An ecological dynamics conceptualisation of physical ‘education’: Where we have been and where we could go next

An ecological dynamics conceptualisation of physical *'education'*:

Where we have been and where we could go?

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Abstract

Background: In this paper, we explore physical education from a relational worldview. Theoretically guided by an ecological dynamics framework, this perspective calls us to conceptualize ‘education’ in its etymological roots – ex-ducere– meaning ‘to lead’ an individual ‘out’ into the world. In doing so, an educator would employ a ‘softer’ pedagogy, seeking to guide the attention and encourage exploration of a less experienced individual toward the perception of things that can support, or regulate, their behaviours. This pedagogical approach could help learners to self regulate in the environment, becoming more responsive to emergent opportunities for action available.

Theory: This is a pedagogy of exploration, search, discovery, invention and adaptation that is devised from three of the contributing theories to ecological dynamics: ecological psychology, dynamical systems theory and complexity sciences. Throughout this paper we show that this progressive view contrasts with the more traditional perspectives of physical education, grounded in established pedagogical approaches that are often pre-occupied with instilling idealised ways of moving in learners, typically at the expense of appreciating how the environment reciprocally shapes behaviour.

Practical Implications: In an effort to support educators with integrating an ecological conceptualisation of PE into their practice we outline three cornerstones. We bring these ideas to life by concluding the paper with the presentation of three practical examples that transcends the physical educational journey from primary/elementary school through to secondary/ high schools. We exemplify how an ecological approach to PE can move us closer to achieving the aim of enabling children to lead a physically active life beyond the school gates.

Keywords: Pedagogy, Children, Education, Motor Learning, Motor Skill

Introduction

For many of us living in urbanised societies, the notion of physical education (PE) takes place on playing fields and gymnasiums in formalized school settings. There, pupils spend 45-60 minutes trying, for example, to participate in sports and activities designed to hone movement skills that will enable and engage them into leading a physical activity life. Often, formal PE lessons are structured in a specific way because teachers follow pre-determined curricula designed to scaffold the learning of specific movement skills and techniques. A teacher will check if a child has learned to be a skilled mover by ticking off 'acquired' competencies relative to a rubric, assessment grid or checklist. However, if we take an ecological dynamics approach to conceptualise PE, we begin to realise that PE in its current format, such as 45-60 minutes of recursive (year on year) blocks of sports/activities undertaken in the same facilities and environments, will likely lead to diminishing emotional engagement due to a lack of opportunities for exploration, search, discovery, invention and adaptation. All these activities are critical in supporting children to lead physically active lives (Department for Education 2013; Australian Curriculum, Assessment and Reporting Authority 2015; National Association for Sport and Physical Education 2009; Shape America 2013).

An enduring, important, focal point and a clear distinction from other educational subjects in formalised schooling systems, is that in PE, children are educated *through* movement. While this is generally understood by professionals in the field, there is a critical point to highlight here: that being an appreciation of how movement emerges. It is at this crux where we set the narrative for this paper. In the following sections, we explain two contrasting worldviews of motor learning: one, situated in a cognitivist worldview, and the other situated in an ecological worldview. The former aligns with education from a cumulative, linear and transmissive perspective, meaning that what is 'learned' (and by default taught and assessed) are prescribed techniques that fit within socio-cultural conventions (Tinning 2010). The latter aligns with education from an etymological perspective – seeking to lead individuals out into a world (Masschelein, 2010) to (self)discover information that supports and enriches actions in a continuous and nonlinear, reciprocal process (Gibson, 1979). From this ecological worldview, learning involves self-organisation of capacities through exploration, invention and adaptation of possibilities for action in different contexts and environments (Rudd et al., 2020). Simply, what is 'acquired' is a functionally adaptable and evolving fit between the action capabilities of an individual and the constraints of the environment in which they dwell (Davids et al., 2012). In the next section, we elaborate on these theoretical perspectives, showing how they influence the pedagogical approaches adopted and implemented in PE.

Theories of learning movement skills and their influence on pedagogical approaches in PE

Where we are…

Research in motor skill learning, similar to dominant educational theories (i.e., cognitive load theory Sweller (2010) [currently a key aspect of the United Kingdom inspection framework- https://educationinspection.blog.gov.uk/tag/cognitive-load-theory/]) sets its scale of analysis somewhat exclusively within the organism (Araújo and Davids, 2011). By this, we mean that it focuses on the internal processes that occur in the mind of an individual, leaning on computational metaphors to explain relatively permanent changes in performance (Schmidt and Wrisberg, 2004). More directly, this worldview is grounded in the belief that the brain acts like a computer, processing inputted information to construct a representation, and then outputs this representation in the form of a behavioural pattern (Anson, Elliot, and Davids, 2005). Thus, learning has been promoted as a process of acquiring and then storing (somewhere in the mind) motor programmes (Wulf and Lewthwaite, 2016), encoded representations (Wulf, Shea and Lewthwaite 2010; Wolpert and Flanagan, 2010), or, more historically, schema (Schmidt, 1975) that are symbolic in substance, intended to help an individual 'know' about things or how to do things when coordinated with certain environmental features (Araújo, and Davids, 2011).

The key aim of this paper it to argue that PE needs to move away from these traditional approaches that view the purpose of education as promoting cognitive growth (Tinning, 2010, Reid, 2013). One reason for this, is that this cognitive worldview has done the subject of PE no favours, as captured by Reid (2013), many in educational circles hold the belief, that PE is useful as it is a recreational diversion from the academic business of the classroom. Whilst reputationally PE has suffered under an educational system that imbues cognitive development, the real damage has been done through assumptions about how we learn movement skills which have lead to the integration of narrow technique-based pedagogical delivery, coupled with weak learning experiences for children (Oslin and Mitchell, 2006).

This pedagogical approach holds with the premise that learning is a gradually linear (cognitive) process, reflective of the continued elaboration of a mental model (Fitts and Posner, 1967). Children are thought to become skilled movers through repetition and rehearsal of technical skills, progressing through three observable stages of learning (e.g. Fitts and Posner, 1967). In early learning, the child is thought to be in the 'cognitive stage'. The child learns about the 'correct' movement execution through continual interventions and prescriptions in the form of verbal instructions and corrective feedback from a teacher, often performing only decomposed parts of a movement, to be reconstructed later. Practice, in this stage, is often undertaken in isolation of context, as it is thought that the child can only focus their attention toward movement execution. Next, the 'associative stage', argues for more refinement and improved control of movement techniques, leading to less conscious intervention, meaning the child can start to direct their attention toward features outside of the body. In the final phase, 'automaticity' of movement control is putatively achieved, meaning that a well-rehearsed movement technique can simply be 'run off' without conscious intervention, allowing the individual to perform additional tasks concurrently. Thus, this pedagogical approach encourages teachers to lead the child to master 'technical proficiency' in movement, often judged, or assessed, relative to predetermined criteria or procedural checklists (Wickens, 1989).

Lessons, employing this approach, consist of a format, where techniques are learned in isolation, before the introduction of performance sequences and game-play. This 'step-wise' and deconstructed form of teaching has been characterized by what Light and Kentel (2010) call a 'hard masculinized pedagogy', where the teacher acts as an authoritative expert responsible for passing on objectified knowledge, resulting in a power imbalance between the teacher and child. This positioning of the educator-learner relationship contrast to what Masschelein (2010) refers to as a 'poor pedagogy'. This perspective argues against the hierarchical divide between the teacher and student, and proposes replacing it with one in which both head out into the world together, learning from each other as they go. Here, we prefer to present these contrasting pedagogies in their more evocative terms of 'loud' and 'soft'. Now, the most significant effect of this 'loud' pedagogy is that it leaves little, to no, room for children to contribute to the learning process, searching and exploring their environments, and adapting their actions. Traditional learning experiences tend to include both prescriptive (following technical demonstrations and instructions from the teacher) and repetitive actions with little variability, as they try to replicate an 'optimal' technique until they can execute a motor skill 'efficiently' (Schmidt, Lee, Winstein, Wulf and Zelaznik, 2018). Verbal feedback and instruction is often a one-way process, with the teacher employing a cyclical methodological pattern, consisting of 'observe – provide feedback – observe again'. During each performance trial, the teacher informs the child what they are doing correctly, or more likely, incorrectly, and proposing a different and often presumed better way of skill development (hence its 'loud' connotations presented above) (Davids, Araújo, Hristovski, Passos, and Chow 2012; Chen, Martin, Ennis and Sun 2008). It is arguable that the rigidity and 'one size fits all' nature of this approach leaves little room for development of highly adaptive, emotionally engaged and motivated children who learn to self-regulate, using perception, cognition, emotions and actions, when navigating performance environments (Woods, Rudd, Robertson and Davids, 2020). Thus, we now present a different worldview of PE, one which we argue the field should push toward as it restores greater balance between the individual and environment when explaining behaviour. To do this, we start with a brief overview of the theoretical framework of ecological dynamics.

Where we're going…

The proposed pedagogy of exploration, search, discovery, invention and adaptation is devised from three theories: ecological psychology, dynamical systems theory and complexity science that reside within ecological dynamics. An ecological dynamics approach views movement as emerging from a self-organising relationship formed between an individual, the task being performed, and the environment in which it occurs (Davids, Handford, and Williams 1994; Warren 2006). Intentional actions are understood as dynamic functional movement solutions that emerge as each learner continuously interacts with an array of constraints related to the task and environment (Davids, Handford, and Williams 1994; Seifert et al. 2018; Button et al., 2020). Ecological dynamics is a combination of several theoretical influences applied to the study of movement coordination and motor learning, including ecological psychology (Gibson 1979), dynamical systems theory (Kugler and Turvey 1987), complexity sciences (Edelman and Gally 2001; Price and Friston 2002), and evolutionary biology (Kauffmann, 1995). Thus, to draw our readers' attention toward how each of these contributes to an ecological dynamics framework and conceptualisation of movement behaviour, we next briefly walk through each.

Ecological psychology postulates a constant, reciprocal, and interactive relationship between an individual and the environment they inhabit. Individuals use surrounding information in their environment, that specifies functional properties available to regulate their actions. Their actions then allow them to perceive further information, a reciprocal process of perception-action coupling (Gibson, 1979). *Dynamical systems theory* emphasises the need to understand that complex adaptive systems in nature, such as the human body, are constantly and dynamically changing over varying timescales, transitioning between states of stability and instability (Davids, et al., 1994). *Complex adaptive systems* in nature have many interacting and related parts from which order emerges and dissolves. For example, in the human body the close interrelationship between the system parts (e.g. bones, muscles, joints, limbs) supports the inherent self-organisation tendencies that regulate how movement coordination emerges. The potential for continuous interactions between system components gives the whole system a certain amount of nonlinearity which provides inherent adaptability, but also unpredictability in a system which is changing over longer timescales (e.g. development, maturation, different conditions and ageing). The complex systems approach in neurobiology and neuroanatomy highlights the need to understand the movement system as a whole (as well as larger systems formed with the task and environment). This conceptualisation signifies that the inherent 'degeneracy' of complex neurobiological systems supports the ability of system elements that are structurally different to perform the same function or yield the same output (Edelman and Gally 2001). Friston (2002) described degeneracy as a many-to-one, structure-function relationship – explaining how different configurations adopted by the movement system can still achieve the same (or highly similar) outputs. For instance, degeneracy in perceptual-motor systems signifies that children can structurally vary their movement behaviours without compromising function, providing evidence for the adaptive and functional role of coordinative variability in order to satisfy interacting constraints (Seifert et al., 2016). This idea is captured during childhood when we observe children, in different phases of development, switching between locomotor patterns (e.g. crawling, walking, galloping, and climbing) to negotiate various regions of their landscapes. What this implies for physical educators is that, in interacting with a dynamic environment, there is no one 'ideal' way of doing for each child, but that several stable performance solutions can emerge depending on development, experience and skill levels (Chow et al., 2016). These interactions also depend on the field of 'affordances' perceived by the child to achieve the task-goal (Gibson, 1979).

Affordances are opportunities or 'invitations' for actions in the form of performance behaviours (Gibson, 1979), exemplified by spaces, gaps, objects, obstacles, inclines, surfaces and even other people. Such invitations for actions are available everywhere and are directly perceivable by an individual as they progressively attune to the surrounding information that specifies the functional, interactive properties of the environment (Bruineberg and Rietveld, 2014; Fajen, Riley, and Turvey, 2009). This process of attunement is embedded, meaning that it involves the entire perceptual system (i.e., visual, haptic, auditory and proprioceptive) that functions to detect information in the environment that specifies the functional properties of an affordance. Thus, information emerges from continuous interactions between individuals and environments, with the perceptual system becoming progressively fine-tuned toward regulating stable and functional movement solutions for achieving intended task goals (Handford et al., 1997; Renshaw and Chow 2019). Importantly, affordances are dynamic, changing across small timescales with (explor)action (Hacques et al., 2020), and longer timescales with development. According to the concept of nested affordances (Mark, Ye, and Smart 2015; Wagman, Caputo, and Stoffregen 2016), children achieve skilled behaviours through continuous exploratory activity that enables them to find available information and use affordances to perform effectively (Hacques et al., 2020).

An ecological dynamics rationale means that children learn to move and discover information, progressively refining this exploration so that they detect richer and more reliable information to support action. This transitory process is facilitated through individuals harnessing self-organisation tendencies that exist in all biological systems, supporting the passage from one organised state of the system to another (Kelso, 1995). Observed changes in movement skill behaviour, in this respect, are functions of the system itself (learners harnessing self-organisation processes). This viewpoint emphasises the importance of search, exploration and discovery to enhance movement coordination. This explanation enables us to move beyond an understanding of movement from a purely cognitive processing perspective, to one which appreciates the embedded nature of the person-environment relationship (Araújo et al., 2019). This perspective, now leads us to propose three cornerstones followed by three exemplars for those interested in situating PE within an ecological dynamics framework.

Cornerstones of an ecological dynamics framework for Physical Education

1. Physical 'ex-ducere': to lead out

An ecological dynamics conceptualization of learning clearly impacts how a practitioner would go about 'educating'. For example, rather than attempting to 'instill' or 'drill' idealized ways of being or doing into the minds of those who are presumed to be ignorant (Ingold, 2000), an educator would work *with* a child, guiding them along a path of active self-discovery to help them 'know as they go' (self regulate) (Dreyfus and Dreyfus, 1986; Ingold, 2000; Woods et al., 2020). This approach demands a *softer* pedagogy, one which invites children to directly experience things as they are: embedded into the performance context in which they emerge. It is an approach that views learning as a process of progressively becoming *attentive* and *responsive*, but also *engaged* as learners do not react, but (inter)act and *experience* things; this is engagement, facilitated by educators carefully guiding the attention of children toward critical environmental features to be interacted with (Ingold, 2000). The educator role is one of *co-constructing* or *co-designing* with learners. At the same time learners have responsibility to become progressively attentive and responsive to the interactions observed, and that they intend to influence, in order to find the key/critical environment features that may promote more functional (but individualised) interactions.

Further, the long-term aim for the subject becomes realistic, that is to lead out and encourage children to engage in physical activity beyond the school gates. This process involves providing children and young people with functional movement skills that enable exploration of physical activity opportunities in their community. To achieve this aim, educators need to begin by asking the question: '*does the physical education curriculum educate children and young people to their world?*' This means we need to recognise, and take into consideration, that children are situated in an ecological niche (i.e., home environment and the local community), which has access to particular play spaces (i.e., garden, street, park or sports club) toys and equipment. This is the landscape that learners are currently (self)navigating. To successfully guide children along a path of active self-discovery it is essential to design curricula that align and invite children to further explore and develop interests in and through movements. For kindergartens or reception classes this could be a form of co-design where the educator invites children to bring in their favourite play toy. They may bring in a ball or they may bring crayons or even a hand-held computer game. These objects inform us about the world they are navigating. More often than not, it is the children who brought in a ball from home who will choose to play with it at break times and it is through this that they continue to increase their range of ball manipulation affordances. Children whose attention is educated in sedentary activities may never end up choosing to play with a ball during break times and opportunities for action later in life for physical activity are likely to be diminished (Stodden et al., 2008, Robinson et al., 2016).

Here, we propose that this guidance of attention can take shape through the use of carefully (co)designed practice tasks that channel a child's attention toward the perception of critical environmental features (e.g. balls in the playground) (Ingold, 2001). Specifically, educators functioning within an ecological dynamics framework are typically encouraged to conceptualise themselves through a *designer* lens (Button et al., 2020; Correia et al 2019), working with children and/or athletes to place the organism-environment interactions at the core of learning designs (Woods et al., 2020). We further elaborate on this idea and on the ways in which educators may go about it, in the three examples presented in the concluding sections of this paper.

2. Accepting and planning for uncertainty

An ecological dynamics approach to PE can benefit from adopting and understanding nonlinear pedagogy (Chow, 2014), since this approach provides us with principles that respect and appreciate non-linearity and non-proportionality of how we learn movement skills. It, therefore, highlights and teaches us to respect there is considerable uncertainty as to how any particular PE lesson will unfold, and consequently lesson planning should act as a guide, rather than a strictly adhered to plan, at the cost of learning. This flexibility is because individuals (or at a higher level of analysis, a class of children) are understood to be complex adaptive systems (Correia et al., 2019). In such systems, movement skill performance will emerge through interactions of task, environment and individuals. Educators, therefore, do not need to spend inordinate time prescribing movement techniques such as forward roll or striking a football, but design activities and environments that will afford these movement solutions to emerge during exploration. Planning, therefore, needs to adopt a frontloaded approach, whereby teachers consider in advance how a combination of activities and designed environments will lead to greater exploration and the emergence of functional movements skills. An example of how emergence can be exploited is playing a game of tag on a grassy hill – this taskscape (with many unique affordances due to incline) will likely lead to the emergence of a gallop as children either try to catch or run away from other children on a fairly steep downslope. Exemplar 1 provides a rich account of how an ecological dynamics conceptualisation of PE can guide teacher planning and curriculum design for teaching children to swim. Furthermore, when taking a nonlinear pedagogy approach, educators modify individual, task and environmental constraints to support exploration. With reference to nonlinearity in learning, variability is seen as inherently present in how movements are coordinated and adapted. Variability in movement coordination can be functional and is to be encouraged because it can support skill adaptation.

3. *Skill Adaptation over Acquisition to support functional movement skills*

Creating PE environments that provide room for exploration, allows the emergence of (functional) variability and fosters movement adaptability for all learners. In the process of solving motor problems the child can find movement solutions that lead to new and highly functional and creative behaviours (Orth, Van der Kamp, Memmert, Savelsbergh, 2017 Withagen and van der Kamp 2017). Environments that are informationally rich (e.g., a sport hall with all of its gymnastics equipment set out) can enhance the skill adaptation of the learner through self-regulation (self-organisation) in search of more functional performance solutions (Araújo & Davids, 2011). This movement variability is crucial because it offers different solutions for learners to explore. Another important consequence of an enriched environment is that it helps the learner by exploring the redundancy of the movement system and the possibilities for transfer of movement (e.g., from gymnastics equipment to playground climbing frames). The positive transfer of movements will increase the likelihood that children will become proficient and confident in their own ability to function (perform effectively and efficiently) across multiple sporting environments – learning to actively self-navigate through a range of diverse regions within a landscape (Chow et al., 2020; Woods et al., 2020). Educators who prescribe a harder pedagogical approach focused on the development of more *specialised* set of movement skills, a narrower field of coordination states will likely emerge (Chow et al., 2020). Whilst these coordination states will be stable, they may also be rather specialised, rigid and inflexible, limiting their transference across environments, inhibiting a child's potential to explore through a range of activities. An enriched learning experience, on the other hand, will create an abundance of stable coordination states (reflecting the exploitation of degeneracy in perceptual-motor systems) that are resistant to perturbations during performance, yet retain inherent flexibility for (re)formation if contexts require. Exploring various learning situations during PE lessons will favour an education of attention (Gibson, 1979; Ingold, 2000; Jacobs and Michaels 2007), as children begin to acquire coordination patterns that allow them to function within different environments.

Exemplars of Physical Education Curriculum based upon Ecological Dynamics

Example 1: Swimming - a critical part of Physical Education: that all children need to learn and too many do not

Helping children learn to swim is a key aim of PE curricula across the globe. In England, 50% of children are unable to swim when they leave primary school and the average fee for a swimming experience (not a lesson) is £4.24 (UK Swim 2017). While this economic constraint may be limiting, the question remains, based upon an ecological dynamics conceptualisation of PE: *will learning to swim in the tepid/warm, calm water found at your local swimming baths address the need for all children to learn to swim in the first place?* (WAID 2018). In the UK, children and adolescents make up the highest percentage of deaths by drowning and the vast majority of these events occur in open water: the sea, lakes, ponds, and rivers. Physical educators appreciate that whilst supporting children to perfect their swimming strokes like a Michael Phelps or Rebecca Adlington is a wonderful aspiration; this is, for most children, neither achievable nor essential (Button, et al., 2020). Technique reproduction should, therefore, not be a major focus of a PE curriculum, but rather a focus for swimming clubs (Button, et al., 2020). The educator of a school-based swimming curriculum would appreciate that for every child there is a need to have *'knowledge of'* (Gibson, 1966) open water environments so they can navigate safely both around and immersed in such contexts. This is because educators who are learned in ecological dynamics understand that drowning is a multifaceted and complex phenomenon and is a consequence of the way a child interacts with their aquatic environment (Moran, 2007). Button (2016) has demonstrated that children who learn survival skills in open water environments develop self-regulation tendencies, enriched by perceptual, cognitive, emotional and physical systems, leading to enhanced survival competencies and skills in only one or two lessons. Swimming pools are highly controlled environments, which mitigate risks as the pool's water temperature does not fluctuate, the enclosed area is well-lit and not open to the elements, the surface remains in quasi-steady state and the downward slope from shallow to deep-end is predictable. The net result is that '*knowledge of'* the indoor pool environment is does not transfer to outdoor aquascapes, where currents, rips, waves, water depths and temperatures constantly fluctuate. Outdoors, the environmental dynamics will (re)specify movements (e.g. the child to tread water, to estimate the duration between two waves, dive to avoid a crashing wave, or float to take benefit from the current or rip). The *'knowledge of'* the environment gained in open water offers a rich landscape of affordances (e.g. waves, currents, rips, obstacles, low visibility) that invites learners to explore and to adapt continuously, which favour learner-environment coupling and is also transferable across these environments (Guignard et al. 2020). We should note here that we are not suggesting that children who cannot swim should learn in these environments but educators should scaffold in opportunities for open water environments at the appropriate time to continue a child's opportunity for exploration and adaptation. This is because transfer of learning is observed when children perform functionally in an untrained situation, as they are able to explore effectively and adapt their acquired skills to this new environment. Designing learning situations that are representative of the richness and complexity of open water environments goes beyond teaching swimming skills and should prioritize water safety skills (where at all possible taught in open water environments rather than in the pool) (Guignard et al. 2020; Stallman et al. 2017). Alongside this, educators should encourage playing games in the swimming pool and at the seaside with their parents and as this will lead to functional adaption under adult supervision. Finally, a skilled swim educator can use nonlinear pedagogy to support children learning to swim in a swimming pool. For instance, adopting a nonlinear pedagogy approach using paddles and fins can be used to artificially increase propulsive surface area of hands and feet in order to amplify how hands and feet should be oriented and move in the water. In contrast loud and linear pedagogical approaches usually use paddles and fins to train propulsion generation, but not really to educate attention, which can create shoulder injuries when children wrongly orientate hands during propelling actions. Through an ecological understanding and through nonlinear pedagogy we instead aim to amplify how hands and feet must be oriented to generate effective propulsive forces. Another good example of a skilled swim teacher using nonlinear pedagogy involves the use of rubber quoits or rings. These weighted rings are usually used to train children to swim underwater, but they can also be used to help learners adapt the orientation of feet in breaststroke. Indeed, if a child with an asymmetric breaststroke, i.e. one leg creates the breaststroke kick by pushing the water with flexed foot, but the other leg performs an undulation with extended foot like in the butterfly stroke, a ring could be used for a flexed foot to emerge. If the foot remains extended, then the ring will slide along the leg and off the foot, and the child will lose the ring. In short, the ring constrained the foot flexion. This example shows how educators can design tasks by adopting a nonlinear pedagogical approach, to enhance movement skill functionality. In summary, water safety skills are enduring over time and, due to their relations with available affordances in open water, will be far more consequential to prevent drowning deaths in children and adolescents compared to learning to swim in the tepid/warm, highly stable aquatic environment of a local indoor swimming pool.

***Example 2:* Primary and elementary school: A comparison of a 'loud' and 'soft' Gymnastics lesson**

A 'loud' pedagogy

In traditional primary school gymnastics lessons, the teacher will typically structure sessions to follow the format of a warm-up and then move on to learning basic movements such as forward and backward rolls, handstands, headstands and cartwheels, before moving on to combining sequences (Metzler, 2017). Similar to a traditional games lesson, most of these 'basics' are taught using decomposed tasks with high levels of prescriptive instruction. for example, when teaching a forward roll to stand, children are often taught using prescriptive instructions, like:

- *Start in a squat on the balls of your feet with knees together.*
- *Place your hands flat on the floor with spread hands.*
- *While maintaining pressure on your hands, tuck your head and place the back of your head between your hands while pushing with your legs to roll over forward.*
- *Maintain a rounded back by contracting your abs, and keep looking at your knees.*
- *As you roll forward, try to maintain momentum to roll up onto your feet and stand up without pushing off the floor with your hands.*
- *Your arms should just reach forward at the end of the roll.*

If the children 'master' this sequence, the teacher will deem it safe to introduce equipment, such as getting the children to perform a forward roll on a bench, with the final part of the lesson involving each child performing what they have learned in front of the rest of the class.

This linear instructional approach to gymnastics assumes that children all have the same capacities/effectivities, and that breaking the skill into components, and then mastering each of these in isolation, will equip all the children to perform the skill, in this case the forward roll, safely.

A 'soft' pedagogy

The ecological approach is built on the *educator* encouraging the children to use their imaginations to create movements that demonstrate a goodness of fit between their current action capabilities and the task demands. This approach supports the exploration of an individualised enriched environment that is unique to each child. Storytelling is a favoured stimulus; for example, in England, the first year of schooling typically sees children read the storybook, 'The Gruffalo' (Donaldson, 1999), which tells the story of a mouse's walk through the woods and to protect himself from being eaten by a number of large and dangerous animals who inhabit the woods, he invents a fictional monster called the Gruffalo. This book is much loved by children and it is, therefore, easy for educators to incorporate the world of the Gruffalo into PE lessons to build on the children's experience of the story. For example, recreating an environment that simulates the woods enables the educator to create an abundance of affordances such as trees, plants and animals that can support the emergence of new functional movement skills for children. In gymnastics, the character of the snake could be used to support rolling, and through embodying the effectivities of a snake, the children move their bodies close to the floor, slithering and sliding as they traverse under, over and around equipment. The owl, comparatively, could be used as metaphor to help children explore being on top of the equipment, and movements such as leaping and jumping emerge naturally without direction from the teacher (hence it being a 'softer' pedagogical approach). Through careful questioning the educator could encourage further exploration of movement solutions by posing questions like: *"can you roll like a mouse down a hill?"* or *"can you roll like the Gruffalo playing in the* *stream?"*. These manipulations are made at the teacher's discretion. However, it is important that the teacher understands that in this type of lesson, it is acceptable, even highly desirable, for children to display different movement solutions to the same task (exploiting system degeneracy) and that regression in skill is inevitable when altering constraints such as equipment.

An important point to highlight here is that in a 'softer' gymnastics lesson, all equipment would be set out prior to the lesson and remains out throughout its duration. Further, the teacher does not prescribe the type of skill to be learned - such as forward roll. Instead, the teacher uses equipment that will make affordances available, that is: invite behaviours such as rolling. For example, designing lots of slopes in the environment by placing wedges and other equipment at angles encourages children to explore different ways to roll based upon their own effectivities. By designing this specific affordance landscape, the teacher provides the children with novel experiences that create invitations to use gravity to learn to roll (Rudd et al 2020).

Example 3: Basketball in urban high school physical education – time for a rethink?

The question that stands out is: *how should we be teaching basketball to our young people in urban environments if we want them to participate in physical activity outside of school?* In urban cities across the world, such as New York and London where street basketball is common, in schools should we teach indoor 5v5 basketball, zone defence and motion offence or should we leave this for basketball clubs? To encourage mass participation as physical educators, should we instead be educating toward street basketball, the urban game that is the hub of activity in many local communities inhabited by children? (Garcia and Couliau, 2012). Both New Yorkers and Londoners play on the streets and the style that has emerged is in tune with the culture of the streets, which is "make it happen the best way you can rather than the more passing based game prevalent in organized competitions" (Garcia and Couliau, 2012). Street basketball, therefore, becomes a focal point for the community and provides entertainment. Games can be 1 v 1, 2 v 2, 3 v 3 or 5 v 5. These games are not governed by codified rules, there is no cost to play nor official start times and no schedules, no coaches or referees. The rules are unique to the local park or individuals playing and are not formally codified, written down or published online.

As educators designing a basketball unit of work in PE, conceptualized through ecological dynamics, we could 'lead out' by going to observe, and even better join into one of these pickup basketball games in the young people's local community. From this truly embedded experience, we could then develop a unit of work that helps prepare children for their local park pickup basketball events. This embedded curriculum would embrace both the culture of the local pickup and play and scaffold the learning experience so that it retains key information and aspects of this world, bringing it to a level that is accessible to children in the class.
Clearly this is a radical perspective of PE, but a few ideas on how to do this are:

1. *Have a 'lesson' organised and run by the young people themselves,*
2. *Encourage and play lots of small-sided games that consist of 1v1, 2v2, 3v3 4v4 and also mismatched teams,*
3. *Promote flair, cheekiness, innovation and outwitting of opposition,*
4. *Lead out – at the beginning of the basketball unit start in sports hall, then move out to the school playground, and at the end of the unit go on a field trip to local park and the pick up and play courts,*
5. *Meet and greet local community leaders and support workers who are ideally regular basketball players who can tell them about how the game is played and also a friendly face if they do decide to go down.*

Within an ecological dynamics framework, these suggestions are based on the concept of affordances, and can be carefully body scaled and matched to the action capabilities of the young people in the class. Competition is important in providing the catalyst for learning and should be carefully designed into events; however, unlike street ball, we strongly support inclusion, and we also argue that fairness means providing opportunities for individuals to display their talents and not be humiliated. Educators should co-design rules that are flexible and sensitive to this requirement. The use of ‘ladders’, instead of round-robin leagues, is one way of ensuring that individuals or teams play against opponents of similar abilities. Through such a curriculum, basketball will prepare children to seek out and thrive in unstructured play (defined here as activity not organised by an adult or professional) that has minimal associated costs and will lead to hours upon hours of physical activity. Unstructured play also provides a strong foundation for the physical conditioning that underpins later expertise needed to confidently participate in sport and physical activities at recreational, sub-elite and elite levels (Renshaw, Davids, Phillips and Kerherve, 2012; Cannane, 2011; Araújo et al., 2010; Renshaw and Chappell, 2010; Coutinho et al., 2016; Coutinho et al., in press). Research (e.g., Phillips et al., 2010; Renshaw and Chappell, 2010; Côté, Baker, and Abernethy, 2003) has suggested that undertaking inherently enjoyable play-like activities, not only provides children with a sound basis for future health and wellbeing, but also offers multiple practice opportunities, needed to succeed at a higher level in sport.

Conclusions

Traditionally, PE pedagogies have adopted a movement skill focus that has aligned and promoted the implementation of what may be termed ‘loud’ pedagogies. The contemporary scientific literature in motor learning includes an ecological dynamics framework, conceptualizing ‘education’ in its etymological roots of ex-ducere – meaning ‘to lead’ an individual ‘out’ into the world by empowering their capacity to self regulate. Adopting this approach, an educator would employ a ‘softer’ pedagogy, seeking to guide the attention of a less experienced individual toward the perception of information that can support or regulate their behaviours. Future research is needed to explore the similarities and differences between an ecological dynamics conceptualisation for physical education and other contemporary pedagogical approaches, such as embodied exploration in learning (e.g., Barker et al., 2017, 2020). All these contemporary educational approaches seek to help learners become more responsive to emergent opportunities for action available in the environment. As highlighted throughout this paper, adopting and even going as far as replacing 'education' with ex-ducere, the long-term aim for PE becomes one of leading out and encouraging children to engage in physical activity beyond the school setting.

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