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USING EMERGING TECHNOLOGIES TO PROMOTE PHYSICAL ACTIVITY: THE PERSPECTIVE OF UNIVERSITY STUDENTS IN GHANA

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ABSTRACT

Despite research advocating the importance of developing and testing new interventions to promote physical activity in emerging adults, such literature is extinct among Ghanaian university students. This study examined the potential of emerging technologies in promoting physical activity among such populations in Ghana. Using semi-structured interviews, we conveniently examined the perspectives of 22 students at the Kwame Nkrumah University of Science and Technology to determine how emerging technologies can promote physical activities and the challenges of using them. The results showed that the students are aware of the existence of some of these technologies. The following themes emerged from the study on the benefits of using emerging technologies to promote physical activities; promote motivation and engagement, personalised coaching and feedback and social support. Further, the results revealed challenges such as cost, over-dependency on technology, and technical issues which are mainly connected with network issues. Based on the findings we recommend that fitness enthusiasts should educate students on how to use some of the technological devices to promote their physicality. Further, we proposed cost-effective techniques such as the use of calisthenic activities to promote physical activity and health among university students to reduce costs.

Keywords: Emerging technology, physical activity, wearable devices, calisthenics.

INTRODUCTION

The impact of emerging technology on sedentary behaviour can be likened to a double-edged sword. One way to look at it is that some new technologies—like sedentary video games and computer games—have exacerbated the epidemic of inactivity and sedentary behaviour (Gao & Lee, 2019). On the other hand, various cutting-edge technologies are being used more and more to encourage physical activity and health (Xiong *et al*., 2019; Cadmus-Bertram *et al*., 2015). For example, newly emerging technologies such as mobile device applications, healthy wearable devices, and active video games have been adopted to promote physical activity and health (Duncan *et al*., 2014; Zhang *et al*., 2015). However, there is a paucity of research on the impact of new technologies to promote physical activities among learners in developing countries such as Ghana.

The integration of emerging technologies into health promotion initiatives offers a promising avenue to address health-related challenges. The proliferation of smartphones, wearable devices, and digital applications has created new opportunities to engage diverse populations in physical activities. For example, there is evidence of the usage of new technologies to promote physical activity among healthy children (Joyner *et al*., 2019; Zach *et al*., 2016) and children with chronic respiratory diseases (Torres-Castro *et al*., 2021; Westergren *et al*., 2016). The health concerns of adults have been addressed using emerging technologies (Fanning *et al*., 2012; McClung *et al*., 2018). Among the groups that researchers aim to help improve their physical well-being are students who use emerging technological devices (Precht *et al*., 2023) to perform numerous activities. These technologies can provide personalised and interactive experiences that encourage and support behaviour change (Glasgow *et al*., 2004) leading to a reduction in physical inactivity.

Among children and adolescents, physical activity has numerous benefits including cardiometabolic health, motor skill development, bone density, quality of life and psychological wellbeing (Saunders *et al*., 2016). Therefore, physical inactivity is a global health problem associated with many adverse outcomes, including obesity, cardiovascular disease, and mental health problems (WHO, 2010). This concern is very important among students, who often face challenges in maintaining an active lifestyle due to academic demands, extracurricular activities, and access to recreational facilities (Romero-Blanco *et al*., 2020).

While there is evidence of emerging technology targeting numerous groups, considerable attention has not been given to university students. In the context of Ghana, such literature is extinct despite Favieri *et al*. (2021) advocating the importance of developing and testing new interventions to promote physical activity in emerging adults. In Ghana, there seems to be a concern about how to develop effective strategies to promote physical activity and improve the overall health and well-being of students. This paper examines ways of using emerging technologies to promote physical activities among university students and the challenges associated with the use of the technologies. The study can contribute to the debate on the use of emerging technologies to reduce sedentary behaviour among young adults and contribute to the discussion in the field (e.g. Benzing & Schmidt, 2018). The next section briefly examines the literature of this study followed by the methods and materials, results and conclusions.

The State of the Art

The Use of Emerging Technologies to Promote Physical Activities

The health consequences of physical inactivity are amplified among different populations worldwide. To some scholars, wearables and sensorable digital tools such as fitness trackers, smartwatches, and sensors have been prescribed as effective modern methods of promoting physical fitness (Benzing & Schmidt, 2018). These tools can monitor metrics like heart rate, steps taken, distance travelled and even analyse movement quality. Arguably, athletes, fitness enthusiasts, and other groups have used these innovative devices to measure progress, create objectives, and improve training regimens with positive health outcomes (Malizia *et al*.,2021).

Maddison and colleagues (2014) observed a positive impact of mobile phones and internet (mHealth) interventions on physical activity levels. This effect is likely due to increased self-efficacy, encouraging individuals to engage in more physical activity at higher intensities (Maddison *et al*., 2014). In contrast, Vandelanotte *et al*. (2013) conducted a qualitative study to explore the perspectives of middle-aged men in Australia regarding Internet- and mobile phone-delivered interventions to enhance physical activity, but their findings differed. These conflicting findings have led to some individuals being hesitant to use regular mobile phones to change health behaviors, with the use of more expensive smartphones being considered more appropriate.

Despite many individuals using mobile phone devices to acquire physical activity interventions, other people use wearables including; Fitbit, Apple Health, Google Fit and Apple Watch to track various body measurements including steps, sleep, heart rate, distance traveled as well as individual types of exercise (Bai *et al*., 2021; Fuller *et al*.,2020). Wearable technology is further incorporated into clothing and other items that may be worn comfortably on the body to improve physical activity participation (Wright & Keith, 2014). It is noteworthy to acknowledge that equipment embedded with sensors can provide instant feedback on technique and performance which supports children and their families to engage in moderate-to-vigorous physical activities including; running, biking, and swimming (Bates *et al*., 2020). On this note, attending to these technologies may give positive support in physical activity participation.

On the other hand, people prefer to use games and interactive mobile apps to support physical movement. These apps could use augmented reality (AR) or location-based technology to create engaging experiences, such as scavenger hunts or fitness challenges that require users to explore their surroundings. This indication was justified in the work of Boulos and Yang (2021) who stated that exergames require the game player to physically move to progress in the game and accomplish specific goals. Biddiss and Irwin (2010) and Peng *et al*. (2013) on the other hand were of the view that Active video gaming (AVG) play results in light-to-moderate intensity physical activity. This positive outcome is evident in the study conducted by (Barnett *et al*., 2012) who supported that AVG play is associated with higher movement skill proficiency in young children. The significance of AVG is key in exercise participation, however, the modest physical activity provision by video games is inadequate for helping individuals meet physical activity recommendations by the World Health Organization (WHO) (Graves *et al*., 2010). To this end, the justifications connote that digital tools enhance physical activity participation even though they may have their shortfalls. Thus, technologies should be more accessible to influence how individuals approach physical activities. However, when using them, it is important to consider the potential downsides of relying

solely on them for training and performance enhancement.

Several studies examined social comparisons for the continuous intentions of using fitness apps (Huang & Ren, 2020), fitness wearables (Gupta *et al*., 2021), or behaviour change techniques in fitness app uses (Huang & Zhou, 2018; Yin *et al*., 2022). According to Bates *et al*. (2020), integrating physical activity tracking using social media platforms and online classes helps promote exercise participation. The researchers explained that Outlook users can share their training, successes, and progress on social media platforms. This technique helps foster a sense of community and friendly competition. In the same way, to reach physical activity benefits, exercisers can offer live or pre-booked online fitness classes from the comfort of their homes. Classes can include regular workouts and unique activities such as dance workouts, martial arts, or high-intensity interval training (HIIT). Aside from the classes, the individual can create personal training applications to achieve fitness goals through the use of AI algorithms. In this respect, the individual can create a personalized training plan based on the user's goals, fitness level, and available equipment that can assist the exerciser in adjusting the settings during training.

Emerging technology and physical activities among students

Digital technologies are used by people almost everywhere and at every time including schools (Lupton, 2021; Rideout, 2015). Students, particularly those in universities, spend most of their daily hours on academic work and fail to engage in vigorous physical activities. In place of acquiring physical fitness components, students use social media apps (e.g.; WhatsApp, Twitter, Facebook, etc.) that coach and motivate them to discuss health-related topics (Middelweerd *et al*., 2015). There is also evidence of wearable devices for monitoring students' lifestyle activities and health, and online websites for searching for health information to promote life longevity (Lupton, 2017). However, students prefer sharing only their positive accomplishments leaving the negatives (Middelweerd *et al*., 2015).

Casey and Jones (2011) authenticated that the use of digital technologies has been noted as one of the key ingredients to enhance physical activities among students. The researchers supported that effective use of video technology enhances engagement in physical education activities which in turn helps students develop a better understanding of various activities performed. In school physical education and sporting activities, the use of artificial intelligence integrating AI-powered algorithms is widely executed. This helps analyse vast amounts of data to provide insights into an athlete's performance and health. This evidence will assist in reducing barriers to regular physical activity by helping students with planning and increasing access to fitness programmes.

Challenges involved in using emerging technologies to promote physical activities among students

The use of emerging technologies to promote physical activities poses serious challenges. For example, due to technological literacy, not everyone, especially older adults, may be familiar with or comfortable using new technologies. This can be a barrier to adopting physical activity promotion tools that heavily rely on digital interfaces. Again, Young *et al*. (2014) stated that using technological tools to promote physical activity can result in some level of illness or infirmity for participants. The experience of excessive screen time and incorrect use of technologies such as smartphones and laptops for health information can lead to negative physical health effects (Manwell *et al*., 2022).

Therefore, striking a balance between tech-assisted physical activities and real-world interactions will be beneficial to those who use these devices.

Moreover, getting access to these devices can be economically challenging. For instance, Ceobanu and Boncu (2014) established that individuals with lower incomes may not be able to afford expensive smart devices that support good internet connectivity to have adequate physical activity participation. In addition, because people from low socio-economic backgrounds experience difficulties in getting access to money, they may also find it problematic to buy internet data for exercise participation (Patel *et al*., 2022). In this regard, Wang and Ashokan (2021) indicated that difficulty in getting access can create a divide between those who have access to these technologies and those who do not, therefore, potentially widening existing health disparities among students (Wang & Ashokan, 2021).

Although the benefits of using devices such as wearables are well documented, the accuracy of sensors and trackers used to monitor physical activity can vary. As a result, research acknowledged that care should be taken in generalising the findings on wearable technology to the domain of fitness tracking technology (Jin *et al*., 2022). This is in the sense that inaccuracy of data can lead to misinformed decisions and potentially discourage users who are not seeing accurate results. Therefore, addressing these challenges requires a holistic approach that considers the needs, preferences, and limitations of users. To successfully integrate emerging technologies into promoting physical activity, it's important to prioritise gender-inclusive, user-centred design, along with considerations for data privacy. Collaboration among technology developers, healthcare professionals, and fitness experts is also crucial.

MATERIALS AND METHOD

A qualitative approach was employed to explore the use of emerging technologies in promoting physical activity among university students at Kwame Nkrumah University of Science and Technology (KNUST). This institution was chosen because it trains students at the tertiary level to be employed in various sectors in the country. Therefore, academic work is demanding and requires students to attend lectures and do various assignments and research which involves the use of technological devices. Because they engage in academic work, the students have little or no time to participate in other non-academic activities such as physical activities. Considering this, this research is significant to examine how some of the technological devices used in different ways by the students can promote physical activity among them. The data included semi-structured interviews. This section includes the participants, data collection procedures, the interview guide and data analysis.

Participants

Twenty-two students shared their views and opinions on the research questions. Convenient sampling was employed to select the students for the study. In qualitative research, data saturation is often used as a guiding principle for determining sample size (Guest *et al*., 2006). Saturation occurs when no new information or themes are emerging from the data. Therefore, after interviewing the 22 participants we reached saturation and decided to discontinue with the interviews. The students were in their first year to fourth year and basically, they were all undergraduate students. This informed the diversity among the participants to improve the results of the study. Participants involved male, (N=14) and female (N=8) students with an age range of 20 to 25 years. The study did not involve any international students and all the participants

were from the 16 regions of Ghana. The majority of the participants were in the fourth year (N=10) followed by the third year (N=6) and the least were in the first year (N=2) as they were feeling uneasy about participating because they were new on campus. In terms of academic major, Sport Management students were (N=8) followed by Physiotherapy students (N=6) while accounting students were the least (N=1). Participants reported participating in some form of structured and unstructured physical activities like going to the gym centers on weekends, participating in aerobic dance, playing football during leisure times, taking the stairs instead of the elevator, and doing household chores among others. Regarding awareness of the emerging technologies that promote physical activities, participants mentioned wearable fitness trackers, mobile apps and health and fitness and smart workout equipment.

Data Collection Procedures

The sample of the study comprises students at KNUST who are being trained in various fields in the country. As an accredited public university, it offers admission to students from diverse backgrounds in the country. After ethical clearance from the corresponding researchers' department, we ensured that other ethical guidelines were in place, including informed consent, participant debriefing, and data security and confidentiality for the study. To promote uniformity in the data collection, we interviewed the participants on 12 different occasions on campus around shuttle stations. This place was conducive because that is where most of the students converge to take shuttles to attend lectures. However, students who were in haste to attend lectures were excluded with the reason that they may be late in attending lectures. The researchers relied on a qualitative approach with semi-structured interviews as instruments. Data on the study participants were gathered from June to August 2023. To ensure that reliable information was gathered, we applied a theoretical saturation (Guest *et al*., 2006). By the time we interviewed 10 participants, we had reached an initial saturation. To ensure that no relevant information was left during the interview, we continued to 22 participants where actual saturation was reached.

As part of the recruitment process, we stood at shuttle stations on KNUST's main campus, the Faculty of Allied Health Sciences and the Business School. This enabled us to identify students who were willing and able to participate in the study (Reason & Bradbury, 2001). In line with informed consent, a form was generated for the participants to sign before the interviews started. The participants were made aware of the purpose of the study and all the ethical issues were explained before the interviews. Therefore, they became aware that no monetary benefits were attached to the study. To ensure that the atmosphere was serene for the study, we moved a few distance away from the shuttle station before the interviews took place. Each of the participants was interviewed for 10-15 minutes.

The Interview Guide

A semi-structured interview guide was developed for the study. The initial version of the interview guide was developed based on previous literature on emerging technology to promote physical activities (Gao & Lee, 2019; Favieri *et al*., 2021). The interview guide was developed and tested among three students to ensure accurate wording and structure of the questions. Afterward, an analysis grid was constructed for the study (Table 1). These were based on variables or characteristics identified from the literature of the study. They supported framing the interview questions to include, but not limited to: (1) "Could you tell me a bit about your involvement in physical activities" "How often do you participate in physical activities" "What are some of the ways you use to participate in physical activities" (2). "Are you aware of any emerging technologies designed to promote physical activity" "What are some of them" etc?

Table 1: Analysis Grid Table

Sub-theme	Characteristics/variables	Interview questions	prompt
Involvement in Physical activity	structured exercise programmes unstructured exercise programmes	Could you tell me a bit about your involvement in physical activity	How often do you train? What are some of the ways you use to train?
Awareness of Emerging Technology to promote physical activity	wearable fitness trackers, health and fitness and workout equipment mobile apps	Are you aware of any emerging technologies designed to promote physical activity?	What are some of the emerging technologies? Could you tell me? some more?
How emerging technologies can promote physical fitness	Increased motivation and engagement Personalised coaching and feedback social support	Explain how such technologies can assist in performing physical activity	How can they help to promote physical fitness among students?
Challenges of emerging technologies to promote physical activity	Technical difficulties cost lack of personalisation Dependency on technology	Could you tell us some of the challenges you face when using technologies to promote physical activities?	Could you tell me more? In your opinion how could some of these challenges be resolved?
Students Profile	Age, level, academic major	Before you go can you Tell me your age. Which level are you? What is your academic major?	

Data Analysis

The gathered data were analysed thematically. We adopted the following procedure with care; familiarisation with the data by reading the transcribed interviews severally. This aided in the generation of the preliminary codes leading to the identification of sections of the data we found relevant to achieve the goal of this study. Again, we identified the various relationships that existed between the initial codes leading to the development of subsequent themes. The themes were well refined until we decided that they were unique before names were assigned to them and represented what the participants were referring to (Braun & Clarke, 2021; Bryman, 2012). To maintain internal consistency in their narratives, we carefully examined retrieved data to ensure that it appeared under several themes (Braun & Clarke, 2006; Seidman, 2019). We conducted both inductive and deductive analyses of the data (Sparkes & Smith, 2014) to show how student perceptions and views about emerging technology are reflected in the literature. Information on student accounts that were consistent with the literature was inductively used to derive the themes and the sub-themes as reported in Table 2.

Table 2: Themes and Sub-themes derived from the students' narrations

Theme 1	**How Emerging Technology Can Promote Physical Fitness**
Sub-themes	Increase motivation and engagement in physical activity Social support Personalised coaching and feedback
Theme 2	**Challenges in using emerging technologies to promote physical activity**
Sub-themes	Cost Over dependency on technology Technical Challenges

RESULTS AND DISCUSSION

In this section, the authors presented the two main themes and the sub-themes derived from the accounts of students' perception of; how emerging technology can promote physical activity and the challenges associated with the use of emerging technologies to promote physical activity. The sub-themes under how emerging technologies can promote physical activity among students were: (1) increase motivation and engagement in physical activity, (2) social support and (3) Personalised coaching and feedback.

1. **Increase Motivation and Engagement in Physical Activity**

The participants were of the view that using the emerging technological device, increases their motivation to engage in physical activity. Freddy, a level 400 student shared his view:

Initially, when I think about training, I feel bored because how can I be training alone? I need someone to train with, but most of my friends are equally reluctant to train, I always sit back feeling that I can die early for not participating in such activities hahaha. These technologies such as the apps motivate me, they tell me the number of steps I have taken and those that I need to take to achieve fitness.

Malicious a level 200 physiotherapy and sport science student echoed:

I am aware that I need to exercise and stay active as a sport student but with the academic demands, I can hardly join any of the fitness clubs on campus or even go jogging with my friends during weekends, with my friend my best friend now I can check my heart rate, pressure and even stress level. When I realise that things are not going well, I use the same apps to encourage me to exercise.

Technologies such as wearable fitness trackers and virtual reality fitness can help increase motivation and engagement in physical activity by providing real-time feedback, tracking progress, and making workouts more enjoyable and interactive (Fabbrizio *et al*., 2023). This finding somewhat supports Maddison and colleague's (2014) claim that the use of mobile phones and Internet (mHealth) interventions have a positive effect on physical activity levels. Such devices are likely to be mediated through self-efficacy which makes an individual undertake more physical activity at increasing intensity. In this regard, tools such as smartwatches, fitness trackers and sensors can monitor metrics like heart rate, steps taken, distance traveled, and even analyse movement quality. Therefore, these innovative devices can aid in measuring progress, creating objectives, and improving training regimens and outcomes that are effective in enhancing health (Malizia *et al*.,2021). These devices because they are programmed to aid someone in participating in physical activities motivate people with their special features.

2. **Social Support**

Through the advent of technology, the participants felt that they could acquire social support.

Gilberto claims that:

Yes, with these emerging technologies, I can easily share my fitness achievements with my friends via social media platforms. They can assist me in challenging my friends and for them to see what I am doing; at times it will be like I don't know how to perform this with my phone could you possibly aid me? This is somewhat interactive but actually, I am achieving some health benefits through learning and using these stuffs.

Kizzy also shared this with us:

There is this friend I always challenge and discuss my fitness issues with at the University of Ghana, by recording some of the activities I performed with these apps she always wants to be the best so it is like we are always competing to get the best which is challenging but promote physical activities

Technologies like fitness apps and online communities can offer social support and encouragement, enabling individuals to connect with others who share their fitness goals and interests (Kim, 2022). In contemporary digital culture, people have numerous opportunities for social comparison through social media, even without face-to-face interactions. Users of fitness apps, particularly those active on social media, may encounter others' fitness posts more frequently. They might come across such posts while browsing, through hashtags, or inadvertently. This increased exposure may lead to more frequent comparisons with others, from observing fitness scenes to watching others' fitness performances. As social comparison is often used for self-evaluation or self-improvement, comparing one's fitness level with others could impact one's sense of competence (i.e., efficacy) in health behaviors and overall physical and psychological well-being, either positively or negatively (Arroyo & Brunner, 2016; Bandura, 1986).

Adding to this, Bates *et al*. (2020) argue that integrating physical activity tracking using social media platforms and online classes helps promote exercise participation. The researchers explained that social media

users can share their training programmes, successes, and progress on social media platforms. This technique helps foster a sense of community and friendly competition. In the same way, to reach physical activity benefits, exercisers can offer live or pre-booked online fitness classes from the comfort of their homes. Classes can include regular workouts and unique activities such as dance workouts, martial arts, or high-intensity interval training (HIIT). Aside from the classes, the individual can create personal training applications to achieve fitness goals through the use of AI algorithms. In this respect, the individual can create a personalised training plan based on the user's goals, fitness level, and available equipment, while the exerciser can also adjust the settings as he grows.

This finding is more linked to students who in their quest to participate in physical activities use social media apps (e.g.; WhatsApp, Twitter, Facebook, etc.) that coach and motivate them to discuss health-related topics (Middelweerd *et al*., 2015). Notwithstanding, it is argued that students prefer sharing only their positive accomplishments leaving the negatives (Middelweerd *et al*., 2015). Therefore, students should share both positive and negative accomplishments so that they can get assistance from family and friends online.

3. **Personalised Coaching and Feedback**.

Smart workout equipment and health and fitness apps can provide personalised coaching and feedback to help students exercise safely and effectively and adjust their workouts based on their progress and goals. In this regard, the participants shared their views on this theme with Salo saying this:

These apps are wow! They are coaches and we have to hire them, that is why we buy them, they tell me almost everything I need to do when I start to train and how to even stop, they are my assistants for now very incredible

Claudius summed up:

The way these apps provide me feedback is fantastic and without reprimanding like the coaches we have in our communities, they can even give you a knock if you are not performing well, they just inform you to adjust some of the kinds of stuff you normally do, I admire them.

The finding supports Wright and Keith's (2014) assertion that the use of wearable technology when incorporated into clothing and other items can be worn comfortably on the body to improve physical activity participation. Bates *et al*. (2020) argue that equipment embedded with sensors can provide instant feedback on technique and performance which supports children and their families to engage in moderate-to-vigorous physical activities including; running, biking, and swimming.

For Casey and Jones (2011) the use of digital technology is instrumental in increasing physical activities among students. Researchers further argue that effective use of video technology increases engagement in physical education activities which in turn helps students develop a better understanding of the various activities being performed. In school physical education and sports activities, artificial intelligence integrating AI-driven algorithms is widely deployed. This helps analyze vast amounts of data to provide insights into an athlete's performance and health. This evidence will help reduce barriers to regular physical activity by helping students plan and increase access to fitness programs.

Challenges in using emerging technologies to promote physical activity

A thorough analysis of student perceptions produced the following concepts and sub-themes; (1) cost, (2) over-dependency on technology, and (3) technical challenges.

Cost

The cost of acquiring these technologies and the internet bundle involved in using them was a challenge to the participants. Kofi exclaimed:

I think the number one factor will be the cost to purchase these apps on mobile devices, and people don't earn much to purchase iPhones and Android phones to use these apps. The second one is, that it requires a lot of internet (data) to use these emerging technologies which one has to buy.

Universal lady was of a similar view by saying that:

Even if you can buy these phones that have apps to be used to promote physical activity once they use the internet, the cost of buying data is at times challenging, so, it is not easy using them.

This point was established in the work of Ceobanu and Boncu (2014) who claimed that individuals with lower incomes may not be able to afford expensive smart devices that support good internet connectivity to have adequate physical activity participation. Therefore, in a developing country like Ghana where many people hardly have a discretionary income, acquiring money to buy some of these devices will be challenging. Grounded on this, people who are from low socio-economic backgrounds and encounter difficulties in getting access to money may also find it problematic to buy internet data (Patel *et al*., 2022). From the work of Wang and Ashokan (2021), it was revealed that difficulty in getting access can create a divide between those who have access to these technologies and those who do not, therefore, potentially widening existing health disparities among students (Wang & Ashokan, 2021). However, the challenge this issue poses is whether students who can afford and have access to these technologies are using them to participate in physical activities or not. Therefore, device providers should also take into consideration the cost of these devices and reduce them for easy access, especially among the student population. Furthermore, fitness providers should inform students of calisthenic training to improve their fitness levels. Calisthenics comprises a collection of bodyweight skills designed to enhance health and fitness (Thomas *et al*., 2017). These exercises focus on improving physical fitness without the need for specialised machines (Guerra *et al*.,2019). There is no need to search for fitness apps if students can use their body weights to train.

Over-Dependency on Technology

Based on the thematic analysis it was found that the use of emerging technologies to promote physical activities depends on technology.

Barron explained:

Well, one time I saw a lady with the iPhone around her arm, she was a bit older, we had a conversation and I found out that it checks her heartbeats and the number of steps she takes daily but she was not versed with technology and was found wanting to try to read the measurement.

Akua added her voice to the challenges by stating that:

Misuse of the app, for instance, my old lady doesn't know how to manipulate when she loses her network connections.

These quotes create the impression that for a person to successfully use these apps, they should be aware of her to use technology. Since technology is not human there may be errors associated with the measurements. Jin *et al*. (2022) claim that one should exercise restraint when extrapolating the discoveries on wearable technology to the domain of fitness tracking technology as the results can vary. Therefore, the accuracy and reliability of these instruments should be paramount

to users. Additionally, inaccurate data might result in informed decisions which may go a long way to affect the user and can discourage others from using them. This creates the impression that due to technological literacy, people such as older adults and illiterates may not be acquainted with using new technologies.

Young *et al*. (2014) stated that using technological tools to promote physical activity can result in some level of illness or infirmity for participants. The experiences associated with excessive screen time and incorrect use of technologies such as smartphones and laptops for health information can lead to negative physical health effects (Manwell *et al*., 2022). Therefore, striking a balance between tech-assisted physical activities and real-world interactions will be beneficial to those who use these devices. This can be a barrier to adopting physical activity promotion tools that heavily rely on digital interfaces.

Technical Challenges

The participants added that technical challenges are associated with using these apps more specifically regarding internet connectivity.

Attesting to this theme, Kofi asserts that:

Also, if it can easily be used without internet access or connection, I think it will help. It's a bit different for people to use devices that deal with internet connection.

Miss Diabe added her voice to this with this saying:

I think the developers of these apps should invent the apps so that some factors like internet connectivity don't not affect their use If that happens people in remote areas and almost every in developing countries like my own can assess and use them.

This challenge was not stated in the previous literature because most of the studies were done in developed countries where internet connectivity is not a problem. Wright and Keith (2014) claimed that wearable technology has been used in clothing and other items that can be worn comfortably on the body to improve participation in physical activity. However, these devices rely on technology and may use internet connectivity to operate. Using embedded devices with sensors can provide instant feedback on technology and performance that supports children and their families to engage in moderate-to-vigorous physical activities; running, biking and swimming (Bates *et al*., 2020). However, they are dependent on the Internet and will be difficult to use in places where there is no connectivity or poor Internet access. These technical could sometimes relate to the inaccuracy of the output produced by these devices. As a result of technical challenges, it is significant to acknowledge that wearables, which are important tools in the investigation of fitness tracking behaviour should be observed critically. This is because the accuracy and reliability of these tools are paramount for users. Sensors and trackers used to monitor physical activity may vary in accuracy. Consequently, research acknowledged that care should be taken to generalise findings to wearable technology in the domain of fitness tracking technology (Jin *et al*., 2022).

CONCLUSION

The study examined how emerging technologies can promote physical activity among one of the less researched populations, Ghanaian students. This was in line with Favieri *et al*. (2021) who advocated the importance of developing and testing new interventions to promote physical activity in emerging adults. Therefore, students who often face challenges in maintaining an active lifestyle due to academic demands, extracurricular activities, and access to recreational facilities

(Romero-Blanco, 2020) were examined. The findings of the study exposed some of the ways emerging technology can promote physical activities which include, increased motivation and engagement in physical activity, social support and Personalised coaching and feedback. Again, challenges such as cost, over-dependency on technology and technical challenges were barriers to the use of technologies to promote physical activity among Ghanaian students. These findings imply that in developing countries before emerging technologies can be used to promote physical activities, smart device providers should take into consideration the cost of these devices and reduce them for easy access. The role of school authorities is relevant as they should provide free internet systems on various campuses to encourage students to use them for physical activities. Internet connectivity has been identified as a challenge in developing countries as Aboagye *et al*. (2020) identified network connectivity to online learning among students during the COVID-19 pandemic.

This study focused on the views of students at shuttle stations on the KNUST campus and did not represent those who do not go to shuttle stations, but may have their private vehicles to attend lectures. Considering this, the results cannot be extrapolated; however, the study provides insight into the views of students in tertiary institutions in Ghana on how emerging technologies can promote physical activity. Further research is needed to capture the views of many students using a qualitative approach. Again, the study did not consider how other activities apart from the emerging technologies can be used to promote physical activities despite identifying that cost is a challenge in buying these devices and internet bundles.

The study provides certain strengths on how emerging technologies can be beneficial to students apart from using them to study and play sedentary games. It creates awareness that these devices can promote health and well-being by using them as aids to train. In as much as these devices have challenges in terms of cost, the use of calisthenic activities which involves using one's weight to train with little or no machines is paramount. The issue here remains whether students are aware of how such activities are done. School managers should endeavour to engage students on the need to exercise and encourage students to use some of these devices. There should also be a way of encouraging learners who may not have access to these modern technologies to participate in calisthenics. Likewise, a combination of these modern devices and calisthenics in a study should be more appropriate to meet the needs of those who have these devices and those who cannot afford them.

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