The effect of a gamified motor skill intervention on emotional intelligence in 9-10-year-old disadvantaged primary school children

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List of Abbreviations

Abbreviation	Definition
BPNSFS	Basic Psychological Need Satisfaction and Frustration Scale
BPN	Basic Psychological Needs
BPNT	Basic Psychological Needs Theory
BREQ-PA	Behavioural Regulation in Exercise Questionnaire – Physical Activity
BREQ-PE	Behavioural Regulation in Exercise Questionnaire – Physical Education
EI	Emotional Intelligence
FMS	Fundamental Movement Skills
MC	Motor Competence
MCA	Motor Competence Assessment
OFSTED	Official for Standards in Education, Children's Services
OIT	Organismic Integration Theory (OIT)
PMC	Perceived Motor Competence
PE	Physical Education
RCT	Randomised Controlled Trial
SSEIT	Schutte Self Report Emotional Intelligence Test
SDT	Self Determination Theory
SES	Socio-Economic Status
SEN	Special Educational Needs
SD	Standard Deviation
SE	Standard Error
SPSS	Statistical Package for the Social Science
KS2	Key Stage 2
KTK3+	The Körperkoordinationtest für Kinder

UK	United Kingdom
USA	United States of America

Glossary of Terms

Term	Definition
Motor competence	Within this thesis, this term is defined as '*an individual's ability to proficiently execute different motor skills and movement patterns'* (Utesch and Bardid, 2019, p.186).
Physical education	*'A high-quality physical education curriculum inspires all pupils to succeed and excel in competitive sport and other physically demanding activities. It should provide opportunities for pupils to become physically confident in a way which supports their health and fitness. Opportunities to compete in sport and other activities build character and help to embed values such as fairness and respect.'* (Department of Education, 2013, p.1)
Primary school	A school for primary education of children who are 4 to 10 years of age.
Emotional intelligence	*'An individual's self-perceived abilities in regulating, using and understanding emotions in themselves and others.'* (Petrides, 2010, p.137)
Intervention	Within this thesis, this term is defined as a targeted approach designed to improve motor competence and emotional intelligence within a physical education setting.
Curricula	Within this thesis, this term is defined as a sequence of planned activities with specific goals, contents, strategies and resources.
Gamification	*'The use of game-like elements in a non-gaming contexts.'* (Deterding et al., 2011, p.9)
Key stage 2	Key stage 2 is defined as the second stage of primary school, which follows the first stage of primary school – Key stage 1. Key stage 2 includes children aged 6 to 11 years, and is split into Years 3, 4, 5 and 6.

Abstract

Emotional intelligence (EI) and motor competence (MC) are important for child development, with evidence to suggest they are positively associated. Physical Education (PE) lessons are an important context for children to develop MC and EI. Motivation is considered a fundamental element to successfully acquire these skills. Accordingly, gamification has emerged as a pedagogical approach that may enhance MC and EI through strategies that make engagement within activities more motivating. However, empirical evidence of the effectiveness of gamification in a primary school context is scarce, with no studies exploring the effects on MC and EI. Therefore, an exploration of the effectiveness of a gamified PE intervention on children's MC and EI was conducted.

Study One involved co-developing a gamified PE curricula with school-stakeholders to increase MC. Ninety-one children and four classroom teachers from three primary schools participated in co-development workshops. Children identified: (1) social (e.g. teamwork, leadership, and problem solving) and foundational movement skills (e.g. catching, kicking, and balancing) they wanted to improve; (2) enjoyable components of PE, such as skill development, and social interaction; (3) a desire to include more equipment in PE lessons; and (4) games and activities to include (e.g. 'jumping beans', 'parkour', 'hot potato with different balls'). Teachers reported: (1) the barriers (e.g. lack of initial understanding of gamification) and facilitators (e.g. novelty, and gamification strategies) to implementing a gamified model in PE; (2) successful components of PE (e.g. structured lessons, peer and/or teacher demonstration, and variation); and (3) the overall development of the intervention using the children's ideas. The co-development process resulted in three gamified PE curricula: (1) The American dream; (2) Treasure Island; (3) A quest through time.

Study 2 evaluated the feasibility, acceptability, and preliminary effectiveness of the co-developed gamified PE curricula developed in Study 1. A single-group, pre-post-trial was conducted in three primary schools in the northwest of England with children aged 9 to 10 years. Classroom teachers delivered the 60-minute gamified PE lessons once a week for 10-weeks. Researcher logs assessed recruitment, retention, adherence and attrition. Feasibility and acceptability were evaluated using semi-structured interviews (teachers; n = 3) and focus groups (children; n = 18). Questionnaires assessed EI, Basic Psychological Needs (BPNs) and motivational regulations. The Körperkoordinationtest für Kinder (KTK3+) measured MC. Three teachers and 63 children (mean age = 9.43 years, 56% girls) participated in the study.

Intervention adherence was good, with 26 out of 30 scheduled lessons delivered, and participant retention was excellent with a 0% attrition rate. Children and teachers reported that the gamified intervention were feasible and acceptable, as lessons were easy to follow, well-structured, inclusive, fun and increased teamwork. Challenges mainly related to logistics (i.e. set up time and equipment management). Pre- to post-test improvements were observed in EI ($F = 41.93$, $p < .001$), MC ($p < .05$), intrinsic motivation for PE ($F = 10.08$, $p = .002$), identified ($F = 11.84$, $p < .001$) and external regulation ($F = 4.15$, $p = .046$) for PA. Findings provide preliminary support for this co-produced curricula's feasibility and effectiveness, warranting a pilot trial.

Study 3 examined the effects and acceptability of a gamified PE curricula on EI, MC, BPNs and motivational regulations. A secondary aim was to develop a tool to assess the implementation of gamification strategies in PE. A quasi-experimental, pre-post-trial was conducted in four primary schools, with two assigned to the intervention group and two the control group. Classroom teachers delivered the 60-minute gamified PE lessons once a week for 10-weeks. The Trait EI Questionnaire – child short form assessed EI, and the KTK3+ and MC assessment (MCA) assessed MC. Questionnaires assessed BPNs and motivational regulations in PE and PA. Acceptability data were collected from the intervention group only, through teacher interviews (n = 2) and child focus groups (n = 4). A total of 76 children, aged 9 to 10 (mean age = 9.53 years, SD = 0.50, 57.9% male) participated. Significant post-test differences were found between groups for most MCA and KTK3+ subtests ($p < .05$), relatedness satisfaction ($p < .001$) and a decrease in extrinsic motivational regulations in PA ($p = 0.30$) in favour of the intervention group. No significant differences were observed for EI and motivational regulations in PE. The gamified PE lessons were acceptable to both teachers and children. Teachers reported the lessons were developmentally appropriate, aligned with educational values, increased children's participation, and were straightforward to implement. Children found the lessons enjoyable and exciting, with perceived improvements in teamwork and movement skills. The System for Observing Gamification in PE (SOG-PE) was developed to assess the implementation of gamification strategies and general teacher and child behaviour. SOG-PE data demonstrated increased use of gamification strategies during the intervention. In conclusion, gamification appears to be a promising pedagogical approach in PE. The findings suggest a gamified PE curricula can enhance certain physical and affective outcomes in children. Future research should explore longitudinal gamified interventions and assess implementation fidelity using the SOG-PE.

Declarations

I declare that the work contained within this thesis is my own.

Peer-reviewed publications

- **Rice, J.,** Foweather, L., Foulkes, J., Magill, C., Meester, A. D., Stodden, D., Lenoir, M., & Davies, K. F. (2025). Co-development of a gamified physical education movement competence intervention with school stakeholders. European Physical Education Review, 0(0). https://doi.org/10.1177/1356336X241301352
- **Rice, J.,** Foweather, L., Magill, C., Foulkes, J., De Meester, A., Lenoir, M., Stodden, D., Fitton Davies, K (under revisions in European Physical Education Review) Feasibility, acceptability and preliminary effectiveness of a gamified education intervention on motor competence and emotional intelligence

Other publications completed by the candidate during the PhD

- **Rice, J** and Wilkinson, C (under review in Journal of School Health) School and school related experiences for children and adolescents with Inflammatory Bowel Disease: A systematic review

Conference communications (oral)

Rice, J., Fitton Davies, K., Foulkes, J., Magill, C., De Meester, A., Stodden, D., Lenoir, M., Foweather, L. The effects of a gamification physical education intervention on motor competence and emotional intelligence among primary school children: a quasi-experimental pilot study, In *International Association for Physical Education in Higher Education*, Florida, May 2025 [oral]

Rice, J., Fernandez-Rio, J., Lousas, J., Diaz, J. Gamification as a pedagogical approach: Insights from primary and secondary schools, teacher training and technology. In *International Association for Physical Education in Higher Education*, Florida, May 2025 [Symposium]

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Rice, J. Gamification: Bridging Theory and Practice for Transformative PE Experiences, In *International Association for Physical Education in Higher Education*, Florida, May 2025 [oral pre-conference workshop]

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Rice, J., Foweather, L., Foulkes, J., Magill, C., De Meester, A., Stodden, D., Lenoir, M., Fitton Davies, K. How can a gamified physical intervention improve children's emotional intelligence through motor competence: an overview. In *International Motor Development Research Consortium UK & Ireland (I-MDRC),* Coventry, November 2022

Conference communications (poster)

Rice, J., Foweather, L., Foulkes, J., Magill, C., De Meester, A., Stodden, D., Lenoir, M., Fitton Davies, K. Co-development of a gamified physical education movement competence intervention with school stakeholders. In *International Association for Physical Education in Higher Education AIESEP*, Finland, May 2024

Rice, J., Foweather, L., Foulkes, J., Magill, C., De Meester, A., Stodden, D., Lenoir, M., Fitton Davies, K. Co-development of a gamified physical education movement competence intervention with school stakeholders. In *Postgraduate Research Festival*, Liverpool, May 2024

Conference communications (3-minute thesis)

Rice, J. Levelling up: Improving movement competence through gamification in physical education lessons. *Science Research Festival*, Liverpool, March 2025 [3MT, 2nd Place winner]

Rice, J. Levelling up: Improving movement competence through gamification in physical education lessons. *Postgraduate Research Festival*, University finals, Liverpool, May 2025 [3MT, runner-up]

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Chapter One: Introduction

Context of the Thesis

Disadvantaged children

In England, children identified as ‘disadvantaged’ are typically those from low socioeconomic backgrounds, most commonly identified through eligibility for free school meals (Department for Education, 2024). Disadvantaged children may face multiple, intersecting challenges within the school environment, encompassing academic, socio-emotional, and structural domains (Johansson and Höjer, 2012). Academically, disparities are evident from the very start of formal education. Upon school entry, disadvantaged children are, on average, 4.8 months behind their peers, with this gap widening to 10.3 months by the end of primary school (Institute for Fiscal Studies, 2024). The COVID-19 pandemic and related school closures exacerbated these inequalities, disproportionately affecting disadvantaged children (Darmody et al., 2021). Many had limited access to digital technology, quiet study spaces, reliable internet, and at-home support (Easterbrook et al., 2023), contributing to greater learning loss. In addition to academic disparities, disadvantaged children are also at greater risk of experiencing behavioural and socio-emotional difficulties (Noonan and Fairclough, 2018). These include elevated rates of hyperactivity and anxiety (Keilow et al., 2020; Newlove-Delago et al., 2023). For example, data from a large UK cohort study indicated that by age seven, 14.7% of children living in the most deprived neighbourhoods scored within the clinical range for social and emotional problems, compared to only 3.6% of children in the least deprived areas (Marryat et al., 2018). Such internalising and externalising difficulties – manifesting as inattention, impulsivity, withdrawal or fear - may negatively impact engagement in classroom learning (Jiang and Dong, 2020) and the quality of relationships with peers and teachers (Tippet and Wolke, 2014). Additionally, disadvantaged children are more likely to have higher rates of school absence, further impacting learning and emotional well-being (Sosu et al., 2021).

Structural inequalities within the education system often compound these individual disadvantages. Children from low-income households are more likely to attend schools with fewer resources, higher staff turnover, and reduced access to extracurricular and enrichment opportunities (Gorard, 2021; Heath et al., 2022). Furthermore, they are disproportionality affected by exclusion policies; for instance, disadvantaged children are four times more likely to be excluded than their non-disadvantaged peer (Department for Education, 2025). Importantly, however, educators working with disadvantaged children are often motivated to address these inequalities and support positive outcomes for their students (Towers, 2022). Government initiatives such as the Pupil Premium (Department for Education, 2025) aimed to mitigate these inequalities, though their effectiveness remains inconsistent and highly contingent on school level implementation (Gorard, 2021). Nevertheless, however, these outcomes are not inevitable. A growing body of research underscores the potential for schools and school-based interventions to reduce disparities and promote positive development for disadvantaged children (Stattin et al., 2019).

Physical Education

Schools play a crucial role in promoting both physical and mental well-being in children (Sakellari et al., 2021). Within this context, physical education (PE) lessons are a compulsory subject at the primary school level and represent a suitable setting to promote physical and mental wellbeing (Olive et al., 2019; Lorås, 2020). Indeed, evidence suggests PE lessons positively affect physical domains such as physical activity (PA) and motor competence (MC) through a variety of structured activities (Adab et al., 2018). The benefits of PE, however, extend beyond the physical, also positively affecting cognitive, social, and affective domains (Piñerio-Cossio et al., 2021; García-Hermoso et al., 2021). For instance, PE lessons have been shown to foster the development of personal and social skills – such as stress management and problem-solving (Wright et al., 2021) – which are key components of social and emotional learning (Dyson and Back, 2023). These competencies are, in turn, associated with improved academic performance, greater resilience, and enhanced health outcomes (Taylor et al., 2017). As such, children who consistently engage in PE are more likely to develop holistically, and consequently, improve both their physical and mental well-being (Bailey, 2018).

For primary school-aged children, one of the key outcomes of PE is the development of MC (Department of Education, 2023). However, despite MC being a key outcome in PE, research suggests that many children, particularly those from low socio-economic status (SES) backgrounds, exhibit lower levels of MC (Duncan et al., 2020; Duncan et al., 2022; Morley et al., 2015). To address these low levels of MC, research suggests that curriculum-based PE may be the most effective for developing MC regardless of age and amount of PE time (Foweather and Rudd, 2020; Lorås, 2020). Moreover, PE interventions that are specifically designed to target MC have found to be more effective than typical PE (Foweather and Rudd, 2020). Taken together, it is therefore essential to explore curriculum-based PE interventions, that are specifically designed to support the development of MC, particularly in disadvantaged children.

Emotional Intelligence

The development of emotional intelligence (EI) competencies, such as self-awareness, self-regulation, empathy and social skills, are important for children's mental well-being (Davis et al., 2019). Not only is EI important for well-being, but EI is also important for academic achievement, pro-social behaviours, and positive physical outcomes, such as MC and PA (Özal et al., 2024; Orangi et al., 2023; Gabour et al., 2024). These EI competencies can enhance children's understanding of both their own and others' emotional and social states, helping them to adapt more effectively to change (Davis et al., 2019). It is particularly important for children to develop these competencies during the pre-adolescent stage (ages 9 to 12) to reduce the risk of emotional problems later in life (Bacter et al., 2021). In a school context, research suggests that PE lessons provide an appropriate setting for promoting EI competencies, as the PE curriculum often directly addresses communication, self-awareness, and emotional expression (Castillo-Viera et al., 2020; Rico-González et al., 2023; Wright et al., 2021). Moreover, PE lessons offer children opportunities for socialisation with peers and teachers, and experiences of interpersonal conflict through communication challenges, competition, and the dynamics of winning and losing (Castillo-Viera et al., 2020). As a result, children learn to manage their emotions and adapt their interpersonal behaviours (Castillo-Viera et al., 2020). Although efforts have been made to implement PE interventions aimed at increasing EI, very few focus on primary-school aged children (Castillo-Viera et al., 2020; Rivera-Pérez et al., 2020), and none have been implemented within the United Kingdom (UK). Consequently, to date, little is known about the effects of PE school-based interventions aimed at increasing EI in UK primary-aged children.

Gamification

For PE to provide positive physical (i.e. MC) and affective (i.e. EI) experiences for children, motivational processes must be considered. Motivation predicts participation in intentional behaviours, and higher quality motivation is associated with more positive physical, cognitive and affective outcomes (Ryan and Deci, 2020; Vasconcellos et al., 2020). Therefore, to ensure children are motivated in PE, and acquire the subsequent benefits, pedagogical approaches must be thoughtfully considered (Saiz-González et al., 2024). One promising pedagogical approach in PE is gamification, defined as 'the use of game-like elements in non-gaming contexts' (Deterding et al., 2011, p.11; Arufe-Giráldez et al., 2022). The underlying concept of gamification is that specific game-like elements make engagement in activities more motivating (Deterding, 2011). In PE, gamification has generally shown positive effects on students' motivation, enjoyment, BPNs, PA, EI and movement skills (Arufe-Giráldez et al., 2022; Navarro-Mateos et al., 2024). However, there is a paucity of empirical research on the effectiveness of gamification in a primary school context (Fernandez-Rio et al., 2020; Sotos-Martinez et al., 2024), with studies primarily focusing on university and secondary school students (Arufe-Giráldez et al., 2022). Consequently, very little is known about the effectiveness of gamification on primary school-aged children's MC and EI.

Introduction to the Thesis

The overall aim of this thesis is to explore the effects of a gamified PE intervention on MC and EI among 9- to 10-year-old children attending schools in disadvantaged communities. Children aged 9 to 10 were targeted in this programme of research as they were identified as pre-adolescent children in full-time primary school education, which included mandatory and structured PE lessons.

Thesis Structure

This thesis comprises of three studies, which are described within the thesis study map, located at the start of each chapter. The grey highlighted section in the thesis study map indicates the study covered in that chapter. The current chapter (**Chapter One)** provides the background to the PhD, including the primary aims. **Chapter Two** provides a review and critique of the previous literature relating to PE, MC, EI, and gamification, with specific reference to primary school-aged children. **Chapter Three** outlines the philosophical foundations of the research, theoretical framework, methodological approach and ethical considerations. **Chapter Four** presents Study One, which describes the process of co-developing a gamified PE MC intervention with children and teachers from Northwest England. **Chapter Five** presents Study Two, which investigates the feasibility, acceptability and preliminary effectiveness of a gamified PE intervention within a primary school context. The final study is presented in **Chapter Six;** a quasi-experimental pilot study investigating the effectiveness of a gamified PE intervention. Finally, **Chapter Seven** provides a synthesis of the PhD main findings, conclusions, overall strengths and limitations, and recommendations for future research, policy and practice.

Thesis Study Map

Study	Objectives
Study One: Co-development of a gamified physical education movement competence intervention with school stakeholders.	• Co-develop a gamified PE intervention with Year 5 children (age 9 to 10 years) and teachers.
Study Two: Feasibility, acceptability and preliminary effectiveness of a gamified physical education intervention on motor competence and emotional intelligence.	• Evaluate the feasibility and acceptability of a co-developed gamified PE intervention in a primary school context. • Evaluate the feasibility of the study process (i.e. recruitment) and management (i.e. data collection) in a primary school context. • Explore the preliminary effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children.
Study Three: The effects of a gamified physical education intervention on motor competence	• Explore the effects of a co-developed gamified PE intervention on EI, MC, BPNs

and emotional intelligence among primary school children: a quasi-experimental pilot study.	and motivational regulations in PE and PA among 9- to 10-year-old children. • Evaluate the acceptability of a co-developed gamified physical education intervention in a primary school context. • Develop and pilot a tool to assess the fidelity of the delivery of gamified pedagogy in PE.

Chapter Two: Literature Review

Introduction

The purpose of this chapter is to review the literature associated with PE, MC, EI, and gamification, with reference to primary-school-aged children. This chapter will conclude with an overview of the aims and objectives of the thesis.

Context

The COVID-19 pandemic significantly and negatively impacted the daily lives of children (Orban et al., 2024). Although direct physical health effects of the pandemic appeared to be minor for children (Howard-Jones et al., 2022), children experienced a myriad of indirect effects. In England, pandemic-related measures such as school closures and the advice to stay at home restricted the possibility of socialising (Fairclough et al., 2024). Such measures resulted in prolonged periods of social isolation, with evidence to suggest these measures negatively affected the mental health of children (Panchal et al., 2023). A review by the National Health Service (2021) highlighted an increase in the prevalence of probable mental health problems among children from pre- to post-COVID-19 (Newlove-Delgado et al., 2021). Specifically, for primary school-aged children (5 to 10 years), the prevalence of probable mental health problems increased from 9.4% in 2017, to 17.1% in 2021 (Newlove-Delgado et al., 2021). This increase was even more pronounced among children of low socio-economic status (SES; Newlove-Delgado et al., 2021). In 2021, 12.8% of children of lower SES had a probable mental health problem, compared to 6.7% of children of higher SES (Newlove-Delgado et al., 2021). Concerningly, this rate continued to rise, with 26.8% of low SES children experiencing a probable mental health problem in 2023 (Newlove-Delago et al., 2023). A study exploring the trajectories of change in children's mental health during the pandemic found that lower SES was associated with higher levels of internalising (i.e. emotional symptoms) and externalising problems (i.e. conduct problems) compared to children of higher SES (Raw et al., 2021). If left unaddressed, these mental health problems can lead to long-term negative outcomes, including lower mental and physical health-related quality of life, reduced educational attainment, and social isolation (Schlack et al., 2021).

The COVID-19 pandemic also restricted children's leisure opportunities such as going to parks, swimming pools and leisure centres, creating a barrier to engagement in PA (Riazi et al., 2021). At the same time, children no longer had access to school-based physical activities such as PE lessons, after school clubs and sports (Walker et al., 2023). These activities are important for children's development, as PE lessons play an important role in the development of MC (Lorås, 2020), defined as an individual's ability to proficiently execute different motor skills and movement patterns (Utesch and Bardid, 2019). The positive relationship between PA and MC is well documented (den Uiul et al., 2023; Logan et al., 2014). Evidence suggests that higher MC predicts higher PA participation among children, while at the same time low MC is associated with reduced PA due to the existence of a proficiency barrier (De Meester et al., 2018). The proficiency barrier is hypothesised to emerge between the phase where children are suggested to develop *foundational movement skills*, such as kicking and throwing, and the phase in which children acquire more complex movement skills, such as sport-specific skills (Seefeldt, 1980; Hulteen et al., 2018). To this end, children with MC levels below the proficiency barrier may demonstrate a decrease in success and enjoyment in a range of activities, subsequently leading to higher rate of dropout in PA over time (Stodden et al., 2013). Nevertheless, as opportunities for participating in PE and/or PA were reduced during COVID-19, opportunities to develop MC also decreased significantly (Carcamo-Oyarzun et al., 2023). This is concerning as many children already demonstrate low MC (Duncan et al., 2020; Lawson et al., 2021), and children from low SES backgrounds usually demonstrate poorer MC than those from high SES backgrounds (Morley et al., 2015; Gosselin et al., 2021).

Taken together, the combination of physical inactivity and social isolation had a synergistic effect on children's lifestyle behaviours, their mental health and wellbeing (Neville et al., 2022; Panchal et al., 2023). Indeed, evidence highlights the importance of identifying protective factors against mental health problems, particularly for children from low socioeconomic areas (Holmes et al., 2020; Reis, 2013). Addressing these protective factors is crucial for mitigating mental health problems and their associated negative outcomes, such as poor quality of life, low academic achievement and risk of later psychoactive substance abuse (Holmes et al., 2020). Moreover, it is essential to develop intervention strategies to address low MC in primary school children, as the development of these skills is particularly important during this stage of development (Stodden et al., 2008; Utesch and Bardid, 2020). As such, PE plays a vital role in supporting the development of MC in primary-school aged children (Lorås, 2020).

Physical Education

Overview of Physical Education

As previously mentioned, PE holds great potential for developing and maintaining children's MC (Lorås, 2020), and for many, it represents one of the few, and first formal settings to engage in PA and motor learning activities (Lorås, 2020). In England, PE is a compulsory subject for primary school-aged children (5 to 11 years old), as outlined in the National Curriculum (Department of Education, 2023), making it an essential setting for promoting MC. A recent review by Lorås (2020) reported that PE classes among primary-aged children had a significant positive impact on overall MC. Beyond physical outcomes, PE promotes integral aspects of positive development for primary school-aged children, including social, affective and cognitive growth (Hills et al., 2015; Opstoel et al., 2020; García-Hermoso et al., 2021). For instance, research demonstrates that PE participation enhances motivation (Vasconcellos et al., 2020), enjoyment – particularly among children under 12 years old (Mo et al., 2024), cognitive development (García-Hermoso et al., 2021), academic performance (Garcí-Hermoso et al., 2021) and PA levels (Errisuriz et al., 2018).

Although these findings are positive, there are still several challenges that schools experience relating to PE. The 2023 report from the Office of Standards in Education, Children's Services and Skills (OFSTED) highlight concerns regarding pupils' confidence and competence in PE (Department of Education, 2023). This review suggests that these issues can be attributed to inappropriate teaching methods that did not always align with children's learning needs (Department of Education, 2023). In addition, many primary school teachers have only a basic level of competence in teaching PE (Freak and Miller, 2017). This is, in part, due to the limited time allocated to PE in their initial teacher education (ITE), with Elliot et al. (2013) and Randall (2023) noting a variation of between 0-15 hours typically allocated to PE over a one-year programme. Further, Randall (2023) found that 30.4% of teachers reported teaching no PE lessons during their ITE, a situation attributed to the use of outsourced providers and the prioritisation of other subjects, such as English, Mathematics, and Science. Unfortunately, however, there is limited evidence of the proportion of generalist teachers' delivery of PE in primary schools. Nevertheless, evidence from a sample of 1120 primary school teachers across Europe, suggests that 43% (n = 503) of generalist teachers were responsible for delivering PE (Marron et al., 2023). In addition, 21% of generalist teachers worked alongside sports coaches to deliver PE (Marron et al., 2023). As generalist teachers received limited PE training during their initial teacher training, pupils may have fewer opportunities to experience a range of activities and pedagogical approaches, which can narrow children's movement experiences (Adams et al., 2023; Domville et al., 2019a; Tsangaridou, 2012). These challenges are further compounded in schools situated in deprived areas, where teachers report barriers such as children lacking the appropriate kit for PE and confidence, limited CPD opportunities, competing curriculum demands, with PE being identified as a low priority and restrictive curriculum policy (Eyre et al., 2022; Domville et al., 2019; Roscoe et al., 2017). Collectively, these challenges highlight how the potential of PE to develop MC, and other positive outcomes, is shaped not only by teacher implementation, but also by the wider socio-economic contexts in which schools operate.

Physical Education in the National Curriculum

In England, the primary aim of the National Curriculum for PE is to provide pupils with multiple opportunities to develop physical confidence in ways that support their health and fitness (Department of Education, 2013). Within the National Curriculum for PE in primary schools, Key Stage 2 (ages 8 to 11) aims are to '…. apply and develop a broader range of skills, learning how to use them in different ways and to link them to make actions and consequences of movement' (Department of Education, 2013, p. 2). In the National Curriculum, there are opportunities for students to be competitive, while enjoying communicating and collaborating with each other (Department of Education, 2013). Furthermore, there is an expectation that students should also develop an understanding of how to improve in different physical activities (e.g. basketball, football, hockey, netball), while evaluating and recognising their own success. Finally, within primary schools, it has been recommended that practitioners deliver a minimum of 2 hours of PE per week (Department of Education, 2024). Despite this recommendation, a recent report found that many schools do not always achieve this (Department of Education, 2023) because of timetabling issues, core-subject demands, poor indoor facilities, limited resources (i.e. equipment, schemes of work), and school ethos (McNamara et al., 2022).

Physical Education and Pedagogy

In the context of implementing PE in schools, there is no singular pedagogy for delivering the primary curriculum; rather, it often depends on the skills and expertise of the practitioners (Sum et al., 2018), as well as the outcome(s) practitioners are trying to get the pupils to develop. Hastie and Casey (2014, p.422) describe a pedagogical model as ‘a way of organising the interdependent elements of curriculum, learning and teaching to achieve specific learning outcomes’.

Over the past few decades, pedagogical models have evolved and shifted from traditional, teacher-centred to more student-centred approaches (Fernandez-Rio and Iglesias, 2024). In teacher-centred approaches, the teacher serves as the primary instructional leader, and students are expected to demonstrate compliance rather than initiative (Mesquita and Graça, 2009). Direct instruction is a prominent example of a teacher-centred approach, with the central aim of promoting on-task behaviour through explicit instruction, ongoing support, and engagement in successful practice (Magliaro et al, 2005). In contrast, student-centred approaches aim to place students at the forefront of the learning experience, under the guidance from the teacher for an optimal achievement of objectives (Segura-Robles et al., 2020; Moya and Cara, 2021). Student-centred approaches seek greater meaningful learning by students, enhancing their sociability and teamwork, critical thinking, and learning interactivity (Bjørke et al., 2023; Dyson et al., 2004), thus enabling pupils to play a more active role in their learning (Ennis, 2014). Examples of student-centred approaches include Teaching Games for Understanding (Bunker and Thorpe, 1982), Cooperative Learning (Dyson and Crineski, 2001) and the Sport Education model (Siedentop, 1998). These approaches are widely recognised and implemented in PE globally (Casey and Kirk, 2020) and have demonstrated positive effects on, among other outcomes, cognitive learning, motor development, social skills, motivation, and team participation (Bores-García et al., 2020; Casey and Goodyear, 2015; Sierra-Díaz et al., 2019).

Building on these approaches, gamification, defined as the 'use of game-like elements in non-gaming contexts' (Deterding et al., 2011, p.11) has emerged as a promising pedagogical approach in PE. Unlike more established pedagogies (i.e. Teaching Games for Understanding, cooperative learning and the Sports Education Model), gamification is relatively novel and an emergent approach in PE. While gamification has demonstrated positive effects on physical, social and psychological outcomes in PE, its impact on outcomes for primary-school aged children, specifically, remains limited (Arufe-Giráldez et al., 2022). Therefore, further investigation is warranted.

Motor Competence

Definition and Conceptualisation

As previously mentioned, PE is an important context for developing MC. MC is a global term used to define goal-related human movement (Robinson et al., 2015) and commonly reflects the various terminology used (e.g. motor proficiency, motor ability, motor performance, and motor coordination; Robinson et al., 2015). For this thesis, MC is understood as an individual's ability to proficiently execute different motor skills and movement patterns (Utesch and Bardid, 2019). MC encapsulates fundamental movement skills (FMS) and is defined as basic learnt movements that require a combination of two or more body limbs (Logan et al., 2018; Foweather and Rudd, 2020). FMS competence is an integral component of children's development (Gallahue et al., 2012; Stodden et al., 2008) and throughout childhood, FMS provide the foundations to develop more specialised movement patterns. For example, sport specific (e.g. kicking a football) (Clarke and Metcalfe, 2002), complex movement skills (e.g.

riding a bike) (Hulteen et al., 2018) and participation in PA (Stodden et al., 2008). Hulteen et al. (2018) extended the classification of FMS, and suggested the term *foundational movement skills,* reflecting a wider variety of skills, including but not limited to an overhead press, cycling, and squat. Globally, these FMS are classified into three categories of movement: object control skills (also termed manipulative), locomotor, and stability skills (Gallahue et al., 2012). Object control (or manipulative) skills are those involving projection and reception of objects (e.g. catching and kicking). Locomotor skills involve moving the body from one place to another using two or more body segments (e.g. running and hopping). Finally, stability skills refer to axial movements on the horizontal and vertical axis, both statically and dynamically (e.g. static balance and beam walking) (Gallahue and Cleland-Donnelly, 2003). These skills are not naturally acquired during the process of maturation (Lubans et al., 2010) and instead require continuous development (Barnett et al., 2016). Therefore, it is important to provide a developmentally appropriate environment that provides encouragement and sufficient opportunities to learn, practice, and reinforce these skills (Clark, 2005; Logan et al., 2012).

Importance of developing Motor Competence

Appropriate development in MC is associated with several positive outcomes for children in the short, and long term. For health outcomes, MC is associated with participation in PA (Lima et al., 2017), healthy weight status and physical fitness (den Uil et al., 2025), cardiorespiratory and muscular fitness (Jaakkola et al., 2019) and perceived MC (De Meester et al., 2020). Conversely, low MC is associated with physical inactivity (Carcamo-Oyarziun et all., 2023) due to avoidance in challenging movements, and other factors such as limited exposure to physical activities during childhood (Peterson et al., 2021) and being overweight or obese (Rodrigues et al., 2016; De Meester et al., 2016). Some researchers have documented the association between MC and broader aspects of health and wellbeing. For instance, evidence suggests that MC is positively associated with self-esteem (Lopes et al., 2022), intrinsic motivation (Menescardi et al., 2022), EI (Orangi et al., 2023), psychosocial outcomes, which include social skills and mental health (Mancini et al., 2018), and self-worth (Piek et al., 2006). At the school level, evidence supports the positive association between MC and executive functions (Schmidt et al., 2017) and school readiness (Robinson et al., 2015). Further, MC is positively associated with academic achievement (de Bruijn et al., 2019; Nobre et al., 2024; Schmidt et al., 2017; Macdonald et al., 2018; Wang and Wang, 2024). Taken together, these findings highlight the importance of developing MC for the holistic development of children.

Theories and Models of Motor Development

Several theoretical motor development models have been proposed (Clark, 1994; Gallahue, 1982; Stodden et al. 2008), each suggesting that early and middle childhood periods are important for later skill acquisition. Stodden et al. (2008; Figure 1) proposed a conceptual model that demonstrated the synergistic and developmentally dynamic relationship between MC and PA during childhood, which is mediated by both health-related fitness and perceived MC. The model suggests that the relationships will strengthen overtime throughout childhood (Stodden et al., 2008). Early childhood participation in PA may drive the development of MC as PA promotes neuromotor development (Okley et al., 2001). In addition, during early childhood the differences in the home environment (i.e. parental influence and resources) is the proposed reason that MC is so variable, and thus why there is only expected to be a weak relationship with PA within the Stodden model during this period (Goodway & Smith, 2005). It is claimed that as children get older, this relationship will strengthen due to increased opportunities to participate in PA, in contexts such as PE and extra-curricular activities, and thus suggest that in middle and late childhood, the direction of the relationship switches, with MC influencing participation in PA (Stodden et al., 2008). Since the development of the conceptual model by Stodden et al. (2008), there has been a lack of consensus in the literature regarding the directional pathway between MC and PA. For example, Robinson et al. (2015) conducted a narrative review of the Stodden et al. (2008) model and found a positive association between MC and PA; however, the causality direction of this relationship remains unclear due to the limited number of longitudinal and experimental study. In contrast, a more recent systematic review by Barnett et al. (2022), which included longitudinal, experimental and mediation evidence, reported inconclusive findings regarding the directionality of the MC-PA relationships. Thus, empirical evidence on this pathway remains equivocal. As such, Barnett et al. (2022) emphasises the need for longitudinal studies spanning early childhood through adolescence, incorporating multiple time points and accounting for potential confounding factors, to better understand the bidirectional relationship between MC and PA.

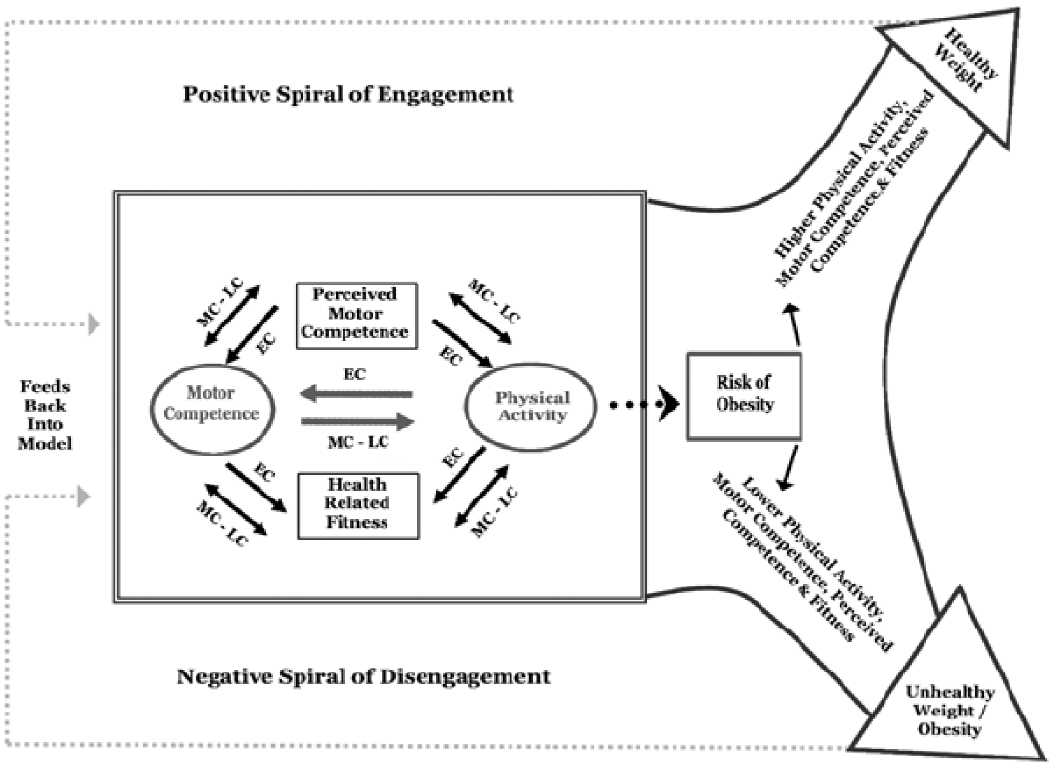

Figure 1. Stodden model on the developmental relationship between MC and PA (Stodden et al., 2008).

Note. Adapted from *A Developmental Perspective on the Role of Motor Skill Competence in Physical Activity: An Emergent Relationship*, D.F. Stodden, J.D. Goodway, S.J. Langendorfer et al, 2008

Motor Learning Theory

Motor skill learning focuses on the learner, the learning process and factors that can influence skill learning (e.g. learner, task and environment). Ecological dynamics is a contemporary theory of how children learn motor skills. An ecological dynamics perspective views movement as the self-organising interaction between the individual, the task at hand, and the environment in which it takes places (Button et al., 2021). Ecological dynamics is based on a combination of two main concepts: ecological psychology (Gibson, 1979) and dynamical systems theory (Bernstein, 1967). The foundational principle of ecological psychology is the constant and reciprocal relationship between the individual and their environment (Gibson, 1979). The idea is that individuals perceive information within the environment, and new movement possibilities arise. These self-organised movements from the individual then allows more information from the environment to be perceived, which is understood as a reciprocal process of perception-action coupling (Gibson, 1979). Dynamical systems theory recognises that complex physical systems, such as the human child, have many interacting elements that span multiple levels, and these elements constrain movement (Bernstein, 1967). Accordingly, ecological dynamics views learners as complex adaptative systems that are offered opportunities for action (affordances) from their environment. These affordances refer to the opportunities and invitations for action that the environment or task provides, considering the relational qualities with an individual's capabilities and intentions (Gibson, 1979). Importantly, these affordances are dynamic, changing across small timescales with action, and longer timescales with development (Hacques et al., 2021). Within ecological dynamics, learners are viewed as complex systems due to the degree of freedom within the movement (Bernstein, 1967). That is, a degree of freedom is a particular way in which a body may move in space (Sherman and Craig, 2018). During the initial stages of learning, a learner tends to restrict certain degrees of freedom, such as limiting the movement of joints, in an effort to find a movement solution. This occurs as the learner has not yet attuned to the relevant task or environmental variables. As a result, the learner must engage in a process of exploration, searching for key information that is crucial and structural to performing the task correctly. Following this stage, the learner begins to gradually release the previously restricted movements, allowing for more fluid and efficient coordination. This happens because, through practice, the learner starts to identify and understand the key information that is necessary for the task. Finally, as an individual becomes more skilled, they are better able to seek out and explore movement solutions. Ecological dynamics has influenced the development of alternative, learner-centred pedagogies in PE by emphasising the importance of context, interaction and the individual learners need.

Motor Competence Assessments

Given the associated positive outcomes of increased motor competency, it is important to identify low MC in children and to assess the effects of interventions aimed at improving MC. Children's MC can be measured using a variety of tools (Cools et al., 2009; Hulteen et al., 2020) and across different settings, such as educational (Scheuer et al., 2019) and clinical (Griffiths et al., 2018). A systematic review conducted by Hulteen et al. (2020) reported on 57 different tools to measure MC in children and adolescents. Most of these tools rely on either a process- or product-orientated measures (Bardid et al., 2019; Valentini et al., 2024). There appears to be no gold standard MC assessment (Bardid et al., 2019; Hulteen et al., 2023). As such, the choice of measurement selected by a researcher depends on various factors including, the purpose of the study, the population being assessed (age), the context in which MC is being measured, time constraints, resources available, and the training of the assessors (Bardid et al., 2019; Bös, 2001 cited in Schuer et al., 2019).

Process orientated measures provide data on the qualitative movement aspects, using a pre-defined technique criterion, which is scored as either present or absent (Barnett et al., 2020; Burton and Miller, 1998). Therefore, *how* the movement is performed is scored. Such tools provide assessors with valuable and more specific feedback on children's skills (Burton and Miller, 1998) and data can be used to inform the design of an intervention (Bardid et al., 2019). The most commonly used tools are the Test of Gross Motor Development (TGMD; Ulrich, 1985) and its variants, the TGMD-2 and TGMD-3 (Ulrich 2000, 2016), due to their high construct validity and reliability (Hulteen et al., 2020), and ability to evaluate changes in children's MC across an intervention (Ulrich, 2017); and the Get Skilled Get Active assessment (Ryde, 2000). Process-orientated tools have many advantages, such as high construct validity and reliability (Hulteen et al., 2020), while at the same time, providing assessors with more specific feedback on skill execution. However, the assessments are typically more time consuming and require more training based on the assessors' differing expertise (Griffiths et al., 2018). The TGMD, for example, requires significant time to administer and interpret, space and equipment, which can make it logistically difficult to deliver in school settings; therefore, its feasibility is questioned (Barnett et al., 2014; Tamplain et al., 2019).

Product orientated measures focus on the outcome of the movement (e.g. speed, distance, height or repetition of movements (Williams and Monsma, 2017; Burton and Miller, 1998; Payne and Isaac, 2017), rather than the quality of the movement. There are many different product-orientated tools including, but not limited to, the Movement Assessment Battery for Children (MABC: Henderson et al., 2007; Henderson et al., 1992), the Bruininiks Oseretsky Test of Motor Proficiency (BOT) (Bruininks, 1978), the MC Assessment (MCA; Rodrigues et al., 2019) and the Körperkoordinationtest für Kinder (KTK: Kiphard and Schilling, 1974) and its variants KTK 2nd edition (Kiphard and Schilling, 2007) and the KTK3+ (Coppens et al., 2021). Product-orientated tools are considered to be easier to score, less-time consuming and typically require less training (Hands, 2002), but they are not without their limitations. For example, product-orientated tools focus on the outcome, for example distance jumped, which neglects the technique used to achieve the outcome.

Prevalence of Motor Competence

Despite the numerous positive associations of developing MC, children globally lack adequate FMS competency (Bolger et al., 2021). Concerningly, a significant proportion of children in England are either not proficient in FMS (Duncan et al., 2020; Duncan et al., 2022) or are failing to master FMS at the expected key stage-related developmental milestones (Morley et al., 2015; Duncan et al., 2022). Duncan et al. (2020) found that fewer than one-fifth of children aged six to nine years old mastered the four key FMS outlined in the UK PE curriculum (i.e. run, jump, throw and catch). Additionally, research suggests that children in the UK generally perform better in certain locomotor (i.e. running and jumping) and object control skills (i.e. catching; Lawson et al., 2021). Therefore, it is important to examine factors that influence the development of MC, which are multi-faceted and contextual (Barnett et al., 2016). These correlates include individual (e.g. sex, age, ethnicity and special educational needs and disabilities, SES), social cultural (e.g. parental beliefs, parental support) and environmental factors (e.g. access to equipment and facilities in the home and neighbourhood).

Individual Level Factors

Sex has been found to influence MC proficiency among children (Bolger et al., 2021; Gao et al., 2024), with girls being more at risk for delays in proficiency (Goodway et al., 2019). Research shows mixed findings, with some studies finding that boys significantly outperform girls in object control skills (Eather et at., 2018; Goa et al., 2024; O’Brien et al., 2023) and that girls outperform boys in specific locomotor skills, such as leaping and hopping (Goa et al., 2024). Other studies, however, have found no significant sex differences in overall FMS, locomotor skills or balance (Kelly et al., 2019; Kokštejn et al., 2017; O'Brien et al., 2023; Rodrigues et al., 2019). These differences may be partly attributed to the types of activities children engage in and the influence of social and environmental factors (Barnett et al., 2013). For example, boys tend to participate more in object-control activities, such as football, while girls engage more in locomotor related activities, such as dance (Barnett et al., 2013).

Age is another factor, with older children typically demonstrating higher MC (Barnett et al., 2016; Bolger et al., 2021). For example, a systematic review by Bolger et al. (2021) found higher FMS levels in 9-10-year-olds compared to 3-5-year-olds. Likewise, a review with meta-analysis found a small to medium effect size for age and aspects of MC, with older children performing better across all FMS (Barnett et al., 2016). Some studies have found no age differences, or even inverse patterns. For instance, Lawson et al. (2021) found no significant differences in total FMS between children in Year Four (ages 8 to 9) and Year Five (ages 9 to 10), and unexpectedly Year Three children (ages 7 to 8) outperformed Year Four in stability skills. That said, older children are generally expected to demonstrate higher MC, as during early childhood MC is influenced by biological maturation. After this period the higher levels of MC result from a combination of maturation, and exposure to quality FMS instruction, feedback and practice opportunities in contexts such as PE lessons (Barnett et al., 2016).

Children with special educational needs and disabilities (SEND) generally have lower MC compared to their typically developing peers, due to factors such as sensorimotor impairments, motor development delays, motor sequencing deficits, low concentration levels and poor comprehension (Kavanagh et al., 2023; Downs et al., 2020; Taylor et al., 2024). In a recent systematic review and meta-analysis, Kavanagh et al. (2023) found children with intellectual disabilities had significantly lower object control, locomotor and stability skills, when compared to their typically developing peers. Children with SEND may find executing object control skills difficult as they typically rely on environmental factors, such as participating with other children, and have a greater involvement of cognitive functions and processes, which children with SEND experience deficits in (Kavanagh et al., 2023). In addition, at a school level, there may be a lack of funding and facilities, and a lack of inclusion training provided on how to deliver PE, particularly for children with SEND (Kavanagh et al., 2023).

Ethnicity has been found to influence MC, with UK-based studies finding that children from Asian backgrounds perform significantly lower in locomotor skills and overall FMS compared to their Black and White peers, irrespective of age (Adeyemi-Walker et al., 2018; Eyre et al., 2018). However, across all cited studies, regardless of ethnicity no child achieved mastery in any FMS. Nevertheless, these differences may be influenced by sociocultural factors, including lower PA levels among Asian children (Smith et al., 2018), cultural and religious norms, significant role models, and how their family engages with the ethnic community (Smith et al., 2018). Additionally, children of ethnic backgrounds are more likely to live in areas of high deprivation (Jivraj and Khan, 2013; Tobin et al., 2021), which can further limit opportunities to develop MC. Taken together, it appears the development of MC may be multifaceted for children from Ethnic backgrounds.

SES has been found to influence the development of MC in children (Goodway et al., 2019). Children from low SES backgrounds are at greater risk of delays, often due to limited exposure to learning opportunities and supportive environments (Gosselin et al., 2021; Goodway et al., 2019), reduced access to sports equipment and organised sports, often due to parental finances

(Yao and Rhodes, 2015) and restricted outdoor play due to safety concerns in their local areas (Noonan et al., 2017; Eyre et al., 2022). Studies indicate that children from low SES backgrounds generally exhibit poorer MC compared to their peers from higher SES backgrounds, both globally (De Waal and Pienaar, 2020) and locally (Morley et al., 2015). For instance, 161 children aged 9 to 10 from low SES areas in England did not achieve mastery in any locomotor or object control skills (i.e. run, hop, bounce, catch) (Adeyemi-Walker et al., 2018). Additionally, children from middle SES groups also demonstrated poorer MC than those from high SES backgrounds, suggesting that barriers may extend beyond the lowest SES (Gosselin et al., 2021). As many children, regardless of SES, fail to master key FMS (Duncan et al., 2022), broader structural factors may be at play.

Social Cultural Factors

Family social-cultural factors have been found to influence children's MC. In a cross-sectional study, Barnett et al. (2013) found that parental confidence in their abilities to support their child was positively associated with object control skills, but not with locomotor skills, likely due to the need for more direct instruction in object control. Regarding parental demographics (i.e. age, employment, education), Szaszulski et al. (2020) found no association between parental demographics and locomotor skills. For family characteristics, Jarvis et al. (2020) found a positive association between girls with higher FMS, and participation in after school activities with grandparents' and their mother's PA levels. For boys with lower FMS, there were more parental involvement in computer gaming, and their parents valued motor and social development less. Boys with higher FMS were more involved with community clubs, but no such association was found for girls (Jarvis et al., 2020). Collectively, these authors suggest that children with poorer FMS may require support, and schools are able to encourage primary school children and their parents to enhance behaviours and attitudes towards FMS. Alguren et al. (2024) and He et al. (2024) also found logistical support from parents to be significantly associated with higher levels of MC, even after controlling for various correlates.

Environmental Factors

The physical environment, both at home and school, can influence the development of MC in children (Alguren et al., 2024; Barnett et al., 2013; Niemistö et al., 2019; Niemistö et al., 2020). Some studies have shown that skill-related equipment in the home was positively associated with FMS (Cools et al., 2011; Barnett et al., 2013), although Cools et al. (2011) found that the general home environment was not directly associated with children's FMS performance. As such, providing a supportive environment with access to toys and skill-related equipment may be beneficial for supporting the development of children's MC (Barnett et al., 2013). Several studies have also found that outdoor play is positively associated with higher MC (Alguren et al., 2024; Nimestö et al., 2019). Additionally, participation in organised sports and living in low-density rural areas were positively associated with higher MC (Nimestö et al., 2019). These differences are likely due to greater opportunities for outdoor play, which have been highlighted as a substantial and meaningful opportunity to develop MC (Nimestö et al., 2019; Flores et al., 2019). In low SES areas, Eyre et al. (2022) identified unsafe local facilities, financial constraints, and inadequate space to be active in the home environment, as barriers to FMS development (Eyre et al., 2022).

There is some evidence to suggest an association between the school's physical environment and children's MC. Alguren et al. (2024) found that presence of amenities, such as benches, wildlife gardens, and available equipment had a significant direct positive association on both girls' and boys' balance. The aesthetic quality of school grounds was also positively associated to girls' overall MC and all FMS categories, while for boys, the school ground aesthetic influenced balance. As such, the authors suggested that the schools' physical environment can have a positive effect on children's MC and specific FMS.

Collectively, these findings highlight that development of MC is multi-faceted and influenced by a range of factors. As such, given that children generally have low MC, there is a clear need for targeted interventions to support the development of MC, irrespective of individual, social and environmental factors.

Interventions to Increase Motor Competence

Considering the aforementioned findings, it is essential to develop interventions aimed at improving children's MC. Given that the majority of primary-aged children's waking hours from Monday to Friday are spent in school (32.5 hours a week, 6.5 hours a day), the school setting is an obvious and commonly used choice when designing interventions that target children's movement skills (García-Hermoso et al., 2020). Opportunities to develop these skills in school arise from structured PE lessons, break time activities, after school clubs, and participation in organised sports (Daly-Smith et al., 2020). Consequently, researchers often design interventions that target these opportunities, typically with favourable results (Moon et al., 2024; Lorås, 2020; Tompsett et al., 2017).

Several systematic reviews have examined the effects of school-based PE interventions (Lorås, 2020; Tompsett et al., 2017) and PA interventions (Moon et al., 2024) on MC and FMS in children and adolescents, reporting positive effects. Tompsett et al. (2017) systematically reviewed 29 intervention studies, including 14 randomised controlled trials, 10 quasi-experimental designs, and five additional studies (e.g. single group pre-post, cluster designs), with sample sizes ranging from 13 to 1,464 participants. Most interventions (n = 27) were conducted in primary/elementary-aged children (5 – 12 years), and the remaining studies (*n* = 2) were conducted with adolescents aged 13 to 15 years old. Apart from three studies, there was a significant improvement in one or more FMS after the interventions. Beneficial effects were also observed for aerobic fitness, PA, and psychological outcomes such as self-perception, although changes in flexibility and strength, and overweight and obesity reductions were negligible. Interventions largely targeted the development of specific FMS, while other interventions engaged participants in general sports games and PA, active video games or teacher professional development. These interventions were typically delivered by a specialist PE teacher, coach or researcher, while some were implemented by a generalist classroom teacher, parent or combination. The intervention duration ranged from 4 weeks to 11 years, with a median duration of 18 weeks, with frequency varying from once per week to daily, and session duration varying between 20 to 90 minutes. However, the variations in number and duration did not appear to be associated with FMS results, which coincides with other literature (Ma et al., 2021; Lopes et al., 2020). The authors concluded that from a pedagogical perspective, specialist-led interventions, focusing specifically on FMS improvement were more efficacious for FMS development. However, given that most primary PE lessons are taught by generalist teachers, the authors (Tompsett et al., 2017) emphasised the importance of implementing teacher professional development to support the implementation of effective pedagogical design to support the development of FMS.

Lorås (2020) conducted a systematic review and meta-analysis examining the effectiveness of curriculum-based PE on MC. The review included studies published between 2002 and 2020, with sample sizes ranging from 40 to 509 participants. These studies included a wide range of curriculum-based interventions, including gymnastics, physical literacy, FMS and health and fitness. Results indicated a significant positive effect on overall MC for children and adolescents compared to children participating in standard PE classes under control conditions. Intervention durations ranged from 4 to 73 hours, delivered over periods of 4 weeks to 1 year. Although previous research has not been able to establish a definitive dose-response relationship between interventions and MC outcomes (Ma et al., 2021; Lopes et al., 2020), the findings by Lorås (2020) suggest that both short-term interventions (4 – 7 weeks: Costello and Warne, 2020; Miller et al., 2016) and long-term interventions (≥ 6 months: Johnson et al., 2019) can be effective in improving MC during PE lessons. This review, however, did not examine whom the interventions were delivered by, which is the key ingredient to know for the successful implementation and design of interventions (Schultes, 2023).

Moon et al. (2024) conducted a systematic review and meta-analysis examining the effects of PA interventions on MC in elementary school children aged 5 to 12. The review included 27 studies, 8 cluster randomised controlled trials (RCT), 2 RCTs, and 17 quasi-experimental studies, with sample sizes ranging from 13 to 4,234 participants. Intervention duration, frequency and length, ranged from 4 to 176 weeks, delivered 1 to 5 times per week, with sessions lasting between 15 and 120 minutes. Most interventions (n = 18, 78%) were delivered by a school-based team (i.e. trained PE teachers, classroom teachers and students), while the remaining were delivered by either a combined team (e.g. research team and school-based team) or solely by the researchers. The intervention curricula included revised FMS activities, movement activities which were related to specific movement skills, goal-directed learning and gymnastics, and were guided by the socio-ecological model, motivation theory and social cognitive theory. Meta-analysis showed a significant large-pooled effect on children's MC (Hedges' $g = 0.79$). The authors concluded that PE as a single component and context is beneficial for the development of children's MC, as well as incorporating motivational theories such as Self-Determination Theory (SDT: Ryan and Deci, 2020). Moreover, the authors suggest a focus on strategies, such as positive feedback and mastery of skills rather than competition would be efficacious for improving MC. Finaly, the authors emphasise the crucial role of school-based teams (i.e. PE teacher and classroom teachers), having highlighted the importance of ongoing teacher training to support the successful implementation of interventions (Moon et al., 2024).

These systematic reviews provide evidence that implementing a school-based PE intervention, focused on FMS (i.e. throwing, catching, running, jumping) may be the most efficacious for the development of MC. When determining intervention frequency, dose and duration, it is apparent that there is no gold standard, and short-term and long-term interventions have shown to increase children's MC. Across the systematic reviews, it appears that for interventions in PE, many of these consist of two sessions per week, and although in England it is recommended that children participate in two PE lessons per week, this is not always achieved. As such, the implementation of one lesson per week, may still be effective for improving children's MC, given the above findings. Although some have suggested that interventions were most effective when delivered by a specialist PE teacher (Thompsett et al., 2017), others emphasise the crucial role of wider school-based staff (Moon et al., 2024). Nevertheless, since many primary school teachers in England are not specialists it is important as researchers, to provide initial teacher training through continuing professional development (CPD) and ongoing support throughout the intervention implementation to increase intervention effectiveness and ensure children are supported in developing MC. Finally, recent recommendations (Moon et al., 2024) highlight the need for interventions to be theoretically supported, through theories such as SDT.

Emotional Intelligence

Definition and Conceptualisation

Another key competency to foster during childhood is EI (Lea et al., 2019). Broadly, EI has become the label used to represent an individual's self-perceived abilities in regulating, using and understanding emotions in themselves and others (Petrides, 2010). The most common theoretical approaches to EI are trait EI (Petrides, 2010) and ability EI (Mayer and Salovey, 1995, 1997). The key difference between trait EI and ability EI is the method of measurement, and their theoretical positioning. Table 1 summarises the conceptual differences between trait and ability EI. Although disparity exists between trait and ability EI, to an extent there is a degree of commonality. That is, both models aim to understand and measure the factors involved in the recognition and regulation of one's own and others' emotions (Goleman, 2001). Furthermore, most key facets of EI in the trait and ability EI models draw from personal traits, social characteristics and emotional attributes (Humphreys et al., 2007). The following section will explore the ability and trait EI model in more detail.

Table 1. The conceptual differences between trait EI and ability EI.

Construct	Measurement	Conceptualisation	Construct validity	Measures
Trait EI	Self-report	Personality trait	Consistent with models of differential psychology. Concurrent and predictive validity with many criteria.	TEIQue[a] SSEIT[b]
Ability EI	Maximum performance	Cognitive ability	Inconsistent with models of differential psychology	EQ-i: YVS[c]

		Limited concurrent and predictive validity

Note. Adapted from Petrides (2011) Ability and trait emotional intelligence. In T. Chamorro-Premuzic, S. von Stumm, & A. Furnham (Eds.), *The Wiley-Blackwell handbook of individual differences* (pp. 656–678). Wiley Blackwell.
[a]Trait Emotional Intelligence Questionnaire (TEIQue) which includes the child variants (TEIQue-Child form and child short form)
[b] Schutte Self Report Emotional Intelligence Test (Schutte et al., 1998)
[c] Emotional Quotient Inventory: Youth Version Short form (Bar-On and Parker, 2000)

Ability Emotional Intelligence

Ability EI is conceptualised as a set of emotion-related cognitive abilities that enable individuals to reason about emotions (Mayer and Salovey, 1997). That is, individuals apply their emotion-related cognitive abilities within a context to enhance their thinking (Mayer et al., 2004). Ability EI operates in a similar manner to other cognitive abilities by processing emotion-laden information, consequently positioning ability EI within traditional cognitive abilities (Mayer et al., 2024). The ability EI model consists of four interrelated abilities. These are: (1) *understanding emotions*: knowledge and understanding of emotions, the causes and consequences of emotions, and how emotions blend together to form emotional experiences; (2) *managing emotions*: regulation of others and ones' own emotions; (3) *perceiving emotions:* accurately perceiving facial and body language, and tone of voice; and (4) *facilitating emotions*: the ability to use their own emotions to aid in problem solving. These abilities are said to be hierarchically organised, from simply processing emotion-related information to complex strategic understanding and regulating emotions (Mayer et al., 2016). However, unlike trait EI, there is no distinction in ability EI between adults and children, and as previously noted differences in emotional experiences occur between the two (Marovelli et al., 2008). Ability EI is measured using maximal ability performance tests, designed to measure the highest level of EI a child can demonstrated in specific situations and measures constructs related to an individual's theoretical understanding of emotions and emotional function (Mayer et al., 2024).

However, because emotions are subjectively experienced, the operationalisation of ability EI measures is problematic, partly due to several influential factors, such as biological, cultural and social influences (Zeidner, 2013).

Trait Emotional Intelligence

Trait EI is conceptualised as a constellation of emotion-related traits and self-perceived abilities which are located at the lower levels of personality hierarchies (Petrides et al., 2018). Simply, trait EI concerns individuals' perceptions of their emotional world, and is unrelated to an individual's cognitive ability (Petrides et al., 2018). The sampling domain of trait EI, which refers to specific traits and facets that make up the construct of EI, comprises of four main factors for adults and adolescents: sociability, well-being, self-control, emotionality, consisting of 15 different facets (Petrides et al., 2018). However, given the differences between adults' and children's perceptions of emotions, Mavroveli et al. (2008) developed specific child-related facets. Trait EI for children is comprised of nine facets; adaptability, affective disposition, emotion expression, emotion perception, emotion regulation, low impulsivity, peer relations, self-esteem and self-motivation (Mavroveli et al., 2008; see Table 2). Trait EI is measured using self-report which measures typical behaviours in emotion-related situations, as well as self-rated abilities, and is typically followed when conducting research with children as specific facets and measures have been developed. Consequently, this thesis follows a trait EI model.

Table 2. The sampling domain of trait EI in children

Facets	Brief description	Example item
Adaptability	Children's self-perceptions of how well they adapt to new situations and new people	'I find it hard to get used to a new school year'
Affective disposition	Children's self-perceptions of the frequency and intensity which they experience emotions	'I am a very happy kid'
Emotion expression	Children's self-perceptions of how effectively they can express their emotions	'I always find the words to show how I feel'
Emotion perception	Children's self-perceptions of how effectively they identify their own and other emotions	'I can control my anger'
Emotion regulation	Children's self-perceptions of how well they can control their emotions	'It is easy for me to understand how I feel'
Low impulsivity	Children's self-perceptions of how effectively they can control themselves	'I do not like waiting to get what I want'
Peer relations	Children's self-perceptions of the quality of their relationships with their classmates	'I listen to other children's problems'
Self-esteem	Children's self-perceptions of their self-worth	'I feel great about myself'
Self-motivation	Children's self-perceptions of their drive and motivation	'I always try to become better at school'

Note. Adapted from Marvoveli et al. (2008)

Importance of Developing Emotional Intelligence

As previously mentioned, developing EI is important for children's holistic and psychological wellbeing (Lea et al., 2019) and can prevent mental health problems in adolescence (Davis et al., 2019). The development of EI is particularly important during the preadolescent stage (ages nine to 12), as this period is characterised by increased emotional vulnerability, which heightens the risk of developing emotional problems (Bacter et al., 2021). There are several outcomes that are positively associated with EI. At the school level, EI is positively associated with academic achievement (Arias et al., 2022), stronger relationships with peers and adult (Petrides et al., 2006), school motivation (Arias et al., 2022), and an overall greater likelihood of success in school (Malik and Shujja, 2013). Conversely, EI is negatively associated with school exclusions (Petrides et al., 2004), aggression and delinquency (García-Sancho et al., 2014) and bullying (Kokkinos and Kipritsi, 2012). As such, children with low EI are more likely to feel excluded, which can lead to antisocial behaviours (Petrides et al., 2004). Furthermore, meta-analyses and systematic reviews have found a significant positive correlation between EI and prosocial behaviours among children (Cao and Chen, 2024; Hui et al., 2022), suggesting that children with higher EI are better equipped to manage stress, resolve conflicts and navigate social interactions. Additionally, EI is positively associated with mental health, with higher EI associated with lower depressive symptoms and feelings of loneliness over a one-year period (Davis et al., 2019; Fernández-Abascal and Martín-Díaz, 2015; Martins et al., 2010). Factors associated with physical outcomes have also been observed. EI has been found to be positively associated with participation in sport due to stronger self-efficacy and interpersonal adaptability (Amado-Alonso et al., 2019), and MC (Orangi et al., 2023). Given these various positive associations, it is evident that EI plays an important role across various domains of a child’s life (Trigueros et al., 2019).

Assessments of Emotional Intelligence

Although there are instruments to measure EI in children, instrument choice is influenced by practical considerations such as availability of resources, completion time, and cost (Brown et al., 2018). The use of self-report measures appears to be the most advantageous given the minimal time and effort required to administer (Matthews et al., 2004). In addition, they do not require special equipment or testing environment, and thus, make them an ideal instrument to use in a school setting (Brown et al., 2018). Of the instruments available, the TEIQue and the SSEIT appear to be the most robust as they provide comprehensive coverage of the different facets of EI. Furthermore, both of these instruments have been used within educational contexts, with primary school-aged children and more specifically in the context of PE (Rico-González, 2023).

The key difference between the distinct models of EI is the method of measurement (Petrides et al., 2018). Instruments to measure trait EI are generally self-report measures and are often developed as scales where there are no correct or incorrect answers. Trait EI instruments require individuals to rate the extent the item relates more or less to their behaviour (e.g. '*I feel great about myself',* Mavrovelli et al., 2008). These instruments measure typical behaviours in emotional-related situations, as well as self-rated abilities, and therefore tend to be a good predictor of actual behaviours (Mavrovelli et al., 2008). Furthermore, since trait EI is a good predictor of coping in everyday situations and measured through self-reports, they are most commonly used in educational contexts with children (Özal et al., 2024; Rico-Gonzalez, 2023). However, a possible drawback is the potential of participants answering questions in a strategic or socially desirable way (O'Connor et al., 2019). Although, when used in research projects, it has been suggested that participants are less likely to fake their answers (O'Connor et al., 2019).

Unlike the trait EI instruments, ability EI instruments are composed of maximal capacity tests (Mayer and Salovey, 2000). Instruments to measure ability EI require participants to solve emotion-related problems where there are correct and incorrect answers (e.g. *what emotion* *might someone feel if someone is kind to them? (a) sadness, (b) happiness, (c) anger, (d) all of the above*). Although these instruments provide a good indication of participants' ability to understand emotions and how they work, they are maximal capacity tests so are not designed to predict typical behaviour. Furthermore, instruments to measure ability EI are typically utilised in contexts where a good theoretical understanding of emotions is required (O'Connor et al., 2019). That is, participants would need to understand how feelings are triggered, processed, and expressed through a mix of physiological responses (e.g. we cry because we feel sad), cognitive interpretations, evolutionary factors and social factors (e.g. how emotions are shaped by cultural norms and social contexts; Matthews et al., 2006).

Although there are several instruments (n = 40) to assess ability and trait EI in adults (Bru-Luna et al., 2021) there are very few which are specifically designed for children and youth (Davis, 2018). More specifically, two instruments exist to measure trait EI in primary-aged children (D'Amico et al., 2024). To assess trait EI, the Trait Emotional Intelligence Questionnaire – Child Form (TEIQue-CF) and its variant, the TEIQue-Child Short Form (TEIQue-CSFSF), are suggested to be the most scientifically robust as they provide comprehensive coverage of trait EI theory and trait EI sampling domain (Petrides et al., 2018). The TEIQue-CF was developed for children aged 8- to 12-years-old. The full instrument comprises of 75 short statements and measures nine distinct facets of the child trait EI sampling domain (i.e. adaptability, affective disposition, emotion expression, emotion perception, emotion regulation, low impulsivity, peer relations, self-esteem and self-motivation). The instrument uses a Likert-type scale from 1 (completely disagree) to 5 (completely agree). Completion time on average is 25-minutes. The short form (TEIQue-CSF) comprises of 36 items and only provides a global score for child trait EI. Completion time for this instrument is between 10 to 15 minutes. The TEIQue-CSF instrument has shown adequate levels of internal consistency (α = 0.73), temporal stability, and construct validity, and to date is the only trait EI instrument specifically designed to assess the emotional facets of children (Mavroveli et al., 2008). The TEIQue and its variants is the most used when measuring EI in children (Molero et al., 2020; Özal et al., 2024; Rico-González, 2023).

In addition to the TEIQue-CF, the Schutte Self report Emotional Intelligence Test (SSEIT; Schutte et al., 1998) was designed to measure EI. Although the SSEIT was initially developed for an adult population it has been used and shown to be valid and reliable to measure EI in primary-school aged children, specifically the SSEIT was used with a sample of children (n = 360) aged 8 to 9 in Tehran, Iran (Orangi et al., 2023). The SSEIT comprises of 33 statements and measures four sub-regulations of EI: optimism and mood regulation, appraisal of emotions, utilisation of emotions, and social skills. The instrument uses a Likert-type scale from 1 (strongly disagree) to 5 (strongly agree) and typically takes 20 to 30 minutes for children to complete. The SSEIT has been found to be a valid and reliable tool, with the instrument adequate levels of internal consistency (α = .87) (O'Connor et al., 2019).

Prevalence of Emotional Intelligence

Despite the multitude of positive associations with EI and various outcomes (Özal et al., 2024), there is a lack of population evidence of EI levels in primary-aged children. This lack of evidence could partly reflect the scarcity of appropriate measurements. As previously mentioned, since emotions are subjectively experienced, they can be influenced by a range of factors, including individual factors (e.g. sex, age), the family environment, cultural factors, and other socialising agents (Zeidner et al., 2003). These factors are discussed below.

Individual Level Factors

Sex differences in EI have been inconsistently reported, likely due to variations in theoretical models and measurement tools. That said, sex differences in EI have been attributed to educational factors (i.e. approach to learning, response to feedback and group work), social factors, such as communication (i.e. verbal, non-verbal, communication styles). For example, girls are generally more verbally expressive, while boys tend to be more direct. Further, sex differences have been attributed to biological factors, such as differences in cerebral processing of information (i.e. perception, emotional regulation; Veijalainen et al., 2021). There is evidence to suggest significant sex differences in global EI, with girls having higher EI scores compared to boys (Arias et al. 2022; Amado-Alonso et al., 2019; Qualter et al., 2012). In contrast, other studies found no sex differences in global EI scores in children aged 10-12 years old (Mavroveli et al., 2008; Williams et al., 2009).

Sex differences in EI facets such as social skills, stress management and self-control have also been observed. Girls generally score higher in intrapersonal and interpersonal skills compared to boys (Qualter et al., 2012; Amando-Alonso et al., 2019). For example, Arias et al. (2020) found girls scored higher in self-awareness, self-motivation, empathy and social skills, although no significant differences were observed in self-control scores. In contrast, D'Amico and Geraci (2022) found boys had higher scores in emotional self-concept (i.e. regulation, awareness and expression), whilst girls scored higher in emotional ability. Collectively, there is considerable variability in the available evidence.

Evidence suggests EI develops with age and emotion-related life experiences (Zimmermann and Iwanski, 2014). Research to date predominately focuses on adolescents and adults, with limited studies on children, resulting in little knowledge about age-expected EI levels.

Nevertheless, studies suggest that older adults (45-76 years) tend to score higher in EI than younger groups (17-31 years), with EI increasing with age (Sharma, 2017). These findings highlight that certain EI competencies, such as social skills and adaptability, need to be given the opportunity to be developed and learned (Sharma, 2017). Conversely, a recent study of adolescents (ages 12-17) found a slight decrease in EI over time (Garaigorbobil, 2020), emphasising the need for childhood EI programmes (Pérez-González and Qualter, 2018). Theoretically, EI is said to develop rapidly during primary school years, as this period reflects significant biological, cognitive, social and emotional changes (Lerner and Steinberg, 2009; Zeinder et al., 2003). This is evidenced in a study conducted by Fili (2016), who found that children aged 12 had significantly higher global EI and EI facets (adaptability, emotion expression, emotion perception, emotion regulation and peer relations), compared to those aged 11 and 10. Thus, although there is some evidence to suggest that EI develops with age, it is important to provide opportunities for early EI development (Fili, 2016).

Family Factors

The family system plays a role in the development of EI, as children learn to express emotions, manage conflict, and negotiate differences within this environment (Sánchez-Núñez et al., 2020). Parents are key influencers of children's wellbeing and, consequently, EI development (Li and Guo, 2023). Specifically, parenting styles can impact EI development. Evidence suggests a positive association between authoritative parenting (i.e. supportive and nurturing) and children's EI, while authoritarian parenting (i.e. strict parenting, obedience and punishing styles) is negatively associated with EI (Al-Elaimat et al., 2020; Argyriou et al., 2016). Parenting practices and family functionality (i.e. how a family operates and supports individuals) can also influence EI. Positive family interactions, such as cooperative activities between mothers and children have been found to positively correlate with EI, while passive activities like time spent watching TV were negatively correlated with stress management (Alegre, 2012). Molino-Moreno et al. (2024) further demonstrated a positive correlation between family functioning and adolescent EI (ages 12-17), with those from dysfunctional families exhibiting lower EI, compared to those with high family functionality. While the family clearly supports EI development, the extent of the family's role, particularly for primary-school-aged children, remains unclear due to the scarcity evidence in this population.

Sociocultural Factors

Culture may influence EI, as culture determines the values and norms of individuals. Research has largely focused on ethnic difference in children's socio-emotional development rather than directly examining EI (McNally et al., 2019). That said, Raccanelo et al. (2019) found that ethnic minority children in Italy (e.g. Colombian, Moroccan, Nigerian) scored significantly lower in emotional understanding and regulation (EI facets) compared to native Italian peers, potentially due to acculturation challenges. Similarly, McNally et al. (2019) found ethnic minority children had lower socio-emotional development compared to ethnic majority children, attributing this to language proficiency issues. These findings suggest potential cultural and linguistic barriers affecting the development of EI competencies; however, the influence of ethnicity on EI is not entirely clear given the scarcity of evidence. Religion may also influence EI, with a significant positive correlation between religious orientation and EI in a sample of 209 Muslim University students, possibly due to religious teachings promoting emotional balance (Butt, 2014). While cultural factors such as ethnicity and religion appear to influence aspects of EI, the evidence base remains limited and inconclusive, particularly for primary school-aged children. As many schools in the UK are multicultural and multilingual, understanding cultural influences on EI is crucial, yet the extent of cultures impact on EI remains unclear.

Teacher-child Relationships

The teacher-child relationship is considered a secondary attachment bond, which is another important bond developed during childhood (Wang et al., 2024). In addition, there is some evidence to show that teachers' management of interpersonal interactions can influence the development of children's EI (Hosan and Hoglund, 2016). That said, empirical studies of the teacher-child relationship and children's EI are scarce for primary-school-aged children, with many of the available studies focusing on pre-school aged children. This might be explained by the decline in teacher-child relationship quality through the primary school years (Rucinski et al., 2018). Nevertheless, Rucinski et al. (2018) found teacher-child relationships were positively related to children's emotional outcomes; highlighting the importance of building and maintaining positive relationships during primary-school. In a pre-school context, Garner et al. (2014) found the teacher-child relationship was associated with better EI in pre-school children who attended a university affiliated or suburban preschool, but not for those children who attended an urban pre-school.

Peers

Previous research indicates peer interactions can influence or restrict the development of emotional competencies, although most of the evidence is derived from studies exploring social-emotional competencies and with pre-school aged children. Positive peer experiences – such as social support and acceptance – are linked to better development of EI facets such as self-regulation (King et al., 2018). Conversely, adverse peer interactions, including peer victimisation, rejection and bullying have been found to be associated with lower levels of self-regulation (Valiente et al., 2020). Some studies have shown that emotional regulation is positively associated with peer status and friendship quality demonstrating, to some extent, its relationship with interpersonal interactions (Wang et al., 2019). One of the only studies exploring the relationship between EI and peers among high school students (n = 912) found a positive relationship between EI and social skills and negatively related to peer harassment (Trigeuros et al., 2020). As such, it appears that positive peer interactions can influence the development of emotional competencies and EI. Therefore, to support the development of EI it is important to create environments that foster positive peer relationships.

Interventions to increase Emotional Intelligence

There is evidence to suggest that interventions to increase EI in primary education can be effective (Puertas-Molero et al., 2020; Özal et al., 2024; Rico-Gonzalez 2023). Puertas-Molero et al. (2020) analysed the effects of interventions related to EI across educational settings, published between 2008 to 2017. The review included 20 studies, including 17 quasi-experimental studies and 3 pre-experimental studies, involving between 66 to 4243 participants, and conducted a meta-analysis to quantify the intervention effects. Intervention programmes were not explicitly described, although the authors noted programme strategies included social and emotional learning, mindfulness and triarchic enrichment (i.e. analytical, creative and practice intelligence). Overall, participation in the intervention group was associated with a high intervention mean effect on EI (M = 0.72). Most of the interventions were conducted in secondary or university education (n = 11) while 9 interventions were conducted in primary education. Considering this, interventions were found to be most effective in primary education, with large effect sizes observed (ES = 0.95), that is, when compared to secondary education, where lower effect sizes were observed (ES = 0.32). Intervention duration ranged from < 3 months to 2 years, although the review does not detail the frequency of sessions delivered across the implementation period. Interestingly, however, from a duration perspective, interventions lasting between 4 and 11 months were found to be the most effective in increasing EI (d = 1.13). These results suggest that long-term (> 11 months) interventions may not need to be implemented to observe favourable changes in EI. Regarding the tools used to measure EI, the review observed that tools related to personality traits (i.e. trait EI instruments) were found to obtain more significant improvements; ES: 1.03) when compared to tools that measured maximal performance (i.e. ability EI instruments; ES: 0.18). Collectively, this highlights that implementing interventions in primary school education, for a duration of between 4 to 11 months, using trait EI instruments may be the most efficacious for improving and measuring EI, respectively.

In the context of PE, Rico-González (2023) systematically reviewed studies examining EI in primary and secondary school children. The author located 27 studies, including 9 correlation studies, 8 pre-post-test studies without a control group, and 6 randomised design and 4 quasi-experimental studies. Amongst the studies, there was low risk of bias. Of the studies that explored intervention effects on EI (n = 18), sample sizes ranged from 23 to 1322 participants. All pre-post-test studies without a control group (n = 8) found an increased global EI and EI constructs (e.g. emotional control and regulation, and emotional empathy) following involvement in the intervention. However, as there was no control group in these studies, the validity and reliability of these studies is undermined, that is, without a control group it is difficult to isolate the causal effects of the intervention. These interventions ranged from 4 weeks to 10 months, offering between 2 to 4 sessions a week, although only 3 studies detailed the duration of the lessons which ranged from 45 to 50 minutes. Similarly, all quasi-experimental and randomised trials (n = 10) found a significant increase in global EI and EI constructs in the intervention groups compared to the control. The interventions lasted between 8 and 16 weeks, with the number of sessions varying from 2 to 48 sessions. Only 3 studies reported duration, ranging from 15 to 45 minutes. These interventions were based on different pedagogical models, including Corporal Expression and Relaxation, Cooperative Learning, Sport Education Model, Teaching Personal and Social Responsibility Model, and computer sciences-based programmes, although the latter was only incorporated into one study. Collectively, however, no detail was provided on the delivery agent of these interventions (i.e. the class teacher, coach, or researcher). Finally, similar to previous findings by Puertas-Molero et al. (2020), most of the studies included in this review utilised a trait EI instrument, specifically either the TEIQue, or its child/adolescent variants, or the Schutte EI scale, to measure children's EI. The authors concluded that PE is a suitable place to promote EI in children, although more research is required to determine the effects of PE interventions on EI. In addition, the authors highlight the importance of considering participants' sex, age and SES when designing interventions, while at the same time promoting an environment for collaborative work among children to develop EI.

Summary of Interventions to increase Emotional Intelligence

These systematic reviews provide evidence that school-based interventions, specifically in primary education, and in the context of PE, can be effective for increasing global EI and EI constructs. Further, it appears that there are no singular prescriptive duration and dose required to observe favourable changes in EI, although an average of between 8 to 16-week interventions, for between 2 to 4 sessions a week (15 – 45 minutes per sessions) were implemented in a PE context. In addition to this, within the context of PE interventions and EI there is a clear need for stronger research designs, such as RCTS and quasi-experimental trials, as few studies utilised these designs. Finally, a consistent finding across these reviews is the utilisation of trait EI instruments to assess EI. Specifically, the TEIQue (and its variants) and the Schutte self-report EI scale, due to their feasibility in educational settings, as well as their demonstrated reliability and validity. As such, it is important researchers consider these instruments, alongside the design of the interventions moving forward.

Motor Competence and Emotional Intelligence

Recently, evidence has emerged of the positive association between MC and EI (Orangi et al., 2023). Orangi et al. (2023) investigated the association between EI and MC in a sample of 540 participants, across three age groups: children 5-11 years old (n = 360), adolescents 12-17 years old (n = 360) and young adults 18-21 years old (n = 400). The correlation analysis between MC and total EI scores revealed strong to very strong associations between both constructs (range r = 0.70 - 0.91). Furthermore, analysis revealed that the group with higher MC also showed higher EI, irrespective of age and gender (Orangi et al., 2023). These findings suggest that even from an early age children with lower MC may have lower EI. However, given the cross-sectional nature of this study, the causality between EI and MC could not be determined (Orangi et al., 2023).

A systematic understanding of the association between MC and EI can be explained by the Elaborated Environmental Stress Hypothesis (EESH: Cairney et al., 2013). The EESH posits that poor MC is considered a primary source of stress, which raises the risk for psychological distress, which are symptoms of depressed affect or anxiety, via secondary environmental risk factors. Secondary environmental risk factors can be defined as interpersonal conflicts with peers, teachers or parents (Wagner et al., 2016). Low MC has also been noted as a secondary stressor, as children with low MC are at greater risk of negative social experiences and interpersonal conflict (e.g. peer victimisation due to their lower ability to perform well in games and sports), which impacts on their self-worth (Cairney et al., 2013; Missiuna and Campbell, 2014). Within the EESH, it is proposed that protective factors such as personal resources, which include conceptions of self (e.g. self-competence, mastery, self-efficacy) and social support (e.g. emotional, perceived and structural) can buffer against the negative impact of stress, and thus protect against internalising problems (Davis et al., 2019). Furthermore, evidence suggests that social skills can mediate the relationship between internalising problems and motor skills in 4- to 6-year-old children (Wilson et al., 2013). As such, children with low MC may avoid participating in PE, PA and social play, while at the same time, fail to find willing playmates on the playground because of their low MC (Cairney et al., 2007). It stands to reason that this will decrease opportunities to develop EI through social participation in group work and being part of a team. For these reasons, and more, improving MC can lead to increased feelings of mastery and the confidence to engage in PAs (Niemistö et al., 2023), while providing children with the opportunity to acquire and reinforce EI competencies (e.g. self-awareness, motivation, self-regulation) through conflict (e.g. winning and losing a game) and socialisation (Castillo-Viera et al., 2020). In turn, developing these EI competencies can help children to manage their own emotions and behaviours as a response to others in an appropriate manner (*sub-constructs of EI)* (Rico-González et al., 2023). Given these findings, it is plausible to suggest that improving MC could serve as a mechanism for enhancing EI; however, further empirical research is needed to confirm this relationship. Gamification has emerged as a promising pedagogical approach in PE to improve MC, and potentially and consequently EI.

Gamification

Definition and framework

As previously mentioned, gamification may be a promising pedagogical approach to support the development of MC and EI, demonstrating favourable effects in PE (Arufe-Giráldez et al., 2022). Gamification is a relatively new pedagogical model (Werbach, 2014) that has been defined from several perspectives, resulting in no universally accepted definition (Seaborn and Fels, 2015). Zichermann and Cunningham (2011, p.14) defined gamification as ‘the process of game-thinking and game mechanics to engage users and solve-problems’, whilst Kapp (2012, p.7) defined gamification as ‘the use of game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning and solve problems'. Within the literature, one of the most widely used definitions is proposed by Deterding et al. (2011, p.11) who define gamification as 'the use of game design elements in non-game contexts'. Werbach and Hunter (2015, p .275) later expanded this definition to include 'the use of game elements and game-design techniques in non-game contexts'. Gamification utilises a wide range of game-like elements, and these can be categorised into three categories using Werbach and Hunter's (2015) pyramidal framework (see Figure 2). Dynamics are the highest conceptual level that regulate socio-emotional competencies. Mechanics are the elements that drive the desired outcome forward, creating a sense of progression and engagement. Finally, components are the primitive and tangible elements that interact with the user. Examples of gamification elements are presented in Figure 2.

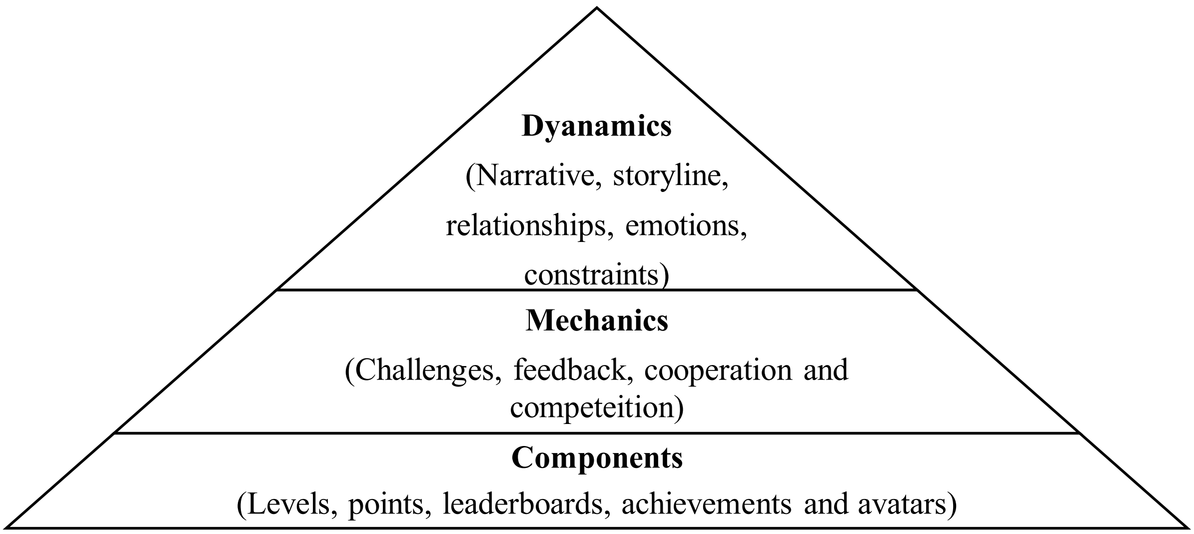

Figure 2. Gamification pyramidal framework adapted from Werbach and Hunter (2012).

These elements, when appropriately aligned to an objective (e.g. increasing motivation, or MC) are fundamental to the success of gamification (Robson et al., 2016). Research using gamification, particularly in PE, primarily focuses on the level of components with the quantity of these gamification elements differing between studies (Arufe-Giráldez et al., 2022). For example, a systematic review found that out of the seven studies conducted in primary school PE, five used points, badges and/or rewards (components), while only one study in the review (Arufe-Giráldez et al., 2022) use a narrative (Fernandez-Rio et al., 2020). In the same review, 10 studies conducted in middle, junior and high school PE, incorporated more gamification strategies' (mean = 3.4), whilst including a broader array of strategies (Arufe-Giráldez et al., 2022). For example, Real-Pérez et al. (2021) included a narrative and progression (dynamics), challenges and levels (mechanics), and points and rewards (components). It is plausible that the use of gamification strategies, specifically components (i.e. points, badges and/or rewards) in primary school studies often align with more traditional forms of classroom assessments, and therefore it is easier for practitioners to apply them. However, the use of strategies in isolation is of contested debate. For example, it is suggested that the isolation of components is said to promote a 'gaming façade' (Tu et al., 2015, p.170) whereby there is sole reliance on just awarding points and badges, which potentially fuels an individual's motivation to participate in the activity, based on the belief that they will be rewarded for the end outcome (extrinsic motivation, Ryan and Deci, 2020). Further, the underuse of gamification strategies, such as mechanics (i.e. challenges, competition) and dynamics (i.e. narrative, relationships, constraints) within the intervention studies may reflect some of the disparity in findings. Extending this disparity is a lack of instrumentation to assess the implementation of gamification strategies in PE settings (Fernandez-Rio et al., 2020; Melero-Cañas et al., 2021).

Nevertheless, gamification is understood to motivate action, engage individuals, promote learning, provoke emotions such as frustration and excitement, and solve problems (Kapp, 2012). It has been suggested that these feelings of excitement can be motivated socially through competition and collaboration, intrinsically through commitment to a narrative and extrinsically though a desire for rewards and feedback (González et al., 2018). SDT (Ryan and

Deci, 2020) has been used as the driving theory for understanding gamification and its effects on positive student behaviour (Fernandez-Rio et al., 2020; Quintas et al., 2020).

Self-Determination Theory and Gamification

SDT is concerned with social conditions that facilitate or hinder human development and wellbeing (Ryan and Deci, 2017). Two mini theories within SDT are the Basic Psychological Needs Theory (BPNT) and the Organismic Integration Theory (OIT) (Ryan and Deci, 2017). Important within SDT is the idea that BPNs are essential for optimal human functioning (Ryan and Deci, 2020). Further, SDT emphasises that motivation is influenced by the social and contextual factors that support the satisfaction of these needs (Ryan and Deci, 2017). These BPNs include autonomy (a sense of having a choice and making decisions), competence (a need to feel effective in one's interactions with the environment and a sense of mastery) and relatedness (a feeling of significance and belonging to others; Ryan and Deci, 2020). BPNs are understood as the psychological nutrients essential to enhancing an individual's personal growth (e.g. a child who feels more supported by teachers is more likely to ask questions and engage deeper with learning**)** and function (e.g. a child who feels free to choose their friends and social activities, is more likely to have fulfilling and authentic social relationships). Further, fulfilment of these BPNs leads to more autonomous motivation. However, when these BPNs are frustrated or deprived, it can lead to feelings of failure, disengagement and ill-being (Ryan and Deci, 2017, 2020; Ryan et al., 2019). Blain et al.'s (2022) model conceptualises how these gamification elements (dynamics, mechanics and components) can satisfy these BPNs. Likewise, the association between gamification elements and BPN's is also made by Davies et al. (2024). For example, 'choice over difficulty level' links to autonomy (p.6). To further exemplify the association between SDT and gamification, elements such as challenges, can support autonomy as they afford choice and opportunities for individuals to navigate activities.

For example, offering a variety of meaningful choices (Beni et al., 2019) and supportive challenges that are not perceived as externally controlled. Likewise, elements such as levels can provide individuals with optimal challenges, while points and achievements can provide informational feedback to individuals. These elements can support the need for competence, with tasks gradually increasing in difficulty, so that individuals can test themselves, thus improving their skills and acquiring new ones. Furthermore, elements such as teamwork and cooperation can support the need for relatedness through social interactions with others. For example, individuals work together to achieve a shared goal, and even when individuals participate individually, gamification elements (i.e. narrative) can promote social interaction by increasing the sense of connection and belonging. Generally, there is evidence to suggest that gamification has favourable effects on BPNs (Sotos-Martínez et al., 2024).

Within SDT there is also the distinction between types of motivation (Ryan and Deci, 2017). Organismic Integration Theory (OIT; Ryan and Deci, 2017) describes the motivation underpinning engagement in behaviours or activities that are not inherently appealing or enjoyable. OIT focuses on how different types of motivation are internalised and integrated within an individual, resulting in different types of motivation and exist on a continuum from non-self-determined to self-determined (see Figure 3). These differing types of motivation influence and effect the occurrences of behaviours and range from controlled to autonomous. At one end of the continuum is amotivation, which is a lack of intention or motivation to engage in an activity. At the other end is intrinsic motivation, which refers to engagement in an activity for its inherent satisfaction and enjoyment rather than for some separable consequence. Within the more controlled forms of motivation is external and introjected regulation. External regulation refers to an individual’s motivation that is driven by external rewards or to avoid punishment. For example, participating in PE to gain a sticker or avoid being shouted at by the teacher, respectively. While introjected regulation refers to motivation that comes from internal pressures. For example, engaging in PE to avoid negative feelings such as feeling guilty for not taking part (Ryan and Deci, 2020). On the other hand, identified and integrated regulations are forms of more autonomous motivation, which is characterised by levels of self-endorsement and validation (Ryan and Deci, 2020). Identified regulation refers to motivation that comes from personal values, for example a child that values the benefits of taking part in PE would demonstrate identified regulation. Although integrated regulation is noted within OIT, it is thought that it only emerges during adolescence and adulthood (Ryan and Deci, 2017). Nevertheless, integrated regulation refers to an individual who internalises and fully integrates external motivation (i.e. social expectations, rewards or goals) into their sense of self, so that engaging in a behaviour feels as though it is inherently part of who they are, even though it may have started as extrinsic motivation. Intrinsic motivation is often considered the best form of motivation, as it is driven by internal factors and tends to be more lasting than extrinsic motivation (Ryan and Deci, 2020). Regarding gamification and the effects on motivation, evidence suggests gamification has favourable effects on more autonomous forms of motivation (Fernandez-Rio et al., 2020; Sotos-Martinez et al., 2023).

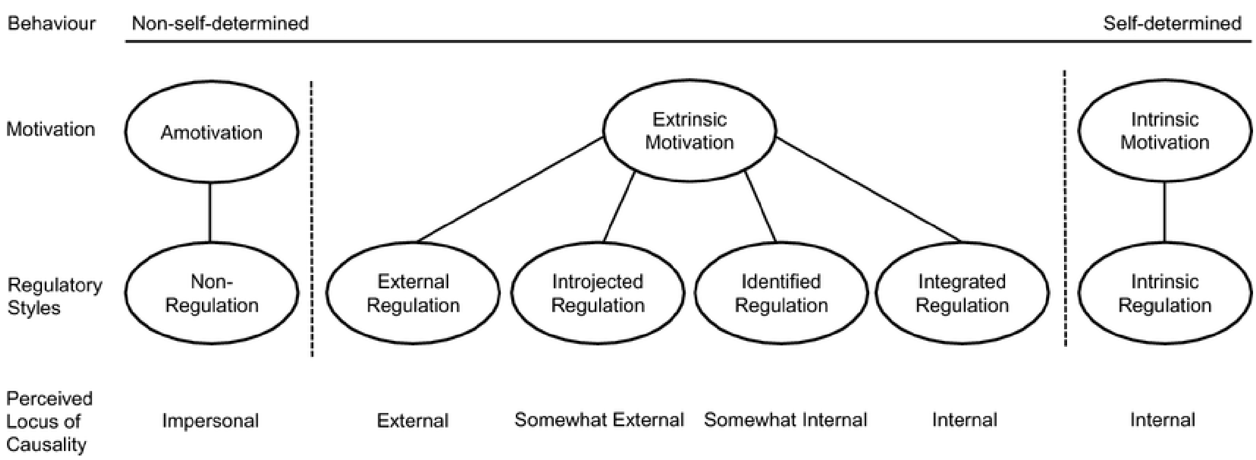

Figure 3. The Organismic Integration Theory Continuum
Note. Adapted from Self-determination theory basic psychological needs in motivation, development, and wellness, R.M. Richard and E.L. Deci, 2017, p 193 Guildford

Gamified Interventions

Gamification has shown positive results across multiple domains, including education (Dicheva et al., 2015), behavioural change (Kim and Castelli, 2021), health and wellbeing (Johnson et al., 2016), mental health (Gkintoni et al., 2024) and PA (Mazeas et al., 2022). The widespread use may be largely down to the expected ability it has to solve perennial challenges of traditional learning environments, while acting as a powerful tool in seeking behaviour modification (Fernandez-Rio et al., 2020). Over the past decade, a number of systematic reviews have been published on gamification in education to improve a range of outcomes in children and adolescents (Dicheva et al., 2014, 2015, Haung et al., 2020; Sailer and Homner, 2020; Yıldırım and Şen, 2021; Zeybek and Saygi, 2024). Within an educational context, there is growing interest in gamified interventions within PE, and will be discussed in the following section.

Gamified Interventions in Physical Education

Evidence suggests that gamified PE interventions can be effective for improving various outcomes, including healthy diet behaviours (Uechi et al., 2018), motivation (Fernandez et al., 2020), social emotional competencies (Ros-Morente et al., 2018), engagement in PA (Mazeas et al., 2022), BPNs (Sotos-Martínez et al., 2024) and academic performance (Ferriz-Valero et al. 2020). So far most of these interventions have targeted individuals at a secondary school and university level (Ferriz-Valero et al. 2020; Sotos-Martínez et al., 2024; Soriano-Pascual et al., 2022; Flores-Aguilar et al., 2023), with few having been conducted at a primary-school level (Arufe-Giráldez et al., 2022). Nevertheless, a systematic review investigated empirical research that has explored the effects of gamification in PE in among children from kindergarten/ (0 - 6 years), Elementary (6 – 12 years, n = 7 studies) and Middle, Junior, and High school level (12 – 18 years, n = 10 studies) (Arufe-Giráldez et al., 2022). The review included 17 studies, and sample sizes ranged from 30 to 516 participants. However, due to the varied nomenclature of educational stages across different countries, only four were conducted with children who would be classified as primary school aged in England. In elementary/primary school, sample size ranged from 142 to 516, and there were positive improvements in motivation, specifically intrinsic motivation, commitment to motor practice, BPNs, student relationships, and collaboration. These aforementioned studies, however, did not use a randomised control design with a control and experimental group, while only four studies used pretest and post measures. Intervention duration ranged from 1 month to a full school year. The sessions per week ranged from one, to three, yet two studies did not specify the number of sessions and duration varied between 45 to 60 minutes. The gamification strategies used ranged from zero to three, five studies used only badges and/or points, one used badges, points and a narrative, one did not specify the gamification strategies used.

For the studies conducted in middle/junior/high school, sample size ranged from 30 to 414, and positive improvements were observed in cardiorespiratory fitness, agility, speed, motivation, enjoyment of PE and cognitive performance, although one study found no improvement in academic performance. Intervention duration also ranged from 1 month to a full school year. The sessions per week ranged from one to three, and duration varied between 45 to 60 minutes. The implemented gamification strategies ranged from one to eight, and included points, levels, badges, narrative, and immediate feedback. The authors concluded that to achieve the greatest effects of gamification in PE, interventions need to correctly align gamification elements to their specific contexts. Furthermore, many of the studies did not use a control group and experimental group, or a pre-post-test design. This is problematic as we are unable to determine if the positive effects were a result of the gamified PE sessions, or just random chance, while also being unable to determine changes in outcomes as a result of the gamified PE sessions.

Therefore, it is evident that future research should conduct randomised controlled designs, including pre and post-test measures to determine the effects of gamification. Since the Arufe-Giráldez et al. (2022) systematic review, very few empirical studies have been conducted at the primary school level in PE (Sotos-Martínez et al., 2023, 2024; Guijarro-Romero et al., 2024; Fernández-Váquez et al., 2024; Rice et al., under review). A summary of the gamified interventions in a primary school PE context for motor skills, BPNs and motivation are presented in Table 3.

Table 3. Gamified PE interventions delivered in a primary school context.

Author	Sample	Research design	Duration (Delivery agent)	Variables	Outcomes
Cenzi-Benjumea et al. (2022)	497 children aged 8- to 11-year-old (EG = 329, CG, = 168)	Quasi-experimental	5-weeks 2 sessions (Delivered by the children's teacher)	• Jumping abilities • Agility • Motor coordination	Compared to the CG children in the EG significantly improved in jumping abilities, agility and motor-coordination (p <.001)
Sotos-Martínez et al. (2023)	72 children aged 9 to 11 years old (EG = 35, CG = 37)	Cluster randomised sampling design	6-weeks 10 sessions (Delivered by the classroom teacher)	• Intrinsic motivation • Identified regulation • Introjected regulation • External regulation	Compared to the CG children in the EG significantly improved intrinsic motivation (p <.001). No changes were observed for the other variables.
Fernandez-Rio et al. (2020)	290 children aged 6 to 14 years old	Pre-experimental	15 weeks 30 sessions	• Intrinsic motivation	A significant increase in intrinsic motivation.

Author	Sample	Research design	Duration (Delivery agent)	Variables	Outcomes
			(2 per week/ 50 minutes - Delivered by the classroom teacher)		
Sotos-Martínez et al. (2024)	506 children aged 8 to 9 years old. (EG = 250, CG = 256)	Quasi-experimental	6 weeks 10 sessions (Delivered by the classroom teacher	• Autonomy • Competence • Relatedness	A significant increase in all BPNs in the EG compared to the CG.
Quintas et al. (2020)	417 children aged 10 to 12 years old (Experimental group = 226, control group = 191)	Quasi-experimental	1 month 9 hours (Delivered by the classroom teacher)	• Autonomy • Competence • Relatedness • Intrinsic motivation • Extrinsic motivation	No improvements in BPNs in the experimental group compared to the control. No improvements in motivational regulations in the experimental group compared to the control.

Gamification and Movement Skills

There is a scarcity of empirical evidence investigating the effects of gamified interventions on primary-aged children's movement skills in PE, with only one study having been conducted (Cenzi-Benjumea et al., 2022). Other studies have investigated the effects of gamification on secondary school students' movement skills in PE (Fernández-Vázquez et al., 2024) and in a home context (Davies et al., 2024). Cenzi-Benjumea et al. (2022) assessed the effects of a gamified programme on jumping abilities, agility and motor coordination among 8 to 11 years old children in Spain. A quasi-experimental design with an experimental and control group, with pre-test and post-test measures was utilised. The sample included 497 children ($n = 329$ in the experimental, and $n = 168$ in the control group) with an equal distribution of boys and girls. Compared to the control group, children in the experimental group significantly improved in jumping abilities, agility, and motor co-ordination ($p < .001$) and was observed for boys and girls in all four age groups. The intervention was delivered by the children's teachers for 2 sessions a week over 5 weeks. The study does not describe any initial training for the teachers on the implementation of gamification strategies. In the design of the intervention, dynamics (e.g. story), mechanics (e.g. challenges, opportunities, level) and components (e.g. points, badges) were also used. Overall, it appears that the duration and frequency, using a gamified approach in PE, and delivery by the classroom teacher was enough to observe changes in aspects of MC.

In the study by Fernández-Vázquez et al. (2024), the effects of combining a virtual reality, gamification and practice teaching style on motor skills and perceived effect in PE was investigated. Seventy-five, secondary school students (mean age = 13.58 ± 0.68) participated in the intervention, and were assigned to one of three groups: (1) practice teaching style; (2) practice teaching style and gamification; or (3) practice teaching style, gamification and virtual reality, although distribution of participants per group was not detailed. For perceived effort, an increase was only observed in the practice teaching style group. Regarding motor skills, all three groups increased their scores in handgrip (p <.001) and flamingo test (p <.05). An increase in lateral jumps was only observed for the two groups using gamification (p <.001). However, given the combination of practice teaching style, gamification and virtual reality in the intervention, it is difficult to determine what extent gamification solely influenced the increase in motor skill outcomes. Finally, in a home context, Davies et al. (2024) investigated the effects of a gamified stability skills intervention on 4- to 5-year-old children's physical skills, as well as self-perceptions and cognitions. A pre-post-test pilot study was conducted with 111 children, and they were allocated to the either the intervention group (n = 66) or the control (n = 45). At post-test, even after controlling for baseline scores, significant differences were observed for stability skills (p < .001), FMS (p < .001), cognition (p <.001) and perceived MC (p = .021) for children in the intervention group. The intervention was delivered at home by the parents for 12-weeks and consisted of two activities per week. In addition, the intervention programme was underpinned by a framework of intervention facilitators and utilised 10 gamification strategies', designed to support BPNs concurrently. As such, it appears that the use of multiple gamification strategies, and supporting BPNs through these strategies, supported the changes observed in this study. Although positive changes were observed, this was a home-based, parent-led intervention, designed with the early years' foundation stage framework in mind, which limits the generalisability for primary school-aged children. Nevertheless, the accumulation of evidence, although limited, provides some evidence to support the use of gamification in PE, and for the development of movement skills, further suggesting that 10-to-12-week intervention may be sufficient to observe changes. However, the empirical evidence, with a methodological robust design is limited, and further investigation is warranted, specifically in PE context with primary-aged students in England.

Gamification and Emotional Intelligence

There is no evidence of gamified interventions in primary PE that specifically target EI. There is, however, research conducted with university students which have found favourable results. For example, Navvarro-Mateos et al. (2024) analysed the effects of a gamified intervention on EI, as well as personal initiative, entrepreneurial attitude and self-efficacy among university students (n = 112). The authors utilised a quasi-experimental design with two arms: intervention (n = 56) and control group (n = 56). Results indicated the intervention significantly improved EI (p <.001), with a small to medium effect size ($\eta 2 = 0.2 – 0.6$) for students in the intervention group, compared to the control. Beneficial effects were also observed for personal initiative, entrepreneurial attitude and self-efficacy. The intervention utilised a range of strategies' (i.e. narrative, missions, levels) and was implemented using a mobile app. The authors concluded that gamification was beneficial on different aspects of psychological wellbeing. Furthermore, through the use of well-constructed narratives, students are more likely engage with the intervention, and therefore more likely to acquire the beneficial effects. In another study, Redaondo-Rodríguez et al. (2022) explored the influence of gamification and co-operative work on EI, motivated learning, among university students aged 18 to 29 years. However, the sample was no probabilistic and therefore can be noted as a limitation of the study. The sample consisted of 102 students who were assigned to the intervention; however, no control group was used in the study. For EI, results indicated a significant increase in emotional clarity (p = .005) and emotional repair (p = .001). Although no significant increase was found for emotional attention, baseline scores were maintained at post-test. Beneficial effects were also observed for motivated learning. The intervention was delivered by the teacher, who had received a 210-minute training session prior to implementation. In addition, the intervention was delivered for three weekly sessions that lasted 90 minutes, and incorporated a narrative, challenges, cooperative activities and resources. Both studies highlight that gamification may be promising to increase EI, however, it is apparent that future trials, using an experimental design are needed. Furthermore, as there is no empirical evidence exploring the impact on primary-aged children, further investigation is warranted given the importance of this developmental period.

Gamification and Motivation

Regarding gamified interventions and motivation, Sotos-Martínez et al. (2023) used a cluster randomised sampling design to investigate the impact of a gamified PE intervention on motivation variables in 9- to 11-year-old children. The sample consisted of 72 students, 35 in the experimental group and 37 in the control group. The intervention was implemented by the children's teacher for 10 lessons over a 6-week duration. Before the implementation, teachers were provided with a session on how to implement gamification strategies in PE. The intervention used points, avatars, narrative, level and perceived feelings. Children were assessed pre- and post-intervention using the motivation questionnaire in PE. The Wilcoxon test results revealed initial increases in intrinsic motivation, identified regulation, introject regulation and external regulation, and no changes in amotivation. Further analysis, however revealed gamification only improved intrinsic motivation significantly compared to the control (p = 0.02). The authors suggested the non-significant changes in amotivation were a result of very low baseline scores, however, this could have been addressed through an ANCOVA which would have factored in baseline scores. Furthermore, it is positive to observe that the generalist classroom teacher could deliver a gamified PE intervention, if they are only supported during the initial stages. In another study, Fernandez-Rio et al. (2020) investigated the experimental effects of gamification on students' motivation using a pre-experimental, one group pre-post-test design. Two hundred and ninety students (age range 6 to 14 years old) participated in the study. The intervention consisted of 30 PE lessons (2 per week/ 50 minutes each) over a 15-

week period. The curricula elements included eight different gamification strategies. Children were tested pre- and post-intervention using the intrinsic motivation scale. In addition, qualitative information was obtained from students. Quantitative results revealed a significant increase in intrinsic motivation after the gamification intervention. Qualitative results revealed students enjoyed the intervention, noting the gamification strategies (e.g. points, narrative) and the novelty of the gamified intervention. The use of mixed methods is useful for several reasons. It provides a more comprehensive understanding of the effects of gamification on motivation. In addition, it can enhance the validity and reliability and triangulate the data (Creswell, 2014). However, as there is no control group in this study, there is an inability to establish casualty and is problematic for internal validity.

Although not conducted with a primary school population, a study by Sotos-Martínez et al. (2022) explored the impact of a gamified intervention on secondary school students' motivation. The sample included 275 participants, aged 12 to 16 (mean age = 13.84 years). Participants were assigned to either the experimental or control group and assessed pre- and post- intervention. Results indicated that for students in the experimental group, intrinsic motivation significantly increased, while amotivation significantly decreased. The intervention was delivered by a member of the research team during eight PE classes over five weeks, lasting 55 minutes each. In addition, the intervention included only points, leaderboards and badges. Despite these findings, it is important to note that the main researcher delivering the lessons was not blind to the conditions; thus, may have subconsciously used a more motivating teaching style. In contrast, a study conducted in a university population found no changes in motivation following a five-week gamified intervention (Ferriz-Valero et al., 2020). The intervention combined gamification and the use of a technological resource and was delivered by the students' respective teacher. These changes therefore may be a result of combining gamification and technological resources, making it less possible to discern if the results are attributed to one or the other, or both factors. Furthermore, the limited use of gamification strategies in Sotós-Martinez et al. (2024) study and then reliance on points, badges, leaderboard model (Ferriz-Valero et al., 2020) may further contribute to the observed inconsistencies in the results, and reduced effectiveness. As such, it appears that there is a need to consider various strategies that support children's autonomous motivation.

Gamification and Basic Psychological Needs

In a primary-school context, two empirical studies have been conducted to explore the effects of gamification in PE on BPNs (Sotos-Martínez et al., 2024; Quintas et al., 2020). In one of the earliest studies in this population, Quintas et al. (2020) analysed the effects of a gamified exergaming intervention on BPNS, as well as motivation, flow and academic performance among children aged 10-12-years-old. The sample comprised 417 students who were assigned to either the control (n = 191) or the intervention group (n = 226). Results indicated no improvements in BPNs in the intervention group, compared to the control group following the intervention. Improvements were observed for academic performance, although no changes were observed for intrinsic motivation, external regulation, or amotivation. The intervention was delivered by the same teacher for one month (nine hours) and consisted of exergaming and the inclusion of gamification strategies' (i.e. levels, challenges). However, as the students in the intervention group participated in both the gamified and exergaming group concurrently, it is difficult to distinguish which design influenced the outcomes. The authors concluded that these designs need to be analysed separately to determine the effects. In contrast to these findings, a trial examining the effects of gamification on BPNs among primary school children found favourable results (Sotos-Martínez et al., 2024). In this study, the sample consisted of 506 participants (mean age = 8.54 years) who were assigned to either the experimental (n =

250) or control group (n = 256). The intervention was delivered by the children's teacher following a three-hour workshop on basic aspects of a gamified intervention and the strategies' and took place over 10 PE lessons within a six-week period. Results indicated a significant increase in autonomy (p = .017), competence (p <.001) and relatedness (p = .002) in the intervention group compared to the control. Qualitative findings indicated co-operation, participation and motivation may have increased due to the gamified intervention.

These empirical studies provide evidence that utilising gamification in PE can be effective in improving physical, psychological and affective outcomes. However, there is a clear need for stronger research designs, including experimental designs with a control and intervention group. Furthermore, there is variation in the dose and duration of gamified interventions which makes it difficult to determine the sufficient dose and duration to observe changes. That said, it appears that interventions that observed changes were implemented for 10 sessions on average. Furthermore, many of these studies incorporated initial teacher training workshops on gamification, and it appears these were important for facilitating and adopting a gamified approach in PE, though few studies describe the teacher training offered in sufficient detail. Finally, with the exception of one study (Davies et al., 2024), no research has been conducted in England, and even then, the study focused on a home-based intervention for early years children and was not implemented in PE lessons. This further highlights the importance and novelty of exploring the effects of a gamified intervention for primary-school-aged children in England.

Summary of Literature

The low levels of MC observed among English primary school children are concerning (Duncan et al., 2022), with disadvantaged children disproportionally affected (Morley et al., 2015). This is particularly concerning given the strong association between MC a range of positive development outcomes (Utesch et al., 2019). At the same time, developing EI is important, as it enables children to navigate daily life successfully and supports their psychological wellbeing, as well as their social, cognitive and physical development (Lea et al., 2019; Trigueros et al., 2019). While many school-based interventions have been implemented to improve children's MC (Moon et al., 2024), there is a notable lack of interventions designed to improve MC in children from low SES backgrounds in England, despite evidence that these children typically exhibit poorer MC than their higher SES peers (Fairclough et al., 2024; Gosselin et al., 2021; Morley et al., 2015). Similarly, there is lack of school-based EI interventions targeting pre-adolescent children (ages 9 – 12), which overlooks a developmental period characterised by increased emotional vulnerability (Puertas-Molero et al., 2020; Özal et al., 2024). These gaps highlight the need to design and implement targeted interventions to support both MC and EI, particularly among disadvantaged children. Without such interventions, children from low SES backgrounds may miss critical opportunities for physical, psychological, and social development. Moreover, it is essential that these interventions are accessible to all children in a school context. In this regard, contexts such as PE present an ideal setting, given the compulsory nature of the subject and the opportunity for universal participation.

As previously stated in the literature review, PE is an important context for developing MC (Lorås, 2020). Existing literature has highlighted gamification as a promising pedagogical approach in PE (Arufe-Giráldez et al., 2022). Yet, the extent to which gamification affects the EI and MC of primary-aged children remains undetermined. Much of the current research is dominated by studies conducted in Spain and focused on secondary and university students. As such, future research in this area is important given the aforementioned positive outcomes;

thus, exploration of the effects of gamification on low SES primary school children's EI and MC should be conducted.

To effectively address and support the development of EI through MC in children, interventions should be tailored to the specific needs of individual schools through a process of co-production (Smith et al., 2023). It is reasonable to assume that through collaboration between school stakeholders and academics, such interventions would be more feasible, acceptable, and successfully implemented in real-world settings, such as PE lessons (Reed et al., 2021). However, the extent to which PE interventions are co-developed (Clifford et al., 2023) and feasible, acceptable and effective in improving MC within a primary school context remains limited (Fairclough et al., 2024). Further exploration of co-developed interventions is needed to guide the design of future PE interventions.

Research Aims and Objectives

The overarching aim of this thesis is to explore the effects of a co-developed gamified PE curricula targeting MC and EI among 9- to 10-year-old children attending schools in disadvantaged communities. The first aim is to co-develop a gamified PE movement competence intervention with school stakeholders (Study 1, Chapter Four). The second aim is to evaluate the feasibility and acceptability of the study design and intervention, and to explore the preliminary effectiveness of the co-developed curricula on children's EI, MC, BPNs and motivational regulations (Study 2, Chapter Five). The third, and final aim is to pilot the effects of a gamified PE intervention on MC and EI among primary school children in a controlled trial (Study 3, Chapter Six). Each aim of this thesis will be achieved through objectives presented below.

Study 1: Co-development of a gamified physical education movement competence intervention with school stakeholders

Chapter Four

- To co-develop a gamified movement competence PE intervention with primary school teachers and year 5 children (ages 9 to 10).

Study 2: Feasibility, acceptability and preliminary effectiveness of a gamified physical education intervention on motor competence and emotional intelligence.

Chapter Five

- To evaluate the feasibility and acceptability of a co-developed gamified PE intervention in a primary school context.
- To evaluate the feasibility of the study process (i.e. recruitment) and management (i.e. data collection) in a primary school context.
- To explore the preliminary effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children.

Study 3: The effects of a gamified physical education intervention on motor competence and emotional intelligence among primary school children: a quasi-experimental pilot study.

Chapter Six

- To explore the effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children, compared to a control following usual PE.

- To evaluate the acceptability of a co-developed gamified PE intervention in primary school contexts, beyond those involved in the co-development process.
- To develop and pilot a tool to assess the fidelity of the delivery of gamified pedagogy in PE.

Chapter Three: Methodology

The purpose of this chapter is to outline the philosophical foundations of the research, with a discussion of pragmatism as the guiding paradigm, followed by the theoretical framework, methodological approach, and ethical considerations underpinning the research.

Philosophical Position

This thesis adopts pragmatism as its overarching research paradigm, reflecting the need for methodological flexibility to address the research aims (Tashakkori, 1998). Pragmatism is concerned with solving real-world problems and enables researchers to move beyond strict dichotomies, such as post-positivism or constructivism (Creswell and Clark, 2017). Within a pragmatic framework, methods are selected for their utility in answering the research questions, rather than adherence to a single philosophical position (Creswell and Plano Clark, 2011). Pragmatism prioritises outcomes and actionable results (e.g. 'what works') over theoretical consistency (Maxcy, 2003), which can provide a practical framework for addressing complex and applied problems. This paradigm is well aligned with this programme of research, which aimed to develop a school-based gamified PE intervention to improve MC and affective outcomes (EI, BPNs and motivational regulations) in disadvantaged children. Pragmatism is closely aligned with mixed methods research, as it emphasises the value of both qualitative and quantitative approaches to address complex research questions (Creswell and Clark, 2017). In parallel, the UK MRC framework advocates a 'pragmatic and pluralist choice of research questions and methods' (p.32) to ensure evidence is both useful and applicable in real-world decision making (Skivington et al., 2021).

Philosophically, pragmatism is characterised by several key elements that shape the research design (Creswell and Clark, 2017). *Ontology* concerns the nature of reality and the relationship between the world and human interpretation, shaping whether reality is conceived as existing independently of human perception or as inseparable from it (Bryman, 2015). From an ontological perspective, pragmatism allows for the recognition of both singular and multiple realities, providing flexibility in how the nature of reality is understood and interpreted (Creswell and Clark, 2017). *Epistemology* refers to the theory of knowledge, concerned with the nature, scope and justification of knowledge and influences the choice of research methodology (Bryman, 2012). From an epistemological perspective, pragmatism emphasises a practical, results-orientated approach, encouraging the collection of data using methods that are most effective for answering the research questions (Creswell and Clark, 2017). Pragmatism treats epistemological and ontological positions as flexible guides rather than rigid frameworks (Bryman, 2015). Lastly, in terms of methodologically, pragmatism supports the integration of qualitative and quantitative approaches, facilitating mixed methods designs tailored to the specific research problem (Creswell and Clark, 2017). Collectively, these philosophical positions have directly influenced both the design and execution of this thesis. In addition, different ontological and epistemological positions were adopted across various phases of the research to best address the distinct research questions.

As pragmatism supports methodological pluralism, it enables the use of mixed methods to provide comprehensive insights (Creswell and Clark, 2017). In this thesis, a pluralistic and pragmatic stance shaped a research design that evolved iteratively across the three studies. In Study One (Chapter Four), a social constructivist epistemology (Guba and Lincoln, 2005) and a relativist ontology (Kamberelis and Dimitriadis, 2005) were employed. This approach enabled an exploration of multiple perspectives and prioritised the lived experiences of children's participation in PE, which was particularly important in the co-development of the gamified PE intervention. Studies Two and Three (Chapter Five and Six) were guided by a more pragmatic stance (Morgan, 2014). Both studies employed a mixed methods approach, integrating quantitative and qualitative data to produce a nuanced understanding of the research problem. This pluralistic approach emphasises practical, actionable knowledge and aligns with the MRC framework, which promotes pragmatic methods for evaluating complex interventions (Skivington et al., 2021). A pragmatic stance shaped the selection of research tools, data collection, and analysis methods, and in these phases the focus shifted towards generating practical, actionable insights. This methodological orientation reflects the researcher's identification as a pragmatic relativist (Morgan, 2014); one who does not seek a universal truth but instead aims to address real-world problems by drawing on the perspectives most relevant and meaningful to the specific context. This orientation has enabled the research to respond flexibly and appropriately to the different phases of inquiry, without sacrificing coherence or rigour.

Theoretical Considerations

This PhD thesis is underpinned by two theoretical frameworks: SDT and Motor Leaning Theory. Gamification serves as the pedagogical approach employed throughout the thesis and is theoretically underpinned by SDT (Ryan and Deci, 2020; see Chapter Two). SDT emphasises the importance of satisfying three BPNs, namely competence, autonomy, relatedness, as well as distinguishing between different types of motivation that are essential for fostering optimal motivation, well-being and sustained engagement (Ryan and Deci, 2020). The Motor Learning Theory underpinning this thesis is Ecological Dynamics Theory (Button et al., 2021). Ecological dynamics views learners as complex adaptive systems, whose skill development emerges through continuous, reciprocal interactions with their environment (Button et al., 2021). This perspective shifts the focus from isolated cognitive processing to the dynamic interplay between the individual, task and environmental context.

There is a clear conceptual synergy between SDT and Ecological Dynamics Theory. Both theories emphasise the importance of environmental interaction and position the learner as an active participant whose growth emerges through interaction with their surroundings. Within SDT, the process of internalisation is described as a natural and active developmental tendency, whereby individuals progressively integrate values and behaviours through meaningful engagement with their environment (Ryan and Deci, 2020). In parallel, ecological dynamics views learning as an emergent property of the continuous and reciprocal relationship between the individual, the task, and the environment (Chow et al., 2019). From this perspective, environments that encourage exploration and afford action possibilities are likely to support both autonomous motivation and motor learning. Thus, the theoretical alignment between SDT and ecological dynamics offers a robust foundation for the design and implementation of gamification, that aims to enhance motivation and skill acquisition through active engagement.

Methodological Considerations

The research design of this thesis consists of one qualitative design (Study One), and two mixed methods designs (Study Two and Three). As outlined above, school-based interventions are effective in promoting physical health and wellbeing in children (Eddy et al., 2018; March et al., 2022). In most cases, school-based interventions are grounded in established theories and developed through a top-down approach by external experts (i.e. academics; Leask et al., 2019). As such, these one-size-fits-all interventions have limited consideration of the context (i.e. the school) and the needs of the individuals (i.e. children, teacher: Evans et al., 2015; Moores and Evans, 2017). In some cases, this has led to a lack of practical and philosophical alignment with the school context, alongside insufficient responsiveness to the unique needs of individual schools (Eisman er al., 20121). Furthermore, this limited understanding of the context can hinder schools' adherence to interventions and create barriers to implementation, ultimately compromising the effectiveness of the intervention (Eisman et al., 2021). One way to address these complex issues and to potentially deliver more effective interventions is by tailoring interventions to specific contexts (Moore et al., 2011). By engaging stakeholders in this co-production process, interventions can be contextualised, thereby enhancing their relevance, adherence, and implementation, ultimately leading to improved outcomes (Craig et al., 2008).

While only one study has investigated the effectiveness of a co-developed intervention on MC (Fairclough et al., 2024), results indicated high adherence to, and acceptability of the intervention. Further, although preliminary, favourable changes in MC and mental health outcomes were observed. Further afield, a recent scoping review of 18 studies (Van Oeckel et al., 2024) explored the impact of participatory school-based interventions targeting PA and sedentary behaviour. The review highlighted the importance of collaboratively involving children, teachers and academics in the process of developing the interventions. This partly reflects certain studies finding no significant changes when only one stakeholder (i.e. pupils) was involved in the co-development process, but other stakeholders (i.e. teachers, other partners) were involved in the implementation phase. It can therefore be suggested that co-developing interventions with children is more likely to reflect the children's needs and provide children with the space to express their views and influence the outcome (Lundy, 2007). As such, this could potentially lead to increased engagement and ownership because of their active role in shaping the intervention. At the same time teachers are crucial in the implementation and embeddedness of the intervention at the school level, while being familiar with the needs of the students and challenges in addressing them. In addition, researchers play an important role in this process as they can facilitate the process, while integrating the scientific and theoretical evidence to ensure that children benefit from the intervention. With regards to the effects of the interventions, most studies reported no effects on health. As previously mentioned, the authors (Van Oeckel et al., 2024) suggested this was a result of not involving all stakeholders (i.e. participants, delivery agent, researchers). Despite these findings, very limited research of school-based MC interventions engages in a co-production process, which has led to a scarcity of practical guidance and frameworks guiding the process of co-production in a school setting with children and teachers (Clifford et al., 2023; Rice et al., 2025).

Study One employed a participatory, co-development process involving school stakeholders and the academic research team to develop the gamified PE curriculums. It was anticipated that such an approach would enhance the feasibility, sustainability and ultimately the effectiveness of the interventions within a primary-school context (Craig et al., 2008). Study Two (Chapter Five) evaluated the co-developed curriculum using a mixed methods triangulation design with a convergence model (Creswell, 1999). That is, qualitative feasibility and acceptability data, and quantitative effectiveness data, were collected and analysed separately before being converged during the discussion. The feasibility study addressed uncertainties related to recruitment, retention, intervention acceptability, data collection procedures, and study design, consistent with MRC guidance for preliminary testing prior to definitive trials (Eldridge et al., 2016). Study Three (Chapter Six) adopted a mixed methods embedded design, whereby the qualitative data provides a supportive secondary role to the quantitative data (Creswell and Clark, 2017). That is, qualitative data came after the intervention to explain the results of the intervention and follow up on the experiences of both children and teachers in schools beyond those involved in the co-development process (Study Two). The rationale for using mixed methods in Studies Two and Three was to provide a richer and more comprehensive understanding of the research problem (Bryman, 2015). By doing so, it was possible to address complex research questions that may not be fully understood through a single method, combining the depth of qualitative insights with the generalisability of quantitative data (Creswell and Clark, 2017). The qualitative data provided details of the experiences of participating (children) and delivering (teachers) the co-developed gamified curricula in specific contexts, while the quantitative data provided evidence of the effectiveness of the interventions. Although this approach offers clear advantages, combining mixed methods can be challenging and influenced by several choices: different research questions, triangulation, instrument design and explanation (Bryman, 2015). Nonetheless, the use of a mixed methods in Studies Two and Three enabled the identification of key features of the intervention, which extends beyond the limitations of exploring just the effectiveness of the interventions.

The development and evaluation of the gamified PE curricula followed the Medical Research Council guidance on developing complex interventions (Skivington et al., 2021). During the intervention development phase, teachers and children participated in a series of co-development workshops, which aimed to improve the likelihood of the gamified interventions' impact and implementation (Craig et al., 2008). Following the intervention development, a feasibility study with a small sample was implemented to obtain information on the feasibility of the intervention, trials methods and preliminary effectiveness. Feasibility studies are typically conducted prior to a definitive randomised controlled trial to address uncertainties related to recruitment, retention, intervention acceptability and feasibility, data collection procedures and study design (Eldridge et a., 2016). Further, evaluation of the trial methods were assessed using a traffic light criterion (Avery et al., 2017). The final study was a quasi-experimental pilot trial, which evaluates the effects of the gamified intervention. Pilot studies are typically conducted following the completion of a feasibility study (See Chapter four) and on a smaller scale before a larger definitive trial is conducted (Bond et al., 2023). In addition, pilot studies can provide detail on the intervention content and delivery for replicability, alongside the effectiveness of the intervention (Pfledderer et al., 2024).

Ethical Considerations

All studies received ethical approval by Liverpool John Moores University Ethics Committee (Study One: 22/SPS/064, Study Two: 23/SPS/008, Study Three: 23/SPS/041). Ethical considerations should be made when involving human subjects and conducting research with children has an added layer of ethical consideration due to their age (World Medical Association, 2013). For children under the age of 16 years, it has been suggested that they are unable to provide informed consent, and therefore assent should be obtained. For this project, tiers of ethical consent/assent were obtained: Gatekeeper, teacher, parental/carers and child (Shaw et al., 2011). Gatekeeper consent allowed for all the children to participate in the gamified PE intervention. Teachers were provided with information packs and were asked to provide informed consent to take part. Parents/carers were provided with information packs about the research project and were made aware that they were under no obligation for their child to take part. Parental/carer information packs contained a consent/assent form and a child-friendly information pack that was of appropriate reading age. Parents/carers were given the opportunity to ask the lead researcher questions about the research project via the email provided on the information pack. If parents returned the consent forms, but no assent forms, the lead researcher sat with the children and explained the project to them. The children were able to ask questions and were asked if they assented to take part in the project. Although parents/carers may have consented for their child to take part, ultimately if the child did not want to assent to take part in the study, they did not have to.

As this project involved going into schools and working directly with children, the lead research obtained an enhanced Disclosure and Barring Service (DBS) certificate. This allowed for the lead researcher to work with the children without a school staff member being present. To ensure confidentially and anonymity, data was anonymised, and storage of data was saved under password protected computers. In addition, codes were assigned to schools, teachers and children as part of anonymisation and to further ensure confidentiality (Shaw et al., 2011). Parents/carers were given the choice to opt-in to their child being audio recorded, and video recorded, and only those parents who consented to audio/video recording were recorded. Other ethical issues were also considered during this project including: the research environment, power issues, giving feedback to participants, and dissemination of the findings (Shaw et al., 2011).

The inclusion of children living in areas of deprivation required careful ethical reflection to ensure participation was both meaningful and responsible. Research ethics frameworks emphasise that socio-economic disadvantage can heighten vulnerability, and therefore research must avoid compounding existing inequalities (UK Research and Innovation, 2025). In line with the United Nations Convention on the Rights of the Child (UNCRC), the studies within this thesis (Chapter Four- Six) were guided by principles of non-exclusion; no child was excluded on the basis of background, literacy, language or ability (Shaw et al., 2011). Children in disadvantaged communities may be particularly vulnerable to exploitation in interactions with adults, and the responsibility lies with the researchers to safeguard children's rights and dignity. Clear safeguarding protocols were followed, including age-appropriate information sheets, support from trusted teachers, and the presence of a trained researcher with current Disclosure and Barring Service clearance, in line with UK legal requirements for working with children.

Differential power relationships between adult researchers and child participants can also affect children's sense of agency, particularly in disadvantaged contexts where compliance with adult authority may feel expected (Kim, 2024). To mitigate this, children were reminded of their right to withdraw at any stage without negative consequences. This was reinforced verbally at the start of every session, and during activities, ensuring children understood they could decline tasks or end participation at any given time. Given the higher proportion of families with English as an additional language in disadvantaged areas, consent forms were translated into community languages, and interpreters were made available through schools, enabling parents to make informed decisions without exclusion due to language barriers. Managing expectations was also important to avoid tokenistic involvement. For children, the emphasis was on their role as co-developers of PE activities, and to provide insights into the delivered gamified curriculum. Games and interactive tasks were embedded to make participation enjoyable, as well as meaningful. In addition, children provided feedback on the co-development workshops to the lead researcher, and this was used to improve the next workshop. Ground rules for sessions (e.g. respecting ideas, taking turns, listening carefully), were co-developed with the children and revisited throughout, reinforcing agency and mutual respect.

Together, these measures embedded ethical considerations into the methodological design. They reflected international and national guidance (Shaw et al., 2011), while responding to the contextual realities of schools in disadvantaged areas. Drawing on previous professional experiences in such settings, I was responsive to the barriers families potentially face, including limited resources, linguistic diversity, and exclusions from decision-making, and sought to design the studies within this thesis that minimised burden, maximised accessibility, and elevated children's voices. In doing so, the thesis upheld children's rights, safeguarded against potential harms, and created an environment where participation was voluntary, inclusive and meaningful.

Chapter Four: Study One

Co-development of a gamified physical education movement competence intervention with school stakeholders

Based on a paper published in European Physical Education Review: **Rice, J.,** Foweather, L., Foulkes, J., Magill, C., Meester, A. D., Stodden, D., Lenoir, M., & Davies, K. F. (2025). Co-development of a gamified physical education movement competence intervention with school stakeholders. European Physical Education Review, 0(0). https://doi.org/10.1177/1356336X241301352

Thesis Study Map

Study	Objectives and Findings
Study 1: Co-development of a gamified physical education movement competence intervention with school stakeholders.	**Objectives:** • Co-develop a gamified PE intervention with Year 5 children (age 9 to 10 years) and teachers.
Study 2: Feasibility, acceptability and preliminary effectiveness of a gamified physical education intervention on motor competence and emotional intelligence.	**Objectives:** • Evaluate the feasibility and acceptability of a co-developed gamified PE intervention in a primary school context. • Evaluate the feasibility of the study process (i.e. recruitment) and management (i.e. data collection) in a primary school context. • Explore the preliminary effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children.
Study 3: The effects of a gamified physical education intervention on motor competence and emotional intelligence among primary school children: a quasi-experimental pilot study	**Objectives:** • Explore the effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children. • Evaluate the acceptability of a co-developed gamified physical education intervention in a primary school context. • Develop and pilot a tool to assess the fidelity of the delivery of gamified pedagogy in PE.

Study Context within Thesis

Chapter Four will present the first study of this PhD thesis, which involved co-developing a gamified PE curricula with children and teachers from primary schools. The aim of this co-development process was to draw upon the experiences and knowledge of school stakeholders to create a curriculum that would be more feasible, acceptable and relevant to their specific school context and needs.

Abstract

Introduction: Movement competence (MC) and emotional intelligence (EI) are positively associated and important for child development. Intervention research is needed to determine causal relationships between these outcomes. Gamification is a pedagogical model that may enhance MC and EI, but implementing interventions in schools is complex and requires multi-stakeholder involvement to ensure feasibility, acceptability, and sustainability. However, methodological evidence to inform co-development work within physical education is lacking and further research is required. **Aim:** This study describes the process of co-developing a gamified PE intervention with school stakeholders to increase MC and EI among primary-aged children. **Methods:** A total of 91 children and four classroom teachers from three primary schools participated in a series of co-development workshops. Data from the workshops were thematically analysed and informed the development of three school-specific gamified PE curriculums. **Results:** Findings from children included: (1) the social and foundational movement skills (FMS) to improve during the intervention; (2) the enjoyable components of PE, which included skill development and social interaction; (3) a desire to include more equipment in PE lessons; and (4) games, activities and gamification strategies to incorporate in the intervention. Findings from teachers included: (1) the barriers and facilitators to implementing a gamified model in PE; (2) the successful components of PE lessons; and (3) the overall development of the intervention. **Conclusion:** This methodology provides a framework for co-developing PE interventions within a school context. Results provide strategies to operationalise gamification. Future research should explore the feasibility and acceptability of the co-developed interventions to increase MC and EI.

Introduction

Mental health is the state of an individual's cognitive, behavioural, and emotional wellbeing (WHO, 2022). Globally, issues such as anxiety and depression present significant health challenges (Erskine et al., 2015). In England, the prevalence of mental health problems in primary-aged children (5 to 11 years old) increased from 9.4% in 2017 to 14.4% in 2020 (Vizard et al., 2020). Unaddressed mental health issues in early life can lead to adverse outcomes, including low academic attainment (Deighton et al., 2018), permanent school exclusion (Paget et al., 2018), poorer peer relationships (Long et al., 2020), and ongoing physical and mental health problems in adulthood (Schlack et al., 2021). Identifying protective factors, particularly among those from low socioeconomic areas (Reis, 2013), is crucial in mitigating mental health problems and associated negative outcomes (Holmes et al., 2020).

EI has been defined as interrelated competencies that enable processing of emotions to guide thinking and behaviour (Mayer et al., 2008). Developing EI competencies (e.g. social awareness) is important for children as it aids their understanding of mental and social wellbeing, helping them to adapt to change (Lea et al., 2019). Moreover, developing EI competencies during childhood can prevent mental health problems in adolescence (Davis et al., 2019). Childhood is a crucial developmental stage, and EI competencies develop with age (Durlak et al., 2011). Importantly, EI competencies are not fixed and can be improved through school-based interventions (Hansenne and Legrand, 2012).

Evidence suggests that high levels of EI competencies can help buffer prolonged internalising behaviours in children (Davis et al., 2019). For instance, higher EI was associated with lower depressive symptoms and feelings of loneliness over a one-year period in children aged 9 to 11 years (Davies et al., 2019). In education, children with higher EI are less likely to be excluded from school, highlighting its importance for socialisation in primary school students (Mavroveli and Sanchez-Ruiz, 2011). Similarly, EI influences children's peer-relations and facilitates prosocial behaviour at school (Petrides et al., 2006). Moreover, EI positively impacts overall physical health (Martins et al., 2010), correlating with increased participation in physical activity (PA) due to stronger self-efficacy and interpersonal adaptability (Amado-Alonso et al., 2019). Therefore, promoting EI through socially interactive PAs can enhance emotional development (Khan et al., 2021).

PE lessons necessitate participation in PAs and support holistic development, encompassing physical, social-emotional, and cognitive learning (Bailey et al., 2019). Globally, PE aims to improve children's MC (Lorås, 2020), defined as the degree of proficiency in performing motor skills (Robinson et al., 2015). Developing MC benefits children significantly, with positive associations found between MC and academic performance (Nobre et al., 2024), self-esteem (Lopes et al., 2022), physical fitness (Den Uil et al., 2023), and perceived physical competence (Niemistö et al., 2023). One aspect of MC is FMS which include both traditional 'fundamental' skills (e.g. running) and 'non-traditional movement skills' (e.g. squat). Developing competence in FMS during childhood can enhance opportunities for PA (Hulteen et al., 2018), laying the foundations for developing more specialised movement patterns, such as sport-specific skills (Clark and Metcalfe, 2002).

To the authors' knowledge, only Mohammadi Orangi et al. (2023) have investigated the association between EI and MC, examining three age groups: children 5-11 years old (N = 360), adolescents 12-17 years old (N = 360) and young adults 18-21 years old (N = 400). This cross-sectional study revealed strong positive correlations between EI and MC scores, suggesting that even from an early age, children with lower MC may have lower EI. The relationship between EI and MC can be explained by the Elaborated Environmental Stress Hypothesis (Cairney et al., 2013; Missiuna and Campbell, 2014), which posits that low levels of MC contribute a primary source of stress causing internalising problems such as symptoms of depression and anxiety. Poor MC is also conceptualised as a ‘secondary stressor’ because children with low MC are at greater risk of negative social experiences and interpersonal conflict (e.g. peer victimisation due to their lower ability to perform well in games and sports), which impacts on their self-worth (Cairney et al., 2013; Missiuna and Campbell, 2014). EI represents a personal resource that buffers against the negative impact of stress, protecting against internalising problems (Davis et al., 2019). Children with low MC might avoid taking part in PE and wider PAs, leading to decreased opportunities to develop EI through social participation in group work and being part of a team. Improving MC can lead to increased feelings of mastery and the confidence to engage in PAs (Lopes et al., 2022; Niemistö et al., 2023), which provide children with the opportunity to acquire and reinforce EI competencies through conflict (e.g. winning and losing) and socialisation (Castillo-Viera et al., 2020), in turn helping them manage their own emotions and behaviours as a response to others (sub-constructs of EI) (Rico-González et al., 2023).

Gamification, defined as ‘the use of game-like elements in non-gaming contexts’ (Deterding et al., 2011), may be a promising pedagogical approach to support the development of EI and MC. Gamification utilises game-like elements grouped into three categories: (1) dynamics: the highest conceptual level which regulates social-emotional competence (e.g. narrative/story); (2) mechanics: elements that create a sense of progression (e.g. challenges); and (3) components: tangible elements between the child and the activity (e.g. points) (Werbach and Hunter, 2015). The underlying concept of gamification is that the specific game elements, known as motivational affordances, make engagement in activities more motivating (Deterding, 2011).

In PE, motivation is crucial for student success (Vasconcellos et al., 2020). SDT is frequently employed as a macro-theory to understand the role of motivation (Ryan and Deci, 2020). SDT has been widely used in PE contexts (Vasconcellos et al., 2020), and specifically in gamification (Fernandez-Rio et al., 2020; Quintas et al., 2020; Sailer et al., 2017). According to SDT, motivation is influenced by the extent to which social conditions support the satisfaction of three BPNs: competence, autonomy, and relatedness (Ryan and Deci, 2020). Blain et al.'s (2022) conceptual model highlights how gamification strategies can support these needs. For instance, challenges can provide children with a choice (autonomy), teamwork offers opportunities for social interaction with peers (relatedness), and graded levels support competence. Evidence indicates that utilising gamification in PE improves student motivation (Chaung and Kuo, 2016) and increased intrinsic motivation (Fernández et al., 2020). Additionally, Ros-Morente et al. (2018) found significant increases in both social and emotional competencies among primary school-aged children following a gamified intervention. Few studies have explored the influence of a gamified intervention on MC (Fernández-Vázquez et al., 2024) and physical outcomes (Shameli et al., 2017). Therefore, more research is necessary to evaluate the impact on both psychological outcomes (EI) and physical outcomes (MC).

Schools are pivotal for promoting health and well-being among children (Shaw et al., 2019). Traditionally, PE interventions are developed and implemented through a top-down approach (Rütten et al., 2017), led by external experts such as academics. Such interventions may lack a nuanced understanding of the needs of the children and schools (Evans et al., 2015). A novel approach to intervention development involves a process of co-production (Smith et al., 2023), where school stakeholders - including teachers, children, and school leadership - collaborate with researchers to design interventions (Craig, 2018). In this study, co-production is defined as ‘collaborative intervention developments by academics working alongside other stakeholders’ (Leask et al., 2019: 2). Recent evidence suggests that co-produced interventions enhance impact (Darby, 2017) while being more feasible, acceptable, and relevant due to direct involvement during the development process (Reed et al., 2021). Drawing upon school stakeholders’ experiences and knowledge of PE could result in more meaningful PE lessons and increase teacher competence and confidence in PE. However, there is limited research on co-producing PE interventions with school stakeholders (Clifford et al., 2023). Therefore, this study aims to describe the development of a gamified MC intervention with key stakeholders.

Methods

Study design

This co-development study was guided by previous recommendations and principles (Leask et al., 2019) and ethical approval was obtained from the institutional Research Ethics Committee (22/SPS/064).

Researcher positionality

A relative ontological view was employed, recognising reality as individually constructed and subjectively experienced (Guba and Lincoln, 2005). This approach ensured that the research reflected multiple viewpoints and was inclusive of the participants’ lived experiences of PE. A social constructivist epistemology was also embraced, aiming to integrate diverse perspectives and collaborative input (Kamberelis and Dimitriadis, 2005).

Participants

To recruit participants for the study, an existing primary school network was utilised. Following an email inviting expressions of interest, gatekeeper consent was obtained from the director of education of a multi-academy trust with six schools in an urban town in Cheshire, England. Purposive sampling was subsequently employed to identify multi-level stakeholders from the schools for the co-development process (Patton, 2002). Thereafter, headteachers from six primary schools attended an in-person meeting, and representatives from three of these schools agreed to participate. Inclusion criteria were: (a) a pupil in Year 5, aged 9-10; (b) teachers responsible for teaching PE to Year 5 classes; and (c) Year 5 classroom teachers. Informed consent/assent was obtained from teachers, parents/guardians, and children. Across Schools A, B and C, 91 Year 5 children (mean age = 9.2 years) were recruited, with one classroom teacher each recruited for Schools A and B, and two classroom teachers recruited from School C due to a shared class timetable. The sample included 59% male and 41% female children, of whom 92% were White, and 8% were of ethnic minority. Socio-economically, 33-63% of children at each school were eligible for free school meals. All teachers (100%) were female (mean age = 42 years) and White British. They all held a Post Graduate Certificate in Education, with three holding a master's level degree. Teaching experience ranged from 5 to over 20 years, with three teachers responsible for teaching PE to their respective class. Of the three teachers, two were PE leads in their schools (School A and School C). One classroom teacher (School C) participated in the co-development process but was not responsible for teaching PE.

Co-development workshops

Previous research informed the co-development process (Clifford et al., 2023; Leask et al., 2019; Reed et al., 2021; Smith et al., 2023), which took place from November 2022 to March 2023. In each school, the lead researcher conducted four one-hour classroom-based workshops with the children during curriculum time, and four workshops, lasting between one to three hours, with the classroom teacher(s) during regular school hours. Additionally, members of the research team, from universities in the UK (KFD, LF, JF, CM), United States of America (ADM, DS) and Belgium (ML), with expertise in child movement skill development, PA, PE and motivation, sense-checked the theoretical alignment of the interventions. This methodology adhered to principles of equitable and experientially informed research, employing an 'inside-out' pathway (Smith et al., 2023). The workshop aims were predetermined, as illustrated in Figure 4, and a detailed descriptive table can be found in Table 4 for children, and Table 5 for teachers.

Workshop One

Children

A one-hour session where the lead researcher introduced the research project, outlined its objectives, and provided an overview of each workshop. Terminology was adapted as needed to ensure accessibility for the children. For example, emotional intelligence was adapted to '*'how we understand, use, and manage ours and others' emotions*' and movement competence to '*muscle movements we use in everyday lives that help us to run, walk, jump, catch and throw'*. To verify the children's understanding, subsequent questions were asked. For example, '*what movement skills can you have'* and *'what emotions can you feel'*. Children were then asked to create a set of rules to facilitate the flow of the workshops (Smith et al., 2023). A discussion was had on the rules, to determine the rules, a vote was had. Children could ask questions throughout.

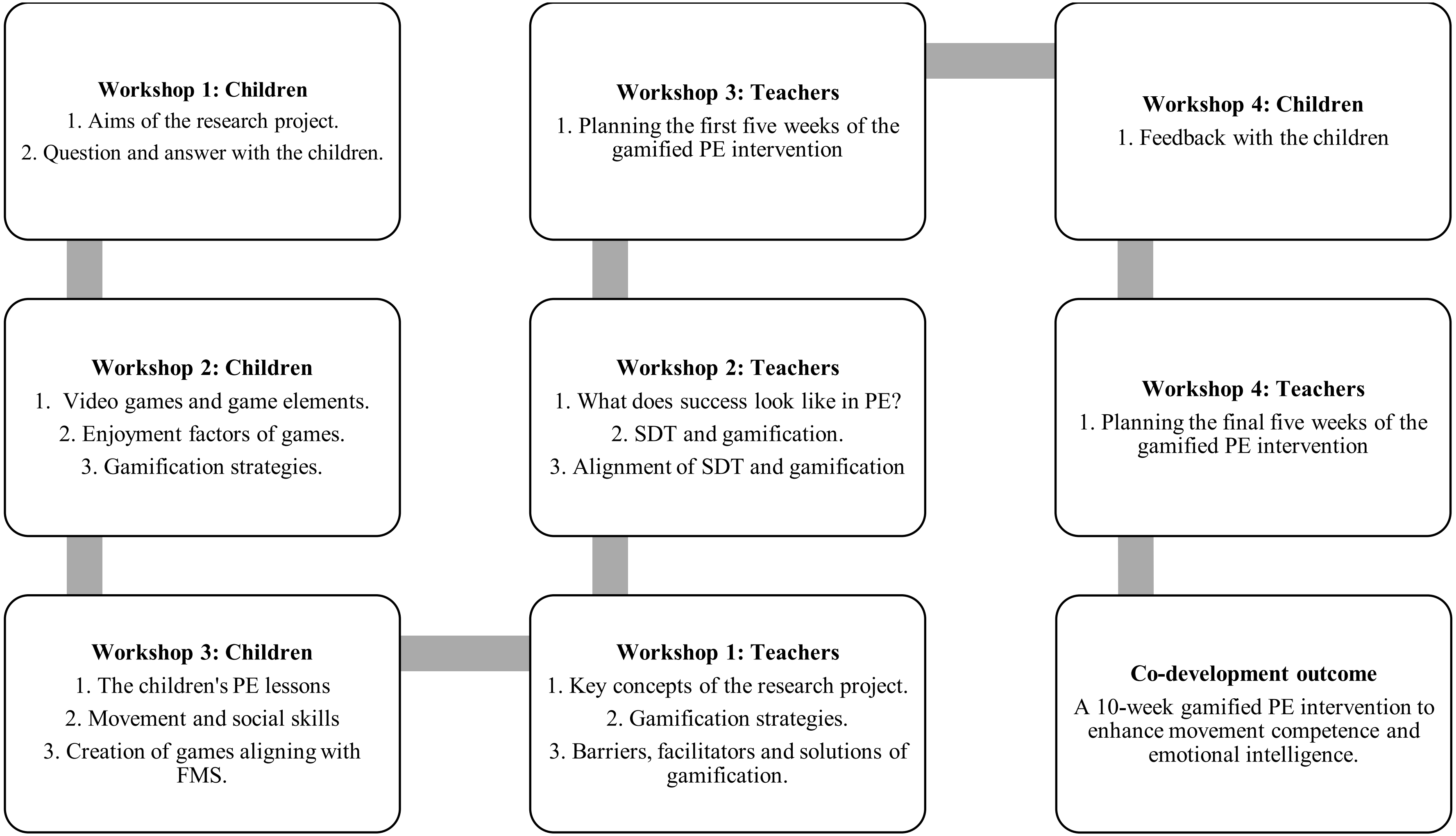

Figure 4. A systematic overview of the co-development process and workshop objectives.

Note. This procedure was conducted at each of the three school

Table 4. Descriptive table of the aims, session descriptions and working methods used in each co-development workshop with the children

Workshop (duration)	**Aim of the workshop**	**Description of the session**	**Materials used**	**Examples**
Workshop One (1 hour)	1) Introduction to the research project and the research objectives.	1) Explanation of the research project. 2) Pair discussion about the key concepts (e.g. emotional intelligence and movement skills) 3) Mind-mapping different emotions and movement skills. 4) Providing an overview of each workshop.	- PowerPoint presentation - Paper - A3 paper for mind-mapping - Marker pens - Pink and Yellow post it notes for reflections. - Dictaphone to record the session.	Example of questions: 'How many movement skills can you think of' 'What emotions can you have?'
Workshop Two (1 hour)	1) To explore different game elements and video games. 2) Explore what makes video games enjoyable for children. 3) Explore gamification	1) Remind the children of the workshop rules. 2) Mind map words the children can relate to either 'game elements' or 'video games' on A3 pieces of paper. 3) Group discussion about some of the ideas wrote down on the sheets. 4) Question sheet about what they enjoy about playing video games, what video game element they like most, and what do they enjoy least about video games.	- A3 paper with the workshop rules on. - PowerPoint presentation - Worksheet with video game questions on. - Different coloured markers and pens - A3 paper with the gamification strategies' on.	Examples of questions asked: what they enjoy about playing video games, what elements in video games are their favourite and what do they enjoy least about playing video games.

Workshop (duration)	Aim of the workshop	Description of the session	Materials used	Examples
	ideas and strategies. 4) Explore prospective themes for the gamified PE intervention.	5) Presentation and Group discussion about the different gamification strategies. 6) Group discussion and identifying the similarities between their ideas and the strategies' given. 7) Brainstorming and working in small groups different examples of the gamification strategies using A3 paper with the strategies on. 8) Group discussion about perspective themes for the intervention. 9) Vote on the top 3 themes for the intervention. 10) Post-it notes, pink (what was good about the workshops) yellow (what could have been improved in the workshops	- Pink and Yellow post it notes for reflections. - Dictaphone to record the session.	Examples of gamification: Dynamics: Story, relationships Mechanics: Rules, levels, challenges, competition, feedback Components: avatars, leader boards, points
Workshop Three (One hour)	1) To explore the wants and the needs of the children in PE. 2) To explore what movement and social skills the children would	1) Remind the children of the workshop rules. 2) Question sheet: what the children enjoy about PE, what elements currently work well in PE, what do the children do not like about PE, and what do they think could be improved about their PE lessons. 3) Group discussion about different movement and social skills	- A3 paper with the workshop rules on. - PowerPoint presentation. - Wants and needs worksheet. - A3 paper with movement or social skills to improve on.	Examples of questions: What do you enjoy about your PE lessons? What works well in my PE lessons? What don't I enjoy about my PE lessons?

Workshop (duration)	Aim of the workshop	Description of the session	Materials used	Examples
	like to improve on. 3) To design activities and games relating to each FMS.	4) Mind map different movement and social skills they would like to improve. 5) Brainstorm different ideas and games they for each FMS. 6) Post-it notes, pink (what was good about the workshops) yellow (what could have been improved in the workshops	- A3 piece of paper with each FMS heading on (10 in total) - Dictaphone to record the session.	What do you think could be improved within your PE lessons? Out of 10, how would you rate your current PE lessons? Examples of themes to create games with: Jumping and landing, throwing, and catching, obstacle course, kicking
Workshop Four (30 minutes)	1) Consensus votes on the developed intervention.	1) Group discussion about the first 5 weeks designed by the teachers. 2) Hands up, hands down vote. 3) Observation book by J. R	- First five weeks of the intervention designed. - Dictaphone to record the session.	Example of questions: Do you like the story? Do you like the games and activities that have been designed?

Table 5. Descriptive table of the aims, session descriptions and working methods used in each co-development workshop with the teachers

Workshop (Duration)	**Aim of the workshop**	**Description of the session**	**Materials used**	**Examples**
Workshop One (1 hour 30 minutes)	1) To explain the key concepts of the research project. 2) Definition of gamification, and the associated positive outcomes. 3) Barriers, facilitators, and solutions.	1) Discussion about the key concepts and objectives of the research project (e.g. gamification, emotional intelligence, and movement skill development) 2) Interview about previous experiences about participating in research. 3) Discussion about gamification, what it is, and the strategies. 4) Write down what the gamification strategies might look like in PE. 5) Discuss and write down any perceived barriers and facilitators to implementing a gamified approach in PE. 6) Identify and discuss any solutions to the perceived barriers. 7) Questions about the research project.	- PowerPoint Presentation - A3 paper with gamification strategies. - A3 piece of paper with barriers, facilitator, and solution table. - Biro pens - Dictaphone to record the session.	Example of gamification strategies: Dynamics: relationships, story, emotions. Mechanics: levels, challenges, co-operation. Components: badges, points, awards.

Workshop (Duration)	Aim of the workshop	Description of the session	Materials used	Examples
Workshop Two (1 hour 30 minutes)	1) Provide further knowledge and understanding of the theoretical underpinning of gamification. 2) Explore what makes PE successful to teachers.	1) Questions relating to what success looks like to them in PE. 2) Video to explain the theoretical underpinning of gamification SDT. 3) Discussion about each psychological need (SDT) and how it relates to PE. 4) Discuss and write down how each psychological need aligns with each gamification strategy. 5) Discuss and write down how each psychological need could be met using gamification strategies. 6) Discussion and questions about the research project.	- PowerPoint Presentation. - Video from YouTube. - A3 piece of paper with each psychological need and gamification strategy. - Biro pens - Dictaphone to record the session.	Examples of questions: What does success look like in PE? And what elements make up a successful PE lesson? Examples of SDT: Competence, Autonomy, and relatedness.
Workshop Three (1- 3 hours)	1) Facilitate the development of the first five weeks of the gamified PE intervention. 2) Feedback ideas generated by the children.	1) Plan the first five weeks of the gamified intervention. 2) Discuss each week of activities. 3) Align with a minimum of four gamification strategies. 4) Draw diagrams to facilitate set up.	- PowerPoint Presentation - A3 Lesson Plan sheets - Worksheets from previous workshops (workshop 1 and 2). - Marker Pens - Table with the ideas generated by the children.	Example of the first five week of outcomes for the intervention: Throwing and catching. jumping and landing. Striking and rolling an object. Agility and obstacle course (week 1-4 recap)

Workshop (Duration)	Aim of the workshop	Description of the session	Materials used	Examples
Worksop Four (1-3 hours)	1) Feedback comments from the children and the academic experts. 2) Recap the first five weeks of the intervention. 3) Facilitate the development of the final five weeks of the intervention. 4) Next steps.	1) Discuss and amend the feedback from the academic experts. 2) Discuss the feedback from the children and amend where necessary. 3) Discuss the first five weeks of the intervention. 4) Plan and write down the next five weeks of the intervention. 5) Discuss and plan the next steps of the project with the teachers. 6) Agreement of J.R to finalise the interventions into a hard electronic and paper copy.	1) Feedback from the academic experts. 2) Feedback from the children. 3) Consolidated first five weeks of the intervention. 4) A3 lesson planning sheets.	Examples of feedback: Movement skill development, alignment with gamification strategies and dosage.

Teachers

A 90-minute classroom session was conducted that included an overview of the project and provided the knowledge and understanding needed for subsequent workshops. Task one involved the teachers identifying any barriers and facilitators to implementing a gamified approach in PE aimed at increasing their confidence and competence in the co-development and subsequent delivery of the intervention. Teachers could ask questions throughout.

Workshop Two

Children

Workshop two consisted of exploring gamification and generating potential ideas of how gamification strategies could be incorporated into PE lessons. Task one involved groups of five children constructing a mind map on an A3 sheet of paper with the subheadings ‘game element’ and ‘video games’. Mind mapping was chosen for its flexible structure (Buran and Filyukov, 2015). Each group were given 10 minutes on each subheading. The lead researcher then facilitated a discussion on the children’s ideas. Task two involved the children identifying what components of video games they enjoyed, based on the concept that gamification is inspired by digital video games (Gee and Price, 2021). Each child answered three questions on an A4 sheet: (1) What do you enjoy about video games? (2) If you could pick only one video game element, what would it be? (3) What do you enjoy least about video games? Children had 10 minutes to complete this task. Building on previous tasks, in task three, children were grouped into threes and provided with an A3 sheet with headings ‘dynamics’, ‘mechanics’ and ‘components’. Prompts under each subheading included ‘What rules could you include?’ (mechanics) and ‘What stories could you use?’ (dynamics). Terminology had been explained earlier and was deemed appropriate by their teachers. Children were then given 10 minutes to brainstorm ideas before moving on to the next heading. The session concluded with children proposing three intervention themes, which were selected through a democratic vote and then presented to the teachers.

Teachers

Workshop two involved exploring success in PE (Beni et al., 2019) and understanding the theoretical underpinnings of gamification (Ryan and Deci, 2020). For Task one, teachers discussed: ‘What does success look like in PE?’ and ‘What factors make up a successful PE lesson?’. Responses were given verbally, and audio recorded. In Task two, a short video was presented to explain SDT (Ryan and Deci, 2020). Following the video, teachers engaged in a discussion about the three BPNs - competence, autonomy, and relatedness - and how these could be addressed during PE lessons. For example, relatedness was explained as ‘*feeling connected to others and being valued’* and could be addressed by providing children with plenty of opportunities for students to work together. The workshop concluded with a question-and-answer session, allowing teachers to ask any remaining questions.

Workshop Three

Children

Workshop three involved exploring each child’s PE preferences (Knowles et al., 2013). Task one involved asking children their likes, what works well, dislikes, and potential improvements in PE. A discussion on skill concepts (e.g. what is a social / movement skill?) was then facilitated. Task two involved asking the children which movement or social skills they wanted to improve, writing their ideas on an A3 sheet of paper. The children were then asked to explain their choices. For the final task, children were asked to brainstorm activity ideas for stability (e.g. balance and landing), locomotor, (e.g. jumping) and object-control skills (e.g. throwing and catching) on A3 paper for five minutes. They were also asked to incorporate gamification strategies. The children were prompted with questions such as: ‘How could you include different levels to make it easier or harder?’ and ‘What choices could you include during your activity?’.

Teachers

Workshop three consisted of presenting ideas generated by their classes in the previous child workshops and developing the first five weeks of a gamified PE curriculum. Teachers were provided with lesson plan worksheets, which included a warm-up, and two activities. Teachers were asked to include at least four gamification strategies (Werbach and Hunter, 2015) but were free to choose which strategies to use. Teachers also integrated strategies and ideas from the children in workshop three. This session was facilitated by the lead researcher, and teachers were provided with prompts to guide the planning process and address any questions.

Workshop Four

Children

A 30-minute mini-workshop was held to gain children’s perceptions of the initial gamified PE lessons designed by their teachers. Children were asked to provide their opinions on the curriculum, including the storyline, activity ideas, and gamification strategies, and to suggest any changes. For the curriculum to proceed, at least 90% of children from each class needed to express satisfaction, determined by a vote. Qualitative feedback was then collected.

Teachers

The lead researcher facilitated a structured discussion of feedback on the initial five weeks of gamified PE lessons from both children and co-authors with expertise in motor development (LF, JF, ML, AD, DS, KFD) and pedagogy (KFD). This feedback was used by teachers to refine the initial five weeks of the curriculum and to develop the latter five weeks, with optional support from the lead researcher. The workshop concluded with a discussion of the next steps of the project, including the digitisation of lesson plans and planning for the delivery of the gamified curriculum in the 2023 Summer term.

Data analysis

Workshops two, three and four with the children and workshops one and two with teachers were audio-recorded and transcribed verbatim for qualitative analysis. Workshop one with the children and workshops three and four with the teachers were not analysed due to insufficient data richness. Data from the included workshops were separately analysed using Braun and Clarke's (2019; 2021) six-phase reflexive thematic analysis, which was appropriate for this study due to its flexibility and capacity to provide rich, detailed, and complex accounts of the data (Braun and Clarke, 2021). This involved familiarisation with the raw data from each workshop by the lead researcher listening to the audio recordings and reading the transcribed content several times. Initial codes from each workshop were generated using inductive coding; there was no pre-conceived theory or coding framework, and the meaning communicated by the participants was prioritised (Braun and Clarke, 2006). Having reflected on these codes, initial themes were generated through an iterative reading, writing and analysis process. The themes were then reviewed with the assistance of critical friends (LF, JF, CM, ADM, DS, ML, KFD) to provoke further reflexivity and understanding of the rich data (Smith and McGannon, 2018). Finally, the lead researcher defined the themes, and all researchers agreed on them. This iterative approach ensured transparency and trustworthiness (Nowell et al., 2017). Confidentiality was maintained by coding participants with letters, e.g. teacher from School A labelled as Teacher A, while boys and girls from School A were labelled as Boy A and Girl A, respectively.

Results

In total, three different gamified PE curricula targeting MC were co-developed with school stakeholders. The findings from the workshops, which were instrumental in shaping the interventions, are presented in the order of the workshops conducted.

Workshop One

Children

No data was gathered from the children's first workshop.

Teachers

When identifying barriers, the most common theme reported by the teachers was the lack of understanding and knowledge of gamification strategies. One teacher noted, 'It's [gamification] something new, so it can take some time getting used to, not only for me but the children as well' (Teacher B). In contrast, another teacher (Teacher A) did not perceive any barriers, attributing this to a willingness to explore new pedagogies and a shift away from traditional PE approaches. For facilitators of using gamification, the most commonly expressed themes were the novelty and the gamification strategies, with one remarking: 'The children love trying new things, you know, it's something different and something they are going to enjoy' (Teacher 1C).

Workshop Two

Children

The most commonly expressed themes were social elements, such as 'I can interact with different people' (Boy C), entertainment factors like '… you don't know what's coming next, and that's fun' (Boy B), and specific game elements such as 'the challenges you can complete'

(Girl B) as the most enjoyable aspects of video games. When asked about their favourite game elements, children ranked them as follows: progression from one activity to the next (N = 39), rewards such as points (N = 39), levels (N = 21), having the choice of what I get to do (N = 19), challenges (N = 18), storyline (N = 18) and working with others in a team (N = 15). For key elements they would change, common themes included the main characters, noting 'the boys are always the main characters, there isn't many girl characters' (Girl B), unclear rules, 'when there are no clear rules' (Boy A), and repetitiveness, 'when you do the same thing five+ times, it's annoying' (Boy C).

Teachers

A theme expressed was the teachers viewed success in PE as on a spectrum, not solely based on a child's skill level. They emphasised effort and teamwork abilities, with comments such as, 'Some children put lots of effort in, and some are good at working with others' (Teacher A). The themes reported by the teachers for successful components in PE included structure, 'structure is key to a successful lesson' (Teacher B); variation, 'having lots of activities to do' (Teacher A); peer demonstration, 'when the children demonstrate' (Teacher 2C); and teacher demonstration, 'when I show the kids, and then they do it' (Teacher B).

Workshop Three

Children

Children were asked what social skills they wanted to improve. The most common reported themes were teamwork, leadership, problem-solving, and listening. At School A, issues with teamwork and conflict management were noted in PE: 'Some people just can't deal with losing, it's not all about winning, and then they get upset, and it can ruin the lesson' (Boy A). Similarly, children in School C reported both teamwork and leadership skills, influenced by their roles as play leaders: ‘We have been doing play-leaders, and I’d like to do more leadership stuff’ (Girl C). Furthermore, children at School B pointed out the need for improvements in patience: ‘People become impatient, so it would be something other people could improve. It would mean I didn’t get stressed out and feel rushed’ (Girl B), and listening to peers and the teacher: ‘need to use their listening ears more’ (Girl B).

The children reported the following movement skills that they would like to improve: ‘catching’, ‘kicking’, ‘running’, ‘jumping for height’, ‘skipping’, ‘hopping’, ‘throwing’, ‘balancing’, ‘bouncing an object’, ‘rolling an object’, and ‘other’ (e.g. ‘football’ and ‘gymnastics’). Children from School A and C reported similar needs for locomotor and object-control skills, whilst School B children focused more on object-control skills (e.g. throwing). Some children mentioned specific sports: ‘I would like to improve on karate’ (Girl A). Additionally, one child emphasised the importance of peers developing their movement skills to increase participation: ‘I would like other people to improve overall on their skills so that they can play and join in during the PE lessons’ (Girl C).

Child PE preferences

The most common themes for the enjoyable elements noted in PE were skill development: ‘there is always a new goal to achieve and new things to learn’ (Girl C), and social interaction: ‘working in teams’ (Girl C). Two children noted preferring to work on their own: ‘I like working individually’ (Girl B). Some children highlighted resources: ‘I enjoy PE when we get to use loads of equipment’ (Boy A), although many children perceived available resources as requiring improvement. Competition was also noted: ‘Sometimes they are competitive, and that is fun’ (Boy A), although primarily by boys. In general, children perceived their PE lessons to be fun: ‘PE is my favourite lesson because they are fun, not like maths’ (Boy C), particularly when teacher instructions were clear: ‘It works well when there are clear instructions’ (Girl B).

A commonly expressed theme for factors they do not enjoy was lesson duration: ‘The lessons are too short’ (Boy B). Further, children commented on peer behaviours making PE unenjoyable, specifically: ‘when people start fighting’ (Boy B), ‘when people start arguing’ (Girl A), ‘when people just mess around’ (Girl B) and ‘people not taking turns’ (Boy C).

When asked for suggestions to improve PE, common expressed themes were equipment: ‘using equipment we don’t usually get to use’ (Girl C), teacher instruction: ‘less talking and more doing’ (Boy A), and task-related issues: ‘more games instead of sports’ (Boy B), as factors that could be improved. Additionally, teamwork: 'being able to choose our teams more often’ (Boy A), and partner work were reported by some children. Nearly all children reported they wanted to ‘make the [PE] lessons longer’ (Girl C).

Children also contributed numerous ideas for activities and games aimed at improving weekly outcomes. These ideas, which were derived from various settings such as breaks, lunch, or previous PE lessons, were compiled and presented to the teachers for curriculum development (see Table 6).

Teachers. Development of the gamified PE lessons

In developing the gamified PE lessons, teachers planned a comprehensive 10-week programme, with each lesson lasting 60 minutes. The following narratives were chosen to align with the interests and themes identified by the children: ‘Quest through Time’ (School A), ‘The American Dream’ (School B), and ‘Treasure Island’ (School C). Teachers emphasised the importance of integrating cross-curricular themes, noting that it enriched the learning experience: ‘You would never think of bringing together America and PE. I think it’s important to incorporate both’ (Teacher A). Each lesson was crafted to include gamification strategies (e.g. a narrative, challenges, achievements). See Appendices A for an example lesson plan.

Workshop Four

Children

Almost all children expressed that they were happy with the progress of the curriculum, design and narrative. Specifically, 28 children (School A), 30 children (School B), and 31 children (School C) were satisfied. However, two children expressed their dissatisfaction with the narrative choices; one preferred a ‘…knights and princess story’ (Girl, School B), and another wanted ‘transformers’ (Boy, School C).

Teachers

The teachers reviewed the recommended changes by the research team (LF, KFD, JF, CM, DS, ADM, ML) with the lead researcher. For School A, this included enhancing the focus on uni-lateral and bi-lateral movements during week 1, such as using one arm or two arms for throwing. For School B, the recommendation was to further incorporate narrative elements in week 3. The teachers approved the changes and emphasised the value of academic input through the development process: ‘It is good to have feedback from academics, it means the children can get the most out of the intervention. It has helped.’ (Teacher C). Due to their current workloads, the teachers opted to delegate the task of digitising the lesson plans to the lead researcher.

Key features of the three gamified movement competence interventions

Following the final workshop with each school, three distinct gamified MC interventions were developed. The key and school-specific features are presented in Table 7. Examples of the gamification strategies employed in each intervention are detailed in Table 8.

Table 6. Children's ideas for activities and games for the gamified intervention

	School A	School B	School C
Week 1: Throwing and catching	• Working with someone and trying to get further and further away from each other without dropping the ball. • Throw and then run to the other side. • Netball • Throw the ball at a target, like the metal men. • Use different balls to catch and throw. • Target walls, throwing the ball at a target on the wall and trying to catch it.	• Throw and catch relay race down the line. • Triangle throw (people around the triangle throwing the ball round to help people, person in the middle trying to get the ball). • Camel: 3-4 people throw, countdown 123 and then everyone must run, the people running need to catch the ball or they join the throwers. • Basketball • Dodgeball	• Throw and move you only have 3 seconds to have the ball. • Clap and catch, someone throw you the ball at you and you must clap once before you catch it, you can't drop it. • Hot potato with balloons and different balls. • Over-arm throw at objects
Week 2: Jumping and landing	• Include different kinds of jumps like hopping forward and then backwards, or side-to-side.	• Triple jump • Squat jump • Jumping over different things, so hurdles, nets – 'net, jump, climb,	• Jumping spots (different sizes) • Floor is lava. • Hopscotch across the room • Jump like different animals (frog jump, kangaroo jump)

	School A	School B	School C
	• Jumping on and off different things, like boxes in squid games. • Working with other people to do a jump, so they jump holding your hand and then you jump.	jump, climb, tunnel, drawl and jump'. • Jump to the pole vault. • A race jumping from one side of the playground the other, if you touch the floor, you are out, kind of like floor is lava but harder. • Frog jump • 'parkour' run under the tunnel, then you do a triple jump, you then must jump over 5 hurdles, then do a frog jump, and then hop through the tunnel and then you must do it again but this time backwards which is hard.	• Jumping beans • Landmark when you must jump and land in the shout position. • Jump and land race (all start on one side of the room in teams must move the spots across the floor there is one less spot and they must get across using jumping and landing, they can throw them as near or as far as they want, they can jump or land with ½ legs • Jump as high as you can and then as far as you can.
Week 3: Striking and rolling an object	• Hungry hippo games, run into the middle grab an object and roll it back to your team. • Set up our own objects and try and knock them over.	• People in the circle, and people on the outside of the circle, they must roll the balls in and everyone in the middle must roll them out. • Trying to kick the ball into a goal.	• Racket relays *bouncing the ball up on the racket, bouncing the ball down on the racket* (using different size rackets and different size balls) using

	School A	School B	School C
	• Rounders • Using different things to hit balls with, so using a cricket bat, or a tennis racquet, maybe a hockey stick. • Bowling • Working in teams and having to play a game of rounders.	• Trying to get as many pieces as possible of equipment from the other time by rolling them back to your team and hitting the stuff the other team got away. • When you hit something, you have got to get it really far you get points, the further you get the more points you get.	different modes of travel (walk, run, skip, jump) • rolling the ball into a target • cricket style games • throwing the bean bag in hoops (got to stay in the hoop, using different size hoops) • elephant ball (all in a circle, there are loads of different balls and they must stand shoulder width apart with their hands between their legs they must stop the ball going between their legs, if it goes through, they must grasp their hands together and if it goes through again, they must go down to 1 hand)
Week 4: Agility	• People wear different coloured bibs, when a colour is shouted, they must run as fast as they can	• 'Balls dodger' go fast on the agility ladders and people on the sides will throw the balls, run or do it with	• Fast feet and don't stop. • Simon says jump back (1 hand and 1 foot)

	School A	School B	School C
	away from the middle, if they get caught, they must join that colour bib that tagged them. • Running, jumping, hoping in different directions when someone shouts left, go left, forward, and backwards. • Running with different objects, so running with a hoola hoop or something.	high knees, people throw the balls in from the side. • Floor is lava with fast feet. • 'Dodgeball ladders' first round you must run forwards, second you run backwards, then high knees, then side stepping, then skipping, then hopping.	• Crawling football (must use different animal crawls to get the ball, 'bear crawl' 'crab crawl') • Agility ladder Simon says (all children involved) 'Simon says left hand up'. • Catch the falling cones (teacher in the middle flinging the cones around the room the children must try catch them)
Week 5: Obstacle course	• Move the mountain. • Using the nets like the army ones and having to crawl under them and then crawling over them. • Working in teams to create our own obstacle courses and being creative.	• Move the mountain. • Making our own obstacle courses in the lesson: we get to pick the equipment and build it and we can show other people how to use it and what to do. • Doing lots of different things in the obstacle course like catching, and then jumping and then running and then a little bit of football	• Move the mountain. • WHO's under the bridge. • Crawling monkeys • Hole in the wall, dodge the incoming wall and each time a different wall appears. • Using the trim trail that is outside to build an obstacle course

Table 7. Standardised features of the gamified PE interventions

Standardised features of the intervention		
Dosage and Duration	Ten weekly, 60-minute PE lessons were designed to be delivered across a 10-week block	
Weekly lesson content	Week One: Throwing and catching	Week Six: Dibbling hands and feet
	Week Two: Jumping and landing	Week Seven: Throwing and catching
	Week Three: Striking and rolling an object	Week Eight: Gymnastics
	Week Four: Agility	Week Nine: Dodging and invasion
	Week Five: Obstacle course	Week Ten: Obstacle course
Structure	Each intervention included a warmup, and two developmental activities. Each intervention included a step-by-step progression which included skill development, game progression and lesson order.	
Gamification strategies	A minimum of four gamification strategies, with at least one from each level was incorporated within each lesson. Dynamics: Narrative/story, progression, relationships, constraints Mechanics: Rules, challenges, chance, competition, cooperation, feedback, levels	

	Components: Avatars, trophies, badges, points, leaderboards
Equipment	Each intervention included as much equipment that was feasible, for example: ‘bean bags’, ‘footballs’, ‘basket balls, ‘rugby balls’, ‘hula hoops’, ‘tennis racquets’, ‘nets’, ‘benches’. Each school had 3 designated equipment managers per lesson, and this changed every lesson.
School specific features of the intervention	
Narrative content	School A: *‘A quest through time’*. A journey through time would take the children on a teleportation adventure to Ancient Greece. The children would complete a series of activities, with each lesson representing a different historical time period. Completion of the activities would return the children back to the present.
	School B: ‘*The American dream’*. The children land in New York and would be travelling across different states of America. The children would need to complete a series of activities that focused on different natural and physical geographical features. The aim was to earn enough points for a flight ticket home.
	School C: ‘*Treasure Island’.* A save the island adventure involved the children exploring the island for the first five weeks, completing different activities. The second half of the intervention involved the children completing activities and being rewarded with crystals which were essential for saving the island.

Table 8. Definitions and examples of gamification strategies

Gamification Strategies	Definition	Examples in the interventions
Narrative	A storyline that continues throughout the curriculum	• **School A: 'A Quest Through Time':** Children embark on a time-travel adventure to Ancient Greece, completing activities in different historical periods to return to the present. • **School B: 'The American Dream':** Children travel across the U.S., completing geography-based activities to earn points for a flight home. • **School C: 'Treasure Island':** Children explore an island, completing activities to earn crystals needed to save it.
Relationships	Encourage peer interactions through activities	'Working in pairs to throw and catch the ball'. 'I would like you to get into groups of 8, you can choose your groups'
Rules	Clear guidelines for each activity	'You can only travel around the beach using different jumps' 'If you drop the luggage (ball) you must return it back to the start'.
Challenges	Individual and class challenges	'Can you try throwing using the arm you would not usually use'. 'Can everyone hop to the middle using the leg you would not usually use'.
Levels	Children progress through levels from easy to hard	Level 1: Dribbling a basketball with two hands while stationary; Level 2: Dribbling with two hands while moving; to Level 5: Dribbling backwards with one hand.

Gamification Strategies	Definition	Examples in the interventions
		Children could choose their level using coloured markers (e.g. green = easy, orange = medium, red = hard).
Choice	Children are given meaningful choices (Beni et al., 2019)	‘You can choose which challenge you complete first’. ‘Choose a piece of equipment that you would like to use’.
Co-operation	Objectives that require teamwork	‘Transporting the moving blocks as a group to make your way across the river’
Achievements	Clear milestones in the storyline	‘You have practised using your compass, you will need this for your next adventure’. ‘The queen is happy with your gymnastic performances and has opened the final portal for you’.
Points	Teams must successfully earn points to advance.	‘You need to get to get 20 points as a team to unlock the gem!’

Discussion

This study aimed to describe the process of co-developing a gamified MC intervention with key stakeholders. To our knowledge, this is the first study to co-develop a gamified MC intervention in a UK primary school context. This research is an important step towards advancing the fields of gamification and the co-development of PE interventions in the school setting, both of which are limited (Clifford et al., 2023). Findings relating to (1) the key features of the interventions, (2) gamification in PE, and (3) reflections on the successes and challenges of co-developing interventions with schools are discussed below.

The focus on FMS for each weekly outcome was influenced by several factors. Participating children expressed a desire to improve a broad range of FMS, which guided the interventions' development. This broad interest aligns with recent evidence indicating that children aged 7 to 10 years often exhibit low proficiency across locomotor, object-control and stability domains of FMS (Duncan et al., 2022; Lawson et al., 2021). Given that MC development is widely recognised to depend on optimal FMS (Lopes et al., 2020), the focus on FMS appears appropriate. Moreover, the underlying mechanisms of gamification are said to support intrinsic motivation (Ryan and Deci, 2020). The positive association between intrinsic motivation and MC is well established (Bardid et al., 2016; Coppens et al., 2021), suggesting that children are likely to enjoy developing their FMS as a result. Recent evidence reported an increase in FMS following a gamification intervention that focuses on FMS (Davies et al., 2024; Morales et al., 2023). However, due to the small sample size and specific populations studied, further investigation is needed to explore the mechanisms and impact of gamification on FMS.

Structure is an important component of intervention design (Miller et al., 2023) and was identified as a key element of a successful PE lesson by both children and teachers.

Consequently, the interventions were developed with a well-structured activity plan (Killen and O'Toole, 2023) to maximise and promote engagement. This structured approach aligns with those used in previous gamification interventions (Morales et al., 2023).

Gamification in PE in a UK context

Evidence on the most effective gamification strategies and their optimal quantities remains limited (Arufe-Giráldez et al., 2022; Blain et al., 2022; Sotos-Martínez et al., 2020). Some recent studies (Ahn et al., 2019; Quintas et al., 2020) did not yield improvements in children's motivation and BPNs, which may partially reflect the failure to utilise essential elements of gamification. To address this, a minimum of four strategies, with at least one from each level (dynamics, mechanics, components) were incorporated. Additionally, the gamification strategies were tailored for each school to ensure a personalised gamified experience (Chan et al., 2023). These gamification strategies were aligned with each BPN (Ryan and Deci, 2020) to sustain children's motivation throughout the intervention (Sotos-Martínez et al., 2023). For example, levels were designed to address competence, choice to support autonomy, and relationships to foster relatedness. Recent evidence suggests that gamified interventions can improve the satisfaction of all BPNs (Sotos-Martínez et al., 2023), although research on gamification's effects on primary-aged children's need satisfaction is limited compared to secondary-aged students (Fernandez-Rio et al., 2022; Sotos-Martínez et al., 2024).

The findings also underscored the importance of designing a narrative/theme (dynamics) that was cross-curricular. The interventions aimed to support a holistic approach to learning, whereby different disciplines overlap and fuse to create an integrated unit of learning (McDowall and Hipkins, 2019). Furthermore, understanding the context and stakeholders' needs was critical in designing the gamification interventions. Differences in how strategies such as narrative, point accumulation, and activity rules were presented across schools highlight this need. Despite the limited evidence on the role of context in developing gamification interventions in education or PE specifically (Richards et al., 2014), it is recognised that school-based interventions should be context-specific and goal-orientated (Norström et al., 2020). Taken together, this study's results provide a foundation for researchers and practitioners interested in applying gamification in PE.

Reflections on co-developing interventions with schools

Capturing diverse perspectives from stakeholders is crucial but often overlooked when implementing school-based interventions (Scultz and Evans, 2015). In our study, standardising certain features – such as the dose and duration, weekly lesson outcomes, and the quantity of gamification strategies – was necessary to evaluate the intervention's impact in future research (Craig et al., 2008; Moher et al., 2010). Following recent research (Cardiff et al., 2023; 2024), it was ensured that children's views were integral to the intervention design (O'Conner, 2022). For instance, the children voiced that they wanted a variety and high volume of equipment during the interventions, which was subsequently incorporated as a result. Previous studies have shown that incorporating student voice in PE can enhance engagement (Howley and O'Sullivan, 2021) and lead to more meaningful PE experiences (Walseth et al., 2018). Although meeting the diverse needs of 91 children posed challenges, the lead researcher strived to ensure that all voices were considered through a group consensus approach (Turner et al., 2020).

During the process, teachers had the option to independently digitise their paper-based intervention lesson plans. However, due to concerns about their current workload (Solvason et al., 2023), they chose to delegate this task to the lead researcher. Despite this, teachers were frequently consulted via email to ensure their ideas were accurately represented. This approach demonstrated a transparent sharing of power throughout the process (Smith et al., 2023). The importance of collaborative work with stakeholders cannot be overstated. A one-size-fits-all approach would not have been appropriate (Clifford et al., 2023). Developing partnerships between school stakeholders and universities has several practical implications. For example, co-developing interventions create a synergy that potentially enhances children's PE experiences (Reed et al., 2021). Similarly, teachers provide contextual knowledge about the children and the school, as well as practical information regarding time, equipment, and space, which together have the potential to increase the feasibility and effectiveness of interventions (Fairclough et al., 2024). Meanwhile, researchers can ensure interventions are theoretically sound and the process is methodologically robust (Skivington et al., 2021). It is hoped that this collaborative approach will increase the interventions' relevance, usability, and acceptability, leading to better implementation and outcomes through greater teacher buy-in and ownership (Darby, 2017; Fairclough et al., 2024). To further support and facilitate academic collaboration with school stakeholders, school sport and PA partnership networks should be established and/or utilised.

Strengths and limitations

This study's strengths are multifaceted and highlighted by its adherence to the principles of co-development and participatory research (Leask et al., 2019; Smith et al., 2023). By involving both teachers and children in interactive workshops, the study captured rich data and insights on implementation and translation to PE contexts that might otherwise have been overlooked. The close collaboration between researchers and teachers during the development of the intervention fostered a sense of ownership and commitment among all stakeholders. This cooperative approach ensured that the interventions were both theoretically sound and contextually relevant. However, several limitations should be noted. A total of 12.5 hours were spent in each school conducting the co-development workshops, and an additional 1.5 hours were dedicated to consulting with the teachers via email about the curriculum, underscoring the significant time commitment required (Oliver et al., 2019). Participating in co-development workshops may be challenging for school stakeholders with limited capacity (March et al., 2022). The scheduling of these workshops was arranged around stakeholder availability and stringent research timelines (Buckley et al., 2019; 2023). Despite our best efforts to adhere to the pre-agreed schedule, sporadic changes within the school setting and the need for teachers to balance their regular duties sometimes made this challenging. Although scheduling disruptions did not directly impact the study, future research should consider adopting longitudinal, action research designs that could afford greater flexibility in co-developing interventions with school stakeholders.

Conclusion

In conclusion, this study offers valuable guidance on co-developing interventions with stakeholders using gamification as a pedagogical model. By adhering to a rigorous co-production process supported by existing research and theory, this study establishes a workable framework for future researchers. Although three contextually specific interventions were developed, educators in other settings can adapt these interventions to their school environments. This study represents the first step in a broader research agenda. Further research is needed to analyse the feasibility and acceptability of these gamified MC interventions and to investigate their potential to enhance EI through improved MC and engagement.

Chapter Five: Study Two

Feasibility, Acceptability and Preliminary Effectiveness of a Gamified Physical Education Intervention on Motor Competence and Emotional Intelligence

Based on a paper under review in European Physical Education Review:

Rice, J., Foweather, L., Magill, C., Foulkes, J., De Meester, A., Lenoir, M., Stodden, D., Fitton Davies, K (under review) Feasibility, acceptability and preliminary effectiveness of a gamified education intervention on motor competence and emotional intelligence

Thesis Study Map

Study	Objectives
Study 1: Co-development of a gamified physical education movement competence intervention with school stakeholders.	**Objectives:** • Co-develop a gamified PE intervention with Year 5 children (age 9 to 10 years) and teachers. **Findings:** • Three gamified PE curriculums were co-developed with primary school children and teachers.
Study 2: Feasibility, acceptability and preliminary effectiveness of a gamified physical education intervention on motor competence and emotional intelligence.	**Objectives:** • Evaluate the feasibility and acceptability of a co-developed gamified PE intervention in a primary school context. • Evaluate the feasibility of the study process (i.e. recruitment) and management (i.e. data collection) in a primary school context. • Explore the preliminary effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children.
Study 3: The effects of a gamified physical education intervention on motor competence and emotional intelligence among primary school children: a quasi-experimental pilot study	**Objectives:** • Explore the effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children. • Evaluate the acceptability of a co-developed gamified PE intervention in a primary school context. • Develop and pilot a tool to assess the fidelity of the delivery of gamified pedagogy in PE.

Study Context within Thesis

Chapter Five will present the second study of this PhD thesis, which aimed to evaluate the feasibility and acceptability of the study protocol, including recruitment, adherence and retention, as well as the gamified PE curriculums. In addition, this study sought to assess the preliminary effectiveness of the intervention on EI, MC, BPNs and motivational regulations in

PE and PA. Trialling both the study protocol and the intervention, allowed for the collection of valuable information and data to inform the design and refinement of a subsequent trial.

Abstract

Introduction: Assessing the feasibility and acceptability of a study protocol and intervention is important for determining the practical viability for a subsequent future trial. **Aims:** This study evaluated a) the feasibility and acceptability of a gamified physical education (PE) intervention among 9-10-year-old children and b) intervention effectiveness on emotional intelligence (EI), motor competence (MC), basic psychological needs (BPNs) and motivational regulations. **Methods:** A single-group, mixed-methods pre-post-trial was conducted in three primary schools in the northwest of England. The gamified PE lessons were delivered by classroom PE teachers for 10 weeks, with one 60-minute lesson per week. Researcher logs were used to assess recruitment, retention, adherence and attrition. In addition, feasibility and acceptability were evaluated using three semi-structured interviews (teachers; n=3) and three focus groups (children; n =18). Child questionnaires were used to assess EI, BPNs and motivational regulations. The Körperkoordinationtest für Kinder was used to measure MC. **Results:** Three teachers and 63 children (105 %) were recruited to participate in the study. Adherence to the intervention was good, with 26 out of the possible 30 scheduled lessons delivered, and participant retention was excellent with a 0% attrition rate. Qualitative findings showed the gamified intervention to be feasible and acceptable, as lessons were easy to follow, well-structured, inclusive, fun and increased teamwork. Challenges were mainly attributed to logistical issues (i.e. set up time and equipment management). An improvement in EI (F = 41.93, p <.001), MC (p < .05), intrinsic motivation in PE (F = 10.08, p = .002), and identified (F = 11.84, p < .001) and external regulation (F = 4.15, p = .046) for physical activity, was observed from pre- to post-test. **Conclusion:** Findings provide preliminary support for this co-produced intervention's feasibility and effectiveness, warranting a larger controlled trial.

Introduction

In Chapter Four, the gamified PE intervention were co-developed with school-stakeholders. This chapter aims to assess the feasibility and acceptability of both the study protocol and intervention, as well as the preliminary effectiveness of the intervention. This exploration of the feasibility and acceptably was important as it facilitated the collection of valuable data to inform the design and refinement of a subsequent trial.

Acquiring EI skills, such as social- and self-awareness, during childhood - particularly during the preadolescent stage (ages nine to 12) - is crucial for holistic development and psychological well-being (Lea et al., 2019). High EI is positively correlated with PA behaviours (Adamo-Alonso et al., 2019), motivation in PE (Rico-González et al., 2023) and MC (Orangi et al., 2023). Cross-sectional evidence suggests that EI is important for holistic development, but experimental evidence is needed to explore cause and effect, and associated mechanisms.

PE is considered a key learning environment to facilitate the development of EI (Castillo-Viera et al., 2020; Rico-Ganzález, 2023). PE lessons expose children to potentially stressful situations, consequently enabling them to learn to manage their intrapersonal competencies, such as self-control and emotional expression (Castillo-Viera et al., 2020). Additionally, PE lessons enable children to develop interpersonal competencies, such as social skills and prosocial behaviours, through communication, cooperation, and problem solving with peers (Opstoel et al., 2020).

MC, defined as an individual's proficiency to execute a broad range of movement skills (Utesch and Bardid, 2019), is also an important aspect of a child's development. For example, MC is positively associated with PA participation (den Uil et al., 2023) and is hypothesized to promote continued PA throughout life (Stodden et al., 2008). Furthermore, MC is positively associated with mental health attributes (Hill et al., 2024) and low MC is associated with less favourable psychosocial outcomes, including poor social skills, depression and anxiety (Mancini et al., 2016).

Few studies have explored the association between MC and EI. Orangi et al. (2023) reported a strong positive association between MC and EI in three different age groups (five to 11 years old, 12 to 17 years old, and 18 to 21 years old). These findings suggest that even from a young age, children with low MC may have lower EI than their peers with higher MC levels. The relationship between MC and EI can be elucidated by the Elaborated Environmental Stress Hypothesis (EESH: Cairney et al., 2013). The EESH posits that low levels of MC act as a primary stressor, which exposes children to secondary stressors such as lack of social interaction and conflicts with peers (Cairney et al., 2013). These experiences can negatively impact self-esteem, overall well-being, and PE participation. EI acts as a protective resource against stress, helping to prevent internalising issues. Improving MC enhances success in various activities, which also is linked to improved self-perceptions and confidence, which encourages sustained participation in PA (Niemistö et al., 2023). Increasing participation affords children opportunities to further develop EI skills through experiences of winning and losing, which help children to manage their emotions and behaviours in social contexts (Rico-Gonzalez, 2023).

Gamification, defined as the use of game-like elements in non-gaming contexts (Deterding et al., 2011), has shown to be a viable pedagogical approach in PE (Fernández-Rio et al., 2020). Unlike traditional models, gamification is a student-centred approach that aims to motivate and engage learners and support-problem solving (Kapp, 2012). In PE, it is essential that children are motivated and engaged to enable the development of MC (Saiz-González et al., 2024). According to SDT, intrinsic motivation, which is positively linked to persistence and performance in PE (Vasconcellos et al., 2020), occurs when children's basic psychological needs (BPNs): autonomy (control of one's actions), relatedness (connectedness to others), and competence (mastery in one's actions) are met (Ryan and Deci, 2020). Prior research has shown that gamified interventions in PE can improve BPNs among primary school-aged children (Sotos-Martinez et al., 2024). Blain et al.'s (2022) theoretical framework illustrates how gamification strategies such as levels, challenges, relationships, narratives, and points can effectively support BPNs. For example, *levels* allow children to exercise decision making (autonomy), *teamwork* fosters peer connections (relatedness), and progressively difficult *challenges* promote skill development (competence). Some studies have also reported positive effects on intrinsic motivation (Fernández-Rio et al., 2020), PA (Guijarro-Romero et al., 2024), movement skills in older children (Fernández-Vázquez et al., 2024) and stability skills in younger children (Davies et al., 2024). Additionally, research conducted with university students found a significant positive effect on EI following a 14-week gamification intervention (Navarro-Mateos et al. 2024). Taken together, gamification may be a viable pedagogical model in PE to improve MC and consequently EI, as conceptualised in the EESH model (Cairney et al., 2013). However, with limited evidence on the effectiveness of gamification in primary PE targeting MC and consequently EI, more research is needed to evaluate the effect of gamification on both MC and EI.

The present study examined whether the co-developed gamified PE curricula (Rice et al., 2025), and the study trial itself, were feasible and acceptable for the intended population (i.e. children aged 9 to 10). In a previous study the gamified PE curricula interventions were co-developed in collaboration with teachers and children (Rice et al., 2025). Co-developing interventions with school stakeholders has the potential to enhance the feasibility, acceptability, sustainability, and relevance, facilitated by the direct involvement of school stakeholders (Reed et al., 2021). Indeed, feasibility studies are typically conducted to determine whether the process (e.g. recruitment) and management (e.g. data collection) can be successfully replicated in a larger, definitive trial (Thabane and Lancaster, 2018). Furthermore, assessing feasibility with both teachers and children is important to ensure the intervention is practical, relevant, and likely to be successfully implemented in school settings (Leahy et al., 2021). The primary aim of the current study was to evaluate the feasibility and acceptability of the intervention. A secondary aim was to explore the preliminary effectiveness of the intervention on children's EI, MC, BPNs and motivational regulations.

Methods

Study design

This study employed a single-group pre-post design (Pearson et al., 2020). The gamified PE lessons were delivered between April and June 2023. Gatekeepers (i.e. headteachers) consented to integrating the lessons into the school PE curriculum, so all children participated, including those who did not consent to participate in the research. Measures were completed at baseline (T0: March 2023) and post-intervention (T1: July 2023) by JR. However, the Motor Competence Assessment (MCA) was only collected at T1 due to delays in equipment arrival for T0. Feasibility and acceptability data were collected from teachers and children in July 2023 following T1 data collection. For the intervention programme, Hastie and Casey's (2014) guidelines were followed. This study received institutional ethical approval (23/SPS/008) and followed CONSORT reporting guidelines (Schulz et al., 2010).

Sample size

Feasibility studies generally do not require a formal power calculation (Eldridge et al., 2016), as the data analysis are considered preliminary. Recommended sample sizes for feasibility studies range from 30 to 50 participants (Beets et al., 2021). For these reasons, the study aimed to recruit 60 children to account for potential attrition.

Recruitment and participants

A convenience sample of three schools and three teachers were recruited for the study. Schools were recruited as part of the co-development study and following headteacher consent (see Chapter Three; Rice et al., 2025). Each school was located in an area of low socio-economic status, as determined by the index of multiple deprivation (Ministry of Housing Communities and Local Government, 2019), with 33-63% of children eligible for free school meals. The inclusion criteria for child participants were: (1) a year five pupil; (2) aged 9 to 10 years; and (3) provided informed parental consent and child assent. For teacher participants, the inclusion criteria were: (1) responsible for teaching PE to their respective year five class. Informed consent was obtained from teachers and parents, and assent was obtained from the children. All three teachers were female (mean age = 42 years) and White British. Two teachers were PE leads in their schools and teaching experience ranged from 5 to 20 years.

Intervention programme

Before delivery, teachers participated in a two-hour Continuing Professional Development (CPD) workshop to re-familiarise themselves with the lesson plans (Goodyear, 2017) created in Chapter Three. The lessons were designed to be delivered during PE lessons once a week for 60 minutes, over a 10-week period by the respective teacher. Lessons focused on different themes each week (see Table 9) and were structured to include a warmup and two developmental activities, as well as a step-by-step content progression (i.e. skill development). Further, each lesson integrated a minimum of four gamification strategies (e.g. narrative, levels, challenges, relationships), along with choices in the activity difficulty, equipment, and peers worked with.

Table 9. Intervention weekly lesson content

Week	**Content**
Week One	Throwing and catching
Week Two	Jumping and landing
Week Three	Striking and rolling an object
Week Four	Agility
Week Five	Obstacle course (incorporation of week one to four skills)
Week Six	Dribbling hands and feet
Week Seven	Throwing and catching
Week Eight	Gymnastics
Week Nine	Dodging and invasion
Week Ten	Obstacle course (incorporation of week six to ten skills)

Each school's curriculum had a different theme and narrative: *A quest through time* took the children on a teleportation adventure to Ancient Greece, with activities in each lesson bringing them closer to the present day (School A); *The American dream* involved the children starting in New York and travelling across different states, completing activities related to each state's geography (School B); and *Treasure Island* involved the children completing tasks to earn crystals needed to save the island (School C). Example curriculums are presented in Appendix A.

Primary outcomes

Trial feasibility

Table 10 presents the traffic light criteria (Avery et al., 2017) used to assess the feasibility of the gamified PE lessons (i.e. green: acceptable, continue to the next stage of the trial; amber: amend and discuss; red: re-design, as the next stage is not appropriate). Previous studies informed our progression system (see Fernandez-Rio et al., 2020; Fairclough et al., 2024). Measures of recruitment (obtaining informed consent from children), adherence (dose of the lessons) and retention (how many children participated in the assessments pre – post intervention) were evaluated using researcher and teacher logs, and qualitative interviews.

Implementation acceptability

Implementation of the gamified PE lessons were explored through semi-structured interviews with each PE teacher (n = 3) and focus groups with a subsample of six children (3 boys, 3 girls) from each school (18 children in total). The interview and focus group questions were informed by Bowen's (2009) framework (see Table 11) and conducted by JR**.** Interviews with each teacher took place on Microsoft Teams, lasting 39, 45 and 53 minutes, respectively. Interview questions included: 'What factors did not work well in the curriculum?' and 'How easy was the curriculum to implement' (see Appendix B for the full interview schedule). Focus groups adhered to previous protocols (Alder et al., 2019) and took place in a quiet classroom, during curriculum hours and lasted 15, 27, and 35 minutes, respectively. Focus group questions included: 'What was your favourite lesson, and why?' and 'Do you think the lessons were easy for your teacher to deliver? (see Appendix C for the full interview schedule).

Table 10. Feasibility Traffic Light Progression Criterion

Progression criteria.	Methods used	Green: Acceptable	Amber: discuss and modify	Red: stop
1. Recruitment: child participants	Researcher logs	≥75% of eligible children consented	35 – 74% of eligible children consented	<35% of eligible children consented
2. Adherence: intervention dose	Semi-structured interviews Focus groups	≥80% of scheduled lessons delivered	40%-74% of scheduled lessons delivered	<40% of scheduled lessons delivered
3. Baseline (T0) child-completed quantitative measures	Researcher logs	≥75% of data collected from children	50-74% of data collected from children	<50% of data collected from children
4. Follow up (T1) child-completed quantitative measures	Researcher logs	<20% data attrition	21-30% data attrition	>30% data attrition

Table 11. Feasibility and acceptability codes and brief descriptions of evidence based on Bowen et al. (2009) framework.

Focus Area	Code	Descriptions
Higher order codes	**Lower order codes**	
Acceptability	Appropriateness	Elements (i.e. activities, narrative, national curriculum, lesson content, structure, and design) of the lessons were suitable for the purpose, situation and participants (i.e. school setting and children).
	Satisfaction	Teacher and child satisfaction (i.e. liking, disliking, gamification strategies, and usefulness to promote social and movement skills).
	Intention for future use of the gamified PE lessons	Intent to use the lessons post-intervention, including participants reasons.
Feasibility Codes		
Implementation	Dosage and duration	Lessons were implemented as intended (i.e. dosage and duration).
	Implementation degree	How the lessons were implemented (e.g. ease of implementation and gamification strategies, and the barriers and challenges to implementation).
Adaptations	Adaptations	Adaptations made during the intervention.
	Adaptations for other populations	Suggested adaptations for other populations.
Integration	Suitability for other participants	Suitability of the lessons for other schools.

Secondary outcomes

Emotional intelligence. The Schutte Self-Report Emotional Intelligence Test (SSEIT; Schutte et al., 1998) is a 33-item questionnaire including four sub-regulations related to optimism and mood regulation (N = 11), appraisal of emotions (N = 6), utilisation of emotions (N = 4) and social skills (N = 5). Items were scored using a 5-point scale ranging from 1 ('strongly disagree') to 5 ('strongly agree'). The questionnaire is a valid and reliable instrument for primary school-aged children and the internal consistency for the questionnaire has a Cronbach alpha of .90 (Schutte et al., 1998).

Motor competence. The Körperkoordinationtest für Kinder (KTK3+; Coppens et al., 2021) is composed of four test items: jumping sideways, moving sideways, eye-hand coordination and balancing backwards. Jumping sideways, moving sideways and eye-hand coordination consist of two trial attempts summed together for a final item score. Balancing backwards has three trial attempts per beam (6.0cm to 4.5cm to 3.0cm) and the final item score is the total amount of steps counted, with a maximum of 72 steps or 8 per trial beam. The KTK3+ is valid and reliable in children aged 6 to 19 (Coppens et al., 2021).

The Motor Competence Assessment (MCA; Luz et al., 2016) is composed of six subscales: Shifting Platforms (SP) and Jumping Sideways (JS) for stability; 4 x 10-meter Shuttle Run (SHR) and Standing Long Jump (SLJ) for locomotor; and Ball Throwing Velocity (BTV) and Ball Kicking Velocity (BKV). For SP, JS and SHR, participants had two trial attempts, and three trial attempts for SLJ, BTV and BKV. The final item score was taken from the best trial. The MCA is valid and reliable in children aged 7 to 10 (Luz et al., 2016).

Needs satisfaction. The Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) was used (Van der Kaap-Deeder et al., 2020). The initial phrase 'how you feel in general' was changed to 'how you feel in PE' to evaluate BPNs and frustration in PE (e.g. Vlachopoulos et al., 2011). The scale consisted of 24-Likert items, assessing overall satisfaction and frustration, with a range of scores from 1 ('completely not true') to 5 ('completely true'). The scale is valid and reliable to use with children aged 7 to 11 years old (Vlachopoulos et al., 2011).

Motivational regulations in physical activity. The Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan et al., 1997) adapted to PA (Sebire et al., 2013) was used to measure students' motivation for PA. The scale consisted of 12-Likert response items assessing intrinsic, identified, introjected and external motivation, with a range of scores from 1 ('not true for me') to 5 ('very true for me'). The questionnaire has been shown to be reliable and valid with children aged 7 to 11 years (Sebire et al., 2013).

Motivational regulations in physical education. The Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan et al., 1997), adapted to PE (Sebire et al., 2013) consisted of 12-Likert response items assessing intrinsic, identified, introjected and external motivation, with a range of scores from 1 ('not true for me') to 5 ('very true for me'). The questionnaire is reliable and valid in children aged 7 to 11 years (Sebire et al., 2013).

Data analysis

Quantitative analysis

IBM SPSS statistical software (Version 29) was used to perform all statistical analyses. Internal consistency on questionnaire items was checked. Cronbach α were interpreted as unacceptable

(< 0.5α), poor (0.6 α ≥ 0.5), questionable (0.7 α ≥ 0.6), acceptable (0.8 α ≥ 0.7), good (0.9 α ≥ 0.8) and excellent (α ≥ 09) (Tavakol and Dennis, 2011). A two-way mixed analysis of variance (ANOVA) test was performed to compare the effects of the intervention on child-level outcomes between genders, with time (pre- and post-intervention) serving as the within-group factor, and gender (girls and boys) as the between-subject factor and time effects on child-level outcomes. For multiple comparisons, effect size (ES) was derived from ANOVA as partial eta-squared (η^2) with $\eta^2 = 0.01$ indicating a small effect, $\eta^2 = 0.06$ a medium effect, and $\eta^2 = 0.14$ a large effect (Miles and Shavelin, 2001). All statistical assumptions were met (Judd et al., 2017), and scores were normally distributed (Shaprio-Wilks test, p >.05). There were no outliers (±3 (SD) and normal Q-Q plot) and there was homogeneity of variances (Levenes test, $p > .05$) and covariances ($p > .001$). Statistical significance was assessed using a p-value threshold of 0.05, with results considered significant when $p < 0.05$ (Di Leo and Sardanelli, 2020).

Qualitative analysis

This study took a relative ontological view, acknowledging reality is not fixed but instead subjectively experienced (Guba and Lincon, 2005). Semi-structured interviews and focus groups were audio recorded and then transcribed verbatim by JR. The transcripts were uploaded to NVivo for analysis. The transcripts were deductively coded (Bingham and Witkowski, 2022) using pre-defined key concepts from the definitions of feasibility and acceptability (Table 11). From there, sections of the transcripts assigned to the codes were then analysed to identify sub-themes. Transcripts were then inductively coded to identify any additional feasibility and acceptability themes. The overall process aligned with the six-phase reflexive thematic analysis (Braun and Clarke, 2019). Letters and numbers were assigned to participants to maintain confidentially and differentiate the teachers and students from three schools. For example, a teacher from school A and a child from school A were coded as Teacher A and Child A, respectively.

Results

Primary outcomes

Trial feasibility

Figure 5 presents a CONSORT flow diagram for participants through the study. From the ninety-one children invited to participate, a total of 69.3% (n = 63; M age = 9.43 ± .05 years; 28 males) children provided informed consent to take part (progression criterion 1 = amber). Consent rates were: 54% (School A), 55% (School B) and 100% (School C). The classroom teachers delivered 86.7% of the scheduled gamified PE lessons, reflecting 26 out of the 30 lessons (progression criterion 3 = green). School A and B delivered 80% of the lessons (n = 8) and School C delivered 100% (n = 10). Non-delivered lessons were due to a school inspection (n = 1, Teacher B) and school commitments (e.g. school trip, sports day; n = 3, Teacher A and B). In contrast to what the teachers reported, children reported that only 66.7% of the scheduled lessons had been delivered, which reflected 20 out of the 30 lessons (progression criterion 4 = amber). According to the children, School A delivered 20% (n = 2), School B delivered 80% (n = 8) and School C delivered 100% (n = 10) of the lessons, respectively. None-delivered lessons were a result of non-teacher delivery (Child A) and school trips and a sports day (Child B). At T0, 100% (n = 63) of children completed the child-level measures, except for the MCA (progression criterion 5 = green). Data attrition at T1 was 0% for all child-level measures, indicating high retention. For the KTK3+ and the MCA test duration was between 20 - 30, and 30 – 50 minutes, respectively, depending on the group size (n = 5 – 8). For the EI, BPNs and motivational regulation questionnaires, test duration was 10-minutes per questionnaire, with a class of 30 children.

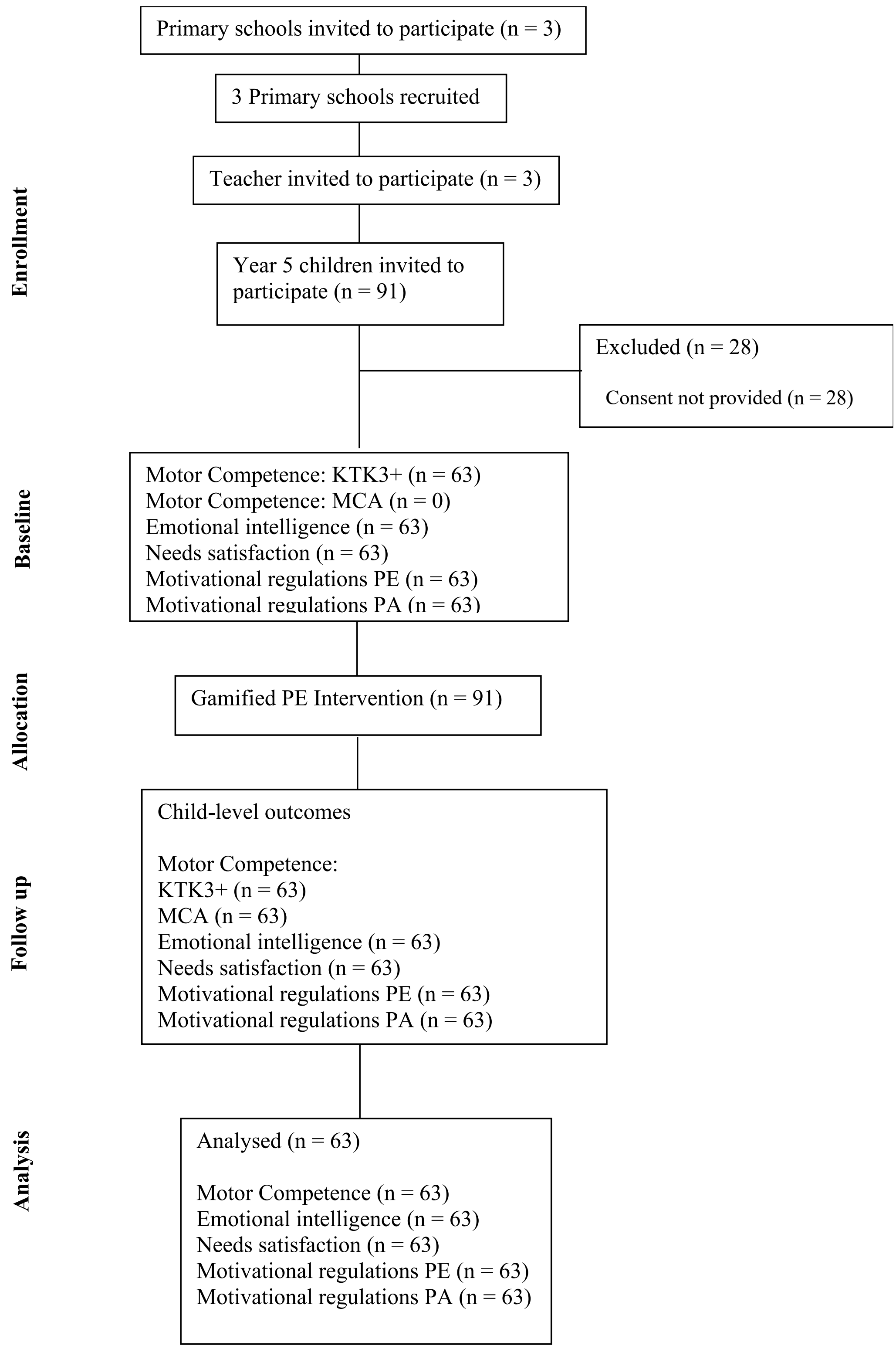

Figure 5. CONSORT flow diagram for participants through the study

Implementation feasibility

Ease of implementation

A commonly expressed theme by the teachers was that the lessons were easy to implement, and were facilitated by the resources*:* ‘the teaching resources were easy to follow’ (Teacher B); lesson diagrams: ‘the diagrams made it easier, and were helpful for setting up and showing the children’ (Teacher C); and lesson structure: ‘the structure of the lessons were clear, so I knew what I needed to teach’ (Teacher A). Further, teachers reported the importance of the CPD workshops, commonly referencing the re-familiarisation with the lessons: ‘we sat down and went over the lessons, it made it easier to then deliver them’ (Teacher C) and implementation of the gamification strategies ‘the workshops beforehand helped me to understand what the strategies were, and how we could put them into play’ (Teacher A).

Challenges to implementation

The most commonly reported themes were attributed to unclear lesson diagrams: ‘the diagrams, I think Miss [teacher] was a bit unsure on the set-up sometimes’ (Child C) and behavioural issues: ‘it’s hard some people have ADHD, and some people mess around making it hard for Miss [teacher]’ (Child B). No challenges or barriers were reported by the teachers, although teachers referenced that set-up time: ‘sometimes the amount of time needed before hand to set up was challenges’ (Teacher C) and the quantity of equipment: ‘having so many different size balls and lots of them’ (Teacher B) was problematic at times. Teachers, however, suggested that it was manageable and just a case of being organised. Instances of environmental factors were mentioned by one teacher, namely practical indoor space: ‘our hall is tiny, when we had to come inside because of the weather, there isn’t much space’ (Teacher A).

Adaptations

The most commonly reported adaptations during implementation were related to special educational needs (SEN): 'I adapted the height of the hurdles [jumping and landing lesson] for the children with SEN, as I could see them struggling' (Teacher A), and child competence: 'we stayed on specific parts [the levels] for longer if they were struggling and would bypass levels, they found easier' (Teacher B). Notably, teachers reported the importance of knowing the needs of the children and how this made it easier to adapt the lessons. Overall, teachers reported that the lessons could be adapted for other schools, suggesting that the research team could benefit from discussions with other schools regarding a) the needs of the children in the class, b) access to equipment, and c) practical PE space.

Integration

Teachers most frequently cited inclusivity: 'they [the gamified PE lessons] appeal to a range of students and teachers and are really inclusive' (Teacher C); the novelty of gamification: 'it is a novel concept, and something that both teachers and children will enjoy' (Teacher B); and increased participation as factors that would make the lessons suitable for other schools. Participation was also commonly reported by children: 'for people who do not like PE it is still fun, and *child's name* joined in, and never normally does' (Child B). Other frequently reported elements reported by the children were the enjoyability of the lessons: 'they will enjoy them, they're fun' (Child C) and the gamification strategies: '…like you can do States [intervention theme] in the classroom but we did them in PE with the levels, challenges and stuff' (Child C).

Implementation acceptability

Appropriateness of the lesson content

The most commonly reported factors were the variety of activities: ‘the variety worked well, there were lots of activities’ (Teacher A), volume of content: ‘it was good to have a lot planned, sometimes I was unsure on how the children would react to parts’ (Teacher C) and the range of skills: ‘the children got to develop different skills’ (Teacher B). Other factors noted by both children and teachers included that the intervention was easy to follow, well-structured and planned. Children particularly emphasised the importance of the narrative: ‘the PE lessons had a storyline you followed, and you completed activities to move on to the next one’ (Child C). Although, a few children reported that the lessons were either too easy or too difficult: ‘some of them were too easy’ (Child A) and ‘some of them were a bit complex and hard’ (Child C).

Appropriateness of the narrative

Children commonly attributed the narrative to be appropriate due to their previous input [co-development process]: ‘we did help to do the story (Child C) and the link between the narrative and activities: ‘all the activities linked to the story’ (Child A). The latter theme was also commonly reported by teachers: ‘they understand why they are doing activities because it’s related to the narrative’ (Teacher A). Another common factor reported by teachers was the novelty: ‘it was something the children hadn’t done before’ (Teacher C) and the coherency of the narrative: ‘the children understood and were familiar with the narrative concepts.’ (Teacher B). Although, a child indicated that the narrative (escaping Alcatraz as a prisoner, using dodging and invading) could be considered ‘controversial’, suggesting: ‘I think it’s a bit controversial, if they learn violence from it, since you know cops, if prisoners don’t listen, they try to inflict violence’ (Child B). Overall, teachers reported the lessons to be appropriately aligned to the PE National Curriculum. Namely, in relation to other areas of the curriculum:

‘the PE lessons linked to other areas of the curriculum’ (Teacher C) and National Curriculum PE aims: ‘yes. It covered learning aims for now, and previous years for PE’ (Teacher B).

Satisfaction

High satisfaction was indicated from the teacher and child perspective; responses and quotes are presented in Table 12. The most commonly expressed themes from both teachers and children were high satisfaction with the obstacle course lessons: ‘I enjoyed seeing all the children working together, I took a step back and let them work together’ (Teacher C); the gamification strategies: ‘I absolutely loved using gamification, it makes it easier to deliver something when you enjoy it’ (Teacher B); and the intervention generally: ‘sometimes I find PE un-fun, but this was fun’ (Child C). Table 13 presents examples of gamification strategies from the children.

Usefulness of the lessons in promoting social and movement skills

Teachers reported the usefulness of the lessons in promoting different skills. The most expressed themes were teamwork, encouragement of peers, and positive leadership. Other themes included promotion of participation: ‘one child in class usually just stands on the side, but they joined in’ (Teacher B). Children also noted the promotion of social skills. Commonly expressed themes were kindness, due to the reduction in competition: ‘people were kinder to each other because there isn’t winners and losers’ (Child B); co-operation: ‘I worked with people I don’t usually and got better at it’ (Child C) and teamwork skills: ‘we worked better as a team’ (Child B). Another theme expressed by children was that the curriculum helped them with specific movement skills: ‘throwing and catching, now I can catch the ball, and it doesn’t just go in my face’ (Child C). The influence of peers was also noted by some children as useful in promoting specific skills:

‘We used to argue a lot in PE, because *child’s name* is good, but I am not as good, but she helped me, and I have helped her. I got to know her better, and I started to play out with more at home’ (Child B)

Dissatisfaction

In addition to demonstrating satisfaction, a minority of children indicated dissatisfaction. Common themes included lesson difficulty: ‘it needed to be harder’ (Child B); specific skills: ‘I didn’t like how you had to land when you jumped’ (Child C); lesson pace: ‘it needed to be faster’ (Child B); unclear rules: ‘the rules needed to be clearer’ (Child C) and students’ behaviour: ‘people didn’t listen properly’ (Child B).

Intention for future use

Two out of three teachers demonstrated intent to continue using the gamified PE lessons. Teacher A reported: ‘I have loved doing it, I plan to try it next year with a new class’. While Teacher C demonstrated that they plan to use it for either (a) cross curricula teaching: ‘we can use different parts of the curriculum for areas of learning in different subjects’, or (b) specific skill development: ‘I can pull out the curriculum if the children are struggling on a specific skill’. One teacher demonstrated no intent to use the curriculum: ‘no, I am moving down to year 1, and the skill level and narrative wouldn’t be appropriate for that age group’ (Teacher B).

Table 12. Examples of quotes from children and teachers for satisfaction

Participant	Satisfaction response	Example quote
Children	Enjoyment	'Because It was fun'
	Competition	'That we sometimes got to go against each other'
	Creativity	'We got to make our own obstacle course, and be creative'
	Skill development	'We learnt new skills.
	Lesson difficulty	'It was easy, medium, and hard. There was always a choice of difficulty, and it was good'.
	Equipment	'We got to use the ropes and equipment that we haven't been on since reception'
	Lesson narrative	'When we got to go to Alcatraz'.
	Range of activities	'When we used the hoops and jumped across'.
Teachers	Narrative/Story	'Children enjoyed the story; they knew what was coming each week'.
	Skill development	'Children knew which skill they were aiming to develop and improve'.
	Inclusive lessons	'Children with autism, or anxiety around PE really enjoyed the lessons, there have been times where they struggle with PE and structure'.
	Novelty	'It was something different for the children'.
	Enjoyment	'The children loved it'.

Table 13. Gamification strategies identified by the children during the focus group

Gamification strategy	Example of quotes from the children
Narrative/ Story	'The story and we collected jewels, and had to fight pirates and like think, it was in sinking sand'. 'When we went to Alcatraz, the story was there was escaped prisoners on the island and there are 3 or 4 cops, and they ran across and tried to dodge out the way'. 'When the guards had to guard the keys away from the prisoners, these were bean bags'. 'They had [PE lessons?] like a story to go through it'.
Emotions	'Sometimes I would get frustrated if I couldn't do something'. 'Having fun, is fun one?'
Relationships	'As a warmup we had spots and we had to try and jump over them, er with your partner, and when you were coming back you had to swap'. 'We were in groups, and we had to work together to do something'. 'We could pick who we worked with in groups'.
Progression	'You had to like to follow and complete activities to move on to the next one'.
Rules	'Rules, some were complex, and some were basic'.

Gamification strategy	Example of quotes from the children
Challenges	‘There were loads of challenges, like loads, sometimes we couldn’t do them all’.
Competition	‘Competing and going against each other in hockey’.
Co-operation	‘In gymnastics, we had to make a routine with other people’. ‘We helped each other throw the luggage down the line’.
Choice	‘We could choose what routine we did’. ‘The obstacle course, we did it ourselves and we could choose how we did them and what we did’
Levels	‘Like you know the different levels and stuff that we had to do’
Points	‘In one game, we had to get points, and the team with most points got to fly first class’
Achievements	‘We got gems after every lesson, and we had to collect them for the final lesson’.

Secondary outcomes

At T0 and T1, 63 children (44% boys, 9.43 ± .05 years) completed all assessments, except the MCA, which was only completed at T1. Table 14 presents descriptive statistics.

Emotional intelligence

Three of the five SSEIT subscales had questionable or poor internal reliability (0.68 for utilisation of emotions; 0.56 for appraisal of emotions; and 0.48 for social skills) and were removed from the analysis. Two subscales had good or acceptable internal reliability (Global EI 0.87 and optimism and mood regulation 0.70) and were therefore analysed.

For global EI, significant differences were found at baseline between genders; F (1,61) = 5.01, p = .029, η^2 = .076. Girls scores (M = 115.25, 95% CI; 109.68, 120.82) were significantly higher than the boys (M = 105.89, 95% CI; 99.68, 112.12). Global EI improved from pre-test to post-test: F (1, 61) = 41.93, p <.001, ^{2} = .407, with scores higher at post-test. For, optimism and mood regulation non-significant differences were found at baseline between genders (p = .172). Optimism and mood regulation improved from pre-test to post-test: F = 35.53, p < .001, η^2= .368

Motor competence

No significant differences were found at baseline between genders for all subsets (p >.05). MC improved from pretest to post-test for jumping sideways: F (1,61) = 51.44, p <.001, η^2 =.458, moving sideways: F (1,61) = 3.34, p = .024, η^2 = .075, balancing backwards: F (1,61) = 4.96, p = .030, η^2 = .075, and eye-hand coordination: F = 19.87, p <.001, η^2 =.246. No significant time x gender interactions for each subtest were revealed (p >.05).

Table 14. Means and standard deviation (SD) from the raw scores for each child-level outcome at pre (T0) and post (T1) intervention (n = 63).

Outcome	**T0 (Mean, SD)**	**T1 (Mean, SD)**	t	***p***	**Effect size (Cohen d)**
Emotional Intelligence					
Optimism and mood regulation	36.85 (5.78)	42.25 (5.87)	5.73	<.001	.72
Global emotional intelligence	111.09 (17.01)	124.44 (13.56)	6.13	<.001	.77
Motor competence: KTK3+					
Jumping sideways	52.33 (14.86)	65.90 (14.73)	7.31	<.001	.92
Moving sideways	30.06 (7.14)	32.46 (8.28)	2.25	.028	.28
Balancing Backwards	35.60 (15.53)	39.22 (14.53)	2.32	.024	.29
Eye-hand co-ordination	19.71 (15.53)	28.55 (15.38)	4.60	<.001	.58
Motor competence: MCA					
Ball kicking velocity		26.33 (3.50)			
Ball throwing velocity		29.60 (4.74)			
Standing long jump		145.74 (18.51)			
Shuttle run		14.00 (1.52)			
Jumping sideways		36.95 (7.22)			
Shifting platforms		17.93 (3.96)			
Needs satisfaction (BPNSFS)					
Total satisfaction	3.51 (0.67)	3.56 (0.66)	.44	.655	.05
Total frustration	2.67 (0.74)	2.63 (0.81)	-.33	.742	-.04

Outcome	T0 (Mean, SD)	T1 (Mean, SD)	t	*p*	Effect size (Cohen d)
Motivational Regulations (PA)					
Intrinsic motivation	4.08 (1.13)	4.37 (0.67)	2.22	.060	.22
Identified regulation	3.96 (1.00)	4.30 (0.63)	3.33	.001	.41
Introjected regulation	2.57 (1.01)	2.69 (0.98)	.84	.401	.10
External regulation	2.21 (1.18)	2.57 (1.22)	1.92	.049	.24
Motivational Regulations (PE)					
Intrinsic motivation	3.86 (1.12)	4.29 (0.71)	2.86	.006	.36
Identified regulation	3.65 (1.11)	4.10 (0.71)	3.22	.302	.18
Introjected regulation	2.60 (1.01)	2.69 (0.97)	.62	.532	.07
External regulation	1.96 (.83)	2.10 (0.93)	.96	.169	.12

Note. KTK3+ = The Körperkoordinationtest für Kinder, MCA = Motor Competence Assessment , BPNSFS = Basic Psychological Need Satisfaction and Frustration Scale, PA = Physical Activity , PE = Physical Education

Needs satisfaction

The Basic Psychological Needs satisfaction of the BPNSF had good internal consistency: ≥.80. No significant differences were found at baseline between gender for satisfaction or frustration scales (p > .05). No significant pre-test to post-test differences were observed for satisfaction: F (1,61) = 0.224, p = .638, or frustration scales: F (1,61) = 0.131, p = .719. No significant time x gender interactions were observed for satisfaction: F (1,61) = .075, p = .784, or frustration scales: F (1,61) = .102, p = .750

Motivational regulations PA

The BREQ adapted to PA had good internal reliability: ≥.80. No significant gender differences were found at baseline for intrinsic, identified, introjected and external regulation (p > .05). Increases from pre-test to post-test were found for identified regulation: F (1,61) = 11.84, p < .001, η^2 = .386, and external regulations; F (1,61) = 4.15, p = .046, η^2 = .064. A significant time x gender interaction was found for intrinsic motivation: F (1,61) = 4.20, p = .045, η^2 = .064. Boys' intrinsic motivation increased from pre- to post-test F (1,27) = 5.71, p = .024, η^2 = .175, but not for girls (p = .640, η^2 = 0.007). No other significant time x gender interactions were found (p > .05).

Motivational regulations PE

The BREQ adapted to PE had good internal consistency: ≥.80. No significant gender differences were found at baseline for intrinsic, identified, introjected or external regulation (p > .05). Increases from pre-test to post-test were found for intrinsic motivation: F (1,61) = 10.08, p = .002, η^2 = .142. No significant increases from pre-test to post-test were found for identified regulation: F (1, 61) =.712, p = .402, η^2 = .012, introjected regulation: F (1,61) = .712, p = .402, η^2 = .012, and external regulation: F (1,61) = 1.51, p = .223, η^2 = .024. A significant time x gender interaction for intrinsic motivation was observed: F (1,61) = 4.88, p = .031, η^2 = .074 Boys' intrinsic motivation significantly increased pre to post: F (1,27) = 10.43, p = .003, η^2 = .279, but not for girls (p = .425, η^2 = .019). No other significant time x gender interactions were found (p > .05).

Discussion

This study aimed to investigate the feasibility, acceptability and preliminary effectiveness of a co-developed, gamification intervention in PE. To the lead researcher's knowledge, this is the first study to investigate these specific aims in England, with only one other study having been conducted in Spain (Fernandez-Rio et al., 2020). In addition, this is the first gamified PE intervention targeting both MC and EI. The findings suggest the study trial to be feasible in a primary-school context, with excellent child recruitment and retention rates indicating that scale up to a definitive experimental trial is feasible. These findings, related to recruitment and retention, are consistent (Fairclough et al., 20247) or better (Johnstone et al., 2019) than those reported for school-based interventions. Furthermore, a contributing factor to high rates of recruitment and retention, could be attributed to the schools' previous involvement in the co-development phase (Rice et al., 2025) and the clear communication of the research programme and benefits during recruitment, which potentially helped minimise attrition. Attrition rates were excellent, which is atypical when conducting research in schools (Henneberger et al., 2023). The co-production of the intervention (Rice et al., 2025) and providing schools with advance notice of data collection periods, while accommodating their schedules helped mitigate high attrition rates. Adherence rates were good, and where lessons were not delivered by some schools, this was communicated to the first author via email. Although, it remains unclear whether one school delivered the lessons, due to the disparity in reporting between the teacher and children. Therefore, it can only be speculated that the teacher faced some challenges in delivering the intervention, resulting from external pressures or lack of available time. To address this in future work, weekly evaluation logs should be provided to the teachers to triangulate data (Wong et al., 2022).

The findings indicated that the gamified PE lessons were feasible. Teachers attributed this to the high-quality teaching resources, which are important indictors of intervention feasibility as they can increase children's participation and learning (Jago et al., 2019). Teachers also highlighted the importance of the CPD workshops, which enhanced their teaching practice to provide optimal learning conditions (Morgan et al., 2013). These findings strengthen the argument that high quality PE is supported by PE-CPD that focuses on pedagogy (i.e. gamification), to further children's engagement and enjoyment (Morgan et al., 2019). While findings suggest implementation was not complex, some logistical and behavioural challenges were present, which are consistent with previous research (Quarmby et al., 2019). Adaptations were feasible, particularly for those children with SEN, contrary to the notion that PE neglects such students (Maher, 2018). Furthermore, teachers' willingness to adapt the lessons suggests their competence and confidence in implementing the intervention (Bowins and Beaudoin, 2011). Findings also indicated that the gamified PE lessons could be implemented in other schools, due to their inclusive and enjoyable nature (Fernandez-Rio et al., 2020).

The findings also demonstrated acceptability. Teachers expressed that using gamification in PE was a novel approach (Fernandez-Rio et al., 2020) and the quantity of gamification strategies did not increase the workload, as previously reported (Fernandez-Rio et al., 2020), further supporting the decision to use a minimum of four strategies per lesson (Rice et al., 2025). The children particularly valued the teamwork element of the lessons, supporting the idea that gamification has the potential to foster social interaction (Gil-Madrona et al., 2022). Further, since children develop MC and EI through social interactions with peers (Holloway and Long,

2019) these findings are significant. Teachers also noted that the interventions were effective in promoting both physical and social skills (Abusleme-Allimant et al., 2023). However, there were reports of dissatisfaction with unclear rules, lesson difficulty and disliking of specific skills (Mclellan et al., 2022) necessitating activity rule adjustments in future studies. Some teachers expressed intention to continuing delivering the lessons post-intervention, although one teacher expressed the unsuitability for their new year one class (aged five to six). This is unsurprising given the difference in expected age-related movement skill development (Bolger et al., 2018) and difficulty of the respective activities.

The findings showed a preliminary effect on most child-level outcomes, with significant improvements in global EI and optimism and mood regulation, which could be attributed to increased social interaction, facilitated by the gamification strategies (i.e. challenges, narrative, relationships). Previous research has indicated these strategies as beneficial for enhancing EI in other populations (Navarro-Mateos et al. 2024). In contrast to a previous gamified intervention that showed no significant effect on MC (Fernández-Vázquez et al., 2024), the present study found a positive effect on children's MC, as indicated by the KTK3+ results. There are two plausible explanations for this difference. Firstly, the gamified PE interventions in the current study were explicitly designed to target MC. Supporting this explanation is previous evidence to suggest that PE interventions specifically designed to target MC are more effective than standard PE interventions (Foweather and Rudd, 2020). Second, the gamification strategies implemented, such as the narrative, levels and challenges, may have contributed to the observed improvements since they theoretically support competence (Blain et al., 2022). These strategies were either absent or not clearly described in the intervention by Fernández-Vázquez et al. (2024), which could explain no effects. Furthermore, the pre-test MC scores were significantly lower, compared to the normative values for the KTK3+ (Coppens et al., 2021). Yet, at post-test scores for jumping sideways and eye-hand co-ordination were higher than the normative values for children aged 9 and 10, while scores for moving sideways and balancing backwards were close to the normative value (Coppens et al., 2021), suggesting a regression to the mean. There was a significant increase in identified motivations for PA, which could partly reflect a change in personal importance and conscious valuing of PA (Vasconcellos et al., 2020). However, as previously suggested by Lonsdale et al. (2011) children may not be able to differentiate between what they enjoy (intrinsic) and what they value (identified), thus providing some context to the findings. Consistent with previous research (Fernández-Río et al., 2020; Sotos-Martinez et al., 2023), there was a significant increase in intrinsic motivation in PE. These findings are positive as more autonomous forms of motivation have been positively associated to affective (enjoyment of PE) and behavioural (effort and intentions in PE) factors (de Bruijn et al., 2023). Overall, findings are positive and in the right direction (Dowling and Barry, 2020), but a comparison group is needed in a future study to help determine causality.

Limitations and future directions

Although this study demonstrates valuable findings, there are also limitations. As this is a single-group design, it is not possible to determine if the improvements were related to the gamified PE lessons, or other unaccounted factors, such as natural maturation (Lopes et al., 2021). A future pilot study should examine the relative impact of the gamified PE lessons through a randomised control trial. Furthermore, the data collection was carried out in a small sample, so a future definitive study should include a larger sample to ensure generalisability of findings. The MCA data were only collected at post-test, and no baseline measurements were taken. As a result, this limitation prevents any causal claims from being made regarding the interventions effect on the MCA data. Finally, whilst the SSEIT has been used in previous studies (Williams et al., 2009), it was not appropriate for our sample to measure certain EI subscales due to the poor internal reliability. Future work should consider using a different and appropriate tool (e.g. TEIQue-Children Form: Mavroveli et al., 2008) to measure subscales of EI in children.

Conclusion

Our findings suggest a full-scale trial would be feasible. The findings demonstrated the gamified PE lessons to be feasible and acceptable and it is encouraging to see that they could be implemented by non-specialist PE teachers. In addition, preliminary data showed favourable changes in children's EI and MC alongside the intervention. Future studies including a control group, and a larger sample size are needed to evaluate the effectiveness. Specifically, a cluster randomised controlled trial, comparing gamified vs traditional PE, stratified by MC baseline, is recommended to isolate intervention effects. To enhance intervention adherence and fidelity, weekly logs and video observation (n = 3 over the 10 weeks) would need to be implemented in the full trial.

Chapter Six: Study Three

The effects of a gamified physical education intervention on motor competence and emotional intelligence among primary school children: A quasi-experimental pilot study

Thesis Study Map

Study	Objectives and Findings
Study 1: Co-development of a gamified physical education movement competence intervention with school stakeholders.	Objectives: • Co-develop a gamified PE intervention with Year 5 children (age 9 to 10 years) and teachers. Findings: • Three gamified PE interventions were co-developed with primary school children and teachers.
Study 2: Feasibility, acceptability and preliminary effectiveness of a gamified physical education intervention on motor competence and emotional intelligence.	Objectives: • Evaluate the feasibility and acceptability of a co-developed gamified PE intervention in a primary school context. • Evaluate the feasibility of the study process (i.e. recruitment) and management (i.e. data collection) in a primary school context. • Explore the preliminary effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children. Findings: • The co-developed gamified PE interventions were feasible and acceptable for a primary school context. • The study trial process and management are feasible, with the exception of the EI scale. • The intervention showed preliminary effectiveness on EI and MC
Study 3: The effects of a gamified physical education intervention on motor competence and emotional intelligence among primary school children: a quasi-experimental pilot study	Objectives: • Explore the effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children. • Evaluate the acceptability of a co-developed gamified PE intervention in a primary school context. • Develop and pilot a tool to assess the fidelity of the delivery of gamified pedagogy in PE.

Study Context within Thesis

Chapter Six presents the third and final study of this PhD thesis, a larger, quasi-experimental trial. This study aimed to investigate the effects of the co-developed gamified PE intervention (Chapter Four) compared to a control group in increasing MC, EI, BPNs and motivation regulations in PE and PA. Additionally, the study explored the acceptability of the intervention for both teachers and children, outside of those involved in the co-development process (Chapter Five). Furthermore, the study sought to develop a gamification fidelity observation checklist to assess whether the gamification strategies were implemented as intended.

Abstract

This study aimed to (a) examine the outcome effects and acceptability of a 10-week gamified physical education (PE) intervention on 9-10-year-old children's MC, EI, BPNs, and motivational regulations in PE and PA; and (b) develop a systematic tool to assess the implementation of gamification strategies. A quasi-experimental design was employed, involving 76 children (44 boys, 32 girls; mean age = 9.30 ± 0.50; 65.78% White British) from four primary schools in areas of high deprivation. Two schools were assigned to the intervention group, and two schools were assigned to the control group. The gamified PE intervention was delivered for 10-weeks by the intervention groups respective teacher. Acceptability interviews with teachers and focus groups with children were conducted with the intervention group. The system for observing gamification in PE (SOG-PE) was developed and assessed the implementation of gamification strategies and general teacher and child behaviour. Analysis of covariance (ANCOVA) was used to examine differences in post-test scores across the groups, controlling for baseline score, sex and age. Acceptability data were analysed using a deductive-inductive approach. In comparison to children in the control group, participation in the intervention group was associated with significant improvements at post-test in most

subtests of MC ($p < 0.05$), perceived MC in jumping sideways ($p < 0.001$), relatedness satisfaction ($p = 0.007$), and a significant decrease in external regulation in PA ($p = 0.030$). Teachers reported that the lessons were developmentally appropriate for the children, aligned with educational values, increased children's participation, and were straightforward to implement. Children also found the gamified lessons enjoyable, fun and exciting, and they perceived improvements in their teamwork and movement skills. The SOG-PE data demonstrated an increase in the extent to which gamification strategies were implemented over the course of the intervention. Gamification appears to be a promising pedagogical approach in PE. The findings suggest that a gamified PE intervention can enhance certain physical and affective outcomes in children. Future research should explore longer term gamified interventions and assess implementation fidelity using the SOG-PE.

Introduction

A significant proportion of children have low MC (Lawson et al., 2021), with children from low SES backgrounds demonstrating significantly lower MC compared to their higher SES peers (Gosselin et al., 2021). The importance of developing MC during childhood is well documented (Lopes et al., 2021), with a growing body of evidence suggesting MC is positively associated with psychological-health (Hill et al., 2024), physical-health (Barnett et al., 2022) and social-emotional (Hill et al., 2024) benefits for children. However, low SES children may lack opportunities to develop these movement skills and miss out on acquiring these benefits (Gosselin et al., 2021). Therefore, addressing these movement disparities and improving MC levels for children living in areas of deprivation requires providing opportunities to learn, practice and reinforce these skills (Sigmundsson et al., 2021). In response to this, there has been an increase in school-based MC interventions (Eddy et al., 2019; Foweather and Rudd, 2020). Embedding these interventions within school settings offers an efficient means of reaching large numbers of children, regardless of their SES (Gosselin et al., 2021), while also targeting critical developmental periods (Lopes et al., 2021). Many of these interventions are typically implemented during PE lessons, which are an integral component of the National Curriculum (Lorås, 2020). During PE lessons, children are provided with opportunities to engage in structured activities and motor challenges, thereby influencing the development of MC (Lorås, 2020). Furthermore, within the English National Curriculum, a key aim for Key Stage 1 and 2 is the development of MC; therefore, implementing an intervention to target this development period is important for children (Department of Education, 2023).

In addition to its role in developing MC, PE also holds significant potential for influencing the development of EI (Rico-González, 2023). Research involving children suggests that EI appears to be an important predictor of health, affective and school-related outcomes (Ozäl et al., 2024). For instance, a recent systematic review identified a positive association between EI and various school-related outcomes, including academic achievement, pro-social behaviour, classroom satisfaction and peer cohesiveness (Ozäl et al., 2024). In addition, research suggests that higher EI in children is positively associated with mental health (Lea et al., 2019), pro-social skills (Trigueros et al., 2020), autonomous motivation (Méndez Giménez et al., 2020), BPNs (Méndez Giménez et al., 2020) and MC (Orangi et al., 2023). PE lessons provide a unique environment for developing EI, as they are rich in social interactions and emotional experiences, which are important for developing EI (Castillo-Viera et al., 2020). Games and cooperative games, for example, have the potential to cultivate skills such as empathy, communication, and emotional regulation (Rivera-Pérez et al., 2020). Through these activities children learn to work together, manage conflicts and cope with winning and losing in a positive and respectful manner. Additionally, the challenges presented in PE, such as mastering new skills or overcoming physical obstacles, provide opportunities for children to build resilience, self-awareness and self-management, which are key facets of EI (Rico-González, 2023). For these reasons and more, it is reasonable to suggest that implementing a school-based PE intervention could be effective for increasing both MC and EI; however, further empirical evidence is needed to confirm these potential benefits.

To support the development of MC and emotional skills in PE, maintaining children's motivation is essential (Vasconcellos et al., 2020). For this reason, gamification may be a promising approach (Arufe-Giráldez et al., 2022). Interventions using gamification in PE have shown favourable outcomes on motivation (Arufe-Giráldez et al., 2022). Specifically, for primary school-age children (5 to 12 years), evidence suggests that gamified interventions demonstrate some positive effects on enjoyment in PE (Quintas and Bustamente, 2023), BPNs (Sotos-Martínez et al., 2024), intrinsic motivation (Fernandez-Rio et al. 2020) and PA

(Guijarro-Romero et al., 2024). That said, some studies have found no effects of gamification on BPNs (Quintas et al., 2020), extrinsic motivation and amotivation (Sotos-Martínez et al., 2023). Nevertheless, studies specifically investigating the impact of gamification on MC and EI outcomes in PE are limited, with the prior research having been conducted with a university population and secondary school students (Navaroo-Mateos et al., 2024). While preliminary findings are positive, the effect of gamification on MC and EI in a primary school context remains unclear due to the scarcity of research.

Although there is growing empirical evidence to support the use of gamification in PE, there is a lack of instrumentation to assess the implementation of gamification strategies in PE settings (Fernandez-Rio et al., 2020; Melero-Cañas et al., 2021). Pedagogical model fidelity, referred to as the extent to which delivery of an intervention adheres to the programme originally developed (Mowbray et al., 2003), is important for understanding how-and whether-an intervention works (Siedlecki, 2018). Without fidelity, it is difficult to understand the impact of gamification and its connection to learning outcomes. This lack of instrumentation is also prevalent in the broader field of pedagogical models in PE (Fernandez-Rio and Iglesias, 2024). Nevertheless, some efforts are underway to develop instruments for assessing gamification in PE. For example, the instrument developed by Melero-Cañas et al. (2021) assesses a dual model of gamification and Teaching Personal and Social Responsibility using a binary coding system (0 = absent of element or 1 = presence of element) to assess each item. In addition, Fernandez-Rio et al. (2020) developed a checklist to assess basic gamification elements, adapted from Werbach and Hunter (2015), including narrative, levels, self-regulated learning, portfolio and points and badges. However, the method for coding the checklist was not specified. The inconsistent findings and reduced effectiveness of gamification in PE could partly be explained by a) varying degrees of implementation, and b) a lack of tools to assess the fidelity of gamification (Fernandez-Rio and Iglesias, 2024). This underscores the need for the development of an instrument to assess the implementation of gamification strategies in PE.

Based on results from Study One (**Chapter three**) and Study Two (**Chapter four**), the process (i.e. recruitment), management (i.e. data collection) and the gamified MC interventions were found to be feasible and acceptable within primary school settings. Further, positive preliminary effects on child-level outcomes were observed. These promising findings led to the development of this larger, quasi-experimental pilot study to further investigate the effects and acceptability of the gamified intervention in primary schools. Pilot studies are typically conducted following the completion of a feasibility study (See Chapter four) and on a smaller scale before a larger definitive trial is conducted (Bond et al., 2023). Pilot studies can provide detail on the intervention content and delivery for replicability, alongside the effectiveness of the intervention (Pfledderer et al., 2024). Further, although the intervention was considered acceptable in the feasibility study, acceptability was considered important to assess beyond those involved in the co-development process. Interventions that are not acceptable to those who deliver (e.g. teachers) or receive it (e.g. children) are less likely to be implemented successfully or engage participants effectively (Sekhon et al., 2022). As such, intervention acceptability plays an important role in influencing implementation, adherence, uptake and overall effectiveness (Skivington et al., 2021).

The present study investigated whether a co-developed gamified intervention (Rice et al., 2025), was effective in increasing MC, EI, BPNs and motivational regulations in PE and PA in 9- to 10-year-old children in comparison to a control group. A secondary purpose was to investigate the acceptability of the intervention within a primary school context beyond those involved in the co-development process. The study also aimed to develop a gamification fidelity observation checklist to determine if the gamification strategies had been delivered as intended.

Hypotheses

This study hypothesised that children who participate in the gamified MC intervention will show greater improvement in their EI, MC, BPNs and motivational regulations in PE and PA in comparison to children in the control group.

Methods

Study design

This study received institutional ethics committee approval (23/SPS/041). A quasi-experimental design was used to evaluate the gamified intervention. Initially a randomised design was planned, however following initial allocation two schools dropped out the research programme. As such, this design was chosen due to logistical reasons, and randomisation not being feasible (Bärnighausen et al., 2018). The first two schools were allocated to the intervention group, and the last two schools, with similar characteristics to the intervention school in terms of deprivation levels (Ministry of Housing Communities and Local Government, 2019) were allocated to the control group. All children were assessed twice, approximately 10-11 weeks apart, in their respective school. Quantitative measures [EI, MC, BPNs and motivational regulations] were completed at baseline (T0: February 2024), post-intervention (intervention group: T1 June 2024) and following 10-weeks (control group: T1 June 2024). The gamified PE lessons were delivered between February and May 2024. Acceptability questionnaire data were collected from teachers and children in the intervention group in June 2024, following the final gamified lesson (10-weeks). Additionally, acceptability interviews (for teachers) and focus groups (for children) were conducted in June 2024 following T1 data collection. This study followed CONSORT reporting guidelines (Eldridge et al., 2016) and the TIDierR guidelines for intervention reporting (Campbell et al., 2018).

Recruitment and participants

Eligible schools across Merseyside and Cheshire were required to be in the top 20% of most deprived areas in England, in accordance with The English Indices of Deprivation 2019 (Ministry of Housing Communities and Local Government, 2019). Sixty-eight primary schools were identified through the local council website and contacted via email to be invited to participate in the study. Out of the 68 schools, six expressed an interest in participating. The remaining schools did not respond to the invitation. The schools that expressed interest were sent study protocol packs. Once gatekeepers (i.e. headteachers) had given written informed consent to participate, schools were subsequently recruited for the study. The study had specific inclusion criteria for both children and teachers. For child participants, the inclusion criteria were: aged 9 to 10 years old and enrolled in Year Five, and provision of informed consent signed by their parents or legal guardians, and child assent. For teacher participants, the criteria included: teaching PE to their respective Year 5 class and providing informed consent. Children's SES were determined by the children's home postcodes, which were collected via consent forms. All children in the intervention group, regardless of parental consent/child assent, participated in the gamified PE lessons as the gatekeeper consented to integrating the lessons into the school PE curriculum. Overall, four teachers provided informed consent (n = 2 intervention group; n = 2 control group). All teachers in the intervention group were female (mean age = 34.5 years) and White British. In the intervention group, one teacher was a qualified PE teacher with 9 years of experience of delivering PE and was the PE lead in their school, while the other teacher was a qualified sports coach and teaching assistant with over 15 years' experience. Both teachers were responsible for teaching PE to their respective class. In the control group, one teacher was male, with 10 years of general teaching experience and was the deputy head and PE lead in their school. The other teacher in the control group was female, with 5 years of experience delivering PE.

Intervention

Workshop

The intervention was co-developed with classroom teachers and students during phase one of the research programme (see Chapter three**).** Based on feedback from the feasibility study (see Chapter four) and evidence within the literature (Morgan et al., 2019), teachers in each intervention school received a two-hour CPD classroom workshop delivered by the lead researcher. The workshop covered gamification as a pedagogy, including the definition, gamification strategies, and how these strategies were integrated into the interventions. Teachers were then introduced to the structure of the curriculums, including its dose, duration, lesson structure and weekly themes (i.e. week 1: throwing and catching). The teachers were given a choice of which curriculum to implement: 'the American dream', 'Treasure Island', and 'Quest through time', each accompanied by a brief explanation of its narrative. Once the teachers had selected their preferred curriculum, discussions focused on curriculum materials, specifically equipment needs and availability (e.g. What equipment do you have access to? Do the interventions need to be adapted for indoor PE?). Teachers were also asked to provide feedback on potential adaptations needed for the intervention (e.g. 'Are the diagrams clear?', 'Is the format of the lesson plan, okay? If not, how can we change them to best suit you?').

Gamified MC intervention

Both teachers in the intervention group wanted to implement 'The American Dream', which involved the children arriving in New York and travelling across different states of America. The children were guided through a series of activities that focused on different natural and physical geographical features in different states of America (e.g. Washington and the Whitehouse). The intervention lasted 10 weeks, with one 60-minute PE lesson per week, each focusing on a different skill. The structure of the curriculum lessons was divided into three connected parts: the warmup, followed by two developmental activities. Each lesson included a step-by-step progression (e.g. game/activity progression, skill development and lesson order). Additionally, the intervention incorporated a minimum of four gamification strategies adapted from Werbach and Hunters (2015) categories: dynamics, mechanics and components. Table 15 provides a detailed description of the interventions' learning outcomes, weekly theme, and narrative, and the gamification strategies included in the intervention, organised by their respective conceptual levels, are as follows:

Dynamics

- Narrative: An ongoing narrative throughout the lessons, and intervention, that provided context and meaning to the activities (see Table 15 for examples: Fernandez-Rio et al., 2020).
- Relationships: A range of interactions with peers to encourage collaboration and social connections (e.g. working in, or against another team, working in pairs).

Mechanics

- Rules: Guidelines that govern how the activity is played, and is relevant to the lesson objective (e.g. I would like you to transport the luggage using an overhand throw)

- Challenges: Developmentally appropriate challenges aligned with the lesson objectives, which could be social, psychological, physical or cognitive (e.g. divergent thinking, teamwork, effort, or MC).
- Levels: Different levels of difficulty that were developmentally appropriate, providing a sense of progression (e.g. level 1= jump with two feet; level 5 = jump with two feet and land on one).
- Feedback: Augmented feedback that helped children recognise their performance and included social, psychological, physical or cognitive (e.g. 'I like how you made quick but accurate decisions'; 'you did a great job encouraging your teammates')

Components

- Points: Points were awarded to students to allow for a sense of progression (e.g. students earned points to gain plane tickets for the next location).

Control group

Children in the control group were requested to follow their usual PE provision, which did not incorporate any gamification strategies. The control group received one PE session per week, with an average duration of 60-minutes. Both control schools implemented the Get Set 4 PE scheme, and the PE lessons focused on athletic activities such as long-distance running, sprinting, relay, triple jump, shot put and javelin. Upon completion of data collection, the control schools were provided with a copy of the gamified PE lessons as a thank you for participating in the study and offered the chance to receive delivery of the gamified PE lessons by the lead researcher in the following autumn term.

Table 15. Descriptions of the interventions' learning outcomes, weekly theme, and narrative.

Weekly Lesson	Learning outcomes	Theme (US State)	Narrative (A = Warm up; B = Developmental activity 1; C = Developmental activity 2; D = Closing narrative)
1	Throwing and catching	New York	A. 'Welcome to New York, today you start a 10-week adventure; your first mission is to unload the luggage' B. 'It is now time to travel across the Brooklyn bridge to store the luggage' C. 'Now your luggage is across the bridge, we need to put the luggage in storage containers' D. 'Congratulations, you have stored your luggage, it is time to travel to Florida'
2	Jumping and landing	Florida	A. 'You have arrived in Florida; it is time to make our way through the uplands' B. 'Now you are at the bottom of the uplands, it is time to travel through the marshes' C. 'Now we are over the marshes, we need to cross four different rivers, using the materials' D. 'Well done, you have crossed all the rivers, next week we will be exploring Miami'
3	Striking and rolling an object	Miami	A. 'Our first job is to clear the pinecones off the forest path' B. 'The warden has asked you to help clear the rubbish off the beach' C. 'Welcome to a game of whacky striking and fielding, collect points for your plane ticket' D. 'Well done, each team got their plane ticket, next step…TEXAS'
4	Agility	Texas	A. 'We need to get to the reserve using different travel movements' B. 'It is time to collect coal, cotton and oil in your teams' C. 'It is time to transport your resources in exchange for a ticket to the next state'

Weekly Lesson	Learning outcomes	Theme (US State)	Narrative (A = Warm up; B = Developmental activity 1; C = Developmental activity 2; D = Closing narrative)
			D. 'Well done, you have transported the goods, and in exchange you have been given a ticket to Utah'
5	Obstacle course (week 1 – 4 outcomes)	Texas	A. 'You have been tasked with building a route through Arizona.' B. 'Welcome to the bottom of the Canyon, the only way to the top is by helicopter, it is time to earn points to take the ride' C. 'It is now time to earn points to go to the capital next week' D. 'Well done you have gained enough points and will be heading to the capital next week'
6	Dribbling hands and feet	Washington	A. 'An alert has been sent by the president; the Whitehouse is under attack; we need to collect supplies for the army' B. 'The commander would like you to come through the gates; but someone has planted explosives, do not touch them' C. 'It is time to save the Whitehouse' D. 'You have saved the Whitehouse; the president will be sending you to Alaska to say thank you'.
7	Throwing and catching	Alaska	A. 'There is lots of snow in Alaska. It is time to practice throwing different size snowballs' B. 'It is time to collect snowballs ready for the ultimate snowball battle.' C. 'It is now time for the ultimate snowball battle' D. 'I hope you have enjoyed the snow, next week we will be heading to California'

Weekly Lesson	Learning outcomes	Theme (US State)	Narrative (A = Warm up; B = Developmental activity 1; C = Developmental activity 2; D = Closing narrative)
8	Gymnastics	California	A. 'Today we will be travelling over cliffs, across beaches and over the river valleys' B. 'Now we are over the cliff, it is time to explore the beach. Be careful there is quicksand' C. 'We need to get across the rivers to the mainland. Be careful of the coyotes' D. 'The mayor called; he needs your help next week to capture the prisoners from Alcatraz.'
9	Dodging and invasion	California	A. 'We have been tasked with helping the mayor capture the escaped prisoners, but first we need to practice being capturers' B. 'Before we capture the prisoners, we need to capture the stolen items' C. 'It is time to capture the prisoners. They are not happy and want the key for the boat to escape' D. 'Well done you have captured the prisoners, next week is our last adventure. As a thank you, the mayor is sending you to Hawaii'
10	Obstacle course (week 5 – 9 outcomes)	Hawaii	A. 'Today we are going to be exploring Hawaii, we don't want anyone to get left behind' B. 'We are going to be working together to earn points for our flight home, we will be completing different obstacles courses'. C. 'You have gained enough points to purchase your flight ticket home. Congratulations!' D. All children receive a plane ticket certificate

Measures

At pre- and post-intervention, each child undertook assessment of EI, MC, BPNs, and motivational regulations in PE and PA.

Emotional intelligence. Based on the feasibility findings (See Chapter 3) the EI instrument was changed from the SSEIT to the Trait Emotional Intelligence Questionnaire – child short form (TEIQue-CSF: Mavroveli et al., 2008). The questionnaire is a valid and reliable to measure EI in children aged 8 to 12 years, with a Cronbach alpha of .86 (Mavroveli and Petrides, 2017). The TEIQue-CSF is a 36-item questionnaire and measures global EI. Items were scored using a 5-point scale ranging from 1 ('strongly disagree) to 5 ('strongly agree). Example items include: 'I feel great about myself' and 'most people like me'. Test duration was 10-15 minutes with a sample of 15 children.

Actual motor competence (AMC). Actual MC was assessed using the Motor Competence Assessment (MCA: Rodrigues et al., 2019). The MCA is a valid and reliable instrument to use with children, with reliability ranging from good to excellent (Rodrigues et al., 2022). The MCA is composed of two tests for each motor domain, specifically: ball throwing velocity and ball kicking velocity for object manipulation; shifting platforms and jumping sideways for stability; and 4 x 10-meter shuttle run and standing long jump for locomotor. For ball throwing velocity, ball kicking velocity and standing long jump participants have three attempts, and the final score is the best of the three. For shifting platforms, jumping sideways and shuttle run participants have two attempts, and the final score is the best of two (Rodrigues et al., 2022). Test duration was 30 minutes based on eight children and two trained administers.

The Körperkoordinationtest für Kinder (KTK3+ Coppens et al., 2021) was also used to assess AMC. The KTK3+ is a valid, and reliable instrument to use with children aged six to 19 years old (Coppens et al., 2021). The KTK3+ is composed of four tests: jumping sideways, moving sideways, eye-hand coordination and balancing backwards. For jumping sideways, moving sideways, and eye-hand coordination participants have two trial attempts, with the scores from both tests summed together for the final score. For balancing backwards, participants have three trials per balance beam with widths that decrease with test progression (6.0cm, 4.5cm, 3.0cm) and the total amount of steps are counted (maximum 72 in total, or 8 per each trial beam). Test duration was 20 minutes based on five children with two trained administers.

Perceived motor competence (PMC). PMC was assessed using questionnaires which aligned with the test items for the MCA ($n = 6$) and KTK3+ ($n = 4$). The PMC questionnaire is a valid, and reliable measure to use with children aged seven to 11 years old (Lefever et al., 2024). Children were asked to evaluate how well they perceived their performance in each of the AMC-tests, before participating in the tests and after visual demonstration. Answers ranged from 1 (not good at all) to 10 (very good).

Basic psychological needs satisfaction and frustration (BPNSFS). The basic psychological need satisfaction and frustration scale (BPNSFS) was used (Van des Kaap-Deeder et al., 2020) to assess basic psychological needs satisfaction and frustration in PE. The questionnaire has shown to be reliable and valid to measure BPNSF with seven- to 11-year-old children (Vlachopoulous et al., 2011; Zamarripa et al., 2020). The phrase, '*how you feel in general'* was changed to, '*how you feel in PE*'. The 24-item questionnaire measures autonomy satisfaction (4 items; i.e. 'In PE, I feel free to choose which activities I do'), autonomy frustration (4 items; i.e. 'In PE, most of the things I do, I do because I have to'), relatedness satisfaction (4 items;

i.e. ‘In my PE class, the people that I like, also like me’), relatedness frustration (4 items; i.e. ‘In my PE class, I feel that the people who are important to me are unkind to me’), competence satisfaction (4 items; i.e. ‘In PE, I can do things well’) and competence frustration (4 items; i.e. ‘in PE, I often have doubts about whether I am good at things’). Items are scored using a 5-point scale range from 1 (‘completely not true’) and to 5 (‘completely true’). Test duration was 10 minutes with a group of children (n = 5 - 10).

Motivational regulations in PE. The Behavioural Regulation in Exercise Questionnaire (12-item; Sebire et al., 2013) adapted to PE was used to measure motivation to participate in PE. The questionnaire has been shown to be reliable and valid with children aged seven to 11 years (Sebire et al., 2013). Items were scored on a 5-point Likert scale from 1 (‘not true for me’) to 5 (‘very true for me’). The items assessed intrinsic motivation (3 items; i.e. ‘….PE is fun), identified regulation (3 items; i.e. ‘…it is important for me to do PE), introjected regulation (3 items; i.e. ‘….when I don’t I feel bad’) and external regulation (3 items; i.e. ‘….other people say I should’). Test duration was 10 minutes with a group of children (n = 5 – 10).

Motivational regulations in PA. The Behavioural Regulation in Exercise Questionnaire (12-item; Sebire et al., 2013) adapted to PA was used to measure motivation to be physically active. The questionnaire has been shown to be valid and reliable with children aged seven to 11 years (Sebire et al., 2013). Items were scored on a 5-point Likert scale from 1 (‘not true for me’) to 5 (‘very true for me’) and assessed intrinsic motivation (3 items; i.e. ‘….being active is fun), identified regulation (3 items; i.e. ‘…it is important to me to do active things), introjected regulation (3 items; i.e. ‘….when I’m not active I feel bad’) and external regulation (3 items; i.e. ‘….other people say I should be’). Test duration was 10 minutes with a group of children (n = 5 – 10).

Development, validity and reliability of the System for Observing Gamification in Physical Education (SOG-PE)

The System for Observing Gamification in PE (SOG-PE) was developed to assess the implementation of gamification strategies in PE. A previously established 5-step process was followed to develop the fidelity tool (Walton et al., 2020). The lead researcher and two members of the supervisory team (LF, KFD) contributed to the iteration process of the SOG-PE and assisted in refining its content.

Step One involved reviewing existing observational tools designed to assess pedagogical models in a PE context (Fernandez-Rio et al., 2020; Iglesias and Fernandez-Rio, 2024; Roberts and Fairclough, 2012; Wright and Craig, 2011). Additional reviews were conducted to explore tools used to assess different aspects of teaching in PE (Weaver et al., 2016; Moon et al., 2023) and scale development and validation guidelines (Smith et al., 2015). Following the review of these tools, comprehensive literature reviews were undertaken to identify definitions of gamification strategies (Arufe-Giráldez et al., 2022; Fernandez-Rio et al., 2020; Werbach and Hunter, 2015). A brief description of the tools, including interval recording methods and coding systems are presented in Appendix D.

Following the review of the literature, **Step Two** involved identifying and compiling the gamification strategies, set out by Werbach and Hunter (2015) into a central framework. The initial framework included 10 gamification strategies: narrative, relationships, rules, challenges, levels, choice, teamwork, feedback, points and achievements. Following this, five general teacher/student behaviours were also included in the tool (three for general student behaviours and two for general teacher behaviours), as it was thought these could influence the delivery of the gamified intervention (Moon et al., 2023). The items in the tool were grouped into two main categories: 1) gamification strategies, and 2) general teacher/student behaviours. After the initial development of the tool, **Step Three** involved devising accompanying guidelines (definitions, descriptions, and examples) for each item that were created to minimise potential rater misinterpretation. Additionally, a 3-point scale (0 = not evident, 1 = partially evident, 2 = evident) was developed, with guidelines providing criteria and examples to distinguish between achieved (i.e. 2 = evident) vs partially achieved (i.e. 1 = partially evident).

Building on the initial version, **Step Four** entailed obtaining feedback from one member of the supervisory team (LF) on the content, coding system, and guidelines to ensure they were accurate, relevant and appropriately worded for their intended use. Following this discussion, three gamification strategies were removed from the tool, to avoid observer assessment burden. For instance, 'achievement' was removed and then merged with 'narrative', as achievements were represented within the narrative milestones. Additionally, two behaviours were removed from the tool, because they were deemed unobservable. Specifically, 'monitoring' (teacher behaviour) which refers to the teacher monitoring students during activities (adapted from Moon et al., 2023) and 'uninvolved behaviour' (child behaviour) which refers to students responding negatively to the teachers and instructions. Refinements were also made to several descriptors of the remaining items to improve clarity. In addition, the coding system and guidelines were changed. During step four, several rounds of iteration and refinements were made to each aspect of the tool (content and wording, coding system and descriptors, and marking scheme and coder training booklet) with members of the supervisory team (iteration round 2-5: LF, KFD; iteration round 5; LF, KFD, ML). The coding system changed, and an adapted version by Wright and Craig (2011) was used, resulting in a 5-point rating scale (0 =

never, 1 = rarely, 2 = occasionally, 3 = frequently, 4 = extensively) which considered the frequency and quality of the observed strategy.

Table 16 presents the final iteration of the System for Observing Gamification in PE (SOG-PE). The SOG-PE is designed to rate each quarter time period of the lesson, which accounts for variation in lesson duration (Smith et al., 2015). For example, a 60-minute lesson has 4 quarters of 15 minutes. At the end of each quarter, the coder is asked to rate each of the 10 items using the 5-point rating scale, ranging from 0 (never: none of the words or actions of the teacher(s) or students clearly convey or align with this component); 1 (rarely: few of the words or actions of the teacher(s) or students clearly convey or align with this component); 2 (occasionally: some of the words or actions of the teacher(s) or students clearly convey or align with this component); 3 (frequently: most of the words or actions of the teacher(s) or students clearly convey or align with this component); 4 (extensively: all of the words or actions of the teacher(s) or students clearly convey or align with this component). To ensure that coders were coding items consistently, a marking scheme, which includes descriptions for the coding scales, as well as examples of the items can be found in Appendix E.

Table 16. The final iteration of the System for Observing Gamification in PE (SOG-PE).

Gamification strategy (definition)	**Checklist item**	**Description**
Narrative (On-going storyline throughout the lesson that provides context and meaning to the activities)	There is a clear narrative *(Fernandez-Rio et al., 2020)*	Teacher delivers a clear narrative to the students at the start of the activity/lesson with the aim of contextualising the activities within the lesson (example A). Teacher provides the students with clear achievements that are represented in a milestone in the storyline at the end of the activity/lesson (example B). ***Example A:*** 'A storm is coming; I would like you to keep your body low to the ground whilst moving the items' **Example B:** 'Well done the mayor is happy with how you practiced your capturing skills; he is now sending you to capture the prisoners'.
Relationships (Fostering interactions between students)	Students are provided with a range of interactions with peers *(Werbach and Hunter, 2015)*	Teacher provides the students with a range of different opportunities for interaction that are relevant and authentic for the narrative and/or the lesson objective. **Example:** Working against another team, working in a team, pairs, groups of 3 or more children, whole class. *Note*. The same relationships can occur on multiple occasions if they are working together.
Rules (Guidelines that govern how an activity is played)	Rules of the activities are explained *(Werbach and Hunter, 2015)*	Teacher explains the necessary rules that are relevant and authentic for the lesson objective, so that students understand what they are required to do during the activity to participate.

Gamification strategy (definition)	Checklist item	Description
		Example: ‘Half of your team will stand down one side of the bridge, and the other half will stand down the other. In your teams I would like you to transport the luggage down the bridge using an over-head throw’
Challenges (Specific tasks or objectives that participants must accomplish)	Students are provided with a range of challenges. *(Werbach and Hunter, 2015)*	Teacher provides the students with a range of developmentally appropriate challenges to complete that are relevant and authentic to the lesson objective. The challenges provided by the teacher can include any of the following (below list is not exhaustive): • Social = teamwork, healthy competition • Psychological = adaptability, effort, motivation • Physical = Motor competence (movement skills), physical activity • Cognitive = divergent thinking, perceived competence
Levels (Providing participants with new levels as they progress; incremental increases in difficulty that are developmentally appropriate)	Students have different skill levels to perform *(Fernandez-Rio et al., 2020)*	Teachers provide the students with a range of developmentally appropriate levels to preform that are relevant and authentic to the lesson objective. ***Example:*** Level 1: ‘Leap across the river’; Level 2 ‘Hop across the river’; ‘Level 3’ hop across the river avoiding crocodiles’.

Gamification strategy (definition)	**Checklist item**	**Description**
Feedback (Allows participants to recognise how they are doing and to initiate further activities)	Students are provided with feedback *(Werbach and Hunter, 2015)*	Teacher provides students with appropriate augmented feedback. Feedback can include: • ***Social feedback***. E.g. 'You did a great job encouraging your teammates during the activity!' • ***Psychological feedback.*** E.g. 'Even when things got tough, you didn't give up!' • ***Physical feedback.*** E.g. 'When you jump, try and touch for the sky!' • ***Cognitive feedback***. E.g. 'I liked how you made quick but accurate decisions'
Points (Given and accumulated during the activity that allows for progression to the next activity)	Students earn points *(Fernandez-Rio et al., 2020)*	Teachers provide the students with the opportunities that are relevant and authentic for the lesson objective to earn points that moves the lesson forward. **Example:** 'Well-done, everyone. You have all gained enough points to ride the helicopter. Next week we will be heading to the capital!'
Behaviours (definition)	**Checklist item**	**Description**
Behaviour management (Ability to manage the student behaviours)	Teacher taking action to resolve negative student behaviours. *(Moon et al., 2024)*	• Teacher re-directs and guides students back to the activity with specific prompts to help refocus attention. • Teacher takes time to talk to students exhibiting disruptive behaviour **Examples can include:** • 'What part of the activity should we be working on right now?'

Gamification strategy (definition)	Checklist item	Description
		• 'Remember, we are throwing over-arm' • 'Can you work together and keep each other focused. Can you remind your partner/team member what the next step is'.
Disruptive (Actions or attitudes that interrupt, disturb or negatively impact the learning environment)	Students display disruptive behaviours. *(Mahzan Awang et al., 2022)*	Student display disruptive actions or attitudes. **Example:** • Interrupting the teacher or peers while they are speaking. • Physical behaviours like pushing, shoving or fighting with peers. • Openly challenging authority, refusing to follow instructions or arguing with teachers and peers. • Disrupting activities.
Children off task	Children off task *(Mellado-Berenguer and Monfort-Pañego, 2024; Crotti et al. 2021)*	One or more children are not engaged in the activity that is presented by the teacher. **Example:** • Not taking part in the activity provided by teacher but does not disrupt anyone else. • Engaged in an activity that is different from the one that the teacher provided.

Observer training and SOG-PE reliability

The final phase (**Step Five**) was to determine the reliability of the SOG-PE (Moon et al., 2023), which followed previous recommendations to establish optimal levels of reliability (Cicchetti, 2001; Hartman, 1977). As part of the training process, time was dedicated to familiarising the observers (KFD) with the SOG-PE manual, the checklist items and descriptions as well as how to use the tool. The lead researcher and KFD discussed and clarified any doubts concerning the SOG-PE. Subsequently, two videos were coded collaboratively. The observers (the lead researcher, KFD) then independently coded one lesson, and training was considered complete once inter-rater agreement reached >75% (Moon et al., 2023) in each category in a single recorded lesson. One lesson was observed to reach the established target. The same lesson was coded by the lead researcher one week later to determine intra-observer reliability (Thomas et al., 2015). A minimum of 75% inter- and inter-observer agreement was deemed acceptable (Hartman, 1977). Intra-observer reliability is a measure of an tools ability to be used in the same way by the same person over time (Thomas et al., 2015).

Video procedure

A total of six gamified PE lessons were video recorded (*n* = 3 from each intervention group school). The gamified PE lessons were video-recorded via a stationary GoPro camera (Hero6; GoPro), and each teacher was asked to wear a wireless radio mic during the lesson so that audio and video recording could be analysed using the SOG-PE described above.

Acceptability of the intervention

A mixed methods approach, using questionnaires, focus groups and interviews were used to assess the acceptability of the intervention to triangulate the findings. The questionnaire items, as well as the focus group and interview schedules, were developed using Sekhon et al.'s (2017) theoretical framework of acceptability. Six out of the seven acceptability constructs were included: affective attitude (how an individual feels about the intervention), burden (perceived amount of effort required to participate in the intervention), ethicality (the extent to which the intervention has good fit with an individual's value system), perceived effectiveness (extent to which the intervention is perceived as likely to achieve its purpose), intervention coherence (extent to which the participant understands the intervention and how it works) and self-efficacy (participants confidence that they can perform the behaviour(s) required to participate in the intervention). Opportunity cost was not included, as no benefits or profits were given up engaging with the intervention.

Acceptability questionnaires

The lead researcher developed the teacher and child feedback questionnaires using the theoretical framework of acceptability (Sekhon et al., 2017). The questionnaires were used to assess their perceptions of delivering and receiving the gamified PE lessons, respectively (see Appendix F). The teacher questionnaire consisted of 22 items, assessing six theoretical framework of acceptability constructs: affective attitude (n = 5); burden (n = 3); ethicality (n = 2); intervention coherence (n = 5), perceived effectiveness (n = 4); self-efficacy (n = 3). Items were rated on a 5-point Likert scale (1= strongly disagree; 5 = strongly agree), with an optional comment area. Teachers completed the questionnaire after delivering the final gamified PE lesson (week 10). The child questionnaire consisted of 13 items, assessing four theoretical framework of acceptability constructs: affective attitude (n = 5); intervention coherence (n = 3); perceived effectiveness (n = 4); and self-efficacy (n = 1). Items were rated on a 5-point Likert scale (1= strongly disagree; 5 = strongly agree). Children completed the questionnaires independently in the classroom, with their respective teacher, after receiving the final gamified PE lesson.

Acceptability focus group

Focus groups were conducted with children in the intervention group following the final gamified PE lesson. The interview schedules were designed to be sufficiently brief to minimise the burden on the children, while also balancing the need for depth towards answering the research question (Alder et al., 2019). The focus groups began with general questions about the research project (e.g. 'can you tell me what this project was about') and the gamified PE lessons (e.g. 'can you tell me what happened during the gamified PE lessons'). The focus group questions aligned with four theoretical framework of acceptability constructs (Sekhon et al., 2017): affective attitude (n = 4); perceived effectiveness (n = 3); intervention coherence (n = 6); and self-efficacy (n = 1). Questions related to the burden construct (i.e. the amount of effort that was required to participate in the intervention) were not included as the gamified PE lessons replaced the children's usual PE provision. To improve the flow of discussions, prompts were provided after each question (Lund et al., 2016). Given that gender can potentially influence experiences of PE (Alcaraz-Muñoz et al., 2023) and responses given during the focus groups (Daley, 2013), the decision was made to conduct same-sex focus groups. In total, four focus groups were conducted (n = 24 children in total) and children were conveniently sampled by their respective class teacher. Specifically, two focus groups were conducted per school, one with a sub-sample of girls (n = 6) and one with a sub-sample of boys (n = 6). The focus groups were held during school hours, in a quiet classroom and were scheduled to last 20 minutes, with an average duration of 18.43 minutes (range = 12.39 – 24.36 minutes). The focus group interview schedules are presented in Appendix G.

Acceptability interviews

Semi-structured interviews were conducted with the two teachers who delivered the gamified curriculums in the intervention group. The interviews were conducted following the final gamified PE lesson (week 10: see Appendix H for interview schedule). The interviews began with questions about the teachers' background (e.g. how many years have you been teaching PE?') and PE within the context of their school (e.g. 'how much time is devoted to PE within the school?'). Teachers were also asked to provide an overview of the gamified PE lessons, including details on the quantity and duration of the lessons, child participation, and any notable events that occurred. The interview questions were aligned with six theoretical framework of acceptability constructs (Sekhon et al., 2017): affective attitude (n = 3); burden (n = 2); perceived effectiveness (n = 3); intervention coherence (n = 3); self-efficacy (n = 2); and ethicality (n =1). Prompts were used throughout the interviews to facilitate the flow of discussion. In total, two interviews were conducted via Microsoft Teams (version 7.6.2, Microsoft Corporation), lasting 39 minutes, 9 seconds and 47 minutes, 6 seconds, respectively.

Data analysis

Quantitative data

Intervention effects. For intervention effects, independent samples t-tests were conducted for each variable to establish whether groups were statistically equivalent at baseline. Next, paired-samples *t*-tests were used to test for significant changes between pre- and post-test within each group. A series of one-way analysis of covariance (ANCOVA) were then performed to examine differences in post-test scores across the groups, while controlling for pre-test scores, sex (De Meester et al., 2020), and age (Stodden et al., 2008). In these analyses, pre-test scores for each variable, sex and age were included as covariates, with group (intervention group v control group) as the independent variable, and post-test scores as the dependent variable.

The System for Observing Gamification in Physical Education (SOG-PE). Firstly, inter-observer reliability was calculated by dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100 (Moon et al., 2023; Russ et al., 2017). The SOG-PE data for observed lessons were analysed with descriptive statistics. Additionally, Cohens Kappa (κ) was conducted to test and interpret the inter- and intra-reliability: poor (< 0.40), fair (0.40 – 0.60), good (0.60 – 0.75) and excellent (>0.75; Cicchetti and Sparrow, 1981; Cicchetti, 2001). Overall median scores and maximum scores were calculated to describe the frequency and quality of the implementation of the gamification strategies and general teacher/student behaviours. For the variables 'disruptive' and 'children off-task', lower scores represent higher implementation fidelity.

Acceptability Questionnaires. To determine intervention acceptability, the mean score for each construct was calculated by averaging the items within the corresponding construct of the questionnaire. Higher scores on the constructs of affective attitude, intervention coherence, perceived effectiveness, ethicality and self-efficacy indicated higher levels of acceptability. For the burden constructs, lower scores suggest higher levels of acceptability.

Qualitative data

A hybrid framework approach incorporating deductive-inductive coding was employed. Deductive coding was informed by Theoretical Framework of Acceptability (TFA) (Sekhon et al., 2017) and inductive coding was utilised to ensure data was captured that fell outside of this framework. The process of analysis followed the stages outlined by Gale et al. (2013). Interviews were transcribed verbatim and anonymised. The lead researcher familiarised themselves with the data through active reading. Next, the lead researcher moved on to charting the data in a priori matrix which was developed using the TFA. This involved writing summaries of the data pertaining to each TFA construct in each transcript. Supporting quotes were inputted into the relevant matrix cells to support the write-up process. There were areas on the excel sheet where additional data that fell outside the TFA framework could also be captured. The lead researcher kept an analytical memo and document with any emerging thoughts or feelings about the data as this process was undertaken. Once all the transcripts had been analysed, one member of the lead researcher's academic supervisory team (LF) met to verify the allocation of data to the various TFA constructs and to identify key issues relating to the acceptability of the gamified PE intervention within each component. This was done collaboratively with consensus reached for each TFA construct before sharing with the wider team for further verification. Each construct was then written up with sufficient detail provided for each section and direct quotations provided to support interpretations. Confidentiality was maintained by coding participants with letters, e.g. teacher from school A labelled as Teacher A, while boys and girls from School A were labelled as Boy A and Girl A, respectively.

Results

Reliability of SOG-PE

Pilot testing

The pilot testing resulted in high agreement percentages. There were some minor modifications made as a result of the pilot test. For instance, the term 'explicit' was included for the strategies: level and challenges, to more clearly discriminate between them. The final variables included in each level (i.e. gamification strategies and general teacher/student behaviours) and their definitions are presented in Table 17.

Reliability testing

Inter- and intra-observer agreement scores were calculated to provide an initial indication of the reliability of the SOG-PE. For the gamification strategies, over an 85% inter-observer total agreement ($\kappa = 0.86$) was reached, which is typically deemed excellent (Brewer & Jones, 2002). For each individual gamification strategy, over a 75% inter-observer total agreement was reached (range from κ = 0.60 – 1.0) suggesting good to excellent agreement. In addition, a 91.6% inter-observed total agreement (κ = 0.88) was reached for the general teacher/behaviours indicating an excellent agreement (McHugh, 2012). While for each individual general behaviour over a 75% inter-observer total agreement was reached (range from κ = 0.60 – 1.0). A high level of overall agreement (κ = 1.00) was reached for intra-observer reliability, as well. Inter-observer agreement scores for each individual gamification strategy and general teacher and student behaviour are presented in Table 17.

Table 17. Inter-observer agreement scores for each gamification strategy and general teacher and student behaviour

Gamification strategies	**Inter-observer percentage agreement (%)**
Narrative	100.0%
Relationships	100.0%
Rules	75%
Challenges	100%
Levels	100%
Feedback	75%
Points	100%
General behaviours	
Behaviour management	75%
Disruptive	100%
Children off task	100%

Implementation of gamification strategies and general behaviours

An average gamified PE lesson lasted 42 minutes 58 seconds (range: 36 minutes 54 seconds – 47 minutes 43 seconds). In total 257 minutes and 24 seconds of video footage was captured to assess the implementation of the gamification strategies and to assess general teacher and student behaviours. Table 18 reports the median and maximum for each item, as well as the global scale of the SOG-PE fidelity assessment. For gamification strategies, the least implemented was *points,* with median scores ranging from 0.00 to 2.00, indicating implementation was ‘never’ to ‘occasionally’ observed. For *challenges*, median scores for each lesson ranged from 0.00 to 2.50 corresponding to the ‘never’ to ‘occasionally’ anchor scales. The median *narrative* scores for each lesson ranged from 0.00 to 3.50 indicating implementation was ‘never’ to ‘frequently’ achieved. For *relationships* and *rules*, the median scores for each lesson ranged from 1.00 to 4.00 and 2.00 to 3.50 respectively, indicating implementation was ‘rarely’ to ‘frequently’ achieved. The median scores for each lesson for *feedback* ranged from 1.00 to 4.00 indicating implementation was ‘rarely’ to ‘extensively’ observed. For the general teacher and student behaviours, teacher *behaviour management* median scores ranged from 3.00 to 4.00 indicating teachers managed behaviour ‘frequently’ to ‘extensively’ which is positive. For student behaviours, *disruptive behaviours* (range = 0.00 – 1.0) and *children off-task* (range = 0.0 – 1.50) were ‘never’ or ‘rarely’ observed.

Participants

Table 19 summarises baseline participant characteristics. A total of 76 children aged 9 to 10 years old (M = 9.53, SD = 0.5) participated in this study. 41 children from the intervention group and 35 children from the control group. Of the 76 children, 57.8% were male. The majority of the sample were White British (65.7%), while 32.4% were classified as other. Children in the intervention and control group had the same average height (1.4 meters), while BMI and weight (19.0 kg/m^2 and 37.4kg, respectively) were higher for children in the intervention group. All the children’s postcodes were located in the top 20% most deprived nationally, as determined by The English Indices of Deprivation 2019 (Ministry of Housing Communities and Local Government, 2019).

Table 18. Medians and maximum score for each item, and global scale of the SOG-PE fidelity assessment

	Observed lessons: Week, Content, Median (M), Maximum score													
	Week 2 Jumping and landing		**Week 4 Agility**		**Week 5 Obstacle course**		**Week 6 Dribbling**		**Week 7 Throwing and catching**		**Week 9 Dodging and invasion**		**Global implementation scores**	
	M	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**
Gamification strategies														
Narrative	3.00	3.00	3.00	4.00	1.00	2.00	3.50	4.00	3.00	4.00	0.00	0.00	2.50	4.00
Relationships	1.00	4.00	3.50	4.00	4.00	4.00	3.50	4.00	4.00	4.00	1.00	4.00	3.50	4.00
Rules	2.50	3.00	3.00	3.00	3.00	3.00	3.50	4.00	3.00	4.00	2.00	2.00	3.00	4.00
Challenges	2.50	3.00	2.50	3.00	2.00	3.00	3.00	3.00	1.50	3.00	0.00	0.00	2.00	3.00
Levels	1.00	2.00	1.00	4.00	0.00	0.00	3.50	4.00	1.00	4.00	0.00	0.00	0.50	4.00
Feedback	2.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	2.50	4.00	1.00	2.00	3.50	4.00
Points	0.00	0.00	0.00	0.00	2.00	2.00	1.00	4.00	0.00	4.00	0.00	0.00	0.00	4.00

	Observed lessons: Week, Content, Median (M), Maximum score													
	Week 2 Jumping and landing		**Week 4 Agility**		**Week 5 Obstacle course**		**Week 6 Dribbling**		**Week 7 Throwing and catching**		**Week 9 Dodging and invasion**		**Global implementation scores**	
	M	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**	**M**	**Max**
General teacher/student behaviours														
Behaviour management	1.50	4.00	4.00	4.00	3.00	3.00	4.00	4.00	3.50	4.00	3.50	4.00	3.50	4.00
Disruptive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	0.00	2.00
Children off task	1.50	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.50	1.00	1.00	2.00

Note. Max refers to maximum scored achieved for each gamification strategy achieved in each lesson.

Table 19. Baseline participant characteristics.

	All		Intervention group		Control group	
	n	Mean (SD)	*n*	Mean (SD)	*n*	Mean (SD)
Age, Years	76	9.53 (0.50)	41	9.48 (0.50)	35	9.60 (0.40)
Sex	76		41		35	
Boys	44	57.89%	24	58.53%	20	57.14%
Girls	32	42.10%	17	41.46%	15	42.85%
Ethnicity						
White British	50	65.78%	21	51.22%	29	82.85%
Other	26	34.21%	20	48.87%	6	17.14%
Height, m	76	1.4 (0.20)	41	1.4 (0.07)	35	1.4 (0.36)
Weight, kg	76	36.8 (9.68)	41	37.4 (8.45)	35	35.7 (12.5)
BMI	76	18.78 (0.36)	41	19.07 (3.32)	35	17.98 (2.62)
IMD Rank (Decile)[1]						
School A			22	3,735 (2)		
School B			19	2,628 (1)		
School C					16	3,523 (2)
School D					19	2,353 (1)

Note. [1] 1 = most deprived (top 10%)

Baseline Characteristics

At pre-test children in both the intervention and control group had moderate levels of EI. Regarding MC, children in the intervention group demonstrated low levels across most of the MCA and KTK3+ outcomes. In contrast, children in the control group demonstrated low levels of MC in the locomotor skills subtest of the MCA, but slightly above average for the remaining

MCA and KTK3+ subtests (Coppens et al., 2021; Rodrigures et al., 2019). For perceived MC in the MCA subtests, pre-tests scores indicated that children in both groups reported high levels across all subtests. In the KTK3+ subtests, children in the intervention group also reported high levels across all subtests, whereas children in the control reported high perceived MC only for eye-hand coordination, and moderate levels for the remaining subtest. In terms of motivational regulation in PA, pre-test scores indicated that children in the intervention group had high levels of intrinsic and identified regulation, and moderate levels of introjected and external regulation. Children in the control group reported high levels of intrinsic motivation and identified regulation, and moderate levels of introjected and external regulation at pre-test. For motivation regulations in PE, children in both groups demonstrated moderate to high levels of intrinsic motivation and identified regulation, and moderate levels of introjected and external regulation at pre-test. Finally, pre-test BPNs scores indicated that children in both the intervention and control groups had moderate levels of autonomy, competence and relatedness satisfaction and frustration.

Intervention effect on child-level outcomes

Table 20 presents the descriptive statistics and paired-samples t-test results for the intervention effects on children's EI, MC, BPN's, and motivational regulations in PE and PA. Table 21 presents the intervention effects. Specifically, ANCOVA adjusted mean post-test scores for each variable by group condition, controlling for pre-test, sex and age covariates.

Emotional intelligence. The ANCOVA revealed no significant differences between groups at post-test ($F_{(1, 71)} = 0.46$, $p = 0.497$, $\eta^2 = .007$). These results did not support the hypothesis that children who participated in the gamified MC intervention will show greater improvement in EI, compared to the control group.

Table 20. Paired samples t-test for each variable to examine changes between pre- and post-test within each group for each variable.

Variable	Intervention Group		Control Group	
	Pre-test Mean (SD)	**Post-test Mean (SD)**	**Pre-test Mean (SD)**	**Post-test Mean (SD)**
Emotional intelligence (TEIQue-Csf)				
Emotional intelligence	3.32 (0.51)	3.46 (0.48)	3.40 (0.48)	3.38 (0.52)
Motor competence (MCA)				
Ball kicking velocity	23.17 (6.04)	30.41 (4.98)**	26.91 (4.36)	27.11 (5.80)
Ball throwing velocity	27.36 (5.71)	32.87 (6.38)**	28.85 (3.91)	29.31 (4.13)
Shifting platforms	15.34 (3.56)	19.73 (3.82)**	18.00 (3.81)	19.60 (2.89)*
Shuttle run	14.43 (1.76)	13.88 (1.69)**	14.15 (1.69)	14.06 (1.48)
Jumping sideways	24.92 (5.25)	37.12 (5.95)**	35.05 (7.81)	36.97 (9.28)*
Standing long jump	126.21 (20.89)	135.60 (20.65)**	145.62 (20.50)	142.31 (20.50)
Motor competence (KTK3+)				
Eye-hand co-ordination	22.43 (14.83)	35.92 (13.93) **	24.45 (13.86)	26.00 (14.98)
Balancing backwards	31.48 (12.13)	38.56 (12.21)**	33.80 (13.40)	34.94 (12.53)

Variable	Intervention Group		Control Group	
	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test Mean (SD)	Post-test Mean (SD)
Jumping sideways	54.46 (12.10)	67.56 (9.34)**	63.82 (14.32)	64.42 (15.02)
Moving sideways	30.78 (7.08)	31.26 (8.74)	30.74 (8.00)	31.31 (8.57)
Perceived motor competence (MCA)				
Ball kicking velocity	7.92 (2.20)	8.60 (1.92)	7.94 (1.57)	8.71 (1.58)
Ball throwing velocity	8.26 (2.01)	8.92 (1.52)	7.77 (1.62)	8.22 (1.53)
Shifting platforms	8.07 (2.05)	8.17 (1.82)	7.88 (1.93)	8.08 (1.85)
Shuttle run	7.80 (2.13)	8.46 (1.71)	7.20 (1.87)	8.08 (1.91)
Jumping sideways	8.02 (1.94)	8.58 (1.53)	7.94 (1.84)	8.20 (1.43)
Standing long jump	7.34 (2.51)	7.90 (2.17)	7.80 (1.95)	7.31(1.82)
Perceived motor competence (KTK3+)				
Eye-hand co-ordination	8.48 (1.81)	7.92 (2.48)	8.22 (2.18)	7.77 (2.41)
Balancing backwards	8.26 (1.93)	7.24 (2.25)	7.77 (1.88)	7.77 (1.88)
Jumping sideways	8.47 (1.70)	8.10 (2.06)	6.05 (1.84)	7.57 (1.86)

Variable	Intervention Group		Control Group	
	Pre-test Mean (SD)	Post-test Mean (SD)	Pre-test Mean (SD)	Post-test Mean (SD)
Moving sideways	8.75 (1.42)	8.36 (2.02)	7.11 (1.77)	8.20 (1.93)
BREQ – PA				
Intrinsic motivation	4.36 (.73)	4.40 (.70)	4.01 (.99)	4.00 (.86)
Identified regulation	4.16 (.73)	4.11 (.84)	3.83 (.91)	3.76 (.84)
Introjected regulation	3.27 (.90)	2.69 (1.21)*	2.59 (.88)	2.75 (.87)
External regulation	2.65 (1.17)	1.98 (1.04)*	2.04 (.88)	2.30 (.91)
BREQ – PE				
Intrinsic motivation	4.43 (.72)	4.42 (.76)	4.04 (1.04)	4.03 (.78)
Identified regulation	4.00 (.75)	4.21 (.76)*	3.87 (.88)	3.82 (.83)
Introjected regulation	2.89 (1.09)	2.98 (.99)	2.71 (.98)	3.01 (1.11)
External regulation	2.54 (1.12)	2.17 (1.19)*	1.96 (.79)	2.39 (.94)*
Basic psychological needs and frustration				

Variable	Intervention Group		Control Group	
	Pre-test **Mean (SD)**	**Post-test** **Mean (SD)**	**Pre-test** **Mean (SD)**	**Post-test** **Mean (SD)**
Autonomy Satisfaction	3.42 (.87)	3.50 (.93)	3.42 (.72)	3.33 (.67)
Autonomy Frustration	2.91 (.95)	2.81 (1.01)	2.76 (.93)	2.88 (.80)
Competence Satisfaction	3.97 (.77)	4.09 (.66)	4.02 (.67)	3.96 (.74)
Competence frustration	2.94 (1.05)	2.65 (1.02)	2.50 (.95)	2.70 (.93)
Relatedness Satisfaction	3.55 (.96)	3.72 (.91)	3.65 (.85)	3.26 (79)
Relatedness frustration	2.64 (1.14)	2.45 (.95)	2.15 (.94)	2.40 (.87)

Note. **P <0.001, * P <0.05 paired-sample t-test within group changes.

Table 21. Intervention effects examining group differences at post-test, controlling for pre-test, sex and age.

Variable	Adjusted (mean ± standard error)		*F*	*p*	η_p^2
	Intervention	Control			
Emotional intelligence (TEIQue-CSF)					
Emotional intelligence	3.46 ± 0.78	3.38 ± 0.85	0.46	0.497	.007
Motor competence (MCA)					
Ball kicking velocity	31.54 ± 0.59	25.78 ± 0.64	39.91	**<.001**	.360
Ball throwing velocity	33.52 ± 0.42	28.56 ± 0.46	61.41	**<.001**	.464
Shifting platforms	20.30 ± 0.49	18.92 ± 0.53	3.39	.070	.046
Shuttle run	13.76 ± 0.11	14.20 ± 0.11	7.17	**.009**	.092
Jumping sideways	40.94 ± 1.02	32.61 ± 1.13	23.28	**<.001**	.092
Standing long jump	143.24 ± 1.56	133.37 ± 1.70	16.52	**<.001**	.189
Motor competence (KTK3+)					
Eye-hand co-ordination	26.62 ± 1.49	25.18 ± 1.61	26.79	**<.001**	.274
Balancing backwards	39.30 ± 1.22	34.07 ± 1.32	8.36	**.005**	.105
Moving sideways	31.26 ± 0.91	31.32 ± 0.99	.002	.962	.000
Jumping sideways	68.01 ± 1.36	59.41 ± 1.48	14.09	**<.001**	.166
Perceived motor competence (MCA)					
Ball kicking velocity	8.62 ± 0.27	8.67 ± 0.29	0.32	.858	.000
Ball throwing velocity	8.89 ± 0.23	8.26 ± 0.25	3.23	.077	.044

Variable	Adjusted (mean ± standard error)		*F*	*p*	η_p^2
	Intervention	Control			
Shifting platforms	8.58 ± 0.21	8.20 ± 0.23	1.30	.247	.019
Shuttle run	8.39 ± 0.27	8.16 ± 0.29	0.31	.577	.004
Jumping sideways	8.47 ± 0.28	6.05 ± 0.30	33.61	**<.001**	.324
Standing long jump	7.94 ± 0.30	7.31 ± 1.87	2.22	.713	.030
Perceived motor competence (KTK3+)					
Eye-hand co-ordination	7.91 ± 0.36	7.78 ± 0.39	0.62	.804	.001
Balancing backwards	7.19 ± 0.33	7.83 ± 0.36	1.63	.206	.022
Jumping sideways	8.07 ± 0.35	7.59 ± 0.38	0.71	.400	.010
Moving sideways	8.20 ± 0.32	8.39 ± 0.35	0.13	.713	.002
BREQ – PA					
Intrinsic motivation	4.35 ± 0.11	4.07 ± 0.12	2.86	.095	.039
Identified regulation	4.04 ± 0.11	3.84 ± 0.12	1.23	.270	.017
Introjected regulation	2.55 ± 0.16	2.91 ± 0.17	1.95	.166	.027
External regulation	1.90 ± 0.15	2.40 ± 0.16	4.89	**.030**	.065
BREQ – PE					
Intrinsic motivation	4.36 ± 0.10	4.11 ± 0.11	2.59	.112	.035
Identified regulation	4.17 ± 0.11	3.86 ± 0.12	3.48	.066	.047
Introjected regulation	2.94 ± 0.15	3.06 ± 0.16	0.25	.615	.004

Variable	Adjusted (mean ± standard error)		*F*	*p*	η_p^2
	Intervention	**Control**			
External regulation	2.05 ± 0.16	2.52 ± 0.94	3.79	.055	.010
Basic psychological needs and frustration					
Autonomy Satisfaction	3.50 ± 0.12	3.34 ± 0.13	0.81	.317	.011
Autonomy Frustration	2.80 ± 0.14	2.91 ± 0.15	0.22	.638	.003
Competence Satisfaction	4.10 ± 0.10	3.96 ± 0.10	0.87	.352	.012
Competence frustration	2.57 ± 0.15	2.78 ± 0.16	0.89	.347	.013
Relatedness Satisfaction	3.74 ± 0.12	3.28 ± 0.13	7.59	**.007**	.097
Relatedness frustration	2.36 ± 0.13	2.49 ± 0.14	0.42	.517	.006

Motor competence. MCA. The ANCOVA revealed significant between group differences at post-test for ball kicking velocity ($F_{(1, 71)} = 39.91$, $p = < .001$, $\eta^2 = .360$), ball throwing velocity ($F_{(1, 71)} = 61.41$, $p = < .001$, $\eta^2 = .464$), shuttle run ($F_{(1, 71)} = 7.17$, $p = .009$, $\eta^2 = .092$), jumping sideways ($F_{(1, 71)} = 23.28$, $p = < .001$, $\eta^2 = .092$), and standing long jump ($F_{(1, 71)} = 16.53$, $p = < .001$, $\eta^2 = .189$). Compared with the control group, children in the intervention group significantly improved in ball kicking velocity (AMD: 5.76, 95% CI: 3.94, 7.58), ball throwing velocity (AMD: 4.96, 95% CI: 3.69, 6.22), shuttle run (AMD: 0.43, 95% CI: 0.11, 0.75), jumping sideways (AMD: 8.22, 95% CI: 4.82, 11.62) and standing long jump (AMD: 9.86, 95% CI: 5.03, 14.70). The ANCOVA revealed no group differences at post-test for shifting platforms ($F_{(1, 71)} = 3.39$, $p = .070$, $\eta^2 = .046$). These results support the hypothesis that children who participated in the gamified MC intervention would show greater improvement in MC, compared to the control.

Motor competence. KTK3+. The ANCOVA revealed significant between group differences at post-test for eye-hand coordination ($F_{(1, 71)} = 26.79$, $p = < .001$, $\eta^2 = .274$), balancing backwards ($F_{(1, 71)} = 8.36$, $p = .005$, $\eta^2 = .105$) and jumping sideways ($F_{(1, 71)} = 14.09$, $p < .001$, $\eta^2 = .166$). Compared with the control group, children in the intervention group significantly improved in eye-hand coordination (AMD: 11.43, 95% CI: 7.93, 15.84), balancing backwards (AMD: 5.22, 95% CI: 1.62, 8.82), and jumping sideways (AMD: 8.63, 95% CI: 4.05, 13.22). For moving sideways, the ANCOVA revealed no differences between the groups at post-test ($F_{(1, 71)} = .002$, $p = .962$, $\eta^2 = .000$). These results support the hypothesis that children who participated in the gamified MC intervention would show greater improvement in MC, compared to the control.

Perceived motor competence. MCA. The ANCOVA revealed significant between group differences at post-test for jumping sideways ($F_{(1, 70)} = 33.61$, $p < .001$, $\eta^2 = .324$). Compared with the control group, children in the intervention group significantly improved PMC for jumping sideways (AMD: 2.42, 95% CI: 1.58, 3.25). The ANCOVA revealed no significant differences between the groups at post-test for ball kicking velocity ($F_{(1, 71)} = 0.32$, $p = .858$, $\eta^2 = .000$), ball throwing velocity ($F_{(1, 72)} = 3.23$, $p = .077$, $\eta^2 = .044$), shifting platforms ($F_{(1, 71)} = 1.30$, $p = .247$, $\eta^2 = .019$), shuttle run ($F_{(1, 71)} = 0.314$, $p = .577$, $\eta^2 = .004$) and standing long jump ($F_{(1, 71)} = 2.22$, $p = .140$, $\eta^2 = .030$). These results partially support the hypothesis that children who participated in the gamified MC intervention will show greater improvement in PMC, specifically for jumping sideways, compared to the control.

Perceived motor competence. KTK3+. The ANCOVA revealed no significant differences between group differences at post-test for jumping sideways ($F_{(1, 71)} = .718$, $p = .400$, $\eta^2 = .010$), balancing backwards ($F_{(1, 71)} = 1.63$, $p = .206$, $\eta^2 = .022$), eye-hand coordination ($F_{(1, 71)} = 0.62$, $p = .804$, $\eta^2 = .001$) and moving sideways ($F_{(1, 71)} = .137$, $p = .713$, $\eta^2 = .002$). These results did not support the hypothesis that children who participated in the gamified MC intervention will show greater improvement in PMC, compared to the control.

Motivational regulations in PA. The ANCOVA revealed significant between group differences at post-test for external regulations ($F_{(1, 71)} = 4.89$, $p = .030$, $\eta^2 = .065$). Compared with the control group, children in the intervention group external regulations significantly decreased (AMD: -0.504, 95% CI: -0.95, 0.05). The ANCOVA revealed no differences between the groups at post-test for intrinsic motivation ($F_{(1, 71)} = 2.86$, $p = .095$, $\eta^2 = .039$), identified regulation ($F_{(1, 71)} = 1.23$, $p = .270$, $\eta^2 = .017$) and introjected regulation ($F_{(1, 71)} = 1.95$, $p = .166$, $\eta^2 = .027$). These results provide partially support the hypothesis that children who participated in the gamified MC intervention will show greater improvement in motivational regulations in PA, specifically a decrease in external regulation, compared to the control.

Motivational regulations in PE. The ANCOVA revealed no significant between group differences at post-test for intrinsic motivation ($F_{(1,\ 71)} = 2.59$, $p = .112$, $\eta^2 = .035$), identified regulations ($F_{(1,\ 71)} = 3.48$, $p = .066$, $\eta^2 = .047$), introjected regulations ($F_{(1,\ 71)} = .255$, $p = .615$, $\eta^2 = .004$) and external regulations ($F_{(1,\ 71)} = 3.79$, $p = .055$, $\eta^2 = .010$). These results did not support the hypothesis that children who participated in the gamified MC intervention will show greater improvements in motivational regulations in PA, compared to the control.

Basic psychological needs satisfaction and frustration. The ANCOVA revealed significant between group differences at post-test for relatedness satisfaction ($F_{(1, 71)} = 7.59$, $p = 0.007$, $\eta^2 = .097$). Compared with the control group, relatedness satisfaction for children in the intervention group significantly improved (AMD: 0.505, 95% CI: 0.140, 0.870). The ANCOVA revealed no significant between group differences at post-test for autonomy satisfaction ($F_{(1,\ 71)} = 0.812$, $p = 0.317$, $\eta^2 = .011$), autonomy frustration ($F_{(1,\ 71)} = 0.223$, $p = 0.638$, $\eta^2 = .003$), competence satisfaction ($F_{(1,\ 71)} = 0.879$, $p = 0.352$, $\eta^2 = .012$), competence frustration ($F_{(1,\ 71)} = 0.895$, $p = 0.347$, $\eta^2 = .013$) and relatedness frustration ($F_{(1,\ 71)} = 0.424$, $p = 0.517$, $\eta^2 = .006$). These results provide partially support the hypothesis that children who participated in the gamified MC intervention will show greater improvement in BPNs, specifically in relatedness satisfaction, compared to the control group.

Acceptability of the intervention

Mean scores for the acceptability questionnaires for children and teachers using the TFA construct are presented in Table 22 and 23, respectively.

Table 22. Child means and maximum scores for the acceptability questionnaires

TFA construct	Mean (SD)	Max.
Affective attitude	4.19 (0.82)	5
Intervention coherence	3.85 (1.14)	5
Perceived effectiveness	3.61 (1.09)	5
Self-efficacy	4.17 (1.21)	5

Table 23. Teacher means and maximum scores for the acceptability questionnaires

TFA construct	Mean (SD)	Max
Affective attitude	4.50 (0.70)	5
Burden	3.00 (1.41)	4
Ethicality	4.75 (0.35)	5
Intervention coherence	4.50 (0.70)	5
Perceived effectiveness	4.00 (0.00)	5
Self-efficacy	4.50 (0.70)	5

Note. With the exception of the burden construct, higher scores, reflect higher acceptability.

Affective attitude

Affective attitude relates to the feelings about participating in the gamified PE lessons. The lessons were generally perceived as *fun, exciting and enjoyable* by the children. Teachers endorsed these feelings, describing the children as excited during the lessons and noted that the activities were appropriate for the children. Most of the children's positive feelings about the intervention were related to the variety of activities: 'I enjoyed that it was always something different, like the activities and games' (Boy B); the increase in teamwork: 'I liked doing things as teams and not just doing things on your own' (Boy A); and the higher energy expenditure: 'it was like a lot more higher energy' (Girl A). Teachers also described positive feelings associated with increased energy levels, suggesting that the children's energy levels remained consistently high, which helped keep the children motivated. A few children did however, mention that they did not enjoy working in teams, and with people that they did not like. Some of the girls raised concerns about the boys not participating fairly, with one stating: ‘the boys never passed to us’ (Girl A), and another adding: ‘the boys would always shout pass, and then we never really got a go because they didn’t pass back’ (Girl A). These feelings were shared by the boys who described the girls as: ‘bossy’ and suggested that: ‘they [the girls] did not let us have a turn’ (Boy A). Despite these individual concerns, the teachers did not report any major issues between the boys and girls. The teachers’ positive feelings were related to the gamification strategies: ‘I thought it was brilliant, the children got into the narrative parts’ (Teacher B). Additionally, teachers found the gamified PE lessons easier to implement compared to previous PE schemes they had used. Teachers, however, described how the initial learning curve posed a challenge for both themselves, and the children, as it involved adjusting to a new format and set of rules. Although, once past this initial stage, the lessons ran smoothly with no further issues. Suggested improvements from the children included adding more gymnastics lessons and making the lessons longer. Teachers, on the other hand, did not suggest any areas for improvement.

Burden

Teachers reported only minor feelings towards the amount of effort required to deliver the gamified PE lessons. One teacher described the amount of equipment required was ‘somewhat challenging’ (Teacher B) but suggested that this was one of the reasons the children enjoyed the lessons so much. Teachers also described the initial issue of preparation time, but stated that, as the weeks progressed, they were able to plan more efficiently. Burden was not a focus in discussions of child acceptability, as the gamified PE lessons replaced their usual PE lessons, an integrated subject within the school curriculum.

Ethicality

The intervention appeared to align with the values of the teachers. Teachers described how the intervention increased participation, particularly among children who had previously been less engaged in PE. Teachers, however, reported that other professionals might be hesitant to adapt a new pedagogical approach: 'I think someone who has taught PE for a long time, might be, like a bit reluctant to trying out a new concept' (Teacher A) and 'for someone who doesn't teach PE often, it can probably be a bit, scary trying something new out' (Teacher B). Despite this, no negative outcomes were identified by the teachers. Ethicality was not a focus in discussions of child acceptability.

Intervention coherence

There was generally good intervention coherence reported by both children and teachers. Teachers described the lessons as straightforward and easy to deliver. This coherence appeared to be enhanced by the structure of the lessons and having the curriculum pack to support delivery: 'I think having the little curriculum pack to go through, you knew what was what and what was coming up and the set up' (Teacher A). Some children supported this view suggesting that the lessons were easy to follow and were provided with clear rules. Although, a small number of children reported finding the lesson structure and rules confusing at times: 'sometimes it wasn't clear, but sometimes it was' (Girl A). One child reported experiencing low intervention coherence due to extra curricula studies (i.e. English and maths) during PE and joining in halfway through: 'I didn't really get it [PE lesson] because when I walked outside after reading or maths, we didn't know what to do, and then nothing would be explained properly' (Girl A), or not attending at all: 'well I would miss one lesson, then another, and then I was confused the following lesson' (Girl A). Teachers acknowledged that the design of the intervention supported a natural progression of skills, which appeared to be facilitated by the gamification strategies. This view was also acknowledged by the children, who reported the coherence of the gamification strategies. The most commonly reported strategies were the levels: ‘if you could do a level you would move up, and if you couldn’t you would move down and then work your way back up until each level was completed’ (Girl B); the narrative: ‘you had to throw the luggage and put it on the X-ray machine, and it started getting quicker’ (Boy B); and challenges: ‘we got to choose what challenges we did, so I picked the hard one’ (Boy A). The children’s understanding of the skills taught during the intervention was generally good, with some referencing the skills learnt in relation to the narrative/theme of their curriculum: ‘in our theme we had to throw and catch the ball pretending it was items for the Washington’ (Girl A). One teacher reported that logistical challenges sometimes made maintaining coherence difficult. This was primarily due to variations in the size of equipment and available space. Teachers suggested that these challenges could be mitigated by having time to set up before the lesson and noted that the lessons ran most smoothly when the children helped with set up.

Perceived effectiveness

Teachers and children described some of the impacts of taking part in the intervention. One teacher reported that they felt unsure if the intervention had an effect on children’s movement skills. They described instead, how they had seen an increase in confidence to participate, particularly for those deemed less confident: ‘the less confident children have definitely become more confident when participating, but I don’t know if I have noticed it physically’ (Teacher A). Teacher B thought that the intervention had a positive impact on movement skills, teamwork, problem-solving and motivation. Both teachers attributed this positive impact to using gamification in PE: ‘I think it’s [gamification] a successful and clever way of gaining skills and becoming more skilful’ (Teacher A) and ‘the students were motivated because of the challenges and levels' (Teacher B). Children also described positive impacts on movement and social skills. These included teamwork skills: 'it helps us with our teamwork skills' (Boy B), throwing and catching: 'I can catch, and I couldn't do this before' (Girl A) and strengthening social bonds: 'I have got closer to people in my class (Girl B). The positive long-term impact was also reported by the children: 'I think it has helped because you have got to do these skills in everyday life….so the things we did in the PE lessons we will always do forever' (Girl A). One child also described the impact on their skills in sport specific content: 'because I am a goalkeeper, it has improved my movement moving side to side' (Boy A). Other positive impacts reported by the children included greater engagement, PA levels and improved communication with peers. Some children thought the intervention might work best for those who do not participate in sports outside of school: 'some people do sports outside of school, and people who don't, I think this would help with their movement skills' (Boy A). A small number of children also mentioned that participating in sport outside of school meant the intervention did not benefit them: 'for me I play for a football team outside of school, so for me it did not benefit me' (Girl A). Generally, however, children and teachers thought gamification was a promising approach in PE. Children described how it was different to their usual PE lessons, that there was less standing around, and working together more. This was a view acknowledge by the teachers, describing how gamification added an extra layer of engagement that traditional PE lessons sometimes lack, and is an innovative way to get more students participating in PE. Teachers, however, raised the issue of planning if a gamification curriculum was not readily available: 'I suppose a weakness would be if I didn't have the programme [lesson plan] and you were kind of having to plan for yourself' (Teacher A).

Self-efficacy

Teachers received a 2-hour workshop prior to delivering the intervention and considered this important: ‘I felt more confident delivering the lessons because of the workshops’ (Teacher B). Teacher A also felt confident in delivering the intervention as they had a previous interest in gamification. Teachers further acknowledged that having a well-structured curriculum and receiving it ahead of time made them feel more prepared to deliver the intervention. They also advised that having sufficient opportunity to engage with the intervention themselves before introducing it to the children was important. Teacher B’s only concern about having the behaviours to deliver the intervention was in relation to the access to resources: ‘the biggest issue might be access to resources, like not every school may have all the equipment, and that can be a problem’. Self-efficacy was only reported by some children, where they felt confident in participating in the intervention, particularly when it involved working in a team: ‘I felt good in myself because I got to work with my friends and in a team’ (Boy B). One child reported low self-efficacy due to issues with other children in the class: ‘it makes me feel less capable of what I am doing after the boys say these things to me’ (Girl A).

Discussion

The first objective of this quasi-experimental trial was to investigate the effects of a gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA in 9- to 10-year-old children from areas of high deprivation. The second objective was to investigate the acceptability of the intervention within a primary school context beyond those involved in the co-development process. The final objective was to develop a tool that could be used to assess the implementation of gamification strategies in the context of PE. The results indicated that the gamified PE intervention was effective in increasing children’s MC, relatedness needs satisfaction, and decreasing external regulation in PA. The gamified PE intervention was acceptable for teachers and children. Finally, the System for Observing Gamification in PE (SOG-PE) was developed. The SOG-PE was deemed as reliable and demonstrated an increase in gamification strategies over the intervention, and children were rarely off-task or disruptive.

Intervention effects on child-level outcomes

The gamified PE intervention was promising in terms of MC, with children in the intervention group significantly improving in MC compared to those in the control group. It has been claimed that methods to engage and motivate children are key elements of effective interventions and can lead to improvements in MC (Salters and Benson, 2025). The results of this study suggest that gamification, underpinned by motivational theory (i.e. SDT) and motor learning theory (i.e. ecological dynamics), could be an effective key element and provides a novel method to improve children's MC. From an SDT perspective, the gamified elements supported competence (e.g. levels and challenges), autonomy (e.g. choice), and relatedness (e.g. narrative and relationships), which are central to fostering motivation, engagement and persistence (Ryan and Deci, 2021). From an ecological dynamics perspective, the observed improvements may be explained by the interaction between the learner, task and environment in motor skill learning (Button et al., 2021). The gamified activities created affordances – opportunities for action – that were meaningful and aligned with the children's abilities and intentions (Gibson, 1979), encouraging exploration and the gradual release of movement constraints (Bernstein, 1967) towards more coordinated patterns. Thus, the structured skill progression of the curriculum provided both opportunities for practice and contexts that supported adaptability, which may explain the improvements in MC. Furthermore, these improvements provide evidence that using a structured programme focusing on different FMS can be effective. Such results align with previous studies to suggest intervention programmes designed to improve FMS with a structured skill progression, such as the one implemented in this study, can be beneficial for promoting and increasing FMS development (Zhang et al., 2024; Salters and Benson, 2025). Results from this study also demonstrated a significant improvement in some stability skills. In this respect, our results expand the limited knowledge on the effects of MC interventions on stability skills (Zhang et al., 2024) and are consistent with those of Davies et al. (2024) who demonstrated that a home-based gamification intervention was effective in improving stability skills in 4- to 5-year-old children. Although MC improvements were observed, it should be acknowledged that data obtained from video observations indicated that the gamified PE lessons were delivered for an average of 42 minutes and 58 seconds, despite being designed for 60 minutes. This suggests that the actual time spent on movement skill development may have been relatively low. To achieve more substantial and sustained improvements in MC, it is likely that an increased dose, frequency and duration would be required. While the ideal length of MC interventions remains uncertain (Slaters and Benson, 2025; Thompsett et al., 2017; Moon et al., 2024), from an ecological dynamics perspective, providing sufficient opportunities for children to interact with varied tasks and environments is essential (Button et al., 2021). More time and exposure increase the likelihood of discovering effective movement solutions and consolidating skill learning (Logan et al., 2012).

In contrast to previous findings (see Chapter Five; Navarro-Mateso et al., 2024; Carcelen-Fraile, 2025), no significant improvements in EI were observed for children in the intervention group compared to the control. It is possible that the use of different measures of EI than both Navarro-Mateso et al. (2024) and those used in Chapter Five, may have impacted findings. However, the present results are consistent with previous studies (Pauletto et al., 2023; Özal et al., 2024), who also reported no changes in EI following 8- to 12-week interventions using the same EI measure, with comparable dosage and frequency (60 minutes, once per week).

Previous research has shown that school-based interventions leading to improvements in EI among preadolescents (aged 9 to 12 years) typically lasted one year or more (Viguer et al., 2017). Thus, it could be suggested that EI may be more challenging to develop in the short-term, particularly as EI profiles become partially stable for children aged 10 to 11 (Keefer et al., 2013). While no significant changes in EI were observed, this study provides partial evidence regarding global EI levels in children aged 9 to 10 years, an area where there is a notable lack of normative data research, despite the growing emphasis on the importance of EI development. Comparison with existing normative data suggests that children in this sample had lower EI than the normative values found in Italian children (mean = 3.61, SD = 0.46; Pauletto et al., 2023) and English children (mean = 3.65, *SD* = 0.45; Mavroveli and Sánchez-Ruiz et al., 2011). As such, further research is needed to better understand global EI levels in primary school-aged children in the UK and thus, researchers can better support this through targeted interventions in PE.

From a theoretical standpoint, given the observed increase in MC, an associated increase in PMC would be expected, given the previously suggested moderate positive association (Stodden et al., 2008; Estevan et al., 2021). However, in the present study, a significant increase in PMC was only observed for the JS subtest of the MCA. It is plausible that the children in this sample overestimated their competence levels at baseline, as most reported moderate to high levels of PMC, despite exhibiting scores that correspond with the lower to upper lower percentile for MC relative to the normative values for children of their age, as indicated by the MCA and KTK3+ (Coppens et al., 2021; Rodrigues et al., 2019). This overestimation may partly account for no significant changes observed in PMC, while there may have been a ceiling effect due to their high PMC scores at pre-test. Moreover, it has been suggested that children from low SES backgrounds tend to overestimate their motor competencies (Nobre et al., 2018) which could further explain the findings of the present study. Previous research has suggested that as children transition from early to middle childhood, their enhanced cognitive abilities enable them to more accurately assess their abilities relative to their peers (Lopes et al., 2016; De Meester et al., 2020). Nevertheless, this overestimation may not necessarily be a negative. Higher perceived MC is important for keeping children engaged in PE (Estevan et al., 2021), which is important as children of lower SES have lower MC and have fewer opportunities to participate in PA outside of school (Gosselin et al., 2021).

The results also revealed a significant decrease in external regulation in PA for children in the intervention group. These results contradict previous research, which suggests that gamification either increases (Ferriz-Valero et al., 2020; see Chapter Four) or has no effect on external regulations for primary-school aged children (Sotos-Martínez et al., 2024). The observed decrease in external regulation is positive for several reasons. Previously it has been suggested that certain gamification strategies, such as points and badges, may fuel external motivation in children (Melero-Canas et al., 2021); however, this was not the case in the current study, and is demonstrated through the fidelity measures that demonstrated low implementation of points during the intervention, despite being planned in. In addition, this finding supports the notion that when gamification strategies are carefully aligned with the intrinsic goals of the activity, the potential for increased external regulation can be mitigated (Rice et al., 2025). As external regulation is negatively associated with maladaptive outcomes such as lack of engagement, amotivation and withdrawal from activities (Vasconcellos et al., 2020), the decrease in external regulation observed here is significant for promoting long-term behaviour change. This change may potentially transfer to other activities across different context (Hutmacher et al., 2020) and is important for the broader development of MC in middle childhood. As children's PA levels were not measured in this study, it is not possible to test whether these changes led to changes in PA, but it would be interesting for future research to investigate these effects in a primary school context, as similar research conducted with adults has shown favourable results (Harris, 2019).

Regarding BPNs, previous studies have found gamification to be effective in increasing all three BPNs in primary school-aged children (Sotos-Martinez et al., 2023). In contrast, the results from this study indicated only a significant improvement in relatedness satisfaction for children in the intervention group compared to the control, and no changes in autonomy and competence satisfaction. Possible explanations for no significant changes in autonomy and competence, may be in part due to the high levels at baseline, and therefore may indicate a ceiling effect. In line with these findings, a study by Ahn et al. (2019) observed improvements in relatedness but no changes in autonomy and competence in children aged 9 to 13 following a gamified PA intervention. It is plausible that the improvement in relatedness is the result of incorporating gamification strategies that priorities relationships (i.e. teamwork, pair work), as well as the narrative structure that fostered a sense of belonging during the lessons. Furthermore, it could be speculated that a frequent dose of the narrative and relationships was sufficient to elicit the intended effects on relatedness need satisfaction. Several studies have suggested that relatedness is an important predictor of engagement in PE (Leisterer and Gramlich et al., 2021) and is strongly correlated with more autonomous PE motivation (van Art et al., 2017).

Acceptability of the intervention

Intervention acceptability is important as it influences the implementation and engagement of participants in the short and long term (Skehon et al., 2022). In considering the acceptability, Sekhons et al. (2022) framework was used. Generally, teachers found both the emotive (ethicality, affective attitude, self-efficacy) and cognitive (intervention coherence, perceived effectiveness) constructs of the TFA to be highly acceptable. In contrast, children found only the emotive constructs to be highly acceptable, while the cognitive constructs' acceptability were perceived as moderately acceptable. Overall, teachers and children responded positively to the gamified PE lessons, with children noting only minimal issues, such as duration and content (i.e. incorporation of more gymnastics) of the lesson. The teachers found the gamified lessons aligned with their values and were not overly burdensome. However, teachers did feel that the amount of equipment required, and preparation time presented challenges, and felt that there may be a reluctancy from other professionals to adapt to a new pedagogical approach. One explanation for the latter feeling is the teachers in this study were either a qualified sports coach or a specialised PE teacher, who potentially had sufficient knowledge and confidence of delivering PE and thus were open to new pedagogies. It could, however, be speculated that the raised concerns were in relation to other teachers' competency, particularly where many of them are not specialists, and in relation to experienced teachers who may be most comfortable with just continuing using a familiar pedagogy and therefore may be more reluctant to incorporating a new pedagogical approach, such as gamification. Although, previous evidence suggests that gamification can be delivered successfully with favourable outcomes by non-specialist PE teachers (see Chapter Four). Concerns regarding primary school teachers' competencies are often presented across the literature (Clohessy et al., 2019) and can be further attributed to the limited and inadequate teaching training and development (Randall and Griggs, 2021).

For intervention coherence, teachers felt positive about delivering the lessons, believing they were straightforward and easy to deliver. However, some children felt that the lessons were sometimes unclear, often due to being removed for additional curriculum subjects (i.e.

Mathematics and English). Approximately seven (out of 24) children reported this removal, which raises concerns about the status of PE in primary schools (Duncombe et al., 2018). At the same time, this is particularly concerning for children from low SES backgrounds, as this removal increases the risk of missing out on positive outcomes typically associated with PE participation, such as academic achievement, enjoyment of learning, metacognition, MC, and the development of life skills (Dudley and Burden, 2020; Dudley et al., 2022). Both teachers and children reported a good understanding of the gamification strategies and movement skills taught during the lessons. Furthermore, teachers and children generally perceived the gamified PE lessons to be effective, with some children highlighting how the skills learnt in PE are transferable and have helped them in sports specific contexts. This is of particular importance as some of the movement skills included in this intervention are suggested to serve as the foundations for developing more specialised movement patterns such as sport specific skills (Hulteen et al., 2018). Some children however, felt that the gamified PE lessons were not effective, or only effective for children who did not participate in sports outside of school. This raises an interesting question on whether external factors such as the physical and family environment play a greater role in the perceived development of some children's movement competencies. However, as we did not measure or collect information on external factors, it was not possible to test this premise further, although this would be an avenue to explore in future studies. If children perceive the external environment to be more officious, it would be interesting for future researchers to explore a gamified movement competence intervention at home. Although not a measurable outcome in this study, children commented on how the gamified PE lessons increased their PA levels because they were with their friends and having fun. These results have previously been highlighted as important facilitators of PA in primary school-aged children (Nally et al., 2022), while at the same time the positive, although weak, associations between PA and MC outcomes have been demonstrated (Barnett et al., 2016). The children and teachers were positive they had the confidence to participate in and deliver the gamified PE lessons, respectively. This is of particular importance as higher self-efficacy is known to be a determinate of the aptitude to participate in PE for children (Bertills et al., 2018), is strongly associated with MC (Peers et al., 2020) and means children invest more time and effort being persistent in accomplishing specific tasks; thus, influencing learning. To maximise success, gamified interventions should embed strategies to increase self-efficacy. For example, providing children with opportunities to experience mastery through gamification strategies such as levels and challenges.

Validity and reliability of the SOG-PE

The final objective of this study was to develop a tool to assess the implementation of gamification strategies in PE. The SOG-PE is the first self-devised tool developed to assess the implementation of gamification strategies in PE. Initial results provide some support for the tool's reliability. Inter- and intra-observer agreement scores suggest that the SOG-PE may be used to collect data from video-recorded gamified PE lessons with a reasonable degree of consistency. However, as the tool has not been validated against a gold standard (Mokkink, 2010), these findings should be interpreted cautiously. The tool could potentially assist in monitoring the implementation of gamification strategies in PE lessons, as it captures the frequency and quality of implementation. Furthermore, the tool may assist researchers in developing interventions, serving as a preliminary scaffolding structure supports and guides the design process.

Following its development and initial reliability testing, the SOG-PE was used to assess the implementation of gamification strategies and general behaviours. The results revealed that *points*, *levels* and *challenges* were rarely to occasionally implemented. Although these medians were relatively low, anecdotal notes during the observations indicated that pupils were provided with a variety of tasks and skills. However, as the terms ‘level and ‘challenge’ were not explicitly used, it is difficult to conclusively categorise these tasks as levels, challenges, or as representing changes between them. It is plausible however, that the low implementation was due to the teacher’s omission of explicitly stating ‘level 1’ (or other synonyms for level, such as stage of class) or ‘challenge’ during the lessons. Positively however, the results showed an upward trend in both the frequency and quality of gamification strategies as the gamified PE lessons progressed. For instance, in week 2, strategies such as *narrative*, *rules*, *levels* and *feedback* were implemented rarely to occasionally; by week 6, the same strategies were implemented occasionally to extensively. To note, the same quantity of strategies was planned for each lesson. Nevertheless, this upward trend can be further explained by the qualitative findings from the teachers, who indicated that adopting a gamified approach in PE was initially challenging, but once the teacher became more familiar with the approach, implementation became easier. While it could be inferred that teachers’ competencies may have improved over time, these competencies were not formally assessed in this study. Future research could further validate the SOG-PE using COSMIN guidelines (Mokkink, 2010) and examine its use in longitudinal gamified PE interventions, alongside assessments of teachers competencies before and after lesson deliver, to help confirm this hypothesis.

Finally, it was important to consider the general teacher and student behaviours observed during the gamified PE lessons, as these can influence how the intervention is implemented. Across the lessons, children were consistently engaged, with disruptive behaviours virtually absent. The only exception was one instance in week 9, where such behaviours were ‘rarely’ observed. This is an encouraging finding, as research suggest that disruptive behaviours tend to be more commonly observed during PE compared with other subjects (Navarro-Patón et al., 2022). These results also align with Sarino-Pascual et al. (2022), who reported that gamification can contribute to more positive classroom behaviours. In addition, the results revealed that the gamification strategy of relationships were ‘frequently’ implemented, which may have supported the positive classroom climate. Observations further revealed that children were rarely off task, which likely contributed to the low levels of disruptive behaviours observed. Off-task behaviour has also been previously linked to lower levels of moderate to vigorous PA (Crotti et al., 2021) and these lower levels of physical activity during childhood can have adverse effect on physical and mental health (Wang et al., 2024). These results may therefore help explain the significant improvements in MC among children in the intervention group. These outcomes were further supported by teachers’ effective behaviour management strategies, which created an environment that maximised participation and skill development.

Strengths, limitations and future directions

This study presents several strengths that are worth highlighting. First, the results provide a foundation to the body of evidence on the effectiveness of gamification in improving MC among primary school-aged children, an area where at present, limited research exists in PE. Second, a mixed-method approach was employed to assess the acceptability of the intervention, allowing for data triangulation. Third, video observations were used to evaluate the implementation of the gamified PE lessons, which were then analysed using the SOG-PE, a tool with evidence of reliability. Implementation instruments are not typically used to assess pedagogical models in PE (Fernandez-Rio and Iglesias, 2024), and therefore, this tool has significant potential for broad application in evaluating the implementation of gamification strategies within PE contexts. Additionally, as gamification is an emerging pedagogical approach, this tool could be beneficial for the growing area.

This study, however, is not without its limitations. One limitation of this study is the absence of a randomised-control trial, which makes it difficult to establish casual relationships and to some extent reduces internal validity. Future research should conduct a randomised-control trial which would help to control for cofounding variables and increase internal validity. In addition, this study was conducted with a small sample size, and although it meets the sample for pilot studies (Bond et al., 2023), future research should be conducted with a larger sample size to confirm these results. Additionally, the relatively short duration, including dose and frequency of the intervention (10 weeks) may have been sufficient to observe changes in MC, but not sufficient to observe changes in EI. Therefore, extending the intervention period, including the dose, duration and frequency, could provide insight into whether the effects vary with the length of implementation. Furthermore, the limited body of literature on the fidelity of implementation of gamification strategies in PE (Fernandez-Rio et al., 2020) restricts the ability to compare the outcomes of this study with previous work. Nevertheless, given the scarcity of gamification studies in primary school settings, future research could investigate the effects of gamified PE interventions for primary school children. Such studies could also incorporate tools to assess PA levels and teacher competencies to complement the findings of the current study. Finally, additional longitudinal studies are necessary to determine the optimal dose of gamified interventions, and use of gamification strategies, to fully assess their potential for improving physical and affective outcomes for primary school-aged children in PE.

Conclusion

Gamification appears to be a promising pedagogical approach in PE. This is the first study to explore the effects of a gamified intervention on physical [MC] and affective outcomes [EI, BPNs, motivation regulations], concurrently. The significance lies in the effectiveness of the gamified PE intervention on certain physical and affective outcomes which are important for positive child development. The results also demonstrate that the gamified PE lessons were acceptable to teachers, and to the children. Moreover, a rigorous process was undertaken to develop the SOG-PE and SOG-PE data demonstrated an increase in the extent to which gamification strategies were implemented over the course of the intervention. This tool can be used and adapted by other researchers to assess the implementation of gamification strategies. These novel results provide a better understanding of how gamification affects MC and potentially offers more meaningful experiences for children to develop MC. Future research should, however, implement longitudinal gamified interventions and assess their implementation using the SOG-PE.

Thesis study map

Study	Objectives and Findings
Study 1: Co-development of a gamified physical education movement competence intervention with school stakeholders.	Objectives: • Co-develop a gamified PE intervention with Year 5 children (age 9 to 10 years) and teachers. Findings: • Three gamified PE interventions were co-developed with primary school children and teachers.
Study 2: Feasibility, acceptability and preliminary effectiveness of a gamified physical education intervention on motor competence and emotional intelligence.	Objectives: • Evaluate the feasibility and acceptability of a co-developed gamified PE intervention in a primary school context. • Evaluate the feasibility of the study process (i.e. recruitment) and management (i.e. data collection) in a primary school context. • Explore the preliminary effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations for PE and PA among 9- to 10-year-old children. Findings:

	• The co-developed gamified PE interventions were feasible and acceptable for a primary school context. • The study process and management are feasible, with the exception of the EI scale. • The intervention showed preliminary effectiveness on EI and MC.
Study 3: The effects of a gamified physical education intervention on motor competence and emotional intelligence among primary school children: a quasi-experimental pilot study	Objectives: • Explore the effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA among 9- to 10-year-old children. • Evaluate the acceptability of a co-developed gamified PE intervention in a primary school context. • Develop and pilot a tool to assess the fidelity of the delivery of gamified pedagogy in PE. Findings: • Intervention effects were found for MC, relatedness satisfaction and external regulation in PA. • The gamified interventions were found to be highly acceptable by the teachers, and the children. • The System for Observing Gamification in PE (SOG-PE) was developed.

Chapter Seven: Synthesis

Overview and Purpose

This final chapter synthesises the findings of the three empirical studies conducted within the thesis. The chapter discusses how the findings relate to existing literature and theory, the strengths and limitations of the thesis, and identifies implications for future research, policy, and practice. It concludes with the researcher's reflections on their doctoral journey.

Research Aims and Objectives

The overarching aim of this thesis was to explore the effects of a co-developed gamified PE intervention targeting movement competence on EI among 9- to 10-year-old children attending schools in disadvantaged communities. The thesis addressed this aim through the following objectives:

1) To co-develop a gamified movement competence PE intervention with primary school teachers and year 5 children (ages 9 to 10).

2) To evaluate the feasibility and acceptability of a co-developed gamified PE intervention within primary school settings.

3) To evaluate the feasibility of the study trial (i.e. recruitment, data collection) in a primary school context.

4) To explore the preliminary effects of a co-developed gamified PE intervention on EI, MC, BPNs and motivational regulations in PE and PA.

5) To pilot the effects of a feasible and acceptable gamified movement competence PE intervention, compared to a control following usual PE.

6) To evaluate the acceptability of a co-developed gamified PE intervention in primary school contexts, beyond those involved in the co-development process.

7) To develop and pilot a tool to assess the fidelity of the delivery of gamified pedagogy in PE.

Synthesis of Findings in Relation to Existing Literature

This thesis contributes to a growing body of literature advocating for more engaging and meaningful PE experiences, particularly for children in disadvantaged settings. The synthesis of findings across the three studies highlights how gamified approaches to PE can be both developmentally appropriate and contextually responsive. While the three studies had distinct aims, together they provide a coherent narrative around intervention, co-development, feasibility and potential impact. Table 24 presents a data integration matrix, which illustrates how the three studies converge and diverge across the domains of intervention design, feasibility and acceptability, and outcomes.

Table 24. Integrated findings across Studies One, Two and Three.

Domain	Study One: Co-development	Study Two: Feasibility and acceptability	Study Three: Pilot trial	Integrated insights
Intervention design	Co-development of the intervention with children and teachers; gamification strategies aligned with SDT.	Intervention demonstrated deliverability in school contexts, though fidelity varied.	Gamified PE lessons were observed using the SOG-PE, but implementation of the gamification strategies were inconsistent.	Co-development of the intervention enhanced feasibility, but teacher training and support are required for consistent delivery.
Feasibility and acceptability	Children reported enthusiasm for the gamification strategies; teachers highlighted logistical challenges.	High recruitment and retention; positive perceptions of the gamified PE lessons.	High acceptability among children (affective attitude, self-efficacy) and teachers. Barriers such as equipment persisted.	Gamification is feasible and acceptable, but sustainability depends on addressing systemic school constraints.
Outcomes	Three gamified PE curriculums; framework of gamification strategies.	Improvements in MC and EI; increased intrinsic motivation and identified regulation; EI measurement issues identified.	Improvements in MC and relatedness satisfaction; decrease in external regulation; no EI effects.	Gamification positively influences MC and motivation, but effects on EI remain inconclusive.

Study One: Co-developing a gamified movement competence PE intervention

Study One (Chapter Four) described the process of co-developing a gamified PE intervention with school stakeholders (Rice et al., 2025). Co-developing interventions has the potential to enhance their impact, while also increasing feasibility, acceptability and relevance due to the direct involvement of key stakeholders during the development process (Reed et al., 2021). Study One addressed a key gap in PE intervention design, where children's voices are often absent (Beni et al., 2017), or only partially considered (Clifford et al., 2023). Through a series of participatory workshops, three gamified PE curricula were co-developed. The results from Study One provide a practical framework for operationalising gamification strategies such as narratives, levels, challenges and relationships, which were designed to align with pupils' interest and developmental needs. These strategies were also theoretically aligned with SDT (Ryan and Deci, 2020) in order to support children's autonomy, competence and relatedness. The teachers' input ensured the intervention was realistic and implementable within curriculum demands and lesson delivery logistics. Capturing this implementation insight is crucial, as its absence can lead to poor intervention uptake in school settings, which in turn can impact the effectiveness of the intervention (Lane et al., 2021). While challenges of the co-development workshops included significant time commitments, scheduling complexities and stringent research timelines, Study One demonstrated that a co-development process with school stakeholders can be successfully conducted with positive results. Future research could build on this approach, potentially adopting a longitudinal action research design to ensure greater flexibility in timelines, structure and scheduling, which might address some of the challenges encountered in Study One, and to strengthen fidelity and sustainability.

Study Two: Evaluating the feasibility and acceptability

Study Two (Chapter Five) evaluated the feasibility and acceptability of the co-developed gamified curricula, an essential process for complex interventions (Craig et al., 2008; Thabane and Lancaster, 2018). The study trial demonstrated feasibility, with high recruitment and retention rates and low attrition, exceeding those typically reported in similar research with children (Fairclough et al., 2024; Jago et al., 2019). These positive results may be attributed to the clear communication of benefits and prior involvement of children in the co-development phase (Chapter Four), although participation in Study Two was not mandatory. Study Two also highlights the importance of working within schools' operational constraints. Despite one school not fully adhering to the intervention, the reasons remained unclear and were consistent with intervention adherence challenges reported elsewhere (Fairclough et al., 2024). The data collection tools (MC, BPNs, motivational regulations) were found to be feasible; however, the Schutte Self Report EI Test demonstrated poor internal reliability for certain EI subscales. Despite evidence supporting its use with 9-10-year-old children (Orangi et al., 2023), anecdotally, both teachers and children reported difficulties understanding the language and item questions. This highlighted the importance of conducting a feasibility trial prior to pilot evaluation and the need to consider more age-appropriate and validated measures, such as child Trait EI Questionnaire – Child Form (Mavrovelli et al., 2008), in Study Three. Consistent with previous research (Fernandez-Rio et al., 2020), the gamified PE interventions were feasible and well received by both teachers and children. Teachers valued the intervention's structure and appeal to children, while also noting issues such as limited hall time, inconsistent staffing, and challenges in explicitly referencing the gamification strategies. These practical challenges (i.e. staffing issues) are consistent with prior literature noting practical barriers to PE innovation in primary schools (O'Byrne et al., 2023). Despite these challenges, high engagement and positive feedback from pupils suggest gamified PE lessons may be particularly effective in promoting enjoyment and participation, which are key predictors of long-term PA engagement (Jaakkola et al., 2017). This is the first study to explore the effects of a gamified PE intervention and therefore adds a novel contribution to the effects of gamification in PE on MC and EI. Furthermore, significant increases in identified regulation in PE and intrinsic motivation in PE were observed. These increases in motivation are encouraging, given the well-established positive associations to both physical and psychological health outcomes (Biddle et al., 2019). Collectively, these results indicated that a pilot trial would be feasible.

Study Three: The effects of gamification in PE

Study Three (Chapter Six) piloted the effects of a gamified PE curricula compared to control group that followed usual PE practice and evaluated its acceptability among participants not involved in the co-development process. Study Three also developed a tool to assess the implementation of gamification in PE. Six PE lessons (three from each intervention school) were video recorded to assess the use of gamification strategies and general teacher and student behaviours. Following a rigorous, iterative process guided by Walton et al. (2020), the System for Observing Gamification in PE (SOG-PE) and its accompanying procedure manual were developed. Initial results provide some support for the tool's reliability, with inter- and intra-observer agreement scores demonstrating a reasonable degree of consistency. The SOG-PE was used to assess the implementation of gamification strategies and general teacher and student behaviours in a gamified learning environment. Results showed an increase in gamification strategies use over time, though some (i.e. points) were rarely implemented. Seventy-six children participated in the pilot study (41 intervention, 35 control). No improvements in EI were observed, potentially due to a ceiling effect with children demonstrating medium to high baseline levels of EI (Ozäl et al., 2024). However, compared to the control group, participation in the intervention group was associated with significant improvements in MC across all MCA and KTK3+ subtests – except shifting platforms/moving sideways. These findings support existing evidence that gamified PE interventions can improve motor skills in primary school-aged children (Benjumea et al., 202). Relatedness satisfaction also increased significantly, an important finding given that environmental factors (i.e. positive peer relationships and good social support) play an important mediating role in the relationship between poor motor skills and internalising problems (Cairney et al., 2013). Finally, a decrease in external regulation for PA was observed in the intervention group. Given that external regulation is linked to maladaptive outcomes in PE (Vasconcellos et al., 2020), this decrease is particularly promising. The gamified PE interventions were highly acceptable among the teachers, with minimal issues reported. For the children, constructs such as affective attitude (the children's feelings about the intervention) and self-efficacy (confidence to participate) were found to be highly acceptable (Sekhon et al., 2017). Consistent with previous literature (Herold, 2020; Simmons and Maclean, 2018), teachers highlighted potential barriers to broader implementation, including resistance to changing delivery practices and limited PE subject knowledge. The findings suggest that the gamified PE lessons were high acceptable and were effective in improving certain physical and affective outcomes which are important for positive child development. However, findings prompt questions about scalability and the support needed for wider adoption.

Key Themes and Contributions to the Literature

Children's voices in PE research

Children's voices serve as a powerful catalyst for their involvement in decision-making (Charteris and Smardon, 2019). However, meaningful child participation requires more than simply listening to children. As such, the Lundy Model of Child Participation (Department of Children and Youth Affairs, 2015) outlines four essential elements (space, voice, audience, influence) that must be fulfilled to ensure children's voices are meaningfully heard and acted upon. Children must be given the *space* to express their views, their *voice* must be facilitated to contribute, their views must be listened to by an appropriate *audience* and their voices must lead to actions and have an *influence,* wherever possible (Department of Children and Youth Affairs, 2015). Across the studies presented in this thesis (Chapters Four, Five, and Six), children's voices were not only meaningfully heard but also acted upon, by both the lead researcher and participating teachers during the delivery of the gamified interventions. *Space* was central in Study One (Chapter Four), where co-development workshops were designed to be engaging and accessible to all participating children. These workshops incorporated a variety of creative and interactive activities, enabling children to articulate their preferences for PE and the gamified interventions. Similarly, in Studies Two and Three (Chapters Five and Six), focus groups were structured to promote open dialogue, not only between the lead researcher and children, but also among the children themselves, thus providing ample space for expression.

In terms of *voice,* in Study One (Chapter Four) children reflected on and expressed their views about existing PE lessons (i.e. likes and dislikes), as well as their preferences for themes and activities to be included in the gamified intervention. The children's voices were continuously sought and clarified through iterative feedback loops, ensuring their perspectives informed the intervention design. Children's views were then enacted in practice, demonstrating the elements of *audience* and *influence*. Additionally, during the focus groups in Study Two (Chapter Five) and Three (Chapter Six) children reflected on and expressed their views of participating in the gamified PE lessons, which informed subsequent refinement of the intervention. These findings illustrate that not only are children competent participants in their own lives, but they are also capable of reflecting critically on their experiences in PE.

Consequently, their insights offer rich and nuanced perspectives, which, without their input, would remain largely unexplored. Following the delivery of the gamified PE lessons, interviews with teachers in Studies Two and Three (Chapter Five and Six, respectively), revealed that children were given agency within lessons, for example, setting up equipment and selecting partners, ultimately supporting both autonomy and relatedness. Children were also given choices in the intervention content through gamification strategies, equipment, tasks and obstacle course-style activities, all of which have shown to positively impact engagement (Enright and O'Sullivan, 2010). In the latter activity, children developed obstacle courses with peers of their choice, further reinforcing autonomy and relatedness. Importantly, their freedom to choose partners supported not only their own voice, but also a respect for the voices of others. This bi-directional communication between children and teachers, as well as among peers, enabled ongoing negotiation and adaption, enhancing the legitimacy, authenticity and impact of children's contributions (Iannucci and Parker, 2022).

Although research on children's voices in PE is still limited, particularly at the primary school level, recent literature underscores its importance (Littlefair et al., 2024; Cardiff et al., 2023; Ní Chrónin et al., 2025). To start, it has been suggested that pupil involvement in the curriculum development process, as demonstrated in Study One (Chapter Four), can help to promote engagement and promote meaningful feelings within PE (Howley and O'Sullivan, 2021). Further, when children's voices are heard and enacted upon, like in Study Two and Three, their motivation, participation, and engagement are shown to increase, ultimately fostering a sense of autonomy and agency in their learning (Ní Chrónin et al., 2024; Iannuci and Parker, 2022). Importantly, amplifying children's voices is particularly important for those in disadvantaged communities, where opportunities to influence decision-making in school and beyond may be limited, and where meaningful inclusion can help counteract structural inequities (Poppe and

Abela, 2023). Admittedly conducting research with children presents challenges, and there is concern that not all voices can be captured, risking tokenism or lip service (Iannuci and Parker, 2022). Nonetheless, this thesis demonstrated that it is both possible and impactful to facilitate children's voices meaningfully in PE practice. This facilitation of child voice within the design of the PE intervention contributes to the limited literature (Clifford et al., 2023) and provides evidence-based directions for primary teachers potentially seeking to incorporate student voice within their PE practices (Iannuci and Parker, 2022). Finally, this thesis offers a practical framework for collecting and facilitating children's voices within PE research.

Emotional Intelligence in children.

The literature review (Chapter Two) highlighted that childhood is a critical period for the development of EI and emphasised its importance for children's holistic and psychological well-being (Lea et al., 2019). Although interventions aimed at increasing EI in primary school children through PE are becoming more prevalent (Rico-Gonzalez et al., 2023; see Chapter Two), there remains a notable lack of such interventions in PE, specifically for primary school children in England (Rice et al., 2025). In response, the development of a gamified PE intervention in Study One (Chapter Four), designed to increase EI through MC, offers a valuable contribution to the literature.

Previous empirical evidence indicates that children with higher forms of autonomous motivation are generally better equipped to manage their emotions and therefore develop higher EI (Vaquero-Solis et al., 2020). In Study Two a significant increase in identified regulation in PA and intrinsic motivation in PE were observed. Although no significant changes were found in intrinsic motivation in PA or, identified regulation in PE, children's post-test scores nonetheless reflected relatively high levels of autonomous motivation (mean = 4.37, 4.29, 4.19). Similarly, in Study Three, children's post-test scores remained high for intrinsic motivation in both PE and PA (mean = 4.36, 4.35, respectively), as well as high levels of identified regulation in PE and PA (mean = 4.17, 4.04, respectively). These findings suggest that the gamified MC intervention increased (Study Two) and sustained (Study Three) children's autonomous motivation. Building on this, findings from Studies Two and Three theoretically suggest that autonomous motivation may mediate the relationship between MC and EI. As children develop MC through structured programmes (Moon et al., 2024), such as the one developed in Study One, they may experience a greater sense of competence, autonomy and relatedness, which supports more self-determined motivation (Ryan and Deci, 2020). In turn, this motivation may facilitate self-motivation and esteem, emotional expression and regulation, and peer relations, which are important facets of EI (Mavroveli et al. 2008). The mediating role of motivation was not directly explored in thesis, however, the findings from both Study Two and Three theoretically support the proposition that autonomous motivation may serve as a mediator through which improvements in MC consequently improve EI. Previous evidence indicates positive associations between autonomous motivation and EI (Mendez-Gimenez et al., 2019), highlighting a promising avenue for future mediation analysis. Practically, these results underscore the importance of creating an autonomy supportive environment in PE.

In Study Two (Chapter Five), the gamified PE interventions were found to be highly effective in increasing global EI and specific EI facets such as optimism and mood regulation. These results provide partial support for the Environmental Stress Hypothesis (Cairney et al., 2013), which posits that interventions aimed at improving MC may also, in turn, promote improvements in emotional outcomes, such as EI. Although improvements in EI were not observed in Study Three (Chapter Six), there were notable increases in relatedness satisfaction.

These findings were further corroborated by qualitative data collected through focus groups, in which children frequently reported strengthened social connections with their peers and a greater sense of belonging. A plausible explanation for these results is that the gamified PE lessons were explicitly designed to provide the children with opportunities to interact with their peers. Supporting this, video observation data indicated that the gamification strategy 'relationships' was frequently implemented during the gamified lessons (see Chapter Six, pp. 203-204). Such structured opportunities for social interaction are important, particularly for children with low MC, as they are more likely to withdraw from physical activities and thus have fewer chances to develop EI (Wilson et al., 2013). Importantly, relatedness has previously been identified as a key motivational factor in the development of EI (Raufelder et al., 2016) and has been shown to be positively associated with EI (Callea et al., 2019). Moreover, as emphasised in the literature review (Chapter Two) positive peer interactions contribute to the development of emotional competencies and EI during childhood. Therefore, although theoretical within the scope of this thesis, relatedness may lead to improvements in EI overtime, as individuals with higher relatedness satisfaction tend to develop higher EI (Callea et al., 2019). These findings also offer partial, albeit theoretical, support for the Environmental Stress Hypothesis (Cairney et al., 2013), suggesting that social resources, such as peer relationships (i.e. relatedness) may mediate the relationship between MC and internalising problems, even among children with lower MC. Collectively, the findings from this thesis suggest that future research aiming to enhance EI through MC-focused interventions should prioritise creating an environment that explicitly fosters relatedness. Additionally, future studies could employ longer intervention periods (Özal et al., 2024) to determine whether improvements in EI become more evident over time. Finally, mediation analyses are recommended to identify the specific mechanism through which the gamified PE interventions influence EI, potentially via changes in relatedness satisfaction.

Gamified interventions in Physical Education

Gamified interventions in PE specifically targeting primary school children, as discussed in the literature review (Chapter Two), are relatively limited compared to the number of interventions aimed at secondary and university students (Arufe-Giráldez et al., 2022; Camcho-Sanchez et al., 2023). Consequently, the development of the gamified PE curricula in Study One (Chapter Four), alongside their implementation and evaluation of the effects and acceptability in Studies Two (Chapter Five) and Three (Chapter Six) represent a meaningful contribution to the existing body of literature on gamified approaches in primary PE. Based on the qualitative findings presented across this thesis, it can be inferred that gamification, as a pedagogical approach, facilitates and positively contributes to children's enjoyment of PE. This extends upon previous qualitative findings suggesting that a gamified PE intervention focused on Marvel superheroes was perceived as enjoyable (Fernandez-Rio et al., 2020). Enjoyment of PE has previously been associated with increased engagement (Domville et al., 2019b; Navarro-Patón et al., 2019), which in turn has been associated with the development of MC (Lorås, 2020). However, research also highlights the challenges of creating enjoyable PE experiences due to the diversity of children's characteristics, perceptions and learning environments (Marron et al., 2021).

Nevertheless, and consistent with prior research (Benjumea et al., 2022; Davies et al., 2024), there was a significant increase in MC among children who participated in the gamified PE interventions in both Study Two and Study Three. These outcomes may, in part, be attributed to children's increased enjoyment, which was reported during the focus groups and subsequent engagement in the gamified lessons. Qualitative findings from children in both studies indicated that the gamified PE lessons were enjoyable – even among those who previously did not enjoy PE or typically did not participate. Teachers also reported that the interventions were inclusive and enjoyable for all children. Beyond these outcomes, the findings of this thesis also extend existing literature by suggesting that gamification strategies in PE can support a need-supportive learning environment, which is critical for fostering enjoyment in PE (Blain et al., 2022; Pérez-González et al., 2019). Although a significant quantitative increase in relatedness satisfaction was only observed in Study Three (Chapter Six), qualitative data revealed how specific gamification strategies contributed to a need-supportive contexts. In terms of relatedness, children highlighted the value and learning from and with their peers and perceived that the gamified PE lessons promoted teamwork and cooperation, an observation also echoed by the teachers. With respect to competence, children reported that the presence of different levels and challenges created a sense of progression throughout the storyline and felt that certain movement skills had improved as a result, which was further supported by the quantitative MC data in Studies Two and Three (Chapter Five and Six, respectively). From an ecological dynamics perspective, these structed levels and challenges created affordances, and thus, encouraged exploration and the gradual release of restricted movement patterns into more fluid and coordinated skills (Button et al., 2021). For autonomy, children noted having choices in the levels and challenges to complete, the equipment to use, and who they worked with. These elements not only align with SDT's emphasis on choice as critical to autonomous motivation (Ryan and Deci, 2021) but also reflect ecological dynamics' view of learners as active agents who interact with and adapt to their environment. Regarding the choice of who children work with, it is noteworthy that teachers often assign groups randomly in PE and may overlook the importance children place on choosing their group members (Iannucci and Parker, 2022; Adank et al., 2024). Further, even simple choices, such as choosing equipment and the level chosen, can positively impact children's engagement, and has been shown to beneficial for pupil's skill development, as well as their physical and mental health (Quennerstedt, 2019). Taken together, these findings suggest that both researchers and practitioners should consider incorporating gamification strategies when designing PE interventions, as they have the potential to foster a more enjoyable, inclusive and psychologically supportive PE environment. Practically, it is recommended that PE teachers should place greater emphasis on the social dimensions of lessons and offer students autonomy, particularly in choosing their peers to work with, as well as the equipment used and task chosen, as this can positively influence both physical and affective learning outcomes.

Original Contributions to the Literature

Study 1

- A framework for co-developing PE interventions with teachers and children within a school context.
- The co-development of three novel, gamified movement competence PE interventions.
- How to operationalise and integrate multiple gamification strategies in PE, expanding the gamification literature.

Study 2

- The first study to investigate the feasibility and acceptability of a co-developed gamified PE intervention in a primary school context in England.
- The first study globally to investigate the preliminary effectiveness of a co-developed gamified PE intervention on primary school children's EI and MC, concurrently.
- The first study in the UK to investigate the preliminary effectiveness of a co-developed gamified PE intervention on BPNs and motivational regulations in PE and PA.

Study 3

- The first study in England to provide empirical evidence of the effectiveness of gamification on primary school children's MC, adding to the very limited research area.

- The development of an observational tool (SOG-PE) to assess the implementation of gamification strategies in PE.

Strengths

Strengths of each study have been presented in each chapter; therefore, over-arching strengths will be discussed here. A notable strength of this thesis lies in the novel and rigorous process undertaken to develop the gamified PE curricula in collaboration with school stakeholders (See Chapter Three). This process represents a significant advancement, as it is the first study to explicitly describe the process of co-developing a gamified PE curricula with teachers and children. This contribution not only provides valuable insight for future researchers seeking to incorporate a gamified methodology in the development of similar interventions, but also offers a structured framework for those interested in co-developing interventions with school stakeholders more generally. Such a framework holds potential to inform broader efforts in educational intervention design and development.

The methodological strengths presented across this thesis are particularly noteworthy. To start, this thesis utilises mixed methods, which facilitated a more comprehensive and nuanced analysis of the studies' design, feasibility, acceptability, and effects of the gamified PE intervention. By integrating both qualitative and quantitative data, the research offers a more holistic understanding of the intervention's impact and provides a richer context for interpreting findings. In addition, this thesis followed a systematic process in the development (Study One, Chapter Four), feasibility and acceptability (Study Two, Chapter Five) and piloting of the gamified PE interventions (Study Three, Chapter Six), and therefore is another key strength of this thesis. This systematic process was important as the UK Medical Research Council (MRC) framework for complex interventions (Craig et al., 2008; Skivington et al., 2021) recommends involvement of diverse stakeholders in the development phase, and in Study One (Chapter Four), teachers, children and the research team were involved in the co-development of the gamified PE interventions, as well as incorporating evidence and theory identified in the literature review (See Chapter Two). From there, the MRC recommends conducting a feasibility trial to determine whether the study can successfully be replicated in a larger, definitive trial, and in Study Two (Chapter Five) the feasibility and acceptability was assessed using a predefined progression criteria and was determined to be feasible and acceptable. Based on the findings from Study Two, a pilot evaluation was determined to be worthwhile and was conducted in Study Three (Chapter Six) which evaluated the effects of a gamified PE intervention in a quasi-experimental trial. This methodological rigour is critical for assessing the broader applicability of the intervention and for establishing a strong foundation for future researchers.

Finally, another strength of this thesis is the population sample with which the research was conducted, children residing in areas of high deprivation. Not only were the gamified PE interventions co-developed with these children, but they were also delivered to and evaluated with this population. Children living in areas of high deprivation face a range of socio-economic challenges and are disproportionately affected by health inequalities. The exacerbation of these inequalities in the wake of the COVID-19 pandemic further underscores the importance of targeting this group. By focusing on this population, the thesis contributes to addressing these inequalities and highlights the critical need for interventions that specifically support children from disadvantaged backgrounds.

Limitations

Limitations for each study have been presented in each chapter, and over-arching issues will be discussed here. The National Curriculum recommends children should participate in two hours of PE a week (Department of Education, 2013). However, the gamified PE lessons were designed to be implemented for 10 weeks, for one session a week, for 60-minutes, and therefore the intervention duration was relatively short. This was initially constrained by the schools' timetabled PE provision, of one PE lesson per week. Further, the frequency of lessons spent on specific movement skills during the gamified PE interventions was relatively low, for example one lesson on jumping and landing. Although significant increases in MC were observed, future research should consider initially designing gamified PE interventions that focus on each skill in isolation for children in the initial phase of motor learning (Porter and Magill, 2010) and from there design gamified PE interventions that adopt a random practice structure (Fialho et al., 2006). Regardless of the structure chosen, future research should increase the frequency and duration of exposure to each skill, as this approach may help ensure that children develop proficiency in MC.

Based on feedback from teachers in studies Two and Three (Chapter Five and Six, respectively), the feasibility of implementing gamified PE lessons without prior input from a research team remains a concern. Specifically, some teachers noted that the delivery of the intervention was supported through CPD workshops, and although not necessarily a limitation, it does raise the question of whether a teacher could independently implement the curriculum without assistance from the research team. Additionally, in Study Three, teachers expressed concerns about established teachers' reluctance to adopt a new pedagogical approach, such as gamification. One teacher also highlighted that teachers who do not frequently teach PE might be similarly hesitant. While other findings in this thesis were generally positive, these concerns raise questions about the broader feasibility of delivering gamification in PE by primary school teachers. Future research should explore the differences between teachers who received CPD on implementing gamification in PE and those who have not to address this limitation. This would enhance our understanding of both the feasibility, and scalability of gamification in PE without input from a research team.

Children were only assessed at pre- and post-test intervention in studies Two and Three. While these assessments provided valuable insights into the immediate effects of the intervention, it would have been beneficial to conduct follow-up tests to determine whether the observed changes were sustained over time. However, due to logistical constraints, particularly the timing of the study, it was decided not to collect follow-up data. External factors, such as the six-week summer holidays, would have made it difficult to control for the potential influences of the summer holiday and change in weekly and day-to-day routine of children on the results. To address this limitation in future research, it is recommended that school-based projects be planned to start at the beginning of the academic year. This would allow researchers to capture follow-up data under more consistent conditions, minimising the impact of external variables and enhancing the validity of the findings.

Implications of Findings

This section will outline the implications for research, policy and practice based on the findings of this thesis.

Research

One major output from this thesis is a co-development framework that can be used with teachers and children. Given that co-development efforts in the context of PE are still in their infancy, this framework provides a theoretically underpinned and empirically tested approach for future researchers to conduct work within this area. A second major output from this thesis is the development of three gamified PE curricula, designed to target all three conceptual levels of gamification proposed by Werbach and Hunter (2015). While gamification strategies have been applied in PE to varying extents, there has been limited guidance on how to meaningfully and systematically incorporate gamification strategies into PE practice. These curricula provide practical exemplars, and a sense of how to authentically integrate different gamification strategies within PE activities, which can be adopted by future researchers. However, future research should be mindful and consider the practical and professional development needs of teachers as part of the intervention planning and delivery.

Policy and Practice

This thesis demonstrates that providing high quality, pedagogically informed PE can support children's holistic development. Supported by both quantitative and qualitative evidence, as well as existing literature, the findings demonstrate that PE contributes not only to children's physical development, but also to their social and emotional development. Although not directly measured in this thesis, the literature also highlights PE's potential in supporting cognitive development. As such, policymakers should aim to priorities the role of PE as a key mechanism for fostering the holistic development of children within the National Curriculum. Currently, however, the National Curriculum predominantly focuses on the development of physical-motor skills (Department of Education, 2013), overlooking the broader development outcomes that PE can offer. To better support children's holistic development, the National Curriculum PE should shift towards placing greater emphasis not only what is taught (e.g. running, jumping, throwing) but also on how PE is taught. Shifting towards more pedagogical informed approaches would be particularly valuable for primary school teachers, many of whom lack specialisation in PE. This would better equip them with the tools, frameworks, and guidance needed to deliver meaningful, developmentally rich PE experiences for all children.

This thesis also underscores the importance of providing teachers with CPD in PE to enhance the effectiveness of teaching practices and ensure teachers are equipped with the knowledge and skills necessary to support children's development. In Studies One and Two, teachers received multiple CPD workshops, while in Study Three teachers received a single CPD workshop. Despite receiving only one CPD workshop, these teachers were still able to deliver the curriculum effectively and highlighted the value of the training they had received. As educational practices continue to evolve, particularly with the introduction of novel pedagogies such as gamification, it is essential that teachers are supported in adopting and implementing these approaches. PE-CPD offer teachers the opportunity to refine their pedagogical approaches and develop the confidence to deliver PE lessons that promote not only physical competence, but also social, emotional and cognitive growth. This is particularly crucial in primary schools, where many teachers are not PE specialists and may lack the specific training required to maximise the impact of PE. By incorporating PE-CPD into ongoing professional development programmes, schools can ensure that all teachers, regardless of their subject specialism, are equipped to deliver high-quality, inclusive and engaging PE that supports the overall development of children.

This thesis further demonstrates that children are not merely passive recipients of PE lessons, but active contributors to its development. Teachers, therefore, should not only solicit children's perceptions of their current PE lessons, but aim to integrate children's ideas into the curriculum planning and delivery. By valuing and incorporating pupils' perspectives, teachers can foster a sense of autonomy and ownership in children's learning, which has the potential to enhance both their physical and psychological development. Allowing children to influence the content and structure of PE lessons can create more engaging and meaningful learning experiences and increase motivation and participation. This approach aligns with contemporary educational practices that emphasise student-centred learning and the development of critical thinking and decision-making skills (Mladenovici et al., 2022). Moreover, this thesis highlights the positive outcomes associated with incorporating children's voices into the curriculum development, suggesting that when children are given the opportunity to contribute, they not only feel more engaged in their PE lessons, but also experience greater benefits. By integrating children's input, PE can become tailored to their needs and interests, fostering a deeper connection to the subject and supporting the overall goal of holistic development. This approach, therefore, could have significant implications for improving both the quality of PE practice and the broader educational experience for pupils, reinforcing the importance of responsive and inclusive teaching strategies in promoting children's well-being and physical development.

Recommendations for Future Research

There are several recommendations for future research. Firstly, future research should be conducted to assess the psychometric properties of instruments used to measure EI in primary school aged children in England. Specifically, it is important to assess the validity, internal consistency and temporal stability of the English version of the Trait EI Questionnaire – Child Short Form and the Schutte Self-Report Emotional Intelligence Test. These assessments should be conducted with a larger and more diverse sample of children to ensure generalisability across different contexts. In addition, it would also be useful to assess the test-retest reliability of both instruments to ensure that instruments produce consistent and stable results overtime. Given the limited research on EI in this population, such investigations would strengthen the validity and trustworthiness of the EI instruments. Beyond psychometric evaluation, future studies should also explore contextual factors that may influence children's EI, such as classroom climate, teacher-student relationships and peer relationships.

As the gamified PE interventions were only implemented with a relatively small sample, future research should further explore the contextual factors that influence the implementation of a gamified PE intervention in a school setting. This process could be guided by the consolidated framework to systematically understand the adoption, implementation, and sustainability of evidence-based practices in real world settings, for example in schools (Damschroder et al., 2009). Further, through the use of the consolidated framework, the barriers and facilitators to implementation outcomes and effectiveness can be explained. Collectively, these recommendations can potentially inform the scalability of a gamified PE intervention in a school context. Future research should further investigate the effects of a gamified PE intervention on MC and EI to strengthen the validity of the findings presented in this thesis. It would also be useful to include follow-up data collection points to explore whether the effects are maintained from post-intervention to follow-up. The effects of gamification in PE on other variables, such as PA, executive function and cognition, should be included so that researchers have a better understanding of how gamification in PE potentially can play a role in supporting and promoting positive physical and mental health trajectories for children.

Future research should develop the SOG-PE further, using the COSMIN guidelines (Mokkink, 2010). That is, further exploration of the reliability, including internal consistency, test-retest, inter and inter-rater reliability should be conducted. Concurrently, the validity, including the content (i.e. face validity), construct (i.e. cross-cultural validity) should also be ascertained. These recommendations would further strengthen the SOG-PE and enable the use in other geographical locations. Following these recommendations, it would be useful to obtain more observational video data of gamified PE lessons to assess the implementation of the gamification strategies. Future research could also obtain video data from PE lessons that use different pedagogical models, to compare and evaluate the pedagogical differences.

Personal Reflections

Pursuing a PhD has challenged me and changed me, both academically and personally. Despite always having aspired to pursue a PhD, I did not anticipate finding myself three years later, in the process of writing, and finishing this thesis. Reflecting on my PhD journey, several key lessons stand out.

The PhD journey has significantly advanced my subject knowledge and skills. At the start, my subject knowledge of gamification, MC, EI, and PE was limited, however over the past three years it has developed significantly through an extensive amount of reading, continual discussions with my supervisors and attending external workshops and conferences. Alongside this, I have acquired many valuable skills, including a more comprehensive understanding of intervention development, implementation, evaluation, research design, data collection, and quantitative data analysis. These skills have undoubtably enhanced my preparedness for a future in research.

The PhD journey has also provided me with the opportunity to publish papers. Although at times it has been challenging writing papers to a journal standard, having been desk rejected and, once past the editor’s desk – engaging in the peer review process, it has been one of the highlights of my journey. This process has helped me build resilience and reduced my apprehension about receiving feedback. It has taught me that mistakes are not failures, but rather opportunities for improvement. In addition, I have also had the opportunity to support and lead lectures at LJMU which has also been a great teaching experience and provided me with an understanding of the learning needs of undergraduate students.

On a personal level, my PhD journey has developed me in more ways than I could have ever anticipated. I am a million miles away from the Jenna that I once was. I am an extrovert by nature, but my confidence in my academic ability is something I have always struggled with. However, I am not sure anyone would have noticed this. My internal and external supervisory team, other academics and the schools involved in this project believed in me, when at times, I did not. During my PhD journey I was provided with opportunities to attend multiple national and international conferences and workshops to present my work. Despite crying on the way home from my first conference, worried that I did not deliver my presentation ‘very well’ or that I had ‘messed up’, I am now able to say that I can confidently stand in a room of people, present my work and answer audience’s questions coherently, without this underlying fear. Some have even gone as a far to say that I am a ‘natural’ communicator. I do, however, still need to play my presentation through my headphones on repeat.

Finally, and the most significant part of my PhD journey has been how it has deepened my commitment to supporting disadvantaged children, which has always been the driving force behind this work. Before starting the PhD, my professional experience has already shown me the complex challenges faced by disadvantaged children and their schools, but I had also witnessed first-hand the difference that meaningful support could make. Throughout this journey, countless moments reminded me why this work matters: building relationships with children and teachers that led to singing Taylor Swift in the playground, being invited to school plays, and being asked if I would return the following year. One pupil described my project as their 'favourite part of Year 5', while another said they wanted to be a researcher. But perhaps most importantly, the children themselves actively shaped the interventions. They voiced their opinions, shared ideas, and helped make the project their own. Their creativity and enthusiasm ensured the work was not only relevant but meaningful to them. Research often talks about *working with* children, but this experience showed me what that truly means in practice. The impact of this work goes far beyond the pages of this thesis and academic metrics. At its heart, it has always been about the children, and the small ways we can make a difference. Without their contributions - and the support of their teachers - none of this would have been possible. Too often, the narrative around disadvantaged schools focuses on struggle, yet my experience has shown that joy, humour, resilience, and creativity are equally present, and equally important. moments will continue to guide and motivate my work in the years ahead, and they have given me a lasting sense of belief: I am capable, I can do this, and I am doing it for them.

Conclusions

This thesis provides a unique exploration of the application of gamification in PE, focusing on how gamification can be operationalised and implemented within PE lessons, as well as examining its subsequent effects on child-level outcomes (EI, MC, BPNs and motivational regulations) within an under-researched demographic: primary school children from areas of high deprivation. A significant contribution of this thesis is the development of three gamified PE interventions, which could be adapted and utilised by researchers and practitioners in the future. The gamified PE interventions were found to be effective in improving children's MC, which is an important aspect of child development. However, the impact of gamified PE interventions on EI remains unclear, as the results across different studies were mixed – one study found an increase in EI, while another did not. This inconsistency suggests that future research is needed to fully understand the potential of gamification in enhancing EI and to identify factors that may influence its effectiveness in this regard. This PhD programme also produced a co-development framework for researchers to use in future studies, which was needed in this area. Another important contribution of this thesis is the development of a tool designed to assess the implementation of gamification in PE. This tool offers a valuable platform for future researchers to evaluate the fidelity and effectiveness of gamified interventions, thereby contributing to the broader understanding of how gamification can be integrated into PE and its impact on various child outcomes. Interventions aimed at improving physical, psychological and affective outcomes among children in deprived areas should consider the unique contextual factors of the schools involved. Additionally, the implementation of longer-term interventions may be necessary to fully assess the sustained effects of gamified PE interventions. By extending the duration of such interventions, future research could provide deeper insight into the long-term benefits, and potential challenges, associated with gamification in PE, particularly in high-deprivation areas.

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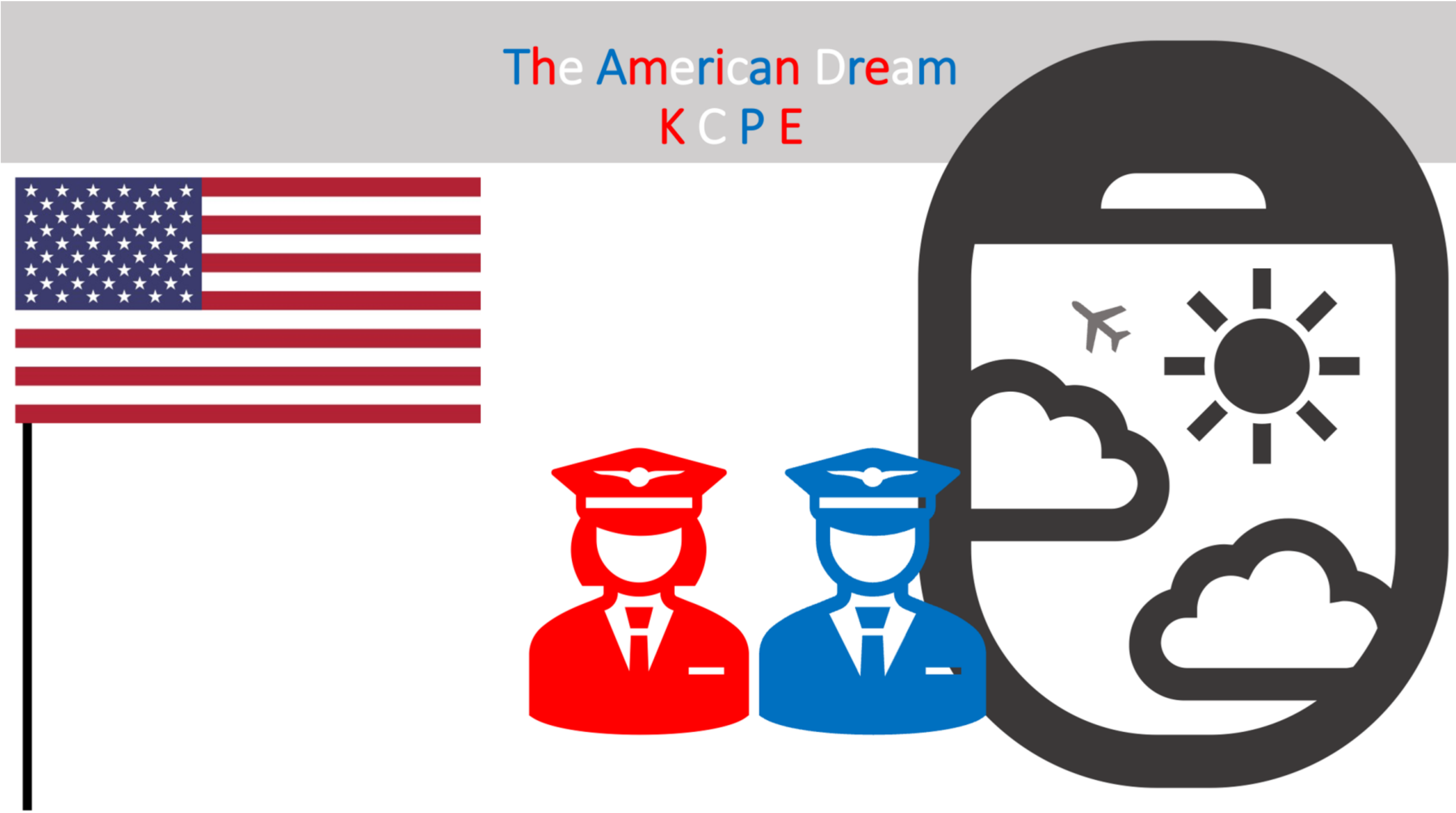
Appendices

Appendix A: Examples of the gamified PE curriculums



Learning outcomes

Week 1	Week 2	Week 3	Week 4	Week 5
• Throwing and catching	• Jumping and landing.	• Striking and Rolling an object	• Agility	• Obstacle course (wk1-4)

Week 6	Week 7	Week 8	Week 9	Week 10
• Dribbling hands and feet	• Throwing and Catching	• Gymnastics	• Dodging and Invasion	• Obstacle course (wk6—9)

Week 1: Throwing and Catching

Equipment List:

Warm up Activity:

- Footballs
- Basketballs
- Any other larger balls to throw
- Foam balls
- Discuss
- Any other medium balls to throw
- Tennis ball
- Airflow ball
- Plastic spots

Activity 1:

- Same equipment as previous activity

Challenge 2:

- Same balls as previous activities.
- Plastic spots
- Bucket
- Hoola hoops

Week 1. Warm up Activity: Throwing and Catching

Warm up activity instructions for teacher :

1) Split class into teams of 5 or 6.
2) Children will stand in a line from one side of the playground to the other. *Please see diagram.*
3) Read out each level to the children.
4) You will need, Large sized balls *(Football/basketball)*, Medium sized balls *(foam balls/ discuss/ any other)* and Small sized balls (*Tennis ball/ plastic ball)*

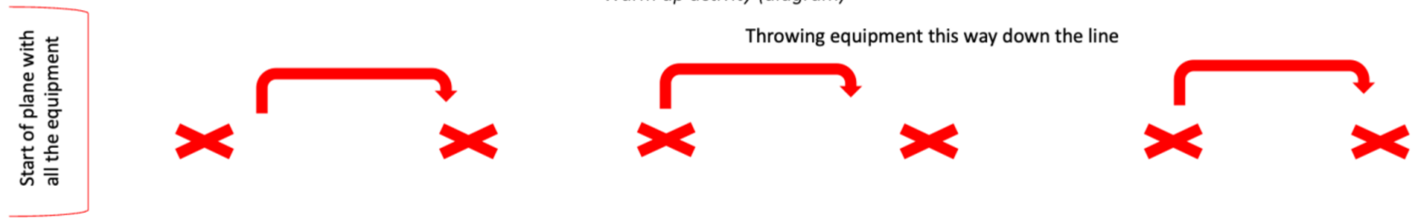
Warm up activity instructions for children:

1) In your teams, throw and catch the luggage down the lines in your teams. If you drop the luggage, you must return it to the start"

"Today you start your 10-week adventure across America. First stop, New York"

"Your first mission is to unload your luggage"

Warm up activity (diagram)



Level 1: "You need to unload the following 6 items from the plane, You cannot start unloading another item until it has been caught by the final person"

Football x 6

Basketball x 6

Any other big sized balls x 6

Level 1 Challenge : "It is time to move the luggage sideways down the line"

Level 2: "You need to unload the following 5 items from the plane"

Foam ball x 5

Discuss x 5

Medium sized balls x 5

Level 2 Challenge: "It is time to move the luggage backwards down the line."

Level 3: "You need to unload the following 4 items from the plane."

Tennis Ball x 4

Small sized balls x 4

Level 3 Challenge : "Every other person must sit down. When I shout change the people sat down will stand up, and the people stood up will sit down"

"We need to work faster, there is another plane waiting to land"

Level 4: You have 1 minute to get the rest of the luggage of the plane.

Level 4 Challenge: You can only throw and catch the luggage with one hand.

"well done. You have successful unloaded your luggage from the plane. It is is now time to explore"

Week 1. Activity 1: Throwing and Catching

Activity 1 instructions for teacher:

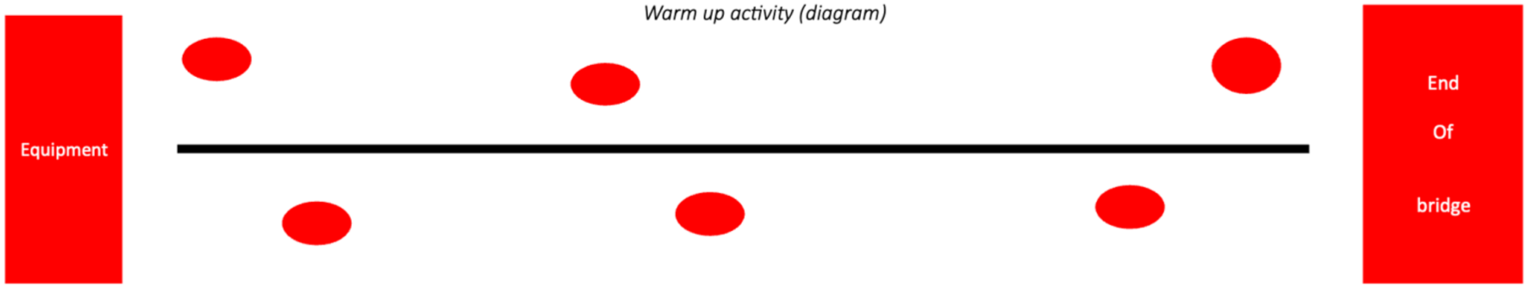
1) Keep children in the same groups as previous activity.
2) Children stood in different positions down the line. *Please see diagram*
3) Read out the levels to the children.
4) You will need same equipment as previous activity.

Activity 1 instructions for children:

1) "Half of your team will stand down one side of the bridge, and half will stand on the other side"
2) "In your teams, you must transport the luggage down the bridge"
3) "Listen out for the handling agents' instructions on how to throw and catch the luggage"

"We need to travel across the Brooklyn bridge to the store your luggage"

Warm up activity (diagram)



Level 1:

Football and basketballs:

"I would like you to stand close to each other on the bridge and throw and catch the luggage with two hands"

Level 1 Challenge: "Half of your team needs to kneel, whilst passing the luggage"

Level 2:

Foam balls/ medium sized balls:

"Each person needs to take 5 steps away from the middle of the bridge and throw the luggage under-arm and catch with two hands"

Level 2 challenge: "Throw the luggage , clap and then catch"

"This time we are going to bounce the luggage across. However, It can only bounce once"

Level 3:

Tennis balls

"Take another 3 steps back from the middle and bounce the luggage."

Level 3 Challenge: Can you try bounce the ball under your leg.

"Well done your luggage is nearly across. Just the final pieces of luggage left"

Level 4:

Any sized balls

Every time you pass the ball, you move one step up the bridge. Who can get to the end of the bridge the fattest?

Level 4 Challenge: You can only throw and catch the luggage with one hand.

"Well done teams. You managed to get your luggage across the bridge"

Week 1. Activity 2: Throwing and Catching

Activity 2: Instructions for teacher

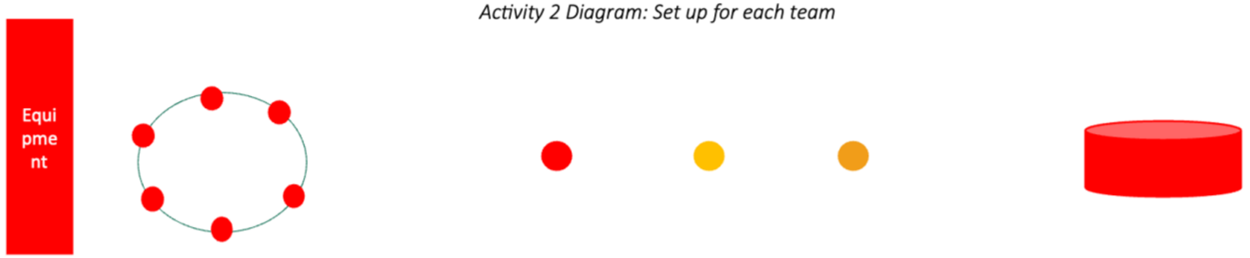
1) Keep children in the same groups as previous activity.
2) Set up the activity. *Please see diagram*
3) You will need same equipment as previous activity. Please place the equipment at one end of the playground
4) Read out the different levels, shout out the next level after 2/3 minutes.

Activity 2: Instructions for children

1) One person must run and collect a piece of luggage.
2) I would like you to throw the luggage to every person in the circle.
3) If you drop the luggage, you must go and place it back in the container.
4) Once the piece of luggage has been to everyone, one person must stand on a coloured spot and throw it in the bucket.
5) Every piece of luggage in the bucket = 1 point.
6) You need 10-points.

"Now your luggage is across the bridge. We need to put the luggage into storage containers"

Activity 2 Diagram: Set up for each team



Level 1: Throw and catch with two hands

Level 2: Throw and catch with one hand.

Level 3: Making the circle bigger.

Level 4: add a time limit, 30 second to pass the luggage round.

"Congratulations, you have stored your luggage it is time to travel to Florida"

Week 2: Jumping and Landing

Equipment List:

Warm up Activity:

- Hoola hoops
- Plastic spots
- Hurdles

Activity 1:

- Hoola hoops
- Plastic spots

Activity 2:

- Same balls as previous activities.
- Different coloured and sized spots
- Cones that the children can knock over
- Different size hoops
- Que cards (Week 1, challenge 2 envelope)

Indoor or outdoor activity lesson

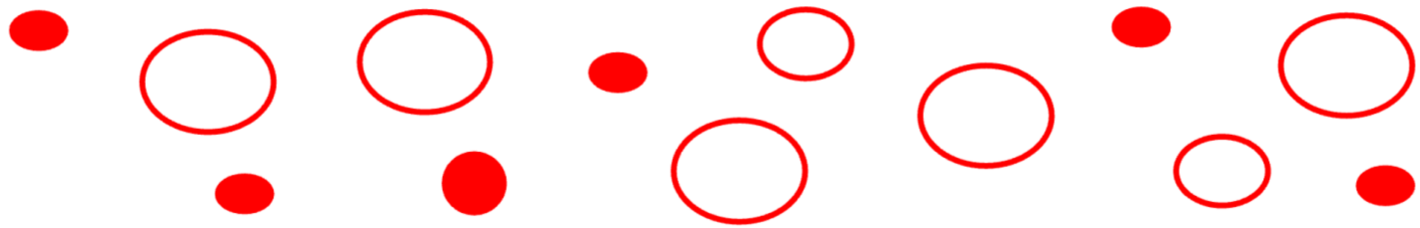
Week 2. Warm up Activity: Jumping and Landing

Warm up activity Instructions for teacher

1) Children working on their own.
2) Lay out different obstacles for the children to jump over. *Please see diagram*
3) Shout out each level, spend approx. 1-2 minutes on each level.

"You have arrived in Florida. It is now time to make our way through the uplands"

Warm up activity diagram



Warm up activity Instructions for children

1) On your own, you are going jump your way up the hill.
2) There are obstacles on the hill that you will need to jump over.
3) Listen out for my instructions on how to jump up the hill

Level 1: "I would like you to jump forward using two feet"

Level 1: "I would like you to jump side to side whilst moving forward using two feet"

Level 1 Challenge: "I would like you to hop forward on one leg"

"well done you are halfway up the hill"

Progress to next level

Level 2: "I would like you to jump forward two spaces and then one space back"

Level 2: "I would like you to jump one space forward and two spaces back"

Level 2 Challenge: "I would like you to hop forward on one leg and land on two feet"

"well done you have made it to the top of the hill. This time we will work in pairs. You need to link arms or hold hands with a partner to jump down the hill"

Progress to next level

Level 3: "I would like you to jump together with two feet.

Level 3: "I would like to hop together on one foot"

Level 3 Challenge: "I would like one person to face the other way and jump down the hill"

Progress to next level.

Level 4: "I would like one person to hop and one person to jump"

Level 4: "swap over"

"Well done. You did well to avoid the obstacles"

Week 2. Activity 1: Jumping and Landing

Activity 1: Instructions for teacher

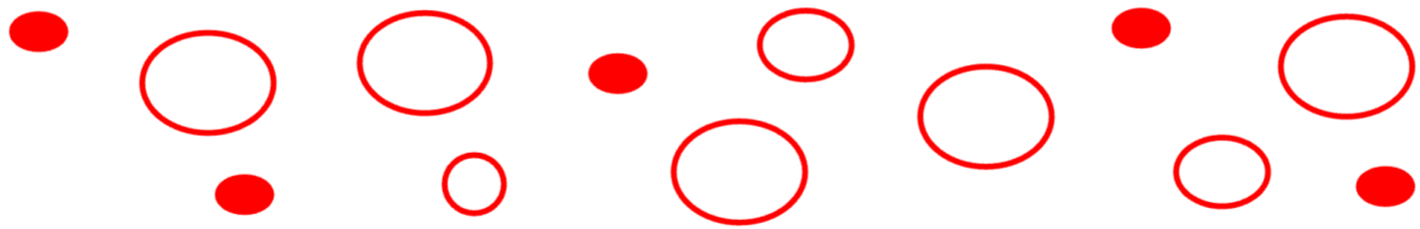
1) Children working on their own and in pairs
2) Place plastic spots/ hoola hoops in the area you are working in.
3) Shout out the different jumps for the children to complete.
4) Shout flooding at any point, the children will use the hoops or plastic spots as safety points.
5) Complete each level twice. You can call out the movements in any order.

Activity 1: Instructions for children

1) You need to skip, leap or jump around the space.
2) I will shout out different jumps for you to do.
3) When you hear flooding, you need to jump as fast as you can to a safety spot.

"Now you are at the bottom of the hill. It is time to travel through the marshes."

Warm up activity diagram



Level 1:

"Jump forward 1 space, using two feet"

"Hop forward, 1 space"

"Jump as far as you can forward"

"Jump as high as you can and land on two feet"

Level 1 challenge:

"Hop forward, 1 space using the leg you would not usually"

Progress to next level

Level 2:

"Jump forward 1 space and hop 1 space left"

"Hop 2 space right and 1 space backwards"

"Jump as high as you can and land on 1 foot"

Level 2 challenge:

"Jump backwards 1 space, hop forward 1 space and then jump as high as you can"

Progress to next level

Level 3:

"Hop forward 3 space's and hop 1 space left and then 1 space right"

"Jump with 2 feet backwards 2 spaces, and hop left 3 spaces"

"Preform a jump of your choice"

Level 3 challenge:

"Jump forward 1 space, hop 2 spaces left, jump and touch the clouds"

Progress to next level.

Extra jumps to include for the children.

Flooding: Jump to a safety spot.

Alligator: Jump as high as you can

Frog: Frog jump

Crabs: Long jump

Fly: Tuck Jump

Snakes: Find a partner and jump together

High tide: Jump onto a high piece of equipment.

"Well done. You have made it through the marshes"

Week 2. Activity 2: Jumping and Landing

Activity 2: Instructions for teacher

1) Children working in groups of 5.
2) Using plastic spots and hoola hoops. For river 4 you will need hurdles for the children to jump over
3) The aim is for them to get across the river as a team using the different materials.
4) Explain the next river, when all children have made it across the first river.

Activity 2: Instructions for children

1) I would like you to work together in your teams to get across each river.
2) Your team needs to get across the river, if anyone does not land on the safety spot, the whole team must return to the start and try again.
3) When everyone has completed each river, we will move on to the next one.

"Now we are over the marshes. We need to cross 4 different rivers. We will use the materials to help us get across."

Activity 2: Diagram: River 1

Lots of hoops for the children to use

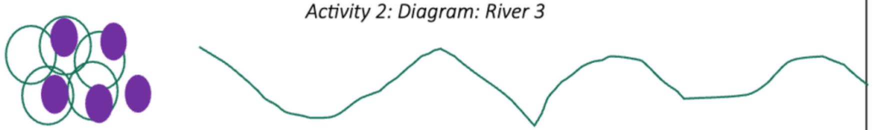
River 1 Using the hoops, as a team you can choose how you jump across the river. Remember the whole team must get across

Activity 2: Diagram: River 2

5 plastic spots per group

River 2 The safety spots have got smaller, and you must hop across this river. You have 5 plastic spots .

Activity 2: Diagram: River 3



River 3 This river is not in a straight line; I would like you create a new route with your materials to get across

Activity 2: Diagram: River 4

River 4 For your final river, you cannot go in a straight line, and there are lots of reads that you must jump over

"Well done. Next week we will be exploring Miami"

Week 3: Striking and Fielding

Equipment List:

Warm up Activity: As many as you have of the following balls:

- Basketball
- Tennis ball
- Rugby ball
- Netball
- Airflow ball
- Foam ball
- Football
- Any other balls that the children might be able to roll that you have.
- Cones to set up square.

Activity 1:

- Same balls as previous activity.
- Cones
- Nets/buckets

Activity 2:

- Same equipment as previous activity.
- Tennis racket
- Cones

Week 3. Warm up Activity: Striking and Fielding

Warm- up Activity Instructions for teacher

1) Split class into 4 groups. Provide them with bibs
2) One team in the square and one team on the outside of the square. *Please see diagram.*
3) Provide the children with different sized balls. (Basketball, Tennis ball, Rugby Ball, other small balls). *Please see diagram*

Warm up activity: Rules for children.

1) One team will be in the circle, and one team will be on the outside of the circle.
2) The team on the inside of the circle must clear the pinecones as fast they can, the way you clear them from the middle will change each time,.
3) The team on the outside must roll them back in.
4) The aim is to clear all the pine cones out of your area.
5) There will be 11/2-minute rounds, after this the team in the middle will swap.

"Today we will travel through the forest to get to the beach. Our first job is to clear the pinecones"

Level 1:
1) Small sized square
2) Big sized balls (football
3) Team in the middle rolling the pinecones.

Swap over teams when 1:30 minutes is done.

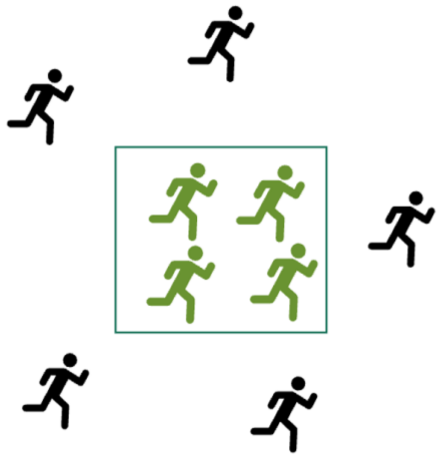
Level 2:
1) Make the square bigger.
2) Medium size balls.
3) Team in the middle can only kick the pinecones.

Swap over teams when 1:30 minutes is done.

Level 3:
1) Really big square.
2) Small size balls.
3) Team in the middle must use an object to strike the pinecones (e.g. tennis racket)

Swap over teams when 1:30 minutes is done.

Diagram (warm-up activity)



"Well done. You have worked well to clear the pinecones. It is time to explore the beach"

Week 3. Activity 1: Striking and Fielding

Activity 1: Instructions for teacher

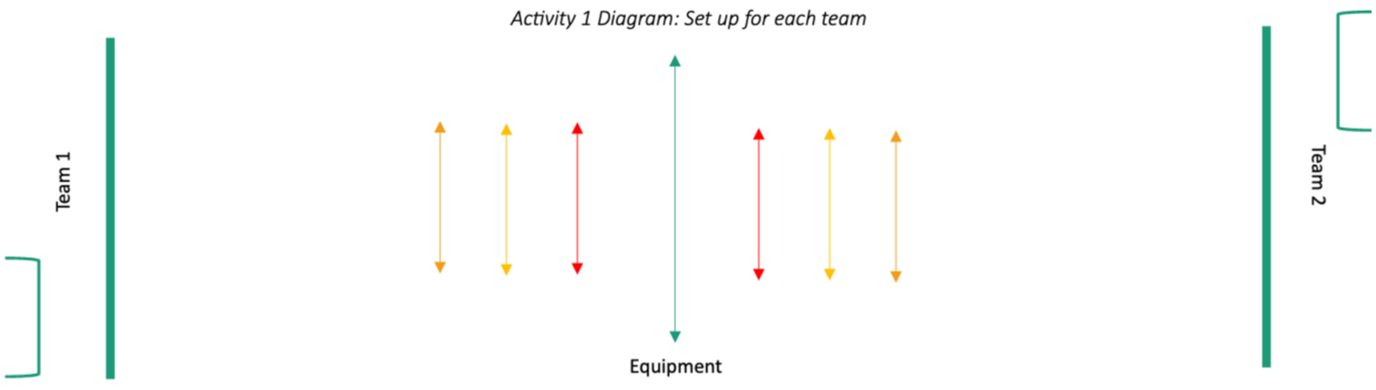
1) Keep children in the same groups as previous activity.
2) Set up the activity. *Please see diagram*
3) You will need same equipment as previous activity. Place the equipment in the middle of the teams.
4) Read out the different levels, and the rubbish to collect *(say the rubbish in any order/ mix it up).*

Activity 1: Instructions for children

1) In your teams one person will run to the middle, collect the rubbish and send it back into the rubbish container (buckets and nets).
2) Listen out for the rubbish the warden wants you to collect and how they want you to send it back to the food container.
3) Only one person can get a piece of rubbish at a time and a different person must go every time.
4) If you get the rubbish in the container or the net, then you will score an extra point for your team.

"The warden has asked for help to clear the rubbish. The warden will shout out the rubbish you need to collect"

Activity 1 Diagram: Set up for each team



Level 1: I would like you to roll the rubbish underarm and then run back to base.

Level 1 Challenge: I would like you to roll the rubbish under

Level 2: I would like you to bounce the rubbish using two hands back to the container.

Level 2 Challenge: Bounce the rubbish using one hand back to the container.

Level 3: I would like you to throw the rubbish overarm back to the container.

Level 3: Challenge: I would like you to throw the rubbish overarm using your other arm back to the container.

Level 4: I would like you to kick the rubbish back to the container and then run back to base.

Level 4 Challenge: Can you use a different object to strike an object.

Optimal challenge: Give the children 1 minute to use any of the skills to send the rest of the rubbish back to their team.

LIST OF RUBBISH

Crisp Packet: Tennis Ball

Bottle: Basketball

Chocolate wrapper: Foam ball
Burger box: Dodgeball

Plastic bag: Plastic hole ball.

Plastic lid: Football.

Toothbrush: Beanbags

"You have cleared the rubbish. The warden has invited you for a game of whacky striking and fielding"

Week 3. Activity 2: Striking and Fielding

Activity 2: Instructions for teachers

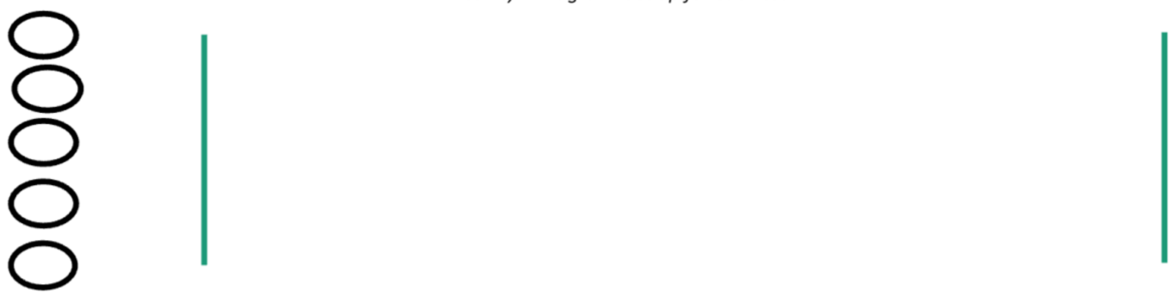
1) Keep children in the same groups as previous activity.
2) Set up the activity. *Please see diagram*
3) You will need same equipment as previous activity. Place the equipment in the middle of the teams.
4) Swap the team they play after they have had a go at striking and fielding.

Activity 2: Instructions for children

1) In your teams I would like you to strike the ball as far as you can.
2) When you strike the ball, you must run around the outside of the cones as fast as you can back to where you started.
3) The other team will strike the ball back to the base.
4) For every team member that makes it back before all the balls are back you get a point. These points will be transferred into plane tickets. There are 4 to play for.
5) You will swap the striking and the fielding team.

"Welcome to your game of whacky striking and fielding"

Activity 2 Diagram: Set up for each team



Round 1: Throwing the ball

- Children to choose the object they throw
- Children to choose where they throw the object from.

Round 2: Striking the ball from a tee.

- Make the pitch size bigger
- Children to choose size ball they strike (e.g. tennis ball/foam ball)
- Fielding team to throw object with non -dominant arm

Round 3: Striking the ball thrown by the other team.

- Children to use tennis racket/ bat they use.

Once the teams have completed all the rounds. Add up the scores and award the following:

First class

Business class

Economy premium

Economy

"Well done, each time got their plane ticket. Next stop....TEXAS"

Week 4: Agility

Equipment List:

Warm up Activity:

- No equipment needed

Activity 1: As many as you have of the following:

- Bean bag
- Coils
- Hoops
- Plastic hurdles

Activity 2:

- Same equipment as previous activity.
- Coloured spots or cones to mark out the areas.

Week 4. Warm up Activity: Agility

Warm up Activity Instructions for teacher

1) Children working on their own, but activity as a whole class.
2) Outside activity.
3) Read out the directions for the children to go.
4) Stand in the middle of the playground.
5) Complete each level a few times.

Warm up activity: Rules for children.

1) I will give you the directions, you need to go on and the travel movements.

"I hope you enjoyed your flight to Texas. We need to get to the reserve. I will give you directions and travel movements"

Level 1: Run forwards.

SHOUT FREEZE

Level 1 challenge: Run backwards.

Level 2: High Knees forward.

SHOUT FREEZE

Level 2 challenge: High Knees sideways

Level 3: Ins and outs moving forward.

SHOUT FREEZE

Level 3 challenge: Ins and outs moving backwards

Level 4: Jump side-ways moving forwards.

SHOUT FREEZE

Level 4 challenge: Jump side-ways moving backwards.

Level 5: in pairs hopping forwards

SHOUT FREEZE

Level 5 challenge: in pairs jumping all the way to the left.

EVERYONE TO THE MIDDLE AS FAST AS YOU CAN

Teacher in the middle of the playground

"You have arrived at the reserve. Well done"

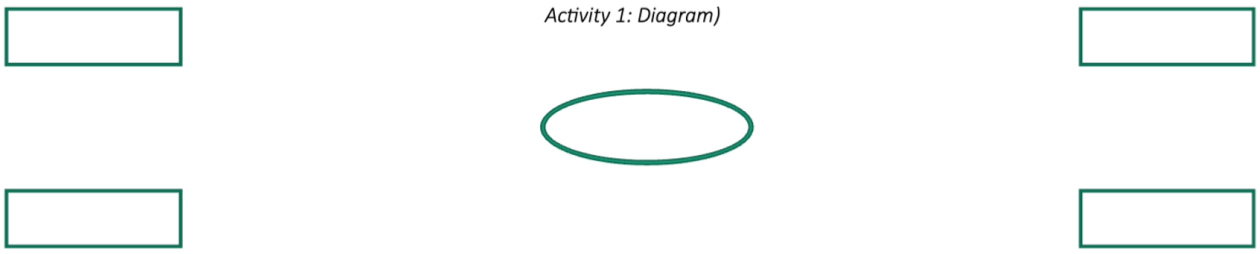
Week 4. Activity 1: Agility

Activity 1: Instructions for teacher

1) Split the class into 4 teams.
2) Set up the activity. *Please see diagram*
3) You will need bean bags, hoops, coils and plastic hurdles for this activity.
4) *Read out each level. Move on to the next level once every child has completed each level.*

"We need to collect coal, cotton and oil. You will need to collect the resources in your teams'

Activity 1: Diagram)



Activity 1: Rules for children.

1) In your teams you need to work together to collect the resources. Coal: Bean bags, Oil: Hoola hoops, Cotton: coils.
2) One person will travel as fast as they can to the middle and get back to their team. Once they are back with their team, the next person can go.
3) Every team member must collect an item before moving on to the next one.
4) Listen out for how they need to be transported back to your team and
5) If you drop your item, you must return it to the middle.

Level 1: Run forwards and bring the oil back on your arm.

Level 1 challenge : Run backwards and bring the oil back on your arm

Progress to next level

Place small hurdles in the children's path to the middle.

Level 2: Hop forwards and bring back the cotton balancing on your head.

Level 2 challenge *:* Jump forwards and bring the cotton between your feet

"You will need to make your way over the obstacle in the reserve"

Place small hurdles in the children's path to the middle.

Progress to next level

Level 3: Jump in and out over the obstacles and carry the coal back under your chin.

Level 3 challenge : Jump in and out sideways with the coal in your hand.

Progress to next level.

Level 4: You can choose any resource you would like and how you bring them back. But you need to be fast. You have 1 minute for everyone to bring a resource back.

"Well done. You have collected all your resources. It is time to transport them across the valley"

Week 4. Activity 2: Agility

Activity 2: Instructions for teacher

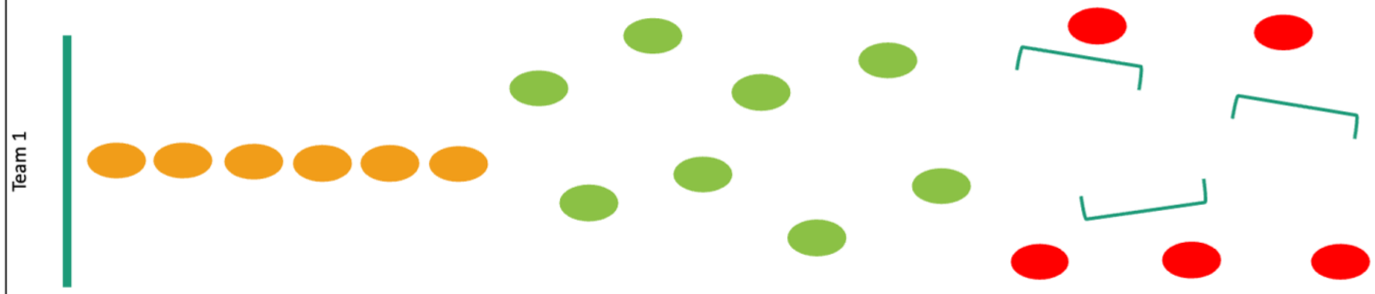
1) Keep the children in the same teams as before
2) Set up the activity for each team using plastic spots and hurdles. *Please see diagram*
3) *Use the equipment they have collected from the previous activity.*

Activity 2: Rules for children.

1) In your teams you need to transport your resources up the valley.
2) One person at a time must go, when they deposit it, the next person can go. Remember you need to be fast.
3) Each route will have 3 different travel movements that you can try.

"We need to collect coal, cotton and oil. You will need to collect the resources in your teams'

Activity 2: Diagram



Round 1: COAL

GREEN: Walk

ORANGE: Jog

RED: Run

Round 2: OIL

GREEN: Side-step

ORANGE: Skip

RED: Jumping with two feet

Round 3: COTTON

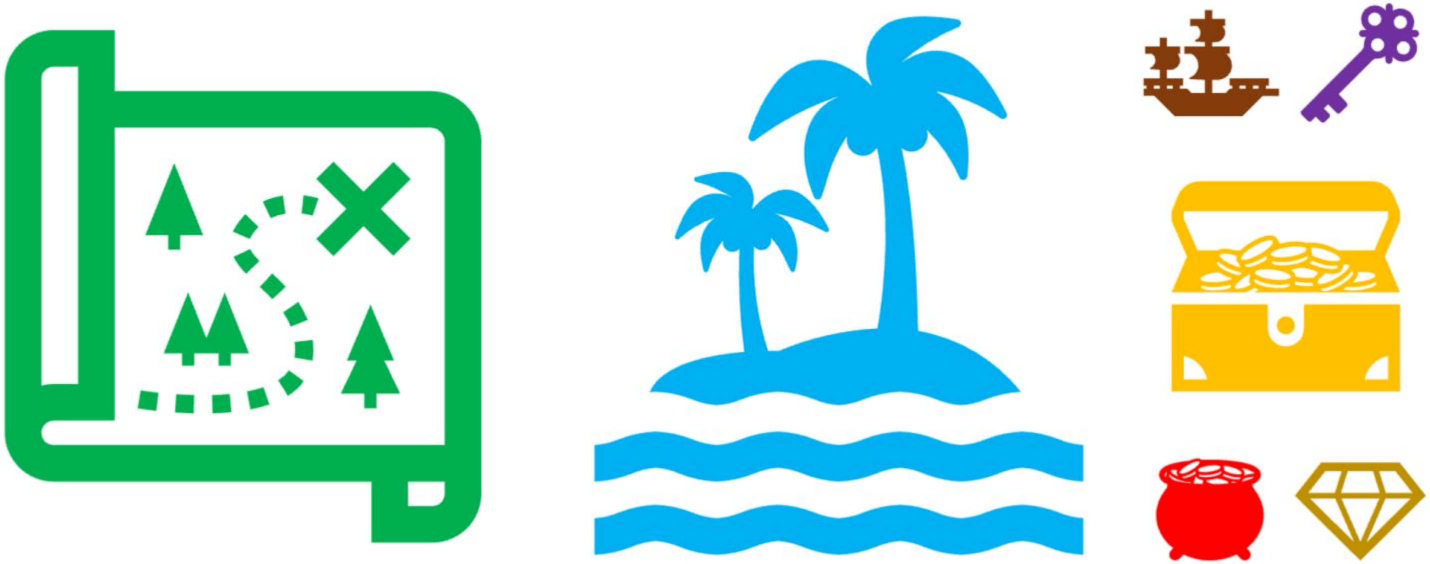
GREEN: Hop backwards

ORANGE: Jog backwards

RED: As fast as you can

Round 4: The children to race to the end as a team together.

"Well done. You have transported the goods and in exchange you have been given a ticket for Utah next week."



Treasure Island

K-C PE

Week 5: Obstacle Course

Equipment List:

- Team cards
- Cones
- A range of different sized balls for the children to use
  - Foam balls
  - Footballs
  - Tennis balls
  - Tennis racket
  - Bean bags
  - Rugby balls
  - Any other balls for them to create their obstacle course with.
  - Whiteboard + pen

Week 5. Obstacle course

Warm up activity Instructions for teacher

1) Outside activity.
2) Split the children into 4
3) Provide each team with a que card and let them spend 10-15 minutes building their course. Ask them to write on a whiteboard what is included in their course.
4) Set them of in different places so they have space to do it. Spend time walking round, ownership on the children for this lesson

Activity 1: Rules for children.

1) In your teams you are going to design your own obstacle course. You will all be given a card with what you need to include. You can choose any equipment you would like to.
2) On your whiteboard I would like you to write down what you are going to be doing in each bit.
3) Remember your whole team needs to be involved, be creative and challenge yourself! Good luck.

"I can hear the volcano bubbling. I would like you to create an obstacle course to get off the island, remember all the diffe rent parts of the island we have tackled.

Team 1:
You need to include:

1) Throwing and catching as a group
2) Jumping and landing (as a group and on your own)
3) Striking and fielding (hitting an object with your hand, a bat or your feet)
4) Fast movements in different directions as a group and on your own.

What else can you include that you have learnt the last few weeks?
Be creative

Team 2:
You need to include:

1) Throwing and catching as a group
2) Jumping and landing (as a group and on your own)
3) Striking and fielding (hitting an object with your hand, a bat or your feet)
4) Fast movements in different directions as a group and on your own.

What else can you include that you have learnt the last few weeks?
Be creative

Team 3:
You need to include:

1) Throwing and catching as a group
2) Jumping and landing (as a group and on your own)
3) Striking and fielding (hitting an object with your hand, a bat or your feet)
4) Fast movements in different directions as a group and on your own.

What else can you include that you have learnt the last few weeks?
Be creative

Team 4:
You need to include:

1) Throwing and catching as a group
2) Jumping and landing (as a group and on your own)
3) Striking and fielding (hitting an object with your hand, a bat or your feet)
4) Fast movements in different directions as a group and on your own.

What else can you include that you have learnt the last few weeks?
Be creative

"The volcano has started to erupt; the captain has some final instructions to get you of the island."

Week 5. Obstacle course

"The captain would like you try out the other teams' routes before the volcano erupts. How many times can you get through each course as a team in 5 minutes?"

Activity 2: Instructions for teacher

1) Set the children off to try out each obstacle course.
2) Spend 5 minutes on each course.
3) See how many times they can complete the obstacle course.
4) Once each team has had a go at each obstacle course, ask them to bring in all the equipment and countdown from 10, this will be the volcano erupting.
5) Once all the children are back in, with all the equipment congratulate them and read the final story (at the end of page)

"Well done everyone, you have managed to get off the island with your treasure. I wonder what next week will bring?."

Week 6: Dribbling

Equipment List:

Warm up Activity:

- 1 Hockey stick and 1 tennis ball/ plastic hole ball per child.

Activity 1:

- 1 hockey stick per child
- Cones
- Foam balls
- Tennis balls
- Plastic hole balls
- Whiteboard and whiteboard pen.

As many of these balls as you can provide the children

Activity 2:

- 1 hockey stick per child
- Cones
- Foam balls
- Tennis balls
- Plastic balls
- Plastic spot
- Cones
- 4 nets for the children

Week 6. Warm up activity: Dribbling

Warm up instructions for teacher:

1) Children to work individually during the warmup activity.
2) Hockey stick and hockey ball.

Warm up: Rules for children.

1) In the first zone, the captain has asked us for some help to move the objects around the island, they will be used to help us unlock the next crystal.
2) Listen out for the captains' instructions on how they want you to dribble the object around the beach

"In the box of treasure, you collected last week, there we missing crystals. The island needs them for conservation purposes . Your job over the next 5 weeks is to collect the missing crystals"

Level 1: Captain would like you to dribble the object from side to side, with two hands, stationary.

Level 1 challenge: Captain would like you to dribble the object forwards and then backwards, using two hands stationary.

Level 2: Captain would like you to dribble the object from side to side, with one hand on the stick staying where you are.

Level 2 challenge: Captain would like you to dribble the object forwards and backwards with one hand on the stick staying where you are.

Level 3: Captain would like you to start walking in a straight line whilst dribbling the object up the beach.

Level 3 challenge: Captain would like you change the direction you are dribbling the object

"The captain has noticed some obstacles in the way. You need to dribble around the obstacles"

Level 4: Captain would like you to dribble the object whilst walking and avoid the obstacles

Level 4 Challenge: Captain would like you to jog whilst dribbling the object around the beach.

Level 5: Captain would like you to dribble the object and when you hear "pass" you will pass your object to a partner.

Level 5 Challenge: Captain would like you to dribble your object round, he will keep shouting "change" and you will need to change direction.

"You have managed to move the objects around the beach. Keep the objects safe"

Week 6. Activity 1: Dribbling

Activity 1 instructions for teacher :

1) Split the class into 4 teams
2) Every child will need a hockey stick. You will also need foam balls, plastic ball with hole and tennis ball.
3) Layout out cones for every team. *Please see diagram.*
4) Provide the children with a whiteboard to note their score

Activity 1: Rules for children.

1) The captain would like you to travel to the end of the beach and bring back one object.
2) When one of your teammates has started dribbling the object back the next person can go.
3) Every member of your team must bring back an object before we can move up the levels.
4) However, If you lose control of the object, you must return to the start of the beach and try again

It is time to work together to gather more objects to unlock the crystal"

Diagram (Activity 1)

Level 1 (FOAMBALL) I would like you to dribble the object in and out of the cones with both hands on the stick.

Level 1 challenge This time I would like you to dribble the object in and out of the cones, but you only have 30 seconds each.

Level 2 (Plastic hole ball) I would like you to dribble the object in and out of the obstacles with both hands on the stick

Level 2 challenge This time I would like you to dribble the object with one hand on the stick.

Level 3 (TENNIS BALL) I would like you to dribble the object both hands on the stick back to your team.

Level 3 challenge This time I would like you to try dribble the object backwards around the obstacles back to your team.

"It is time to work faster to move the objects through the island.

Challenge Level:

Bring back as many objects as you can in

"You have gathered the objects with speed. You will need these to unlock the crystal in the next round"

Week 6. Activity 2: Dribbling

Activity 2: Instructions for teacher

1) Keep the children in the same teams.
2) Every child will need a hockey stick. You will also need football, foam ball, plastic ball with hole and tennis ball.
3) Layout out cones for every team. *Please see diagram.*

Activity 2: Rules for children.

1)The captain has said this crystal is important so would like everyone to practice their shooting.

2)In your teams, I would like you to dribble in and out of the obstacles, and 1 at a time shoot into the goal.

3)The next person in your team can go once the other person in front is halfway up the obstacle course.

4)We will practice with all 3 objects before we move onto the getting the crystal.

"To unlock the crystal, we need to shoot the objects at the goal"

Diagram (Activity 2)

Practice round's:
Round 1: Dribble in a straight line and shoot close to the goal.

Round 2: dribble around the circle clockwise and shoot from the middle with object of their choice.

Round 3: dribble around the obstacles and shoot from the left

Round 4: dribble around the obstacles and shoot from the right

Round 5: Dribble around the obstacles and shoot from a far distance.
"The captain thinks you are ready. ARE YOU READY?"

Activity 2.1: Rules for children.

1)Each member of the team will stand on the marked spots.

2)The first person will dribble the object to the next and remain in their spot.

3)You will do this till the object reaches the end person. The person at the end will dribble the object and shoot it into the special goal.

4)This person will then run back to the first spot.

5)Every member of the team must have shoot once.

Diagram (Activity 2.2)

Level 1: Two hands on the stick dribbling (football)

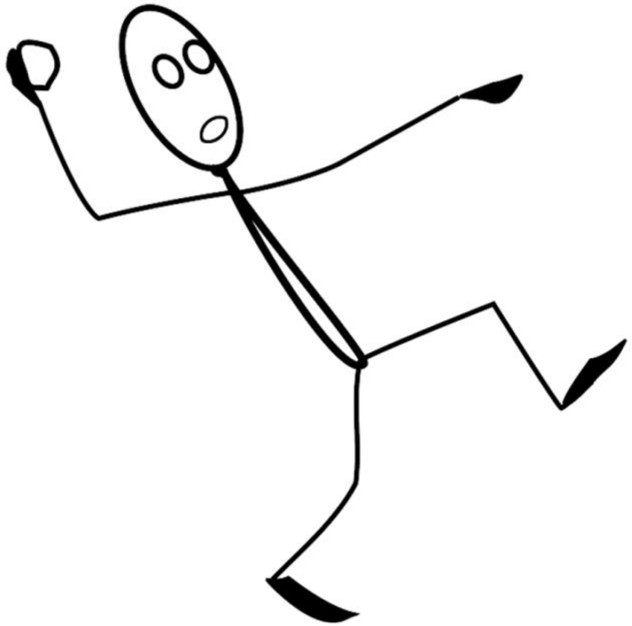
Level 2: One hand on the stick (plastic hole ball)

Level 3: Dribbling backwards (tennis ball round)

Each team will need to get 15 objects in the goal to unlock their crystal. If a team does not get 15, ask them to try again and count down from 30.

Well done everyone. You have unlocked the crystal "

Week 7: Throwing and Catching



Equipment List:

Warm up Activity:

- Foam balls
- Tennis Balls
- Bean bags
- Dodge balls
- Rugby Balls Basketballs
- Other soft balls you may have

Activity 1:

- Same balls as warm up activity.
- Plastic spots or cones.

Activity 2:

- Same balls as previous activities.
- Cones
- Hoop x 3

Week 7. Warm up Activity: Throwing and Catching

Warm up activity Instructions for teacher

1) Outside activity.
2) Split children into 5 teams.
3) Set up the children in a circle and scatter different balls around the playground. *Please see diagram*

Warm up activity: Rules for children.

1) The captain will shout out different jewels he would like you to find, and how to throw and catch them when your back to your team.
2) 1 person from the team will run and get the jewels. This needs to be someone different every time
3) When you're back to the team, you need to throw and catch to every single person before you can get another jewel.
4) If you drop the jewel, you must re-start the round.

"This week we need to get the 2nd crystal. We need to find some jewels to exchange for the crystal"

Level 1: Throw and catch using both hands.
Challenge: Take a step back to make the circle bigger and throw and catch using both hands.

Level 2: Throw with one hand, catch with two hands.
Challenge: Throw with two hands, catch with one.

Level 3: You must throw to the person on your left.
Challenge: You must throw to the person on your right.

Level 4: Using your cone upside down to catch the ball and throw with your hand.
Challenge: Using your cone upside down to catch the ball, throw with the hand you do not usually use.

Level 5: Half of your team mates to sit down on the floor and throw and catch.
Challenge: the other half of your team mates to sit down on the floor and throw and catch.

Level 6: this time I would like you get two jewels and throw and catch them around them in your team.

Diagram (Warm up activity)

"The jewels will now disappear. You have 30 seconds to throw and catch to every person in your team before the jewel disappears"

Level 7: Count-down from 10 for the jewel to be passed around the team.
Super challenge: Can you try and get two jewels this time and pass them

To keep your jewels, you need to throw them in the air and catch them. When you have done this, step over to me and your jew els will be safe"

Week 7. Activity 1: Throwing and Catching

Activity 1: Instructions for teacher

1) Children to remain in the same in the same teams.
2) *You will need the same jewels from the previous activity.*

Activity 1: Rules for children.

1) The captain would like you to stay in your teams and would like you to arrange yourselves in a line facing the captain.
2) You need to throw and catch the jewels down the line, every time the person at the back has thrown the ball to the person in front they must run to the front of the line. You can only transport more jewels once you have made it through the zone and the jewel is safely deposited.
3) The captain may shout out different commands whilst you are transporting the jewels.
4) Be-careful though, these jewels still need to be looked after, if you drop the jewel everyone will have to go back to the start of this zone

"Now some of your jewels are safe. We need to start transporting them through the zone. "

Level 1: Throwing and catching with two hands, and move once they you have thrown the bal.

Level 1 Challenge: you have 45 seconds to get the jewel across.

Level 2: Every other person take a step left. Throw and catch with two hands and move once you have thrown the ball.

Level 2 Challenge: Everyone who stepped left, take another step left. This time you will be throwing the jewel with one hand, and you can catch with 1 or 2 hands

Level 3: Make the space bigger between the person in front and the person behind. You can choose the way you catch and throw the jewel.

Level 3 challenge: Make the space bigger again between the person in front and the person behind you. You can choose the way you catch and throw the jewel.

Level 4: Before you throw the jewel to your teammate, the captain would like you throw it in the air and catch it.

Level 4 challenge: Before you throw the jewel to your teammate, the captain would like you to bounce it on the floor and catch up.

Diagram (Activity 1)

Captain stands here

"The jewels have been transported. We need to work together to exchange them for the crystal. Are you ready?"

Week 7. Activity 2: Throwing and Catching

Activity 2: Instructions for teacher

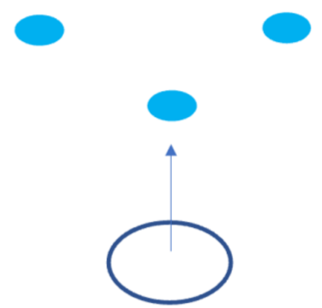
1) Split the class into 3 teams.
2) Layout the mini zones. *Please see diagrams*
3) Before setting the children of on the zones, explain what they will be doing on each zone.

Activity 2: Rules for children

1) In your teams I would like you to make your way around the 3 mini zones. To unlock the crystals at the end you need to have successfully got the jewel into the net 6 times on each zone.
2) Each zone will be laid out differently. You will have 4 minutes on each zone.
3) When the captain shouts stop, it will be time to move on to the next zone. The captain will also ask how many jewels you shot into the net.

"It is time to exchange the jewels for crystals at the end. Listen out for the captains' instructions"

Mini zone 1



Instructions:

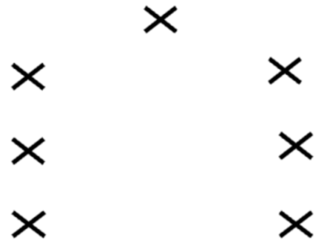
1) The jewel needs to be passed down the line.
2) The person closest to the net will shoot first. Once they have had their go, they join the back and continue passing the jewel down.

Mini zone 2

Instructions:

1) The jewel needs to be passed to every member in the team.
2) A different person each time then needs to run to a spot of choice and a teammate throw to them.
3) The person on the spot will catch the jewel and then try and shoot.

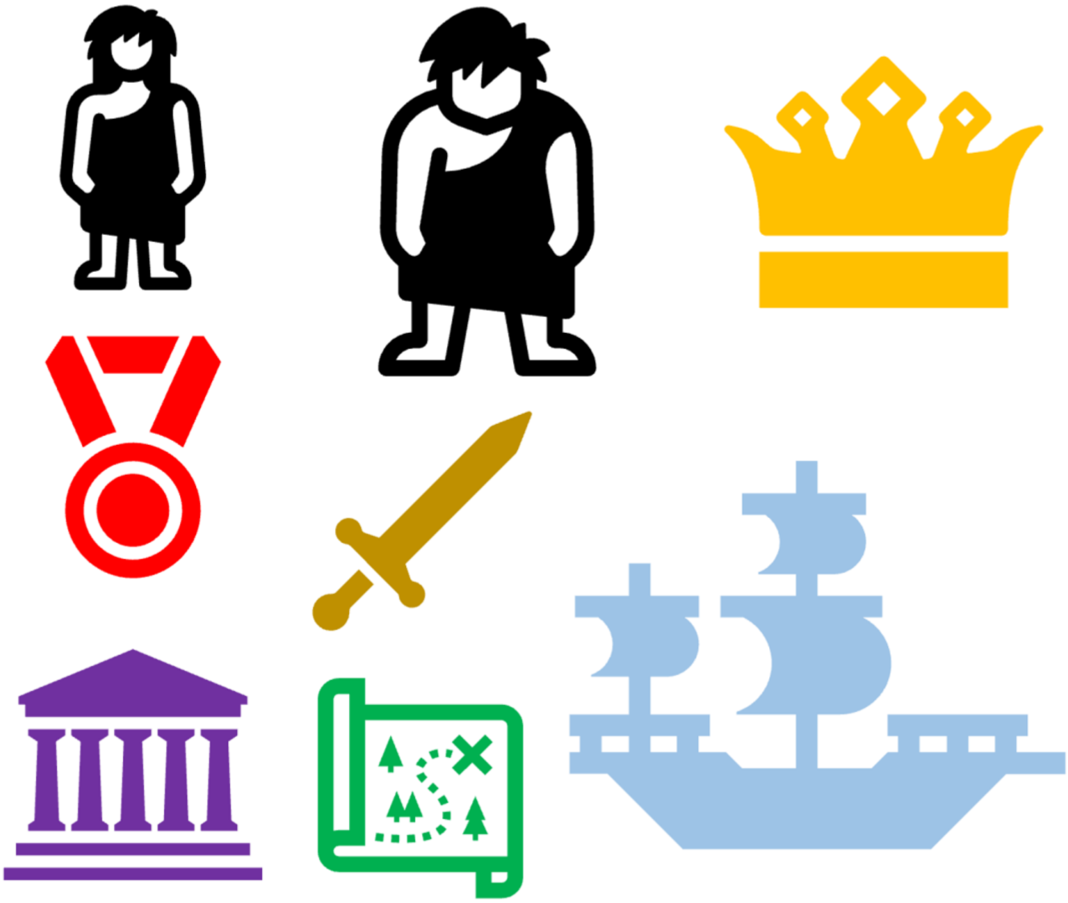
Mini zone 3



Instructions:

1) The jewel needs to be passed sideways up to the person closest to the net.
2) Once they have tried to shoot you move to the next X.
3) Keep going until it is time to move on to the next mini zone.

"Well done everyone. You have managed to unlock the 2nd crystal. Only 3 more to go!"



Quest through time

K-C PE

Week 8: Dodging and Invasion

Equipment List:

Warm up Activity:

- Foam balls
- Plastic spots
- Different size hoops
- Cones
- Benches for the children to stand on or if your outside just set up cones for them.

Challenge 1:

- 4 different coloured cones, as many as possible.

Challenge 2:

- Tag rugby belts with two belts for each child
- Cones

Indoor or outdoor activity lesson

Week 8: Dodging and Invasion

You conquered world war one. To get through the next portal, you need to dodge your way in out of the objects in your way. **Lay out cones for them to dodge through**

Well done, you have travelled and managed to dodge through the objects in the portal. Today we are going to be entering World War 2.

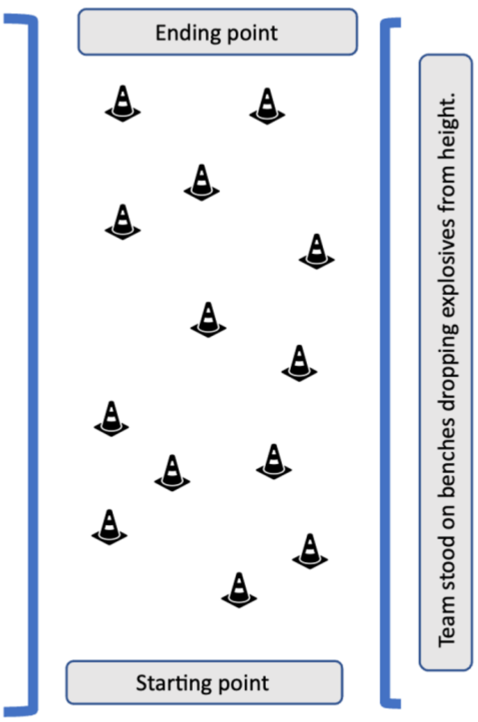
Warm up activity Instructions for teacher

1) Children working in 4 groups (different from previous weeks)
2) In their 4 groups, split them off into 2v2. *Please see diagram*
3) One team on either side of the land, and one team at the starting points of the land.
1) You will need: Foam balls, plastic spots, hoops and cones.

Warm up activity: Rules for children.

1) In your teams you will need to travel through the land without touching any explosives.
2) Explosives can come from the plans above, the tanks from the side and underneath the ground.
3) If you get hit by the explosive, or touch one, you must return to the start of the land.
4) Each team will complete 3 different lands, the course ill get harder as we go through.

Diagram (Warm-up activity)



Round 1 Set up:
- One team will skip across the land dodging all the explosives.
- Other team stood on the benches dropping the explosives (foam balls) and **rolling** them in from the side.

Swap over once whole team is across.

Round 2 Set up:

- One team will crawl across the course dodging all the explosives.
- Other team stood on the benches dropping the explosives (foam balls) and rolling them in from the side.

Swap over once whole team is across.

Round 3 Set up:

- One team will side step across the course dodging all the explosives.
- Other team stood on the benches dropping the explosives (foam balls) and rolling them in from the side.

Swap over once whole team is across

Well done everyone, you have managed to travel across the land with only a few touches from explosives.

Week 8: Dodging and Invasion

It is now time to take over some territory and build up the land. How much can you get?

Challenge 1: Instructions for teacher

1) Children working in 4 groups (same as previous task

1) *Lay out 4 different coloured cones (right side up). Lots of them. Each colour will be associated to each team.*

Challenge 1: Instructions for children

1) In your teams you need to work together to take over pieces of land.

2) Your team has a different coloured cones. You need to flip them upside down.

3) Other teams can flip your land the right side up, so be careful.

4) You cannot flip the same piece of land. You have to move to a different piece.

Diagram (Activity 1)

Round 1: 1 minute: Running and taking land
Round 2: 1 minutes: Galloping and taking land
Round 3: 1 minute round: Side stepping and taking land

So now you have taken some land, we are going to see who can take the most land as a team.

Challenge 2: Instructions for teacher

1) Children working in 4 groups (same as previous task)

2) *Lay out 4 different coloured cones as done previously.*

3) Set the 4 teams into different colours.

4) Shout out coloured cones (move on to the next colour when they have all done)

5) Remind the children someone different must go every time and everyone should have a turn.

6) Count up the teams cone and award the team with the most land (they could start as the English in the next activity.

Challenge 2: Instructions for children

1) In your teams you need to work together to take pieces of the land.

2) One person at a time must run and collect that coloured piece of land. Once they are back in your base with the coloured piece of land the next person can go.

3) A different person must collect the land every time

Well done everyone you all did really well in taking over some land.

Week 8: Dodging and Invasion

You have all built some ground, and taken over some territories. It is now time to capture and defeat the Germans so you can get through the portal.

Challenge 3 : Instructions for teacher

1) Nominate 1 person to start in the middle (a child that has shown sportsmanship/ has done well in todays lesson)
2) Each child to wear a tag rugby belt with two tags on.
3) Lay out (indoors or outdoors). *Please see diagram below*

Challenge 3: Instructions for children

1) Germans, you must race across the land, if the English remove a tag, then you will become injured and must hop until your captured
2) If they remove another tag, you are now captured and become part of the English team and you will help to capture the Germans.
3) English you can only move across the line, left to right.
4) Germans, listen out for how I want you to get across the land.

Are your ready?

Diagram (Challenge 3)

Round 1 Running across the land. X 2
Round 2 Stepping sideways across the land. X 2
Round 3 Galloping across the land. X 2

A member of your army has become really injured. You now need to cross the team in pairs

Round 1 Hopping together keeping hold of one another
Round 2 Jumping together keeping hold of one another.

Smoke is in the air, lots of bombs have gone off, we need to keep low whilst avoiding being captured.

Round 1: Crawling across the land
Round 2:crab walks across the land
Challengeif any Germans are left by the end. Shout capture and allow the English to capture them without staying on the line.

You have captured all the Germans!!! congratulations.

Week 9: Gymnastics

Equipment List:

Warm up Activity:

- No equipment needed

Challenge 1:

- Prompt cards for the children.

Week 9: Gymnastics

Well done, you defeated the Germans. To get through the portal today you need to balance on 1 leg for 10seconds. 10, 9, 8, 7, 6, 5, 4, 3, 2, 1.

Well done, you have balanced your way out of the portal. We have landed in the 1923 and will be practicing ready for the royal variety performance at the end.

<u>Warm up activity Instructions for teacher</u>

1) Children working on their own, in pairs and in groups.
2) Shout of different gymnastics moves as they are travelling.

<u>Warm up activity: Rules for children.</u>

1) It is time to start warming up for the show.
2) The instructor will shout out different activities for you to do.
3) Listen out because you might be doing it on your own, in pairs or in groups of 3.

Diagram (Warm-up activity)

Travel movements

- Duck walk
- Kangaroo jump
- Jump and turn
- Skipping
- Hopping
- Marching
- Bear walk
- Crab walk
- Choose a way to travel
- Flamingo jump

Balances: Can be done on their own, in pairs or groups. You decide

- Create a bridge shape
- A balance of your choice
- Balance on 4 body parts
- Balance on 3 body parts
- Balance on 3 body parts
- Balance with your hands touching
- Balance with your feet touching
- Balance on one leg for 3 seconds
- create a balance with a partner
- create a balance in 3's/4's

Well done everyone, the conductor is impressed with your skills

Week 9: Gymnastics

The instructor is happy that you have warmed up. It is now time to start practicing your routines ready for the show.

Challenge 1 :Instructions for teacher

1) Split groups of into small groups.
2) Task them with creating the most creative routine they can.
3) The children will have 10 minutes to design and plan their routine as a group.
4) Once this is done, they will preform their routines like they are at the royal variety.
5) Attached is prompts if they are struggling.

Challenge 1: Rules for children.

1) In your groups you will be creating a gymnastics routine to perform at the royal variety show. The queen wants them to be really creative.
2) You can use different pieces of equipment.
3) If you are struggling to think of ideas, the instructor has some cards that you can use to help you create your routine.

Prompt cards for children

Can you include different balances with different body parts?

Can you include different jumps?

Can you include different travel movements, on your own and as a group?

Can you create a start shape as a group in the start of your routine?

What other gymnastics skills can you include?

Can you include any rolls?

Can you include balances on your own, in pairs and as a group?

- **Children to perform their routine at the very end.**

The queen is happy with your performances, and has opened the final portal for you. Well done everyone.

Prompt cards for children

Can you include different balances with different body parts?

Can you include different jumps?

Can you include different travel movements, on your own and as a group?

Can you create a start shape as a group in the start of your routine?

What other gymnastics skills can you include?

Can you include any rolls?

Can you include balances on your own, in pairs and as a group?

Prompt cards for children

Can you include different balances with different body parts?

Can you include different jumps?

Can you include different travel movements, on your own and as a group?

Can you create a start shape as a group in the start of your routine?

What other gymnastics skills can you include?

Can you include any rolls?

Can you include balances on your own, in pairs and as a group?

Week 10: Obstacle course

Equipment List:

Warm up Activity:
- Bean bags
- Tennis racket
- Tennis ball
- Cones

Challenge 1:
- Footballs
- Hockey stick
- Tennis ball
- Net for the children to shoot the ball into
- Hoola hoop (large)
- Bean bag
- Plastic spots

Challenge 2:
- Same equipment as previous activites.

Indoor or outdoor activity lesson

Week 10: Obstacle Course

You are so close to making it back to present day. To make it through to the portal today you must jump over the portal entrance. **Line the children up and ask them to jump as far as they can.**

Well done, you have jumped through the portal. Today marks an important celebration. The kings coronation, but we need your help. You will be transporting the kings crown and jewels from the tower of London to west minister abbey.

<u>Warm up activity Instructions for teacher</u>

1) Children working in 4 groups (different from previous weeks)

   The duke and duchess of Cambridge
   The duke and duchess of Sussex
   Earl and countess of Wessex
   Duke and princess of York

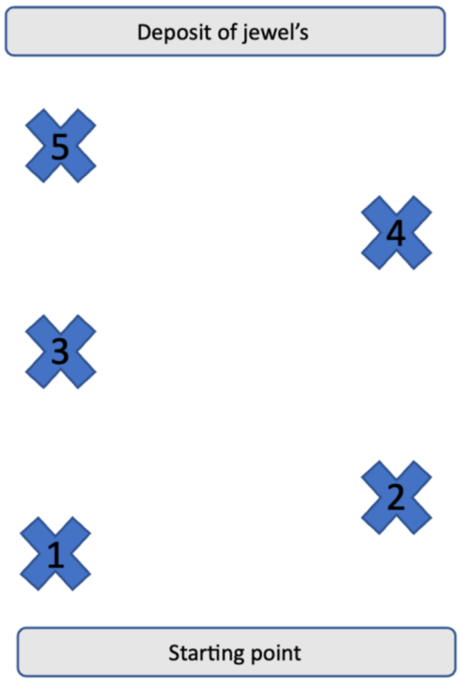
1) Layout the course. *Please see diagram below*

2) You will ned: hoola hoops, bean bag, football, tennis ball and racket

<u>Warm up activity: Rules for children.</u>

1) In your teams, you need to get the crown and jewels out the tower of London.
2) There will be 5 rooms you need to go to get the different jewels and crown. In each room there is a marker that each person needs to stand on
3) Every time you move rooms, you will move to a different number station.
4) You need to listen out to how the tower guards instructions on how to move the jewels and crown

Diagram (Warm-up activity)



Room 1: Crown (bean bag)
I would like you to balance the crown on your head. The person must take the crown of your head, and place it on theirs.

Room 2: Bracelet (each child to have their own tennis racquet)
I would like you to transport 5 bracelets. You can only get another bracelet when you have passed it to the next person.

Room 3: Orb (Tennis ball)
This room has laser beams meaning you cannot move from your spot. I would like you to throw and catch 8 orbs. If you drop the earrings the whole team must freeze for 5 seconds.

Room 4:
There is even more laser beams in this room, so we must stay low to the ground. I would like you to roll the earrings.

Room 5:
In this room everything is backwards. I would like you transport the 7 necklace's one at a time around your neck, travelling in a backwards motion.

Well done teams you have got the jewels out of the tower of London. It is time to make your way over the Southwark bridge to west-minister abbey.

Week 10: Obstacle course

We need to transport the jewels over the Southwark bridge. You can only bring over 1 jewel at each time.

Challenge 1: Instructions for teacher

1) Children staying in the same teams.
2) Children in different sections so that they have space.
3) Lay out the activities as you can through. *Please see diagrams below.*

Challenge 1: Rules for children.

1) In your teams, you need to move the jewels over the Southwark bridge
2) Each jewel needs to be brought over separately.
3) Listen out for the tower guards instructions.

Level 1: I would like you to use your feet to bring over the earrings. Every person must bring over an earing.

Dribbling in and out of the cones with the earrings (football)

Diagram (Level 1)

Level 2: I would like you dribble the orb using a hockey stick in and out of the obstacles and shoot the orb into the net.

Challenge: I would like you to dribble the orb using only one hand and shoot the orb into the net.

Diagram (Level 2)

Level 3: I would like you to throw the crown around your team. Once everyone has touched the crown (bean bag)you must throw it into the bucket. Every person must have a turn at throwing it into the bucket. If you miss, you must try again.

Challenge: Throw and catch the crown 10 times in a minute before putting it in the bucket.

Diagram (Level 3)

Level 4: I would like you to balance the bracelet on the tennis racket and pass them to your team.

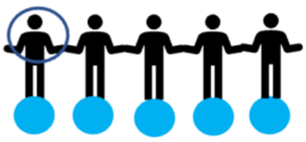
Challenge: try and carry the bracelet with one hand on the racquet.

Diagram (Level 4)

Level 5: I would like you to transport the necklace down the line from one team member to another. But you must stay connected by holding hands.

Challenge: I would like every other team member to kneel down and you must transport the necklace.

Diagram (Level 5)



Well done, you have managed to transport the jewels over the bridge. It is time for our final task. The coronation is looming.

Week 10: Obstacle course

Oh no, we are so close, but there is allot of traffic. We need to manoeuvre around the cars. The coronation is starting soon, so we need to move fast.

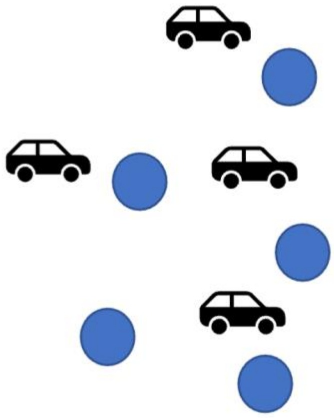
Challenge 2: Instructions for teacher

1) Keep children in the same teams.
2) Set up activity. *Please see diagram below.* Lay out different obstacles for the children to position themselves around.

Challenge 2: Rules for children

1) I would like you to all position yourselves with a plastic spot in between the traffic. You have 3 minutes to decide where each person in your team is going to stand.
2) Every time the jewel reaches west-minister you will change positions.

Diagram (Challenge 2: Activity 1)



Level 1: ORB
The first jewel you need to transport to Westminster is orbs. I would like you to throw and catch the orb and place it in Westminster.

Challenge: "FREEZE" ask the children to move further away from each other.

Level 2: EARINGS
I would like you to transport the earrings using a dribbling motion with either your hands or feet.

Challenge: "FREEZE" ask the children to try and dribble with their non-dominant limb

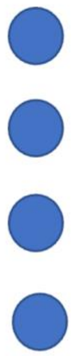
Level 3: Bracelet
I would like you to transport the bracelet with the arm you do not usually.

Challenge: "FREEZE" ask the children to bounce the ball on the racket whilst moving.

The traffic is getting worse, there are more cars and we are running out of time.

Add more obstacles for the children to manoeuvre round

Diagram (Challenge 2: Activity 2)



Level 4: Necklace
I would like you line up and pass the necklace over your head and then over the person in front. You will need to move down the line to make sure you get the jewels to safety.

Challenge: "FREEZE" ask the children to preform this backwards.

Level 5: THE CROWN
You have got all the others jewels. It is time to carry the crown across. Place the crown on your head. As a team, holding hands you must make your way across, avoiding the traffic. If anyone drops their crown, the whole team must go back to the start.

Congratulations everyone. You delivered all the jewels on time. The king has been coronated and you have successfully made it back to present day. Your quest through time is over. Congratulations.

Appendix B: Feasibility semi-structured interview schedule with the teachers

Feasibility of Gamification Physical education curriculum

A statement will be made to the participant 'This interview is now being recorded by the principal researcher. You can stop the recording at any time and can request breaks when you need them. Are you okay for the interview to proceed?'

Today I would like to ask you some questions about the curriculum that we co-designed to learn more about how feasible the curriculum is going forward.

I hope to use this information to help develop and adapt the curriculum further.

This interview should take about an hour. Are you okay to respond to some questions currently?

(Transition: Let me start by asking you some questions about the research project. Please be honest and open with your answers, I will not take anything you say personally)

1) What was it like to be part of the research project?

   This includes the co-production element of the project, the data collection, the curriculum, and the observations.

2) If there anything you did not like about being part of the research project? **Timing**
3) Are there any highlights about the research project that you would like to share?
4) Is there anything else you would like to add about the research project? Both positive and negative.

(Transition: Thank you for your answers, I am now going to ask you some questions about the design of the gamified PE curriculum)

Body: ACCEPTABILITY QUESTIONS

1) After delivering the lessons that were co-designed between yourself, the children and myself, do you think the design of the curriculum was suited to a year 5 cohort?

- If so, then how?
- If not, then why?
- Any additional comments?

2) Do you think the design of the curriculum aligned well with the national curriculum?

- If answered yes, please provide an example of alignment with the national curriculum.
- If answered no, how do you think we could align it better with the national curriculum?

3. What worked well within the design of the lesson plans?
4. Were there any factors that made the curriculum particularly enjoyable?
5. Were there any barriers to implementing the curriculum? If so, what were they?
6. Can you explain what was good about the curriculum that prompted success?
7. What factors did not work well in the curriculum?
8. Do you think the curriculum is sustainable long term?
    - If so why?
    - If not why?

(Transition: I am now going to ask you some questions about the implementation of the curriculum)

1. In total, how many sessions were delivered?
2. Do you think 10-weeks was enough time to deliver the PE lessons? For both you, and the students.
3. Do you think enough time was allocated to the lesson?
4. How easy were the components of gamification to implement?
5. Were there elements of gamification that were easier than others to implement?
6. To what degree do you think the lessons were effective?
7. How successful do you think the lessons were?
8. How well do you think the curriculum was received by the children?
9. Reflecting on the last 10 weeks, how have you felt about delivering the curriculum?

Prompt: did you feel competent? Confident? Up skilled? Unsure? Not confident? Prompt: please be honest with how you felt about the curriculum

(Transition: I am now going to ask you some questions about the practicality of the curriculum)

1. How easy was the curriculum to implement? Follow up:
2. Do you think the lesson plans were easy to follow?
3. Do you think the children were able to follow the curriculum?
4. How easy was it to use the amount of equipment that was in the curriculum?

(Transition: I am now going to ask you some questions about the adaptation of the curriculum)

1. During the intervention were their times that you had to adapt the curriculum for the children? or yourself?
2. Do you think other schools would be able to adapt the curriculum to meet the needs of their class?
3. How easy do you think it would be for another school to pick up the curriculum and deliver it? Do you have any advice on how this could be best achieved?

(Transition: I am now going to ask you some general questions about the curriculum)

1) Reflecting on the last 10-weeks, please could you state a few highlights, if any, of the curriculum.
2) Reflecting on the last 10-weeks, please could you state, if any, difficulties you have faced.
3) If you were to deliver the curriculum again, is there anything that you would change?

   Prompt: this could be timing, the games/skills delivered, the adaptation for the children, the storyline, the dosage of the curriculum.

4) Do you think you are likely to continue to use the curriculum post study? If so why, if not why?
5) Are there any additional comments you would like to make about the curriculum?

(Transition: Well, it has been a pleasure finding out more about how the intervention went. I am just briefly going to summarise the information that I have recorded during our interview, and check I have not missed anything)

Closing

1. Thank you for taking your time for this interview. Is there anything else you think would be helpful for me to know?
2. I should have all the information I need. Would it be okay to contact you via email if I have any more questions? Thanks again and thank you for being a part of this process.
3. Audio recording to be stopped.

Appendix C: Feasibility focus group schedule with the children

A statement will be made to the participants 'This group discussion is now being recorded by the principal researcher, Jenna. You can stop the recording at any time and can request breaks when you need them. Are you okay for the interview to proceed?'

Today I would like to ask you some questions about the lessons that we co-designed so that I can learn about how it went for you, and how easy it will be for other children to be involved in going forward.

I hope to use this information to help develop and adapt the curriculum further.
This interview should take about 30 minutes.

Before we start, when one person is speaking, everyone else will be respectful. Everyone will get a chance to speak, and everyone will get chance to give their opinion. It is okay to have different opinions to your friends and other people in the group. You can express your opinions open and freely.

Are you okay to respond to some questions at this time?

Can you start by each stating your name, your age, and your favourite physical activity.

(Transition: Let me start by asking you some questions about the design of the gamified PE lessons. In the first part of the interview, I will ask you some questions about the research process that you have been involved in and then for the second part we will gave a look at what you enjoyed or did not enjoy about the curriculum, and if there was anything you would change about it, and why)

Body (Research process questions)

1) Can you remember what the research you took part in was?
2) What has it been like to be a part of a research project?

(This could be anything from taking part in the different activities before your PE lessons, to when we co-designed the PE lessons)

3) Is there anything you have learnt from being part of the research project?
4) Do you think more children should be part of a research project? And if you do, why do you think this?
5) What did you think about the co-production process?
6) How did the process make you feel?
7) What were your favourite activities during the workshops? and why.
8) What were your least favourite activities during the workshop? And why.
9) Remember when we did the activities in the hall, what did you think about them?
10) Was there an activity that was your favourite?
11) Did you wear your watch?
12) What was it like to wear your watch?

(Transition: Thank you for your answers, I am not going to ask you some questions about your gamified PE lessons that you have taken part in over the last 10-weeks).

Body: Gamified PE lessons: Acceptability

1) Do you think the activities in the PE lessons were suitable for children your age?

If so, then why?

If you don't think they were, then why not?

Is there anything else you would like to add?

2) What was your favourite lesson? Why did you like this lesson?

Prompt: Do others have different thoughts? What does everyone else think?

3) What was your least favourite lesson? Why did you not like this lesson?
4) Can you think of lesson during the intervention that you enjoyed the most? Why did you enjoy the lesson?
5) If you were to take part in the PE lessons again, is there anything that you would change?
6) Can you remember any of the gamified elements that were part of your gamified PE lessons?

Prompt: Levels, challenges, story, achievements, relationships.

7) From the elements that have you said, can you give me an example of when these elements were used?
8) Do you think the story that was in your PE lessons was suitable for children your age? If so, what made the story suitable?

(Transition: I am now going to ask you some questions about how you think it went for your teacher, this part of the focus group will look at how easy or hard you thought it was for your teacher to explain the activities or lessons) IMPLEMENATION.

1) Do you think the lessons were easy for your teacher to deliver?

What makes you say that (if yes or no)

2) Do you think there were any barriers for your teachers?

A barrier is something that makes it difficult for them to deliver the lessons.

3) Can you remember how many lessons your teacher delivered?
4) Can you remember how long the lessons lasted? Do not worry if you cannot remember.

(Transition: I am now going to ask you about how we can adapt the Gamified PE lessons. adapt means how we can make it more suitable, or change it so other children and their teachers can use it) ADAPTATION.

1) Do you think the next year 5 class would enjoy taking part in the PE lessons? If you do, then what reasons might they enjoy the PE lessons?

   If not, why not?

2) Do you think a teacher from a different school, who did not help to design the PE lessons, would be able to deliver them without any help?

   If so, why? If not, why not?

(***Transition, I am now going to ask you some general questions about the gamified PE lessons)***

1) Do you think the use of equipment was easy, or difficult to use during your PE lessons?
2) Thinking about the last 10-weeks, what emotions did you feel when you took part? Did you feel happy, sad, excited, confused, bored.

   Prompt: It is okay to say how you feel, nobody will be angry about how you felt.

3) Thinking about the last 10-weeks, please could you state a few highlights, if any about the PE lessons.
4) Thinking about the last 10-weeks, please could you state if any, difficulties you have faced during your PE lessons.
5) Thinking about the last 10-weeks, are there any skills that you have developed?

   These could be physical or social skills that you have developed.

6) If your teacher had the decision to keep the PE lessons, would you continue to use it in your PE lessons?

   If so why? If not, why not?

7) Are there any additional comments that you would like to make about the curriculum?

(Transition: Well, it has been great finding out more about how your PE lessons went, I am just briefly going to summarise the information that I have recorded during our focus group, and check I have not missed anything)

Closing

Thank you for taking the time to be part of this focus group, is there anything else that you think might be helpful for me to know?

I should have all the information I need, thank you again, and thank you for being part of this research project, I hope you have all enjoyed it.

Audio recording to be stopped.

Appendix D: A brief description of previous observation instruments

Instrument	Descriptions & Variables assessed	Interval recording	Coding system
5-item gamification checklist (Fernandez-Rio et al., 2020)	To assess the implementation of gamification strategies. • Gamification strategies (n = 5)	N/A	N/A
(Melero-Cañas et al., 2021)	To assess the implementation of gamification strategies and personal and social responsibility elements. • Gamification strategies (n = 5) • Personal and social responsibility (n = 7)	11 observation periods of 5 minutes	Binary system (0 = absent, 1 = present)
SOTG-PE Roberts and Fairclough, 2011)	To observe and record an individual target child's PA type, the lesson activity context and teacher interactions. • Child activity type	Partial interval recording (10 seconds of observation followed by 10 seconds for recording what was observed)	Event sampling

Instrument	Descriptions & Variables assessed	Interval recording	Coding system
	• Lesson context • Teacher interactions		
TARE (Wright and Craig, 2011)	To assess the implementation of the personal and social responsibility model • Teaching behaviours (section one) • Personal-social responsibility themes (section two) • Student responsibility (section three)	5-minute intervals	Section one: circle to indicate code has been employed. Section two: 5-point Likert scale (0 = never, to 4 = extensively) Section three: 5-point rating scale (0 = very weak, to 4 = very strong)
SOFIT+ (Weaver et al., 2016)	To assess teaching practices that promote or restrict children's participation in MVPA • Lesson context (n = 7) • Activity context (n = 8) • Teaching behaviours (n = 6) • Activity management (n = 6)	Partial interval recording (10 second observe, 10-second record intervals).	Binary system Present or absent

Instrument	Descriptions & Variables assessed	Interval recording	Coding system
SOVRTL-PE	To assess instructional practices in the specific context of synchronously delivered online physical education. • Lesson structure • Lesson focus • Lesson event • Instructional style • Teaching behaviour • Motivational aids • Technology integration	Partial interval recording (10 second observe, 10-second record intervals).	Binary system Present or absent

Appendix E: System for Observing Gamification in PE marking scheme

System for Observing Gamification in Physical Education (SOG-PE)

Description and procedures manual

1. Introduction

The System for Observing Gamification in Physical Education (SOG-PE) is an instrument created to assess the implementation of gamification strategies in a physical education context. This tool, on one hand, evaluates the implementation of gamification strategies during the physical education lesson and, on the other hand, teacher and student behaviours that occur during the lesson. The structure of this document is inspired by the SOFIT+ manual (Crotti et al., 2021).

2. Definitions and technical descriptions of the SOG-PE

The SOG-PE is split into two dimensions: gamification strategies and general teacher/student behaviours. The observer must code gamification strategies and general behaviours following each quarter of the lesson duration. For example, a 55-minute lesson would be split into 4, 13.75-minute sections.

2.1. Gamification strategies

The observer should code the gamification strategies. In each quarter a decision should be made related to the **frequency** and **quality** of the gamification strategy. For each of the gamification strategies, the observer should code the extent the gamification strategy has been implemented. In the case of the gamification strategy not being present, the observer should code the strategy as 0 (never) for that segment. The marking scheme is presented on page 11 and provides further guidance for each code.

The gamification strategy and checklist comprise of the following items:

- **Narrative:** *There is a clear narrative.* Teacher delivers a clear narrative to the students at the start of the activity/lesson with the aim of contextualising the activities within the lesson. Teacher provides the students with clear achievements that are represented in a milestone in the storyline at the end of the activity/lesson (Fernandez-Rio et al., 2020).

Examples can include:

- **'**Welcome to New York, The first task is to unload your luggage from the aeroplane using throwing and catching' (i.e. narrative at the start of the lesson)
- 'Well done the mayor is happy with how you practiced your capturing skills; he is now sending you to capture the prisoners' (i.e. Clear achievement represented in a milestone in the storyline)

- **Relationships:** *Students are provided with a range of interactions with peers.* Teacher provides the students with a range of different opportunities for interaction (e.g. working in a team, pairs, groups of 3/4/5/6/7 or against another team). The interactions between the students should be relevant and authentic for the narrative/and or lesson objective. (Werbach and Hunter, 2015).

Examples can include:

- '**In teams,** I would like you to **transport the items across the Brooklyn bridge'** (i.e. narrative);
- **'In pairs,** I would like you to help each other **jump** (i.e. lesson objective)**;**
- '**In pairs**, I would like you to help each other **jump** across the river avoiding the marshes' (i.e. narrative and lesson objective.

Observer note. The same relationships can occur on multiple occasions throughout the lessons or across quarters, as long as you observe the children working together.

- **Rules:** *Rules of the activities are explained.* Teacher explains the necessary rules that are relevant and authentic for the lesson objective so that students understand what they are required to do during the activity to participate. Any rule changes during the lesson/activity should align with and be contextualised within the narrative (Werbach and Hunter, 2015).

Examples can include:

- 'The commander would like you to bring the items to the white house using throwing and catching' ***rule change*** 'Oh no, **the commander has spotted explosives. You will need to avoid the explosives** whilst throwing and catching the items'

- **Challenges:** *Students are provided with a range of challenges.* Teacher provides the students with a range of developmentally appropriate (i.e. meet the needs of the children and/or aligns with the respective age national physical education curriculum: UK [Department of Education, 2013][1] Australia[2], USA[3]) challenges to complete that are relevant and authentic to the lesson objective. The challenges provided by the teacher can include the following (list not exhaustive; Werbach and Hunter, 2015):
  A) Social: Teamwork, healthy competition
  B) Psychological: Adaptability, effort, motivation
  C) Physical: Motor competence (movement skills), physical activity
  D) Cognitive: Divergent thinking.

1 https://assets.publishing.service.gov.uk/media/5a7c4edfed915d3d0e87b801/PRIMARY_national_curriculum_-_Physical_education.pdf

2 https://www.australiancurriculum.edu.au/f-10-curriculum/health-and-physical-education/structure/

3 https://www.shapeamerica.org/standards/pe/new-pe-standards.aspx

- **Levels:** *Students have different skill levels to perform***.** Teacher provides the students with a range of developmentally appropriate levels (i.e. meet the needs of the children and/or aligns with the respective age national physical education curriculum) to perform that are relevant and authentic to the lesson objective (Fernandez-Rio et al., 2022).

  Examples can include:

  Level one: ‘Jump with two feet’

  Level two: ‘Hop with one foot’

  Level three: ‘Hop with one foot, and land on two feet’

- **Feedback:** *Students are provided with feedback***.** Techer provides students with appropriate augmented feedback (feedback to help children understand how they did and how they can improve, based on information beyond what they directly perceive). Feedback can include:

  A) Social feedback: ‘That was great pass to Kyle, can you now try and pass to Ben’

  B) Psychological feedback: ‘You didn’t get it this time, but that’s okay! The more you practice, the better you'll get’

  C) Physical feedback: ‘When you jump, try and touch for the sky’

  D) Cognitive feedback: ‘When you throw the ball, think about stepping with your opposite foot and following through with your arm. This will help you create more power and control in your throw’

- **Points:** *Students earn points***.** Teacher provides the students with opportunities that are relevant and authentic for the lesson objective to earn points and moves the lesson forward.

  Examples can include:

- ‘You are now playing for a plane ticket to Texas next week, in your teams I would like you to work together to get points for your plane ticket’

Observer note. During the lesson, points (i.e. house points [school behaviour strategy] may be awarded. These should not be coded as the points awarded should be relevant to the lesson objective.

Example of one observation:

SOG-PE RECORDING SHEET

Date: 09/02/2025 **Observers name: Jenna Rice**

Lesson duration: 47 minutes 43 seconds **Lesson content: agility (week 4)**

			Time			
			Q1 = 0-12.25	Q2 = 12.25 – 24. 50	Q3 =24.50 37.15	Q4 = 47.43
			0 = Never	1 = Rarely 2 = Occasionally	3 = Frequently	4 = Extensively
Gamification strategy (definition)	**Checklist item**	**Description**				
Narrative (On-going storyline throughout the lesson that provides context and meaning to the activities)	There is a clear narrative *(Fernandez-Rio et al., 2022)*	Teacher delivers a clear narrative to the students at the start of the activity/lesson with the aim of contextualising the activities within the lesson (example A). Teacher provides the students with clear achievements that are represented in a milestone in the storyline at the end of the activity/lesson (example B). ***Example A:*** ‘A storm is coming; I would like you to keep your body low to the ground whilst moving the items’ **Example B:** ‘Well done the mayor is happy with how you practiced your capturing skills; he is now sending you to capture the prisoners’.	0 1 2 3 **4**	0 1 2 **3** 4	0 1 **2** 3 4	0 1 2 **3** 4
Relationships (the interactions fostered between the students)	Students are provided with a range of interactions with peers *(Werbach and Hunter, 2015)*	Teacher provides the students with a range of different opportunities for interaction that are relevant and authentic for the narrative and/or the lesson objective. **Example:** Working against another team, working in a team, pairs, groups of 3/4/5/6/7, whole class. *Note.* The same relationships can occur on multiple occasions if they are working together.	0 1 **2** 3 4	0 1 2 3 **4**	0 1 2 **3** 4	0 1 2 3 **4**
Rules (guidelines that govern how an activity is played)	Rules of the activities are explained *(Werbach and Hunter, 2015)*	Teacher explains the necessary rules that are relevant and authentic for the lesson objective, so that students understand what they are required to do during the activity to participate. ***Example:*** ‘half of your team will stand down one side of the bridge, and the other half will stand down the other. In your teams I would like you to transport the luggage down the bridge using an over-head throw’	0 1 2 **3** 4	0 1 2 **3** 4	0 1 2 **3** 4	0 1 2 **3** 4
Challenges (Specific tasks or objectives that participants must accomplish)	Students are provided with a range of challenges. *(Werbach and Hunter, 2015)*	Teacher provides the students with a range of developmentally appropriate challenges to complete that are relevant and authentic to the lesson objective. The challenges provided by the teacher can include any of the following (below list is not exhaustive): Social = teamwork, healthy competition Psychological = adaptability, effort, motivation Physical = Motor competence (movement skills), physical activity Cognitive = divergent thinking, perceived competence	0 1 **2** 3 4	0 **1** 2 3 4	0 1 2 **3** 4	0 1 2 **3** 4
Levels (providing participants with new levels as they progress; incremental increases in difficulty that	Students have different skill levels to perform *(Fernandez-Rio et al., 2022)*	Teachers provide the students with a range of developmentally appropriate levels to preform that are relevant and authentic to the lesson objective.	0 1 2 3 **4**	0 **1** 2 3 4	0 **1** 2 3 4	0 **1** 2 3 4

2.2. General behaviours

In this dimension, the observer should record the general teacher and student behaviours during the lesson. At each quarter, a decision must be made about how the teacher and student behaves at that time. The observer must choose one code (0, 1, 2, 3, 4: for more information on the marking scheme see page 11).

The *behaviours* comprise of the following variables:

- **Behaviour management:** *Teacher taking action to resolve negative student behaviour***.** Teacher re-directs and guides students back to the activity with specific prompts (i.e. verbal reminders, signals/cue, redirecting with a question, positive reinforcement with redirection, clarifying expectations, repeating instructions) to help refocus attention and teacher takes time to talk to students exhibiting disruptive behaviours (Moon et al., 2023). The opposite would be if the teacher allowed for disruptive behaviours.

Examples can include:

- 'What part of the activity should we be working on right now?'
- 'Remember, we are throwing over-arm'
- 'Can you work together and keep each other focused. Can you remind your partner/team member what the next step is'.

Observer note. If you do not observe behaviour management from the teacher, and no disruptive/off task behaviour from the students, code this specific quarter as a 4.

- **Disruptive behaviours:** *Students display disruptive behaviours***.** Students display disruptive actions or attitudes. The opposite would be the case if no students display disruptive behaviours. Disruptive actions or attitudes can include the following (Mahzan Awang et al., 2022):

A) Interrupting the teacher or peers while they are speaking.

B) Physical behaviours, like pushing, shoving or fighting with peers.

C) Openly challenging authority, refusing to follow instructions or arguing with teachers and peers

D) Disrupting activities (taking equiptment of other teams when this is not been asked of them)

- **Children off task.** *Children off task.* One or more children are not engaged in the activity that is presented by the teacher (Weaver et al., 2016; Crotti et al., 2021). Counterexamples would be if all children were engaged in the activity presented by the teacher. Off task behaviours can include the following:

  A) Not taking part in the activity provided by the teacher but does not disrupt anyone else.

  B) Engaged in an activity that is different from the one that the teacher provided.

Example of one observation:

Behaviours	Checklist item	Description				
Behaviour management (ability to manage the students behaviour)	Teacher taking action to resolve negative student behaviours. *(Moon et al., 2023)*	• Teacher re-directs and guides students back to the activity with specific prompts to help refocus attention. • Teacher takes time to talk to students exhibiting disruptive behaviour	0 1 2 3 **4**	0 1 2 3 **4**	0 1 2 **3** 4	0 1 2 3 **4**
Disruptive (RC) (Actions or attitudes that interrupt, disturb or negatively impact the learning environment) (reverse code)	Students display disruptive behaviours. *(Mahzan Awang et al., 2022)*	Student display disruptive actions or attitudes. Example: • Interrupting the teacher or peers while they are speaking. • Physical behaviours like pushing, shoving or fighting with peers. • Openly challenging authority, refusing to follow instructions or arguing with teachers and peers. • Disrupting activities.	**0** 1 2 3 4	**0** 1 2 3 4	**0** 1 2 3 4	**0** 1 2 3 4
Children off task (RC)	Children off task *(Mellado-Berenguer and Monfort-Pañego, 2024; Crotti et al. 2021)*	One or more children are not engaged in the activity that is presented by the teacher. Example: • Not taking part in the activity provided by teacher but does not disrupt anyone else. • Engaged in an activity that is different from the one that the teacher provided.	**0** 1 2 3 4	0 **1** 2 3 4	0 **1** 2 3 4	0 **1** 2 3 4

3. Data collection technique in the SOG-PE

The SOG-PE is designed for use with video recordings. The video duration should be segmented into four parts. For example, a 44-minute video / 4 = 11 minutes. Ideally, the observed should make notes during each segment to remind themselves on what has been implemented, and then decided on the **frequency** and **quality.** The video should be paused following each segment (n = 4) regardless of what is going on. The coder should then spend time deciding on a code for each gamification strategy and general behaviours observed in that segment before moving on to the next quarter. The observer should only record gamification strategies and behaviours that can be directly observed and should avoid inferences or deductions that are not obvious. An illustrative example of the use of SOTC-PE is as follows. The PE teacher begins explaining an activity/lesson, the observer should observe this until the first quarter time has elapsed. At the end of each quarter, the observer should record the gamification strategies and behaviours observed.

4. Coding sheet

The SOG-PE coding sheet is presented below.

SOG-PE RECORDING SHEET

Date: **Observers name:**

Lesson duration: **Lesson content:**

			Time			
			Q1 =	Q2 =	Q3 =	Q4 =
			0 = Never 1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
Gamification strategy (definition)	**Checklist item**	**Description**				
Narrative (On-going storyline throughout the lesson that provides context and meaning to the activities)	There is a clear narrative *(Fernandez-Rio et al., 2022)*	Teacher delivers a clear narrative to the students at the start of the activity/lesson with the aim of contextualising the activities within the lesson (example A). Teacher provides the students with clear achievements that are represented in a milestone in the storyline at the end of the activity/lesson (example B). ***Example A:*** 'A storm is coming; I would like you to keep your body low to the ground whilst moving the items' **Example B:** 'Well done the mayor is happy with how you practiced your capturing skills; he is now sending you to capture the prisoners'.	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4
Relationships (the interactions fostered between the students)	Students are provided with a range of interactions with peers *(Werbach and Hunter, 2015)*	Teacher provides the students with a range of different opportunities for interaction that are relevant and authentic for the narrative and/or the lesson objective. **Example:** Working against another team, working in a team, pairs, groups of 3/4/5/6/7, whole class. *Note*. The same relationships can occur on multiple occasions if they are working together.	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4

<table>
<tr><td rowspan="3" colspan="3"></td><td colspan="4">Time</td></tr>
<tr><td>Q1 =</td><td>Q2 =</td><td>Q3 =</td><td>Q4 =</td></tr>
<tr><td colspan="4">0 = Never; 1 = Rarely; 2 = Occasionally; 3 = Frequently; 4 = Extensively</td></tr>
<tr><td>Rules
(guidelines that govern how an activity is played)</td><td>Rules of the activities are explained
(Werbach and Hunter, 2015)</td><td>Teacher explains the necessary rules that are relevant and authentic for the lesson objective, so that students understand what they are required to do during the activity to participate.

Example: ‘half of your team will stand down one side of the bridge, and the other half will stand down the other. In your teams I would like you to transport the luggage down the bridge using an over-head throw’</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td></tr>
<tr><td>Challenges
(Specific tasks or objectives that participants must accomplish)</td><td>Students are provided with a range of challenges.
(Werbach and Hunter, 2015)</td><td>Teacher provides the students with a range of developmentally appropriate challenges to complete that are relevant and authentic to the lesson objective. The challenges provided by the teacher can include any of the following (below list is not exhaustive):
Social = teamwork, healthy competition
Psychological = adaptability, effort, motivation
Physical = Motor competence (movement skills), physical activity
Cognitive = divergent thinking, perceived competence</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td></tr>
<tr><td>Levels
(providing participants with new levels as they progress; incremental increases in difficulty that means participants are never overwhelmed)</td><td>Students have different skill levels to perform
(Fernandez-Rio et al., 2022)</td><td>Teachers provide the students with a range of developmentally appropriate levels to preform that are relevant and authentic to the lesson objective.</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td></tr>
<tr><td>Feedback
(allows participants to recognise how they are doing and to initiate further activities)</td><td>Students are provided with feedback
(Werbach and Hunter, 2015)</td><td>Teacher provides students with appropriate augmented feedback. Feedback can include:

Social feedback. E.g. ‘you did a great job encouraging your teammates during the activity’
Psychological feedback. E.g. ‘even when things got tough, you didn’t give up’</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td><td>0 1 2 3 4</td></tr>
</table>

			Time			
			Q1 =	Q2 =	Q3 =	Q4 =
			0 = Never 1 = Rarely 2 = Occasionally 3 = Frequently 4 = Extensively			
		Physical feedback. E.g. ‘your passing technique has improved. Make sure you are following through with your foot to ensure greater accuracy and power in your passes’ ***Cognitive feedback***. E.g. ‘I liked how you made quick but accurate decisions’				
Points (given and accumulated during the activity that allows for progression)	Students earn points *(Fernandez-Rio et al., 2022)*	Teachers provide the students with the opportunities that are relevant and authentic for the lesson objective to earn points that moves the lesson forward. Example: Well-done, everyone. You have all gained enough points to ride the helicopter. Next week we will be heading to the capital!	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4
Behaviours	**Checklist item**	**Description**				
Behaviour management (ability to manage the students behaviour)	Teacher taking action to resolve negative student behaviours. *(Moon et al., 2023)*	• Teacher re-directs and guides students back to the activity with specific prompts to help refocus attention. • Teacher takes time to talk to students exhibiting disruptive behaviour	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4
Disruptive (RC) (Actions or attitudes that interrupt, disturb or negatively impact the learning environment) (reverse code)	Students display disruptive behaviours. *(Mahzan Awang et al., 2022)*	Student display disruptive actions or attitudes. Example: • Interrupting the teacher or peers while they are speaking. • Physical behaviours like pushing, shoving or fighting with peers. • Openly challenging authority, refusing to follow instructions or arguing with teachers and peers. • Disrupting activities.	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4
Children off task (RC)	Children off task *(Mellado-Berenguer and Monfort-Pañego, 2024; Crotti et al. 2021)*	One or more children are not engaged in the activity that is presented by the teacher. Example: • Not taking part in the activity provided by teacher but does not disrupt anyone else.	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4

<table>
<tr><td colspan="3" rowspan="3"></td><td colspan="5">Time</td></tr>
<tr><td>Q1 =</td><td>Q2 =</td><td>Q3 =</td><td colspan="2">Q4 =</td></tr>
<tr><td>0 = Never</td><td>1 = Rarely</td><td>2 = Occasionally</td><td>3 = Frequently</td><td>4 = Extensively</td></tr>
<tr><td></td><td></td><td>• Engaged in an activity that is different from the one that the teacher provided.</td><td></td><td></td><td></td><td colspan="2"></td></tr>
</table>

1. Marking scheme

The observer must make a decision on how the teacher has delivered the gamification strategy based on the **frequency** and **quality**. If the teacher achieves ***all*** for 0,1, 2, 3, 4, of the guidance outlined the marking scheme, then the score is met. Examples are presented below on how this could be achieved.

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
Narrative	The teacher **never** introduces a clear narrative, and so there is no contextualisation of the activities. There are no clear	The teacher **rarely** attempts to provide a narrative, it is unclear or under-developed and so the activities are rarely contextualised. The achievements or milestones are vague or infrequently mentioned.	The teacher **occasionally** introduces a narrative. However, this narrative might not always be fully clear or consistent but does provide some context for the activities. The achievements or milestones may not	The teacher **frequently** provides a clear narrative. The activities are usually contextualised to the wider narrative. The achievements or milestones are explicit and developed.	The teacher **extensively** provides a clear and engaging narrative The activities and equipment are thoroughly contextualised within a well-defined storyline. The achievements or milestones are clearly identifiable. **Example:** 'You have landed in New York, today you

Component	**0 = Never**	**1 = Rarely**	**2 = Occasionally**	**3 = Frequently**	**4 = Extensively**
	achievements or milestones at any point.	**Example:** 'Your first mission is to move the luggage' but there is little to no further explanation of how unloading the luggage contexts to the story.	always be explicit or fully developed. **Example:** 'Today you start your adventure, your first mission is to unload your luggage'.	**Example:** 'Today you started your adventure, your first mission is to unload your luggage from the aeroplane in your teams'	started your adventure. Your first mission is to unload your luggage from aeroplane by throwing and catching it in your teams'
Relationships	The teacher **never** provides any opportunities for student interaction.	The teacher **rarely** provides opportunities for student interaction. The interactions may loosely connect to the lesson narrative or	The teacher **occasionally** provides opportunities for student interaction. The interactions are partially relevant to the lesson	The teacher **frequently** provides opportunities for student interaction. The interactions are relevant to the lesson narrative and/or objectives.	The teacher **extensively** provides opportunities for student interaction. The interactions are clearly relevant to the lesson narrative and objectives.

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
		objectives, or not at all. **Example:** 'I would like you to work in pairs'. The children have been given the opportunity to pair up, but is not clear as to why.	narrative and/or objectives. **Example:** 'I would like you to work in pairs to jump'.	**Example:** 'I would like you to work with a partner to try and jump across' and/ or 'I would like you to work with a partner to get across the river'	**Example:** "I would like you to work with a partner to try and jump across the river' and 'I would like you to work in three's to jump across the river'
Rules	The teacher **never** explains the rules to the students.	The teacher **rarely** explains the rules. The rules are not always relevant or clear in relation to the lesson	The teacher **occasionally** explains the rules. The rules may be partially relevant to the lesson objective	The teacher **frequently** explains the rules. The rules are relevant to the lesson objective and narrative. Any rule	The teacher **extensively** explains the rules. The rules are clearly relevant to the lesson objective and narrative. Any rules changes

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
		objective and/or narrative. Any rule changes are not connected to the lesson objective and/or narrative. **Example:** 'We need to get some supplies. You need to start jogging or walking'	and/or narrative. Any rule changes are explained and partially relevant to the lesson objective and/or narrative. **Example:** 'We need to get some supplies. The commander would like you to start by jogging or walking. Listen out for the instructions'	changes are explained and relevant to the lesson objective and narrative. **Example:** 'The Whitehouse is under attack, so we need to get some supplies for the army. The commander would like you to start by jogging or walking around Washington. Listen out for the instructions'	are clearly explained and relevant to the lesson objective and narrative. **Example:** 'The president needs your help. The Whitehouse is under attack, so we need to get some supplies for the army. The commander would like you to start by jogging or walking around Washington. Listen out for the commanders' instructions'

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
Challenges	The teacher **never** provides any challenges for the students.	The teacher **rarely** provides any challenges. The challenges are not always developmentally appropriate. The challenges are not relevant to the lesson objective and/or narrative. **Example:** 'Challenge: Dribble the basketball'	The teacher **occasionally** provides challenges. The challenges are developmentally appropriate. The challenges partially relevant to the lesson objective and/or narrative. **Example:** 'Challenge 1: Dribble the basketball' and 'challenge 2: Dribbling	The teacher **frequently** provides challenges. The challenges are developmentally appropriate. The challenges are relevant to the lesson objective and/or narrative. **Example:** 'Challenge 1: Dribbling the basketball and avoiding things' and 'Challenge 2: Dribbling the basketball, with one hand avoiding things'	The teacher **extensively** provides challenges. The challenges are developmentally appropriate. The challenges are clearly relevant to the lesson objective and narrative. **Example:** 'Challenge 1: Dribbling the basketball forward and avoiding the explosives' and 'Challenge 2: Dribbling the basketball, with one hand forward avoiding the explosives' and

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
			the basketball with one hand’		‘Challenge 3: Dribbling the basketball whilst swapping hands, avoiding the explosives.
Levels Observer note. The teacher may refer the levels as ‘grade’, ‘rank’, ‘stage’, ‘class’. This is okay, as	The teacher **never** explicitly provides any levels for the students.	The teacher **rarely** explicitly provides any levels. The levels are not always developmentally appropriate. The levels are not relevant to the lesson objective and/or narrative.	The teacher **occasionally** and explicitly provides levels. The levels are developmentally appropriate. The levels partially relevant to the lesson objective and/or narrative.	The teacher **frequently** and explicitly provides levels. The levels are developmentally appropriate. The levels are relevant to the lesson objective and/or narrative. **Example:** We are going to practice throwing large	The teacher **extensively** and explicitly provides levels. The levels are developmentally appropriate. The levels are clearly relevant to the lesson objective and narrative. **Example:** We are going to practice throwing large snowballs: ‘Level 1: throw

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
long as they are explicitly stated.		**Example:** 'Level 1: throw and catch'	**Example:** 'Level 1: throw and catch', 'Level 2: step back and throw'	balls 'Level 1: throw and catch', 'Level 2: take a step back and throw and catch the ball'	and catch the snowball with two hands', 'Level 2: take a step back and throw and catch the snowball', 'Level 3: Throw and catch the snowball in the air'
Feedback	The teacher **never** provides feedback.	The teacher **rarely** provides feedback. The feedback is not always relevant and/or clear. The feedback is not connected to the lesson objective.	The teacher **occasionally** provides feedback. The feedback may be partially relevant and/or clear. The feedback is explained and partially relevant to the lesson objective.	The teacher **frequently** provides feedback. The feedback is relevant and/or clear. The feedback is explained and relevant to the lesson objective.	The teacher **extensively** provides feedback. The feedback is relevant and clear. The feedback is clearly explained and relevant to the lesson objective. **Example:** 'Well done on your throwing and catching

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
		Example: ‘Well done’. This may only be rarely said.	**Example:** ‘Well done on your throw and catch’.	**Example:** ‘Well done on your throwing and catching of the snowballs’	of the snowballs, could you try a bigger/smaller snowball this time?’
Points	The teacher **never** provides opportunities for students to earn points.	The teacher **rarely** provides opportunities for students to earn points. The opportunities to earn points are not always relevant and clear in relation to the lesson	The teacher **occasionally** provides opportunities for students to earn points. The opportunities to earn points may be partially relevant to the lesson objective and/or narrative.	The teacher **frequently** provides opportunities for students to earn points. The opportunities to earn points are relevant to the lesson objective and narrative.	The teacher **consistently** provides opportunities for students to earn points. The opportunities to earn points are clearly relevant to the lesson objective and narrative.

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
		objective/ and or narrative. **Example:** You need to collect points in your team	**Example:** You need to collect points in your team to earn a ticket next week.	**Example:** For every team member that makes it back before all the balls are back you get a point. These points will be transferred into plane tickets. There are 4 to play for.	**Example:** For every team member that makes it back before all the balls are back you get a point. These points will be transferred into plane tickets. There are 4 to play for.
Behaviour management	The teacher **never** attempts to address or resolve negative	The teacher **rarely** attempts to address and/or resolve negative student behaviours.	The teacher **occasionally** attempts to address and/or resolve negative behaviours.	The teacher **frequently** attempts to address and/or resolve negative behaviours.	The teacher **extensively** attempts to address and/or resolve negative behaviours.

Component	0 = Never	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Extensively
	student behaviours.				
Disruptive behaviours	Students **never** display disruptive actions or attitudes.	Students **rarely** display disruptive actions or attitudes.	Students **occasionally** display disruptive actions or attitudes.	Students **frequently** display disruptive actions or attitudes.	Students **extensively** display disruptive actions or attitudes.
Children off task	Students are **never** off task.	Students **rarely** become off-task during activities presented by the teacher.	Students **occasionally** become off-task during activities presented by the teacher.	Students **frequently** become off-task during activities presented by the teacher.	Students **extensively** become off-task during activities presented by the teacher.

5. Data analyse

For the gamification strategy dimension of SOG-PE, implementation fidelity can range from 0 – 122, with higher scores reflecting higher implementation fidelity. For each gamification strategy, implementation can range from 0-16. For the behaviour dimension of SOG-PE ***students display disruptive behaviours*** and ***children off*** task are reverse coded (0 = 5, 1 = 3, 2 = 2, 3 = 1, 5 = 0) with lower scores reflecting higher implementation fidelity. For ***behaviour management*** higher scores reflect higher implementation fidelity.

Appendix F: Pilot acceptability questionnaires

A. Child acceptability Questionnaires

Thank you for taking part in the gamified PE lessons. We would like to hear how they went for you. All statements are about the **gamified PE lessons**. Please read each statement and tell us how much you agree with it.

	Disagree completely.	Disagree	Neither agree nor	Agree	Agree completely.
(1) I enjoyed taking part.	1	2	3	4	5
(2) I liked the narrative/theme.	1	2	3	4	5
(3) I looked forward to taking part.	1	2	3	4	5
(4) The activities were fun.	1	2	3	4	5
(5) I would recommend the lessons to other children in other schools.	1	2	3	4	5
(6) The instructions given by my teacher were easy to follow.	1	2	3	4	5
(7) The rules of the activities were clear	1	2	3	4	5
(8) I knew what skill I was learning each week.	1	2	3	4	5
	1	2	3	4	5

	Disagree completely.	Disagree	Neither agree nor	Agree	Agree completely.
(9) I was more engaged in the gamified PE lessons compared to my usual PE lessons.					
(10) I participated more during the gamified PE lessons that I usually would	1	2	3	4	5
(11) Taking part in the lessons helped me to improve my movement skills.	1	2	3	4	5
(12) Taking part in the lessons helped me to improve my social and emotional skills.	1	2	3	4	5
(13) I felt confident taking part.	1	2	3	4	5

B. Teacher Acceptability Questionnaires

Feedback on the gamified PE curriculums

Thank you for delivering the gamified PE lessons. Please read each statement and tell us how much you agree with it. Please only **circle one** per statement. There is space underneath each statement to add additional comments to help us further understand your answer.

	Disagree completely.	Disagree	Neither agree nor	Agree	Agree completely.
(1) I enjoyed delivering the gamified PE lessons.	1	2	3	4	5
Comments: What did you enjoy?					
(2) I liked the theme/narrative of the curriculum	1	2	3	4	5
Comments: What did you like about it?					
(3) I looked forward to delivering the lessons.	1	2	3	4	5
Comments: was there a specific reason you did?					
(4) The activities were fun for the children.	1	2	3	4	5
Comments: what made them fun? If they were not fun, why not?					
(5) I would recommend the lessons to another teacher.	1	2	3	4	5
Comments					
(6) It required effort to deliver the gamified PE lessons	1	2	3	4	5
Comments: If anything, what was required?					
(7) It required time to set up the lessons.	1	2	3	4	5
Comments: what in particular took time?					
(8) It required effort to get through the content of each lesson	1	2	3	4	5
Comments:					

	Disagree completely.	Disagree	Neither agree nor	Agree	Agree completely.
(9) The gamified PE lessons aligned well with my personal values about PE.	1	2	3	4	5
Comments:					
(10) The gamified PE lessons aligned well with the school structure.	1	2	3	4	5
Comments:					
(11) The teaching resources were easy to use.	1	2	3	4	5
Comments: What made them easy to use? What was challenging about them?					
(12) The instructions were easy to follow.	1	2	3	4	5
Comments:					
(13) The activity rules were clear.	1	2	3	4	5
Comments:					
(14) I understood what skill I was delivering each week.	1	2	3	4	5
Comments:					
(15) The gamification strategies were easy to implement.	1	2	3	4	5
Comments: What made them easy to implement? Could you provide some examples of how they were implemented.					
(16) I saw an increased level of engagement	1	2	3	4	5

	Disagree completely.	Disagree	Neither agree nor	Agree	Agree completely.
Comments:					
(17) I saw an increased level of participation	1	2	3	4	5
Comments:					
(18) I saw an improvement in the children's movement skills during the intervention	1	2	3	4	5
Comments:					
(19) I saw an improvement in the children's social skills during the intervention.	1	2	3	4	5
Comments:					
(20) I felt confident delivering the lessons	1	2	3	4	5
Comments:					
(21) Whilst delivering the lessons, I felt confident implementing the gamification strategies.	1	2	3	4	5
Comments: was there a specific reason you did?					
(22) I feel confident that other teachers could deliver the gamified PE lessons.	1	2	3	4	5
Comments:					

	Disagree completely.	Disagree	Neither agree nor	Agree	Agree completely.

Appendix G: Focus group interview schedules for the children in the pilot study

Warm up	Q1: Can you tell me what this project was about. Q2: Can you tell me what happened during the gamified PE lessons? Q3: Can you tell me what you learnt during the gamified PE lessons? Q4: Can you tell me about what you did during the gamified PE lessons?
Affective Attitude: How an individual feels about the intervention, after taking part	Q1: Can you tell me what you enjoyed about the gamified PE lessons. Q2: Can you tell me something you enjoyed least about the gamified PE lessons. Q3: What would you change about the gamified PE lessons. Q4: Have you got any other comments about the gamified PE lessons. ***Prompts:*** *Can you tell me a little bit more? What was that like? Why did you like that? Why did you not like that?*
Burden: The amount of effort that was required to participate in the intervention	N/A
Perceived Effectiveness: The	The gamified PE lessons were designed to help children improve their movement, and social emotional skills. Movement skills are a

extent to which the intervention is perceived to have achieved its intended purpose	child's ability to do different physical movements, like running, jumping, catching, throwing and kicking. Social and emotional skills are how children understand what they are feeling and what to expect when interacting with others. Do you think the gamified PE lessons have helped improve your movement skills? **Prompt:** *if so, can you tell me a little bit more about why and how they have?* Do you think the gamified PE lessons have helped improve your social and emotional skills? **Prompt:** *if so, can you tell me a little bit more about why and how they have?* Do you think the gamified PE lessons were good for all children?
Intervention Coherence: The extent to which the participant understands the intervention and how it works	The PE lessons that your teacher have been delivering use gamification. Gamification is adding in different elements (like a story, levels, points, challenges, teamwork) to make the lesson more fun and engaging. Q1: Can you tell me the theme of your PE lessons. Q2: Can you remember how some of these elements were included in your PE lessons? **Prompt:** *can you tell me a little bit more? Can you give me an example of this in the lesson.*

	Q3: Do you think the gamification elements were clear in the curriculums? **Prompt:** *were there any specific gamification elements that were clearer in the lessons than others.* Q4: We think that gamification in PE could be good. What do you think? Why do you think this? Q5: Can you remember what skills you learnt during the gamified PE lessons? Q6: When your teacher was delivering the lessons, do you think the instructions were easy to follow, were the rules clear? **Prompt:** *can you tell me a little bit more about why you think that.*
Opportunity Cost: Experienced opportunity cost: The benefits, profits or values that were given up to engage in the intervention	N/A
Self-efficacy: The participant's confidence that they can perform the behaviour(s) required to participate in the intervention	How did you feel during the gamified PE lessons? **Prompt:** *why was that? Can you tell me more?*

Ethicality: The extent to which the intervention has good fit with an individual's value system	N/A

Appendix H: Semi-structured interview schedule for the teachers in the pilot study

Background of the teachers	Q1: Can you introduce yourself. Q2: Can you describe your current role. Q3: Can you describe your prior experiences of PE (either as a pupil, student, teacher or TA). Q4: What do you see the purpose of PE? Q5: What is your typical involvement in PE provision in the school Q6: How many years have you been teaching PE.
Context of the schools	Q1: How do you perceive PE in the schools Q2: Where does PE fit within year 5. Q3: How much time is devoted to PE within the school? Q4: How do other staff members perceive PE? Q5: How does your headteacher perceive PE?
Warm up.	Can you give me an overview about how the gamified PE lessons went. How many lessons did you deliver? How long did you deliver the lessons for? How many children participated in the lessons Can you describe any interesting events that occurred during the implementation? **Prompt:** approximately is ok.
Affective Attitude: How an individual feels about the intervention, after	Q1: Can you tell me how you felt about delivering the gamified PE lessons? Q2: Can you tell me how you feel about the gamified PE lessons in general. Q3: How appropriate were the lessons for the children?

taking part	***Prompts:*** *Were there any barriers to delivery? Were there any facilitators to delivery?*
Burden: The amount of effort that was required to participate in the intervention	Q1: do you feel like the gamified PE lessons required effort to participate in? Q2: Were there any unexpected issues during delivery of the gamified PE lessons? ***Prompt:*** *What were they?* *Did you experience any (other) burden(s) because of participating in the gamified PE lessons?*
Perceived Effectiveness: The extent to which the intervention is perceived to have achieved its intended purpose	Q1: Do you think the gamified PE curriculum has affected the children's movement skills? **Prompt:** *if so, what specifically was it that made it effective?* Q2: Do you think the gamified PE curriculums have affected the children's social and emotional skills? **Prompt:** *if so, what specifically was it that made it effective?* Q3: What do you think the strengths and weaknesses of the gamified PE lessons are? **Prompt:** Challenges, benefits, outcomes, social interactions, autonomy, competence, activity levels.
Intervention Coherence: The extent to which the participant understands the intervention and	The PE curriculums used gamification as a pedagogical model. Gamification is the use of game-like elements in non-gaming contexts and includes (state examples). Could you please describe how some of these were displayed in your curriculums.

how it works	**Prompt/additional Q:** *do you think the gamification strategies were easy to implement, and if so, then why? And if not, then why not.* Do you think the gamification strategies were clear in the curriculums? **Prompt:** *were there any specific gamification strategies that were more prominent in the curriculums than others.* We think that gamification in PE is promising approach. What do you think?
Self-efficacy: The participant's confidence that they can perform the behaviour(s) required to participate in the intervention	How confident were you that you could deliver the gamified PE lessons? **Prompt:** *did anything help you to feel more confident?* How confident do you think another teacher would feel about delivering the gamified PE lessons? **Prompt:** *is there any advice that you would give?*
Ethicality: The extent to which the intervention has good fit with an individual's value system	Do you think there are any issues about delivering gamified PE lessons in school? ***Prompt:*** *In what ways do you think schools would challenge or accept gamification in PE.*