infusing elements of relationship, information and communication technologies for learners' review at home prior to classroom discussions (Lopez-Belmonte et al., 2021). The Health-Based Physical Education model addresses the significance of developing health habits in students' lifelong processes than becoming redundant (Arufe-Giraldez et al., 2023). Equipped with this basic knowledge, students can personally navigate the Internet in search of relevant information for upkeep of their health systems. Specific to the foregoing models is that if ICT is productively used as a pedagogical practice in PE, then students will develop cognitively, philosophically, emotionally and socially. Engaging students in ICT-mediated learning makes ICT a significant element for modern PE teaching.

Digital Literacy Defined

Digital literacy is a critical competence for empowering citizenship in a digital world (Marin & Castaneda, 2023). In educational pedagogy, technology skills and digital literacy can influence students' preferences and learning style processes and how they can access information. This digital literacy influence on student learning outcomes has taken centre stage in research (Ervianti et al., 2023) in most institutions. educationists for the past two decades sought to define and measure computer literacy. Most often than not, blending of terms like computer, information, technology or digital matched with literacy, proficiency, competency or fluency have commonly featured in the literature (Murray & Perez, 2014). As stated by UNESCO (2018), digital literacy goes beyond knowledge on computer use to encompass basic skills together with living skills that apply to all aspects of modern life. On the other hand, Manubey et al. (2022) have taken digital literacy to mean the ability to use information and communication technology effectively to access, evaluate and process information in various digital forms. Khan et al. (2022) affirmed that by being digitally literate, one can create, manage, and gather information and turn that information into something useful. Thus, the ability to generate, access, search, and skilfully manage digital information in academic research and writing, effective knowledge building, sharing content knowledge, problem-solving, and critical thinking (Liu et al., 2020; Ferrari, 2013; JISC, 2013) are essential digital literacy tool kits needed in the modern world that is digitally-driven by scientific and technologically-laden transformative systems.

Digital Literacy Frameworks: Transitions

Regarding UNESCO's (2018) pillars of Global Framework to Measure Digital Literacy, multiple aligned frameworks have been developed. The University of British Columbia (2020) suggested a framework underpinned by elements of research and information literacy, critical thinking, problem-solving and decision-making; creativity and innovation, digital citizenship, communication and collaboration, and technology operations and concepts. Along similar lines, MacQuire University (Sydney) developed a 6 item Digital Dexterity model comprising digital identity and wellbeing, information literacy, media literacy and data literacy; digital learning and development; ICT proficiency and productivity; digital creation, problem-solving and innovation; and collaboration, communication and participation. On the other hand, the DQ Institute (2021) broadened digital literacy horizons from mere skills to more technically-mediated operations in 8 categories: mainly, digital literacy impacting personal identity, rights, critical thinking skills and emotional intelligence. The items are further split to include Digital Identity (Digital Citizen Identity); Digital Co-Creator Identity, Digital Change maker Identity), Digital Rights (Participatory Rights Management, Intellectual Property Rights, Privacy Management), Digital Literacy (Data and AL literacy, Content Creation and Computational literacy); Digital Communication (Public and Management Communication, Online Communication and Collaboration, Digital Footprint Management); Digital Emotional Intelligence (Relationship and Management, Self-Awareness and Management, Digital Empathy); Digital Security (Personal Cyber Security Management, Network Security Management, Organisational Cyber Security Management); Digital Safety (Behavioural Cyber-Risk Management, Commercial and Community Cyber-Risk Management and Digital Use (Balanced Use of Technology, Civic Use of Technology).

Furthermore, digital literacy has been observed by the Canadian Centre for Media and Literacy (2022) from an ICT innovation view point (rights) and responsibilities, social awareness and identity, pooling knowledge, judgement, problem-solving, reflection, synthesising, safety and security, Navigation skills, accessing skills and opportunity; constructive social action; create, understand, use, access, distribution, infraculture, tools; critical/creative thinking; cultural empowerment, citizenship, research/information fluency, distributed cognition, appropriation, creativity, networking, simulation, decision-making, multi-tasking, input/output skills, tools and text skills and competence. Equally translated, combined technical knowledge and ICT use become crucial tools that transform learners into citizens able to fit into a modern technology-driven world in institutes of Higher learning.

The Australian Edith Cowan University Digital Literacy Framework (2022) was developed as a 5-item policy of digital technologies; information, academic, media and data literacy; digital citizenship and identity; digital creation and communication; and digital learning (professional and lifelong learning). Drawing from these discussions, PE lecturers need to establish the importance of pedagogical integration of ICT to developing learners' meta-cognitive lifelong processes and keep abreast of modern technological developments. It is in this sense that Dela Cruz (2019) and Karaboga (2019) saw the importance of orienting the global citizenship concept to students at tender ages for them to see the importance of technology and how it manifests in every corner of the world. These authors argued that exposure of this kind places users in a comfort zone of being global citizens in Internet use from 2D, 3D, the Metaverse and multidimensional elements, although information suppression still stands as a barrier to plug gaps of this nature in most societies (Tinmaz et al., 2023). This provides the basis for becoming authentic digital natives making them more relevant to scientific information and the technology revolution in this era of knowledge explosion, than being digital immigrants (Ibrahim et al., 2023) unable to cope with the complexities of modern society (Fraillon et al., 2020).

The German government has moved towards developing a 'responsible and welfare-oriented' use of AI with a competence-oriented approach (Fiedler et al., 2020) as a framework for learning and

teaching technically-related AI competences and certification in universities (Stuttgart, 2025). Methodical competence of this nature becomes the empirical base that shapes and develops an AI-relevant workforce and society driven by AI applications (Arfeli, Weber, Ackermann & Popovic, 2025). Subsequently, this makes graduates more relevant to the demands of the modern sports industry as they are equipped with cognitive, social, and digital competencies.

Digital Literacy Knowledge in Physical Education

At the global level, dynamic transformation has increased the significance of understanding digital literacies and their practical implementation (Tinmaz, Ivanovici & Baber, 2023). This digital literacy gave birth to global citizenship during the COVID-19 pandemic in search of digital skills to learn, work and live in a more equitable digital world (Buchholz et al., 2020). Digital knowledge encompasses personal efficacies in accessing ideal information (Ali et al., 2023), critically reviewing it and packaging the information into knowledge (Ali et al., 2023; Hjort & Tian, 2021; Buckingham, 2015). The underpinning factor is the ability to handle basic software and execution of information retrieval tasks (Koh et al., 2022) which require synchronisation with pre-determined goals on tasks at hand.

Global statistics show that about 37% of the world's population (2.9 billion) still grapple with Internet access, 96% of whom are in developing countries. A survey conducted among Tunisian high school PE teachers by the Ministry of Youth Affairs and Sports revealed that a significant proportion of over 40% had substantial DigiTech deficiencies in ICT use for teaching and learning purposes (MYAS, 2020). Let alone Zimbabwe which falls within the Economic Misery Index and in subsequence, most people suffer limited Internet accessibility. This digital divide gap is further rooted in digital literacy (Hargittai & Micheli, 2019) which subsequently alienates most societies from world Internet connectivity (World Bank, 2021). Ocana et al. (2019) advised that co-opting AI in contemporary digital literacy frameworks is a critical requirement. In upholding digital literacy, UNESCO's (2018) proposed a Global Framework to Measure Digital Literacy based on 6 critical pillars, namely, Information and data literacy; Communication and collaboration; Digital Content Creation, Safety, Problem Solving and Career-Related Competence. Drawing from these pillars it is incumbent that Higher Education institutions embrace new curriculum that are digital and AI-powered and drift from basic digital literacy to more of higher order computational thinking skills (Tinmaz et al., 2023, Francesc et al., 2019).

Is ICT the Right Matrix for PE Learners Meta-Cognitive Development?

Studies show that ICT use is a potential pedagogical tool supporting PE delivery modes (Trabelsi et al., 2021; Calderon et al., 2020; Sea & Koh, 2020). ICT uses encourage development of students' critical thinking skills (Phillips et al., 2014) while adolescent students' health existence is endorsed (Seah & Koh, 2020). This considerably expands their knowledge and acquisition base levels (Hinjo Luceno et al., 2020). Krause's (2017) study of experienced PE pre-service teachers indicated success and efficacy of ICT pedagogical tools use upon attainment of ICT-specific skills training. A similar study conducted by Trabelsi et al. (2021) among 424 Tunisian public school PE teachers revealed positive attitudes towards ICTs as critical educational tools that could expand digital literacy usage rates given the appropriate technological resource bases and training. In Koh et al.'s 2022 study of 11 PE teachers in Singapore schools, self-efficacy in relation to adopting ICT tools in PE emerged as an essential factor in influencing ICT implementation in PE. Emerging findings also showed that the integration of ICT tools in PE lessons potentially boost learners' cognitive, affective and psychomotor parameters. From the study teachers reported that use of videos assisted students in referring to past performances and identification of areas in need of upgrading. Further, students' health aspects (locomotor skills) can be enhanced through exergames (Andrade et al., 2020; MacGann et al., 2020) together with motor competence skills, athleticism, self-esteem and self-assessment from video feedback (Potdevin et al., 2018) mediating supportive pedagogies

(Yates et al., 2021) with enhanced authentic digital assessment (Jopp, 2020). By using technology they could visualise, replay, and get instant feedback with longer retention capacities (Koh et al., 2022). For instance, digital game designs have been reported to impact on students' learning experiences (Pill et al., 2021) while Massive Open Online Courses have also been confirmed to have a positive impact on professional growth (Griffiths et al., 2021). The use of Video Assisted Referee (VAR) during soccer tournaments has even improved expertise handling capacities in refereeing throughout the world, although in developing countries this is still lagging. Communication between officials and among players and spectators becomes clear giving satisfaction and enjoyment to all stakeholders. Subsequently, technology should be viewed as transformative teaching and an enhancer, and not merely treating it as a substitute to the teacher (Phelps et al., 2021). This transformation should be transitioned to leisure and mass sport systems at all levels of participation where learning is further enhanced.

Screen-based devices critically enhance learning experiences during motion analysis, observational learning and feedback during PE classes. In such cases, movement and repertoire, where necessary, can be modified to meet the desired performances (Trabelsi et al., 2020; Soussi et al., 2020). Instructional and educational assistance presented by way of ICT endorse learners' multimodal physical literacy capacities. Thus, audiovisual production and presentation equipment, digital health-tracking devices, smart watches, virtual reality simulators and exergames are potential metacognitive enablers to quality PE teaching and learning (Trabelsi et al., 2020; Gibbs et al., 2017).

What Determines ICT Adoption in Physical Education? A number of factors determine ICT adoption. Koh et al. (2022) skilfully summarises some of these critical aspects as shown in figure 2 below:

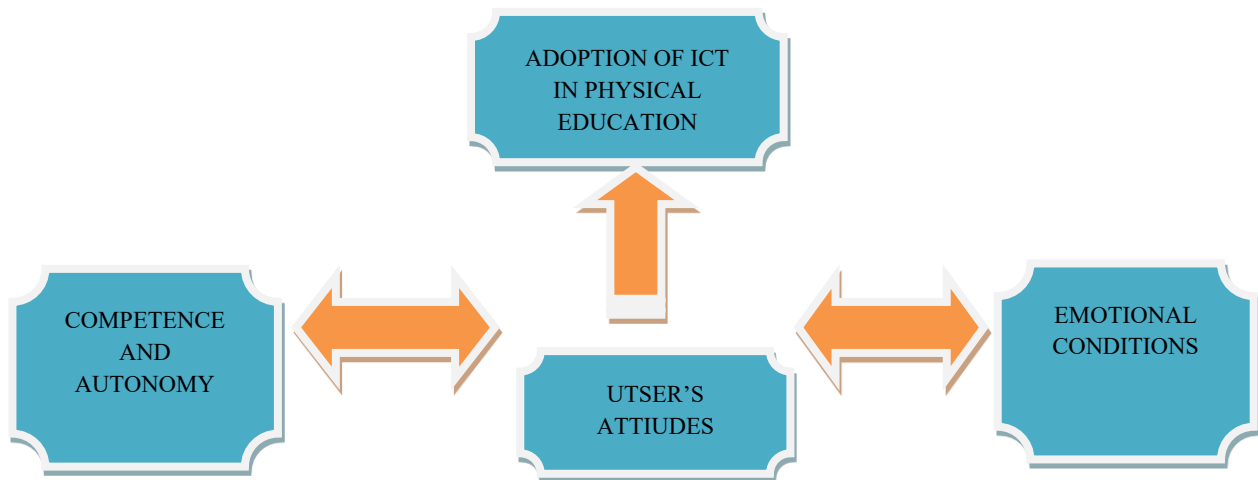


Figure 2: *Determinants of ICT adoption in Physical Education, Source: Koh et al. (2022)*

RESEARCH METHODS AND DATA ANALYSIS

The study used a descriptive cohort design anchored on the quantitative approach. The Technology Pedagogical Content Knowledge (TPACK) Framework underpinned this study. A purposive sample of 30 university lecturers and students, drawn from the Department of Physical Education and Sports section were used for the study. Informed consent was obtained from study participants. Anonymity and confidentiality of data were established to meet ethical standards. Ethical clearance

was sought from the University Research Board. The Cronbach's Alpha statistic was used to determine the internal consistency of the questionnaire items before the instrument was used in the field. The test yielded the Cronbach's Alpha of 0.78 which indicates acceptable reliability. The instrument was pilot-tested using a smaller related sample from the University prior to its administration to the intended respondents to ensure its validity before the data collection process started. Pilot-tested questionnaires were used as data collection tools for the study.

RESULTS AND DISCUSSIONS

In this section the results of the study are explicated in view of the 2 two research questions that guided the study. Discussion of results and conclusive remarks are provided below

Table 1: Demographic information of university PE lecturers

Background characteristics	PE Lecturers N (10)					
	Male N (8)		Female N (2)		Total	
	N	%	N	%	N	%
Age group (years)						
30-40	1	10	-	-	-	10
41-50	1	10	-	-	10	10
51+	6	60	2	20	8	80
Educational background						
PhD	2	20	2	20	4	40
M.Phil	-	-	-	-	-	-
MSc	1	10	-	-	1	10
Med	2	20	-	-	2	20
BSc honours (PES)	1	10	-	-	1	10
BSc (PES)	1	10	-	-	1	10
B.Ed (PES)	1	10	-	-	1	10
Diploma (PE Major)	-	-	-	-	-	-
Experience						
1-5 years	-	-	-	-	-	-
6-9 years	3	30	-	-	3	30
10+	7	70	-	-	7	70
TOTAL	10		10		100	

Results show that most lecturers (80%) are above the age of 50 years with 4(40%) having PhDs in Physical Education while the rest have a minimum qualification in PE. Of these, 7(70%) have over 10 years lecturing experience in Physical Education in Higher Education. A segment of 3(30%) have experience of between 6 and 9 years in the field. This generally depicts an experienced crop of specialists in the area of PE with expertise in the area of specialisation.

Research Question 1: Do technologically-mediated pedagogical approaches effectively enhance learners' metacognitive dimensions?

Table 2: Usage rate of ICTs for teaching by PE Lecturers: N (10)

Technology description	Responses				
	Strongly Disagree (SD)	Disagree (D)	Neither agree or disagree (A nor D)	Agree (A)	Strongly Agree (SA)
Assistive technological tools	-	2 (20%)	-	2 (20%)	6 (60%)
Video production equipment	-	4 (40%)	-	3 (30%)	3 (30%)
Computers in classroom	4 (40%)	2 (20%)	2 (20%)	2 (20%)	-
Tablets in classroom	10	-	-	-	-
Smart phones in classroom	-	3 (30%)	4 (40%)	3 (30%)	-
Video projectors in classroom	-	5 (50%)	1 (10%)	4 (40%)	-
Video camera	7 (70%)	3 (30%)	-	-	-
Sports video games	4 (40%)	3 (30%)	-	2 (20%)	1 (10%)
Dietary tracking apps	10 (100%)	-	-	-	-
Exergaming equipment	10 (100%)	-	-	-	-
Fitness tracking apps	10 (100%)	-	-	-	-
Activity trackers	6 (60%)	-	2 (20%)	2 (20%)	-
Motion analysis apps	10 (100%)	-	-	-	-
Class management apps	10 (100%)	-	-	-	-

Although technology critically transforms educational pedagogical approaches, most resources and technological applications are a scarcity in institutions, as affirmed by the majority of respondents (exergaming, (100%), fitness tracking (100%), dietary tracking (100%), motion analysis (100%) and classroom management apps (100%). Video-enhanced platforms are rarely used 70% (SD), sports video games 40% (SD) and 30% (D) while use of video production equipment 30% (SA) confirmed use of such platforms. This implies absence of assistive technological devices (60%) for use during integration of PE teaching pointing to the likelihood of insufficient funding from concerned administrators. Subsequently, students may not see the importance attested to technological application in enhancing their learning in the absence of clear hands-on practical links. As a consequence, they may be deprived of entry into the fast-growing world of digital technological developments and scientifically-mediated knowledge. This may, however, be different for well-resourced cases.

Table 3: Perceived Technological support, opinions and attitudes of PE lecturers towards ICT integration in teaching/learning: N (10)

Statement	Responses				
	S D	D	A nor D	A	SA
When using technology:					
Students create products that show higher achievements	-	-	-	-	-
Students are motivated	-	-	-	2(20%)	8(80%)
There is more student collaboration	-	-	-	1(10%)	9(90%)
There are more disciplinary problems	5 (59%)	3 (30%)		2 (20%)	-
I feel that:					
Most technology will improve my PE teaching	-	-	-	2 (20%)	8 (80%)

Technology can change my teaching approaches	-	2 (20%)	-	3 (30%)	5 (50%)
Students are more knowledgeable in ICT use than I can	-	1 (10%)	-	3 (30%)	6 (60%)
There is rapid technological change but with no support and training for PE lecturers	-	-	-	1 (10%)	9 (90%)
Technology is a good tool for collaboration in planning	-	-	-	2 (20%)	8 (80%)
I get enough support from admin for ICT integration in PE teaching and learning	6 (60%)	2 (20%)	-	1 (10%)	1 (10%)
I receive enough purchasing funds for technological equipment from admin	8 (80%)	2 (20%)	-	-	-
Technology use is important to my students learning	-	-	-	-	10 (100%)

KEY: A = Agree; SD = Strongly Disagree; D = Disagree; SA= Strongly Agree; A nor D = neither Agree or Disagree;

Pedagogical technological integration in teaching creates motivational environments as indicated by 80% of respondents, while this establishes group effort among students (90%). Most respondents opined on technology as an empowering tool to their teaching approaches (80%, SA) and game changer to learning processes. Despite the positive developments, most respondents reported lack of support for training services to keep abreast of the fast-growing technological changes in PE teaching (90%). This may not sufficiently develop learners' meta-cognitive dimensions to undertake modern technical ICT integration demands in PE teaching and learning due to lack of funding (80% SD) and support (60% SD) from administration

Table 4: Students' responses on the use of ICT in PE learning (meta-cognitive) N(20)

Statement	Responses				
	SD	D	A nor D	A	SA
I want to become a digital native	-	-	1 (5%)	1 (5%)	18(90%)
ICT technological use appeal to all my senses	-	-	-	-	20 (100%)
Technology motivates and I feel empowered	-	-	-	2 (10%)	18 (90%)
ICT technological use brings team cohesion	-	2 (10%)	-	2 (10%)	16 (80%)
I feel much engaged when ICT is integrated during PE learning	-	-	-	3 (15%)	17 (85%)
ICT offers me real interesting learning moments	-	-	-	-	100 (100%)
My family provides support for purchasing ICT tools	3 (15%)	2 (10%)	-	2 (10%)	13 (65%)
ICT provide scientific global transformation?	-	-	-	1 (5%)	19 (95%)
Our PE lecturers have ICT competencies	-	1 (5%)	3 (15%)	3 (15%)	11 (55%)
Enough ICT tools at our institution?	3 (15%)	1 (5%)	-	10 (50%)	6 (30%)
ICT can mould bad behaviour in students?	4 (20%)	2 (10%)	-	2 (10%)	12 (60%)

As shown in Table 4, most students (100%) indicated that technology is a critical empowering tool to their learning through its scientific global transformation benefits (95%). This attests to the reasons for their quest to be digitally literate natives in their area of specialisation as shown by the majority of their responses (90%, SA). Although to some extent some students get support for purchasing ICT tools for their use (75%), acquiring such resources is burdensome to some families (25%). Further, a figure of 80% reported lack of ICT tools at their institutions (80%) while 20% confirmed availability of technological gadgets at their institutions. This resource gap may further indicate separate groups existing in one classroom, digital migrants (non-resourced) versus digital natives (well-resourced). Nevertheless, the issue of ICT competencies among PE lecturers is evident as indicated by 70% of respondents. This could be indicative of institutions that have revised their curriculum models towards the fast ever-changing educational and pedagogical technological transformations and world of digital literacy. The 3 respondents (15%) who neither agreed nor disagreed is indicative of insufficient knowledge and understanding regarding existing technologically-mediated pedagogical educational learning transformations and they may not be worried about being fully engaged in-depth with digital literacy development and upgrading.

Research Question 2: Are lecturers knowledgeable with instructive digital modes that enhance Physical Education teaching?

Table 4: General factors that influence technology use: N (10)

Positive	Number	%	Negative	Number	%
Student learning	9	90	Student	4	40
Knowledge	8	80	Knowledge	3	30
Personal feelings towards DigiTech use	7	70	Personal feelings towards DigiTech use	3	30
Competence	8	80	Competence	4	40
Classroom management	6	60	Classroom management	2	20

Regarding factors that positively influence technological engagements, the most popular reasons in order of regularity were for student learning (90%), followed by knowledge acquisition and competence at 80% respectively, personal feelings towards DigiTech use (70%) with classroom management having the least number (60%). This indicates goal-directed pathways towards the need for review on existing curriculum models that are in sync with education 5.0 and modern investment in research, industrialisation, innovation, teaching and community service. Embracing these pillars allows teachers to re-assess and revise their pedagogical methodologies for PE practicals so that graduates are turned into productive digitally literate natives. Although there were more positives regarding effective technological use, personal feelings towards DigiTech use (30%) and knowledge deficiencies (30%) on the part of lecturers could be hindrances to productive teaching in some institutes. Subsequently, some incompetent staff may remain anchored in the 'digital illiterate immigrant' group affecting students' potential life-long learning processes (40%).

DISCUSSION AND IMPLICATIONS

From a physiological perspective, understanding how the body works and responds to different load intensities during workouts serve as protective and essential measures of health. While sport is a massive puller in institutions, lecturer-coaches need to understand the medical backgrounds of student-players to avoid compromising their health or pushing them beyond their limits. There is, however, a great need to migrate from traditional approaches and infuse AI and technologically-oriented data storage modes. Thus, fitness tracking and dietary tracking apps provide individual

players with authentic profiling of data for monitoring training progresses and dietary habits (Trabelsi et al., 2020; Gibbs et al., 2017). This ICT integration further contributes to adolescent students' health existence (Andrade et al., 2021; Seah & Koh, 2020) and knowledge acquisition base levels, encouraging independent learning (Hinjo Luceno et al., 2020). Correspondingly, use of exergames, screen-based and motion analysis devices endorse theoretical and practical skill conversions, enabling modifications to desired routines (Soussi et al., 2020) in sports training through authentic digital assessments as indicated in various studies (Koh et al., 2022; Yates et al., 2021; Jopp, 2020; Potdevin et al., 2018). This further provides the basis for critical issues raised in the aforementioned models, namely: The Heath-Based PE Model (Arufe-Giraldez et al., 2023); Motor Literacy Model (Choi et al., 2022); Practice-Based Model (Arufe-Giraldez et al., 2023); The Ludo-Technical Approach Model (Choi et al., 2023); The Teaching Games Model for Understanding (de Medeiros et al., 2017) and The Sport Education Model (Siedentop, 2019).

Despite the significance of ICT, poor Internet connectivity and coverage still remains a prohibitive factor to authentic learning. Subsequently, this impacts on students' critical golden constructs of self-esteem, self-actualisation, and ideal-self and overall, their self-authored empowerment bases to significant learning. Thus, as indicated by the World Bank (2021) the absence of Internet services hinders most societies from world connectivity making communication, learning, and teaching more excruciating tasks to lecturers and learners. Unless full ownership in funding is instituted, keeping abreast of the ever-changing ICT transitions will remain daunting tasks in most institutions in view of Economic Misery Indexes that entrap most countries. This is evident in results reported in this study. The graduates, if not taken through enhanced life-long ICT-oriented learning pathways, may not fit well in modern job markets due to insufficient business-related training.

Whereas technology is a global transformative teaching and pedagogical enhancer in educational settings (Phelps et al., 2021; Trabelsi et al., 2021; Calderon et al., 2020), the shortage of ICT tools in most institutions could seriously impact learning styles preferences and eventually shutter student their dreams of becoming competent digital natives. This digital divide gap (Hargittai & Micheli, 2019) may predictably have serious implications on their preferential areas of specialisation and lifetime routes. This makes the results of this study relevant in the context of the World Bank's (2021) 39% (2.9 billion) global statistics rate of Internet inaccessibility of which 96% are reported to be in developed countries. Further, the issue of 40% DigiTech deficiencies has been raised by MYAS (2020) among Tunisian PE teachers. This also equates to results reported in this study which subsequently affect student outcomes that may not fit well in the world of digital transformation.

While at most institutions digital literacy implementation is still at infancy, they, however, appear destined towards achieving UNESCO's (2018) pillars of Global Framework to Measure Digital Literacy. This might be a positive pointer towards embracing DigiTech Literacy development in local universities (paperless world) although versions of implementation could substantially differ from British Columbia University (2020); the DQ Institute (2021); Canada Centre for Media and Literacy (2022) and Edith Cowan University (2022). The existing political landscape could be a contributory factor for local Universities to keep abreast of the rapid technological changes due to financial instabilities. While the Technical Pedagogical Content and Knowledge (TPACK) is an ideal technical and goal-oriented framework (Koehler & Mishra, 2006) for local use, our local universities may have an uphill task for its full implementation due to economic upheavals. This could remain white elephants for the greater part of the decade as affirmed by results of this study.

CONCLUSIONS AND RECOMMENDATIONS

In this section conclusive remarks are provided and linked with key goals of the study. It then ends with recommendations for future consideration.

CONCLUSION

ICT is a critical pedagogical enabler in PE that develops students' meta-cognitive dimensions of learning. However, there is a serious shortage of ICT tools and assistive devices that can enhance lecturers' pedagogical delivery modes in PE in most institutions. Technological deficiencies regarding integration of ICT still exist among PE lecturers in most institutions. There are no defined technological models that should integrate with ICT in PE teaching, along with lack of financial resources to support purchase of ICT pedagogical tools. Theoretical and practical knowledge gaps for the development of students' physiological and socio-psychological dimensions from insufficient ICT supportive tools exist in tertiary institutions. There is a lack of requisite technological skills in some PE students due to financial instability.

RECOMMENDATIONS

Universities need secure relevant ICT tools and assistive devices that enhance students' learning in PE. Lecturers in tertiary education institutions require training empowerment to improve their pedagogical digital literacy base levels in using ICT tools. Technological models need to align with ICT teaching in institutions. Full ownership and substantial funding towards securing of sufficient ICT pedagogical assistive tools that develop students' technological skills is needed. There is need for bridging theoretical and practical knowledge gaps on students' learning to fully develop their meta-cognitive skills. This research was only limited to one research site with few respondents. Future researches need to consider using more research sites with more respondents to avoid bias in the findings.

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