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Citation for published version:
Ahson, K, Kumpulainen, K, Gray, S, Camacho Minano, MJ & Rich, E 2023, 'Exercising space: Re-examining young people's use of digitisedhealth and physical education (HPE) technologies through aspatial lens', *Learning, Media and Technology*. https://doi.org/10.1080/17439884.2023.2230120

Digital Object Identifier (DOI):
10.1080/17439884.2023.2230120

Link:
Link to publication record in Edinburgh Research Explorer

Document Version:
Peer reviewed version

Published In:
Learning, Media and Technology

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Download date: 30. Jul. 2023

Exercising space: Re-examining young people's use of digitised health and physical education (HPE) technologies through a spatial lens

Word count: 8527

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Key Words

Space, Digitised Health and Physical Education (HPE) Technologies, Lefebvre, Learning Environments

Abstract

The potential for technologies to transform health and physical education (HPE) has received increasing international attention in both policy and academic contexts. However, what is absent from much of this work is a lack of appreciation of the spatial dimension that recognizes the relationship between *how* young people use digitised HPE technologies and *where* they use them. Applying Henri Lefebvre's (1991) spatial theory, in this narrative review we examine how space is currently treated in existing research on digital HPE technologies with attention to how spaces are perceived, conceived, and lived by young people. Our work demonstrates how the spatial analysis of existing research sheds light on the materiality and power relations inherent in young people's use of digitised HPE technologies. Our review highlights the significance of recognising spatial dynamics in research on 'borders and boundaries' and the transformative potential of digital technologies for learning and education.

Introduction

Young people increasingly use digitised health and physical education (HPE) technologies to gather information about health, share experiences and view others' experiences to gain social support and inspiration, and to engage in self-tracking of their health and well-being (Radovic, and Badawy 2020; Lupton 2018). The potential for technologies to transform HPE has received increasing international attention in both policy and academic contexts. Since the 1990's HPE has become increasingly digitised, with the use of new digital technologies advocated in school health literature and educational policies. Elements of digitised HPE technologies, such as the use of Ipads and exergaming (Öhman, et al. 2014), Wii Fit Plus (Almqvist et al. 2016), and heart rate monitors (Thomas and Stratton 2006), have been in physical education (PE) classes for some time now. Recent reviews have highlighted these developments and covered the relevance of health-related content being created and shared through digital technologies (Lupton 2021a), the importance of social media interventions and user-generated content, and physical activity outcomes related to different population groups (Goodyear et al. 2021), and the development of PE pedagogies through technology (Sargent and Calderon 2021). Together, this research has contributed to our understanding of the role of digitised HPE technologies in the social formation of young people.

However, what is absent from much of this research is a lack of appreciation of the relationship between *how* young people use digitised HPE technologies and *where* they use them. Despite some recognition that PE occurs across different contexts – families, schools, and social media, for example – the relevance of 'space' in the use of HPE technologies has been largely ignored in the research.

The aim of this narrative review is to consider the question: Does *where* young people use digitised HPE technologies matter? We draw on Henri Lefebvre's (1991) spatial theory to help introduce a 'spatial turn' to digitised HPE technologies and explore how it is relevant to how young people monitor, share and learn about their bodies, health, physical fitness, and wellbeing. Applying his spatial lens to a body of research on digitised HPE technologies, we consider how *space* is currently treated in the research and illustrate why space should be acknowledged as a key dynamic in research on digitised HPE technologies.

What space?

Examining the social constructions and interactions of knowledge, space and technology is not new (Ahson 1999) and interest in a 'spatial turn' in research on education and learning has been around for a while now (Gulson and Symes 2007). Some of this research has focused on how different spaces and practices and students' experiences combine and/or interact in different learning environments to affect educational experiences and outcomes (Kraftl et al. 2022; Closs et al. 2021; Jornet and Erstad 2018). The role of digital technologies in delivering and shaping learning over different contexts, environments, and sites has also been the subject of consideration (Yu et al. 2019; Ash et al. 2018). There has also been research on how boundaries between online and offline, formal and informal, in and out of school, and education and work are negotiated and experienced by learners and/or educators, and how these create opportunities and tensions, continuities and discontinuities for learning and education (Smith 2021; Bronkhorst and Akkerman 2016; Kumpulainen and Sefton-Green 2014). Research on how learners move between different learning environments and settings, particularly in terms of mobility and challenges, and the imagined geography of education has grown (Finn 2021; Sefton-Green and Erstad 2017; Leander, et al. 2010). There has even been interest in the idea of 'body as a space' (Melcer 2018) and a recognition of 'embodied space' where human experience and consciousness take on material and spatial forms (Low 2003).

Space is often used interchangeably with *place* in the social sciences and humanities, and both have multiple meanings and interpretations (Harvey 1990). In simple terms, space can be considered as a dimension within which matter is located (Agnew 2011). In contrast, place can refer to a portion of space in which people dwell together and a locality (ibid.), a rank in a list (in the first place), a temporal ordering (something took place), and a position in a social order (knowing your place). It can also relate to a sense of emotions that are attached to a particular area, which give a 'sense' of place (ibid.). Despite various theories of spatiality there is widespread agreement on the need to move beyond thinking in terms of 'bounded spaces' and focusing on how they are 'socially constructed' (Massey 1995). This is especially relevant for education and learning given the claims that space is increasingly being 'digitally disrupted' (Watermeyer et al. 2021).

The work of Henri Lefebvre's (1991) has been hugely influential in challenging historical materialism and economic and temporal determinism and highlighting the importance of space. His spatial 'triad' (admittedly in opaque prose) focuses on how space is socially produced and

how social relations are affected by space (ibid., 38-39). The first aspect of the triad is *spatial practice* (perceived space) which he describes as follows: 'The spatial practice of a society secretes that space; it propounds and presupposes it, in a dialectical interaction; it produces it slowly and surely as it masters and appropriates it. From the analytic standpoint, the spatial practice of a society is revealed through the deciphering of its space.' Therefore, for Lefebvre perceived space requires an understanding of real space which includes a level of competence and performance which can be shown through daily routines and practices, the social relations of production, and the taken for granted. Critically, how we understand a space is often reinforced by how we describe it and what is *seen*.

The second dimension of the 'triad' is *representations of space* (conceived space) which covers: 'space of scientists, planners, urbanists, technocratic subdividers and social engineers, as of a certain type of artist with a scientific bent - all of whom identify what is lived and what is perceived with what is conceived' (ibid.). Conceived space is more abstract and is an aspect of our experience of the world and can include ideology, plans and power. Importantly, for Lefebvre this space represents the knowledge of space, such as properties of a location, and can be communicated through planning and design. The physical properties of space also influences how we experience only in conjunction with our own perception of it and what is *thought*.

The third aspect of the 'triad' is *representational spaces* (lived space) and covers the following: space as directly lived through its associated images and symbols, and hence the space of 'inhabitants' and 'users', but also of some artists and perhaps of those, such as a few writers and philosophers, who describe and aspire to do no more than describe. This is the dominated — and hence passively experienced — space which the imagination seeks to change and appropriate. It overlays physical space, making symbolic use of its objects' (Ibid.). According to Lefebvre, lived space is linked to our subjective experience of using the space through our personal narratives and what is *felt and imagined*. It also points to potentially new ways of experiencing space and how knowing how others might use a space can change its essence. Lived space, therefore, refers to ways that space is experienced directly outside of verbal description and often conveys meaning through memories, signs, and symbolism.

The use of the spatial 'triad' in research on education and learning is not unique. For example, Ford (2015) has shown how Lefebvre can help educationalise theories of space in the development of a pedagogy for space. Middleton (2017) has considered the specific work of

Lefebvre on education. Benade (2019) has used Lefebvre's work in the context of inclusion and exclusion in the development of flexible learning environments. Kellock and Sexton (2018) have added the dimension of time to understanding the uniqueness of children's learning experience. Kohe and Collison (2020) examined the connectivities within organisational partnerships between sports, education and business, and Simmons (2021) has examined the production of social spaces for children with multiple learning difficulties from a Lefebvre analysis. Lefebvre's treatment of space has also not gone uncriticised. For example, his privileging of space over time, and his commitment to a particular understanding of the way in which society is shaped whereby spaces are created within which capitalist production can proceed, has been challenged (Unwin 2000).

Methods

Applying Lefebvre's (1991) spatial lens, our narrative review (Hammersley 2001) is motivated to generate knowledge on how *space* is currently treated in existing research on digitised HPE technologies. Our review is hence both retrospective and prospective. Importantly, in following the traditions of narrative review our aim is not to provide an exhaustive summary of what is known in the field but rather to contribute to the cumulative understanding of digitised HPE technologies in young people's lives and learning from a spatial perspective (Taylor and Spicer 2007).

For our review, two electronic databases (Scopus and Web of Science) were searched in January 2022 and covered articles in English and appearing since 2011. Titles, abstracts and keywords were searched using the following search terms "digitised", "health and physical education", "technologies", "space", and "young people". Our search concentrated on articles that were freely available through databases or the university library and eighty-seven papers were identified. A manual search was also undertaken which resulted in the addition of three other articles on digitised HPE technologies. Publications that had a clinical and/or treatment focus were excluded. Forty-three articles were finally included in this review.

Analysis

The forty-three articles were analysed using the concept of 'close reading' (Smith 2016) to develop a better understanding of any spatial relevance within the articles, and then teasing out

specific themes that could be connected to Lefebvre's spatial 'triad', that is, spatial practice (perceived space), representations of space (conceived space) and representational space (lived space). After reviewing the forty-three articles from the search, thirty-one were considered to have some 'spatial' reference (see Table 1).

Author	**Spatial practice (perceived space)**	**Representations of space (conceived space)**	**Representational spaces (lived space)**
Almqvist et al. (2016)	Digitised HPE technologies offer technical solutions to problems of place and equipment in schools		
Azzarito and Hill (2013)	Young people move between different spaces at home when engaging in PE	Certain educational spaces around PE produce gendered sites which encourage alternative spaces to be created using digitised HPE technologies	Digitised HPE technologies challenge some of the real-world experiences of young people
Camacho-Miñano et al. (2021)	Certain dedicated fitness routines encourage the crossing of boundaries when exercising from home	Gendered habitus of young women is often at odds with the traditionally masculine learning space of PE	The status of curricular PE in schools and formal learning spaces is being challenged by digitised HPE technologies in more informal settings
Casey et al. (2017)	Digitised HPE technologies open up new possibilities and spaces in which to learn		
Casey and Jones (2011)	Digitised HPE technologies are not necessarily revolutionising the educative spaces where PE is taught	The use of digitised HPE technology enjoys a 'status' in some school lessons in socially deprived areas	
Chambers and Sandford (2018)			Digitised HPE technologies affect how space and place are experienced by young people
Dania and Griffin (2021)	Digitised HPE technologies provide spaces to support practitioners' collaboration and interaction		
Deliu et al. (2021)	Sensors and data from algorithms can help students create a 3D system in PE that allows		

	them to track speeds and positions in space		
Goad and Jones (2017)			Online PE presents a unique set of challenges in translating traditional PE to a digital space
Goodyear and Armour (2021)	Social media is a valuable health-related learning tool in and outside of school environments	The desire to allocate resources to buy or use digitised HPE technologies reflects certain demographic characteristics of a school's catchment area	Digitised HPE technologies foster democratic communication
Goodyear et al. (2021)	Social media provides more opportunities to reach and engage diverse groups to positively influence PE		
Goodyear et al. (2014)	Social media in PE operates as a communicative space		
Kang and Kang (2019)	Virtual reality technology offers the opportunity for disabled people to set up suitable level and to gain repetitive (PE) experience in the virtual space that is similar to the reality		
Kolokoltsev et al. (2020)	There is a decline in the level of physical health of students, due to the intensive computerisation of the educational space		
Lizandra et al. (2020)	PE has now become a permeable space for including technological devices		
Lupton (2021a)	Young people choose to use digitised HPE technologies to help meet PE goals		
Lupton (2021b)	School settings highlight the importance of routine in using digitised HPE technologies	There are different student and teacher expectations around the use of digitised HPE technologies	Digitised HPE technologies have a positive impact on generating interest in PE
Mooney and Gerdin (2018)		Digitised HPE technologies can capture social practices and spaces in ways that words	

		alone cannot in gendered experiences in PE	
Munoz et al. (2017)	Teachers implemented several designs which include learning artifacts of different types that are accessed from the web space of Moodle		
Mutz et al. (2021)	Digital sport is used as a workaround during the lockdown and many users switch back to traditional offline sports activities as soon as restrictions are suspended		
Öhman (2016)			Digitised HPE technologies can help deal with the awkwardness of PE for some young people
Papastergiou et al. (2014)	Digitised HPE technologies can complement and extend the practical courses offered by academic PE departments		
Radhakrishna et al. (2020)	Digitised HPE technologies are used to digitally track and encourage physical activity		
Rhodes et al. (2018)	The family home offers a critical setting for increasing child physical activity and includes the opportunity to use digitised HPE technologies		Digitised HPE technologies offer an inexpensive, safe, and controlled experience in the family home
Rich et al.(2020)	Different types of digitised HPE technologies are preferred as children move from primary to secondary school	Young people are often given a mobile phone because of parents' concerns about their safety	Digitised HPE technologies impact on the importance of perfect bodies in young people
Sargent and Casey (2021)			PE can be an exclusionary and marginalising space for many young people
Sargent and Casey (2020)	Incorporating digitised HPE technologies into pedagogical practices needs simple and consistent routines	The location of the school can be linked to barriers to the take-up of digitised HPE technologies because of a lack of knowledge of stakeholders	Digitised HPE technologies have a positive impact on learners

Stassen et al. (2020)		Digitised HPE technologies can help empower young people to make health enhancing decisions	
Toto and Strazze (2018)	Digitised HPE technologies have created a new environmental space to experience		Digitised HPE technologies can create regressive spaces
Valentine and Jensen (2021)			Digitised HPE technologies games facilitate the liberation of play from a particular time or space
Vrontis et al. (2020)	Digitised HPE technologies are an alternative to the gym because they are more flexible and economical		

Results

We can draw four main findings from our review summarised in Table 1. First, only six of the articles had any significant contribution to all three aspects of Lefebrve's spatial triad. Second, the majority of the research pointed to aspects of spatial practice (perceived space), such as the physical limitations of classroom space (Chao et al. 2021), the types of tools that can be used in classroom spaces (Dania and Griffin 2021), the general computerisation of learning spaces (Kolokoltsev et al. 2020), or online PE (Goad and Jones 2017). Third, despite the use of various spatial references in the studies - 'habitus', 'hybrid fields', 'landscape', 'marginalised', 'setting', 'sociospatial', and 'spatialities', for example – the articles still treated space as a *de facto* descriptive metaphor. For example, there are references to education spaces (Almqvist et al. 2016), physical sites of emerging community of practice (Goodyear et al. 2014), and opportunities created in family homes to increase child physical activity (Rhodes et al. 2018). Fourth, the majority of the articles were overwhelming optimistic about the impact digitised HPE had on young people, such as the new possibilities to learn (Casey et al. 2017), how social media was a valuable health-related learning tool in and outside of school environments (Goodyear and Armour 2021), and how they complemented and extended the practical courses offered by academic PE departments (Papastergiou et al. 2014). There were, however, some more negative assessments of digitised HPE technologies, such as the regressive spaces they

create for young people (Toto and Strazze 2018). Taken together, our findings support the idea that *where* digitised HPE technologies is used has not been fully explored.

As highlighted in Table 1, we only found six articles with some relevance to all three aspects of Lefebrve's spatial triad. Notwithstanding some of the limitations of our judgement and application of the 'triad', these six articles allowed us to consider in further depth the question: 'does *where* young people use digitised HPE technologies matter?', and to consider the nuanced spatial dynamics of materiality, power and imagination in young people's use of HPE technologies. Azzarito and Hill (2013) undertook research in the UK to understand ethnic-minority girls' emplaced embodiment by investigating the link between girls' physicality and their views of physical activity spaces in their communities. In particular, they considered some of the contested spaces of home, gendered boundaries of male-dominated spaces, and the imaginative space of home and the reality of Nintendo Wii. Camacho-Miñano et al. (2021) examined some of the tensions that are evident between young women's 'habitus' and the specific health-related learning spaces of PE and Instagram in Spain. Based on interviews and focus groups they considered what and how young women learned about the body, physical activity, and health in the contexts of PE and Instagram. Goodyear and Armour (2021) examined young people's uses of health-related social media in the UK, and focused on how school policies and practices enrich, support and/or hinder young people's informal learning through social media. They also considered the range of perspectives of young people, teachers and key stakeholders in education and health, such as researchers, professionals, and practitioners. Lupton's (2021b) research with teachers and other professionals working in schools in eastern Australia highlighted how people came together through digitised HPE technologies and how they are linked to different 'assemblages', such as space, place, and policy settings. Rich et al. (2020) undertook extensive research in England on young people's experiences of digitised HPE technologies to promote healthy lifestyles. Using a mix of quantitative and qualitative methods they also included data from young people wearing a tracking device and sharing their experiences. Finally, Sargent and Casey (2020) looked at digitised HPE technologies in flipped learning (FL) as a pedagogical approach in PE. Based on specific research on UK-based PE teachers they explored why and how they used FL to complement their use of digitised HPE technologies and move direct instruction from a group learning environment to individualised learning spaces.

Spatial practice (perceived space)

The importance of daily routines is suggestive of *spatial practice*. For example, Lupton's (2021b) research on the 'situated contexts' in school settings highlighted the importance of routine with certain policies and practices in the classroom, such as sharing devices between students. In this case providing one laptop to be shared between two students affected where and how such placements and sharing took place in a classroom (and possible learning outcomes). The routine in providing digitised HPE technologies to young people can also be connected to certain learning spaces. For example, Rich et al. (2020) highlighted how tablet computers and mobile phones became preferred devices when children moved from primary to secondary school (acquiring a smartphone became a priority). Interestingly, Rich et al. (2020) also showed how the practical aspects of device design, such as battery life, could restrict young people's engagement in certain situations or learning environments. In a different vein, the study by Sargent and Casey (2020) stressed the importance of using simple and consistent routines to incorporate digitised HPE technologies into certain pedagogical practices and learning environments in schools to address the limited time allocated to PE in the curriculum (some of which is lost when students are changing their clothes) and the need for students to be physically active during lessons.

Another possible area of *spatial practice* centred on the crossing of spaces (or boundaries). For example, Goodyear and Armour (2021), explored the importance of crossing and (lack of) connections between informal and formal learning spaces and experiences associated with certain types of social media, and how specific school policies and practices acted as a barrier to meeting young people's learning needs. Tellingly, such barriers between these different learning environments were also socially constructed because young people were not involved in the creation of these spaces. Camacho-Miñano et al. (2021) pointed to how certain dedicated fitness routines, which targeting certain body parts, encouraged exercising from home. The need to create a culture of routine through digitised HPE technologies was also noted by Sargent and Casey (2020) as teachers often used digitised HPE technologies to establish links between how they defined pre-classroom and classroom cultures which crossed different spaces in and outside of school.

The idea of connecting and crossing spaces in online and offline worlds in young people's experience of digitised HPE technologies also pointed to another example of *spatial practice.* For example, Rich et al. (2020) considered some of the assumed binaries between these worlds

and highlighted how young people routinely crossed them when searching and sharing information. Importantly, they also highlighted how young people's communication across their online and offline worlds formed an integral part of their daily activity and who they were. Sargent and Casey (2020) also showed an example of *spatial practice* through how conventional approaches to classroom learning were being challenged through digitised HPE technologies by bringing in students' experiences and expectations from outside of school to reinforce real world applications into the classroom. The study by Azzarito and Hill (2013) also highlighted how the participation in certain sports, such as football, was linked to an assumed physical prowess which made certain outdoor spaces unsafe. Interestingly, the use of digitised HPE technologies was seen to challenge some of these real-world experiences of the young people and open positive opportunities which were played out in *safer* indoor spaces.

The use of tracking data over different spaces (and time) was highlighted by Rich et al. (2020) and pointed to another possible area of *spatial practice*. They showed how young people used data to make sense of their lived experience of their bodies and quality of life. This was especially relevant when it came to them setting targets and how these were aligned to where and when the data were produced and consumed. In addition, they also pointed out that although there was some interest in (spatial) data - for example how many steps were taken each day - this did not necessarily change the activity patterns of young people. The relevance of the *spatial practice* of data was also touched on by Camacho-Miñano et al. (2021) who pointed to the value in online content and the use of certain metadata tag, such as 'Fitspiration', attached to user generated material. Critically, such material making activities encouraged (the perception of) greater freedom outside of formal learning spaces connected to PE.

How and where data from digitised HPE technologies were used also was suggestive of *spatial practice*. Goodyear and Armour (2021) considered the different value of social media as a health-related learning tool in and outside of school environments. The relevance of these data also raised questions on how to define, and what was expected from, a teacher/student relationship, and highlighted a possible tension in the roles teachers played in virtual spaces that characterise social media and traditional physical spaces of the school/classroom. Unsurprisingly, young people's expertise in social media gained from outside of the (formal) school space was seen as an opportunity when combined with teachers' expertise in young people's health and development. The work of Rich et al. (2020) also touched on data and how and where, for instance, the diagnosis of biomedical data and information in mental health apps was interpreted by a young person experiencing mental ill-health.

The digitised HPE technologies also highlighted certain 'agential' capacities, such as for organising and assessment, which signified potential *spatial practice*. For Lupton (2021b), digitised HPE technologies simply allowed teachers to prepare and organise lessons more effectively. Furthermore, the work of Sargent and Casey (2020) highlighted how digitised HPE technologies could optimise time in which students were physically active and support their examination. This allowed teachers to develop their own culture of setting which combined pre-class homework with routines used in the classroom and was reflective of certain *spatial practice*. However, it was also recognised that students would not necessarily undertake the pre-class work or PE homework, such as watching videos, and rely on the work of others in the lessons itself. This reinforces the notion that certain spaces outside of the classroom were seen as less desirable by young people to enact certain tasks and expectations associated with PE because of the lack of participation in shaping them. In contrast, for Camacho-Miñano et al. (2021) the creation of alternative spaces to learn about healthy lifestyle practices through, for example, Instagram was considered by some young people as giving them greater control than traditional PE space (within the limits of what algorithms permit).

Representations of space (conceived space)

One example of the *representations of space* of digitised HPE technologies centred on resource allocation. In her study, Lupton (2021b) pointed to the link between the location of schools and the actual and/or desire to allocate resources to buy or use digitised HPE technologies. Specifically, more affluent areas and larger schools attracted more resources to these technologies, whereas the socio-economic disadvantage of a school had a material effect on what was provided, for example, small rural schools tended to have older equipment and less reliable infrastructure which closed off their capacities to successfully engage in digitised pedagogies. Tellingly, parents who lacked education and digital skills tended not to support digitised HPE technologies used in the school whereas parents in high socioeconomic areas expected the very latest technologies to be introduced. Goodyear and Armour (2021) hinted at the idea of the allocation of resources to buy or use digitised HPE technologies being linked to certain demographic characteristics of a school's catchment area, such as race and ethnicity. They also noted how young people might consider teachers as a 'site' for reliable information on health and well-being. In a different vein, Sargent and Casey (2020) noted that the location of the school could act as a barrier to the take-up of digitised HPE technologies because of a

lack of knowledge of some stakeholders, such as parents. In this case, expectations around the use of digitised HPE technologies were also suggestive of the resource dimension in the *representations of space.*

The highlighting of scale (for example, national vs. local) was also suggestive of *representations of space*. For example, Rich et al. (2020) pointed to differences in how interest and resource allocation at a national level did not necessarily translate easily at a local level. Similarly, Goodyear and Armour (2021) pointed to the disconnect between policy and funding cycles at the different scales. Possible tensions in scales and how these reflected *representations of space* were also identified by Azzarito and Hill (2013) in the context of how they cut across issues related to ethnicity and the provision of facilities promoting PE in formal and informal spaces. They suggested that the dominant 'bodies-at-risk' discourse associated with young (urban) ethnic minority women in many public policy debates impacted on how to address any inequalities in young people's health and physicality. The relevance of links in and between scales was also identified in the work of Rich et al. (2020) who looked at the use of different expert knowledge, such as between the National Health Service (NHS) and local personalised data gained through tracking. They also highlighted whether the findings from their research in South West England had any relevance to the wider Global North.

Privacy issues were another example of *representations of space* and how it was *thought* of. For example, Lupton (2021b) raised the issue of when teachers were expected to start/stop their pedagogic practices, and how digitised HPE technologies were blurring the boundaries between public and private spaces of teachers and expectations around when and where they should respond to student concerns. In contrast, Azzarito and Hill (2013) showed how some young people used and moved between the different spaces at home when engaging in different exercises, such as yoga in the privacy of the bedroom or Nintendo Wii gaming in more public home spaces, such as the living room. They also noted how certain educational spaces around PE, such as the playing field, created gendered sites which encouraged alternative spaces to be formed using digitised HPE technologies which were insulated from the public eye. They also showed how some young women crafted a body moving in between the 'real' and 'virtual' sport-based spaces whereby digitised HPE technologies allowed them to experience different sports that were seemingly unavailable to them in public spaces. Similarly, the use of the gendered habitus of young women by Camacho-Miñano et al. (2021) was suggestive of the *representations of space* as they were often at odds with the traditionally masculine learning spaces of PE. This resulted for many young women in the re-opening of spaces for PE through

digitised HPE technologies, such as Instagram. Some issues related to privacy also blurred into discussions on safety. For example, Rich et al. (2020) noted how young people were often given a mobile phone at a young age because of parents' concerns about their safety outside of certain private spaces (such as homes) and public spaces (such as schools). Such blurring between private and public spaces was also illustrated in the issue of safety information connected to digitised HPE technologies. Goodyear and Armour (2021) pointed to the relevance of where young people learned about safety issues, especially if it was in a formal learning space, such as a school. They also highlighted that most young people found this information outdated and irrelevant.

Representational spaces (lived space)

Potential *representational spaces* centre on the lived space of home and how they are *felt and imagined*. In their study, Azzarito and Hill (2013) challenged the depiction of ethnic minority girls as passive and subordinated in the spaces of home and instead represented this space as relevant to their physicality. Here the Nintendo Wii marked a transformation in girls' physical culture, bringing fitness and especially 'sports,' a traditional male domain in the public space, into the intimate space of the home. Many of the girls who regularly played on the Wii felt that the exercise that they gained through gaming gave them access to many sports they would not normally do. They also highlighted how it increased their fitness and provided them with opportunities to learn new skills in a safe and private environment. The lived space of home as *representational spaces* was also seen in the work of Camacho-Miñano et al. (2021) as it allowed greater frequency in exercising and the accumulation of physical capital for young people. Interestingly, physical activity on Instagram was commonly described by young women through neoliberal discourses. Tellingly, many of the micro practices of the high intensity workouts done at home could be done in little time and without equipment.

Different uses of space was also suggestive of *representational spaces*. Sargent and Casey (2020) showed that the changing room could be used for pre-class preparation in school before students entered the designated spaces for PE. In the example from Goodyear and Armour (2021), given the importance of health and wellbeing in some cultures, the use of digitised HPE technologies was even seen as a means of democratic communication. However, they also highlighted some of the contradictory practices in schools, such as using iPads in lessons but

banning phones from schools, which brought about tensions in the supposed lived space of democratic communication.

The idea of status in education and learning was also linked to how space was felt and imagined. For example, Sargent and Casey (2020) noted the positive impact of the digitised HPE technologies in certain socioeconomically deprived schools and how it brought a certain *cache* to developing a quality learning environment for the students. The study by Camacho-Miñano et al. (2021) also showed how the sanctioned status of curricular PE in schools and formal learning spaces was being challenged by digitised HPE technologies in more informal setting or uses, such as Instagram. This aspect of *representational spaces* also raised questions around how young people elevated the importance of certain spaces for PE compared to how teachers considered them. In the study by Lupton (2021b), the positive impact of digitised HPE technologies on generating interest in physical activity among students was also shown and was suggestive of *representational spaces.* In a slightly different vein, Rich et al. (2020) showed that in producing and consuming knowledge on health and well-being through digitised HPE technologies, young people preferred to draw on the knowledge and experience of other young people outside of formal learning spaces and to also avoid the gaze of adults.

References to different images, signs, and symbols were identified in some of the studies and were also suggestive of *representational spaces*. For example, Rich et al. (2020) touched on the importance of perfect bodies and the social media body pressure that affects many young people. The work of Goodyear and Armour (2021) pointed to the importance of images of health-related content and how the production of images, such as where photos were taken and posted, could impact young people. Similarly, Camacho-Miñano et al. (2021) highlighted the real time, customisation of posts, images and ideas through Instagram that allowed spaces to be represented and reproduced in the context of young people's experience of health and wellbeing. Importantly, they also pointed to the fact that there was not always active agreement from young people in how digitised HPE technologies were being used.

The links between space and time in the studies pointed to other forms of *representational spaces*. For example, Lupton (2021b) emphasised the need to find an appropriate time and a place for the use of digitised HPE technologies and to ensure the pressure of incorporating digitised HPE technologies, such as the use of a drone, did not make excessive demands on teachers' workloads. Additionally, Sargent and Casey (2021) highlighted the need to optimise class time for PE as a key benefit of using digitised HPE technologies. They pointed to how

digitised HPE technologies were being used in multiple ways in the same space when it came to some lessons, such as gymnastics and trampolining, where all the students could not exercise at the same time. Importantly, how the space (and time) was optimised through the digitised HPE technologies, allowed simultaneous performance, analysis and reviewing to taking place. The work of Camacho-Miñano et al. (2021) also highlighted a link between space and time in the context of where young people participated in PE and exercising during their free time. Conversely, in highlighting concerns with how much 'screen time' young people were occupied with, Lupton (2021b) pointed to the *representational spaces* of where this time is being played out.

Discussion and Conclusion

Despite *space* not being an explicit focus of any of the studies in our narrative review, there is strong evidence to suggest that *where* young people use digitised HPE technologies matters. Using Lefebvre's (1991) spatial 'triad' we were able to highlight and distinguish some of the spatial associations and connotations linked to the use of digitised HPE technologies by young people. The spatial analysis enabled us to explore in more depth the materiality and power relations inherent in young people's use of digitised HPE technologies. It also allowed us to see how spaces are produced, experienced and imagined by young people with digitised HPE technologies.

Our spatial analysis has helped us in highlighting the potential relevance of space and how it might affect the use of digitised HPE technologies for young people. This is especially relevant given that digitised HPE technologies are a unique and important context to explore these questions because of the centrality of the body (for young people) and how it relates to 'space'. Here the 'body' is significant in terms of how it looks, how it moves, how it feels and how it learns. It is also significant in terms of how body is positioned, understood, and 'worked on' in both online and offline spaces. This significance echoes work in the field of PE which points to how particular ideas and values embedded within these particular social spaces, and the resources they afford to individuals, can impact an individual's social practice and their performance of identity and understand and explain everyday social practices (Chambers and Sandford, 2018). This also reflects ongoing work on pedagogy that invites young people's interest and curiosity, provokes them or makes them feel comfortable, and helps them learn something new (Kuby and Christ, 2020). Similar questions can be asked about teachers

working in PE and how digitised HPE technologies affect young people both inside and outside of formal education contexts.

Critically, our narrative review points to the need for more empirical research that considers the relevance of space (and place) when it comes to digitised HPE technologies. Moreover, there remain important theoretical (for example, how space is connected to time or the role of the 'body' as a space) and methodological (for instance, the importance of micro actions in and across different learning environments) questions to be considered.

Our narrative review has significance both in terms of understanding how space works in different learning environments and the development of critical educational research about learning with new digital technologies. It also has significance when thinking about 'borders and boundaries' and the transformative potential that digital technologies are bringing to learning as they too risk being treated as simplified descriptive metaphors to understand division or connections between different learning sites. With this in mind, researchers who are planning on investigating digitised HPE technologies should give consideration to how 'borders and boundaries' are social phenomena with inherent material and power relations, and how this might relate to young people's subjective and embodied positions in fostering their own agency and imagination in relation to the use of (digital) technology in education and learning.

Acknowledgements

The authors would like to thank two anonymous referees for the comments and suggestions.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by UNA Europa funding (An interdisciplinary, international and collaborative research approach to developing critical digital health pedagogies for teachers of physical education - SF2019002).

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