Development of a teacher-oriented movement assessment tool for children aged 4-7 years

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Abstract

Children's competence in performing fundamental movement skills (FMS) is positively associated with physical activity levels, health-related fitness and healthier weight status. The early years of primary school provide a crucial platform for children to develop FMS. It has been recommended that teachers become more involved in assessing children's FMS so that they can subsequently support their development of these skills more effectively. However, there is a shortage of FMS assessment tools available for teachers to use within primary schools. To address this shortfall, this research programme was conducted to develop a movement assessment tool (MAT) for primary school teachers to assess the FMS of children aged 4-7 years old. Qualitative and quantitative research methods were implemented across four studies. In the initial three studies, the perspectives of primary school teachers and experts from the field of children's movement development and primary school Physical Education were sought to establish recommendations for the format of the MAT and to establish its content. Based on these findings, a prototype of the MAT was developed. In the final study, a Mixed-Methods Research design was implemented with primary school teachers to evaluate the feasibility of the MAT prototype being used in lesson time. Until now, there has been a paucity of literature discussing teacher-oriented assessment of children's FMS. Therefore, the original contribution to knowledge presented in this thesis is the detailed understanding of how teachers should assess young children's FMS in school settings. The findings of Study One signify that teachers perceive a need for a MAT that is simple to use, quick to administer, and that provides valuable feedback to guide future teaching and learning. In Study Two, three dichotomous dilemmas emerged from the data in relation to assessing children's FMS competence. These dilemmas relate to the intended purpose of the assessment, the nature of its implementation and the context that it will be used. Study Three established content validity for the movement tasks within the assessment of FMS for children aged 4-7 years. The findings of Study Four revealed that the MAT is feasible for teachers to implement within PE lessons and teachers reported improvements in their awareness of assessing children's FMS as a result of using the MAT. The overall findings present a MAT that allows primary school teachers to assess the FMS competence of children aged 4-7 years old within PE lessons. Considering the shortage of teacher-oriented MATs, this protocol may be attractive to teachers as it enables them to better understand and support children's development of FMS.

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Abbreviations

AfL	Assessment for Learning
AoL	Assessment of Learning
BOTMP-2	Bruininks-Oseretsky Test of Motor Proficiency- Second Edition
CAMSA	Canadian Assessment Movement Skill and Agility
CoP	Community of Practise
CPD	Continuing Professional Development
FMS	Fundamental movement skills
ITT	Initial Teacher Training
KTK	Körperkoordinationstest für Kinder
MABC-2	Movement Assessment Battery for Children – Second Edition
MAT	Movement assessment tool
MMR	Mixed-Methods Research
MOBAK	Motorische Basiskompetenzen
MVPA	Moderate-to-vigorous intensity physical activity
PA	Physical activity
PE	Physical Education
PETE	Physical Education Teacher Education
PLAY	Physical Literacy Assessment for Youth
TGMD-2	Test of Gross Motor Development – Second Edition
UK	United Kingdom
YST	Youth Sport Trust

CHAPTER 1

INTRODUCTION TO THE THESIS

Chapter 1: Introduction to the thesis

1.1 Background and context to this research programme

Fundamental movement skills (FMS) are the foundation of more complex skills and movement patterns used within organised and non-organised games and sports (Hands, 2012; Barnett, Stodden et al., 2016). FMS are considered to play an important role in the physical and social development of children into adolescence and through to young adulthood (Clark & Metcalfe, 2002; Gallahue, Ozmun & Goodway, 2012). Defined by Clark (1994) as gross motor skills involving the arms, legs and trunk, FMS are further classified into three sub-categories of skills: stability (e.g. one leg balance, walk along a beam), object control (e.g. overhand throwing, kicking a ball) and locomotor (e.g. running, hopping, skipping) (Gallahue et al., 2012). Children have the physical and psychological attributes to develop FMS by the age of seven years old (Gallahue et al., 2012), with early-mid childhood considered a critical period to practise and become competent in performing these skills (Payne & Isaacs, 2011). However, research conducted in the United Kingdom (UK) (Bryant, Duncan & Birch, 2015; Foulkes et al., 2015; Foweather et al., 2015; Morley et al., 2015) and globally (Barnett et al., 2009; Hardy et al., 2010; Hardy et al., 2012; Lopes et al., 2012; De Meester et al., 2016) has demonstrated that many children have low levels of FMS competency and, in some cases, are reaching adolescence with poor FMS, making it difficult to develop more advanced and sport-specific skills (Hardy et al., 2012; O'Brien, Belton, and Issartel, 2016).

Seefeldt (1980) indicated that children who do not reach a competent level in performing FMS (termed "proficiency barrier") would be prevented or discouraged to participate in PA. A recent study (De Meester et al., 2018) in which 90% of children with below average FMS competence did not meet PA guidelines, provides evidence to support Seefeldt's (1980) hypothesis. This relationship between FMS competence and PA is illustrated in a theoretical model presented by Stodden et al. (2008) that suggests a

synergistic positive association between children's FMS competence, physical activity (PA) and health-related fitness, and an inverse association with healthy weight status (See Figure 1.1).

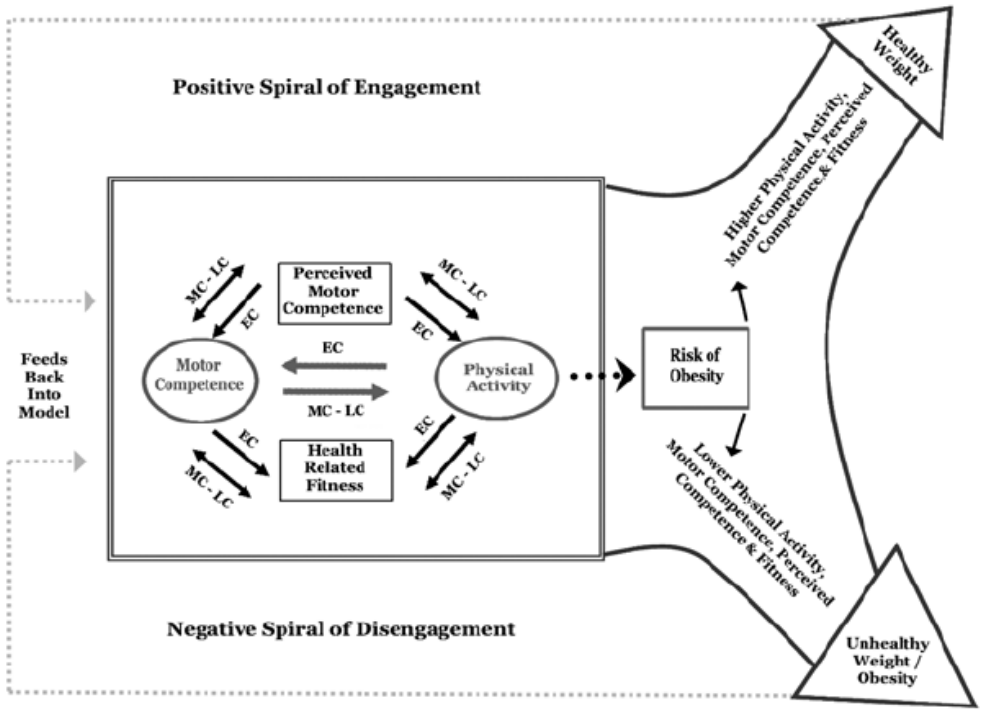


Figure 1.1: Developmental model proposed by Stodden et al. (2008) hypothesising developmental relationships between movement competence, health-related physical fitness, perceived movement competence, physical activity, and risk of obesity

In recent years, a number of systematic reviews have evidenced that children with higher levels of FMS are more physically active within childhood and later in life (Lubans, et al., 2010; Logan et al., 2015; Barnett, Lai et al., 2016b; Cattuzzo et al., 2016). Furthermore, it has been suggested that children's competence in performing FMS is positively associated with higher fitness levels (Booth & Patterson, 2001; Barnett et al., 2008, Haga, 2008; Hardy et al., 2012) and lower levels of obesity in childhood and adolescence (Williams et al., 2008; Stodden, Langendorfer & Roberton, 2009; Lubans et al. 2010; Hills, Andersen & Byrne, 2011; Slotte et al., 2015). In addition to physical

benefits, there is also evidence associating higher levels of FMS competence with improved academic performance (Lopes et al., 2013; Jaakkola et al., 2015). A comprehensive review (Robinson et al., 2015) covering literature published since 2008 found substantial evidence to support the model proposed by Stodden et al. (2008), suggesting that children's competence in FMS is positively associated with increased PA levels, health-related fitness and maintaining healthy weight. Thus, demonstrating the likely existence of Seefeldt's "proficiency barrier' and emphasising that a focus should be placed on developing FMS competence from early childhood to equip children with the skills to be physically active during childhood and into adolescence.

One of the visions for the legacy of the London 2012 Olympics was to provide more opportunities for children to take part in sport and be active (HM Government, 2012). This was an important step, as up until then, the PA levels of children at all ages within the UK fell below public health guidelines (Department for Health, 2011; Hallal et al., 2012). The Department for Health (2011) recommend that children under five years should be physically active for up to three hours a day, while children aged 5-18 years are to engage in moderate-to-vigorous intensity physical activity (MVPA) for at least 60 minutes every day. Despite PA guidelines being widely publicised to professional organisations, schools, health authorities and the public (Change4Life, 2017), PA levels of children in the UK remain in decline compared to previous generations (British Heart Foundation, 2015; Jago et al., 2017). Of note, a study examining PA of children in the UK (Griffiths et al., 2013) reported that in 2013 only 50% of 7 year olds met the recommended guidelines of completing 60 minutes of PA per day. This is alarming considering the correlations between PA, health-related fitness and maintaining healthy body weight (Stodden et al., 2008; Robinson et al., 2015). Also, there is evidence to suggest that physical inactivity during childhood is likely to progress through adolescence and into adulthood (Barnett et al., 2009; Belton et al., 2016). Within the UK, physical

inactivity is responsible for 1 in 6 deaths (Department for Health, 2011) and causes an increased risk of obesity and other health related problems (Department for Health, 2011; Lee et al., 2012). Physical inactivity does not only come at the expense of the health of the nation's population. The economic impact of physical inactivity within the UK is estimated to be £5.1 billion annually (Scarborough et al., 2011), with the overall cost to society rising to £27 billion (McKinsey Global Institute, 2014).

This is clearly an unsustainable problem that requires attention and considering the predicament of children's PA, it is understandable why multi-sector emphasis has been placed on schools, health providers and families in the UK to reverse this trend of declining PA and increasing obesity levels during childhood (Department for Health, 2016; Change4Life, 2017). This has included a greater emphasis from Government on Physical Education (PE) provision in primary schools with the introduction of PE and Sport premium funding allocated to schools to spend solely on "additional and sustainable improvements to the quality of PE" (Department for Education, 2018). Whilst the National Curriculum for PE in the UK has undergone a number of minor modifications since its inception in 1992, what has remained constant is the focus on children's movement competence, most typically couched under the auspices of activities such as games, gymnastics, dance and outdoor and adventurous activities. In the most recent PE curriculum for the UK (Department for Education, 2013), the emphasis on movement is obvious, where 'pupils should develop fundamental movement skills, become increasingly competent and confident and access a broad range of opportunities to extend their agility, balance and coordination, individually and with others' by teaching pupils to 'master basic movements including running, jumping, throwing and catching, as well as developing balance, agility and co-ordination'. Concentrating on the development of FMS competence within PE during early childhood is reflected in curriculum guidelines globally (Ontario Ministry of Education, 2015; Australian Curriculum, Assessment and

Reporting Authority, 2016; Society of Health and Physical Educators America, 2016) and the importance of children's movement development is articulated within the domain of physical literacy (Youth Sport Trust, 2013; Canada Sport for Life, 2016). Whitehead (2013) defined physical literacy as 'the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life'. Considering this definition, the main area of focus for this study was 'physical competence' as manifested through a child's FMS competence and specifically how best to assess children's FMS competence.

Morgan et al. (2013) suggest that teachers play an important role in providing an optimal environment for young children to learn and acquire FMS. In response, a one-day teacher training intervention, BUPA 'Start to Move', has been delivered by the Youth Sport Trust (YST) to over 4000 primary teachers in the UK since 2011. Start to Move aims to equip teachers with the confidence and competence to develop children's FMS in Key Stage 1 (4-7 years old). An evaluation of the BUPA 'Start to Move' intervention (Youth Sport Trust, 2016), recommended that primary teachers should become more involved in assessing children's FMS. Providing teachers with an assessment that enables them to measure, track and monitor children's FMS competence could subsequently allow them to better support their development (Morley et al., 2015) and facilitate the introduction of curriculum guidance and interventions (Lopes et al., 2011).

At secondary school, PE is delivered by specialist PE teachers, who are required to complete a minimum of one-year specialist study to teach PE. However, typically, PE in primary schools is taught by generalist teachers, responsible for teaching all subject areas. Worryingly, these teachers typically only receive an average of six hours of PE specific training during their teacher-training courses (Youth Sport Trust, 2016). Subsequently, assessment in primary PE is often sporadic and highly dependent on the differing competence and confidence of the class teacher (Morgan & Bourke, 2008;

Harris, Cale & Musson, 2011; Ní Chróinín & Cosgrave, 2013). A recent report conducted with schools in the UK, suggests that just 1% of schools formally measure children's FMS (UK Active, 2015). There is limited evidence to indicate why assessment of FMS in schools is so low, although conclusions can be drawn from the negative perceptions of teachers of assessing within PE (James, Griffin & France, 2005; Morgan & Bourke, 2008; Harris et al., 2011; Ní Chróinín & Cosgrave, 2013;) and the limitations of existing FMS assessments for use by teachers (Cools et al., 2008; Giblin, Collins and Button, 2014). Furthermore, the significance placed on other subjects lifts their level of priority over spending time on specific PE assessment (Harris, Cale & Musson, 2012).

During my previous employment as a primary school teacher from 2011-2015, I gained first-hand experience of teachers relying on resources and support from more experienced and knowledgeable colleagues with no quality assessment or statutory monitoring within PE taking place. Instead, children's overall attainment in PE was reported to parents at the end of the school year based on informal judgements. There was no regular, structured monitoring process, similar to that which occurs in other subject such as, numeracy or literacy. The lack of such statutory guidance and appropriate levels of teacher training for primary teachers in PE suggests that the mode and frequency of assessment in PE will be highly variable, resulting in significant differences across schools, regions and the nation as a whole.

Providing teachers with appropriate resources and tools that they can incorporate within their curriculum delivery are likely to require planning and understanding of what is appropriate for teachers. A recent systematic review by Tompsett et al. (2017) highlighted that PE based FMS interventions were most successful when specialist PE teachers were involved in the delivery. However, as primary PE in the UK is typically taught by generalist teachers, who are not PE specialists, it is recommended that pedagogical design and delivery of PE based FMS interventions should consider the

needs and specialism of the teachers (Tompsett et al., 2017). To improve the quality of FMS assessment and increase learning opportunities, Lander et al. (2015) recommended FMS assessments be designed considering the specific settings and level of understanding of the teachers.

In response to the unique challenges and environment that primary teachers contend with, it has been suggested that technology can be used to better support teachers' subject knowledge and application of teaching within PE (Graham, Holt/Hale & Parker, 2013; Giblin et al., 2014; Haynes & Miller, 2015). Giblin et al. (2014) suggest that a future direction of assessing children's FMS competence should involve modern technology, such as motion capture systems (e.g. Microsoft Kinect, Nintendo Wii). As yet, this technology has not been implemented within teacher-oriented FMS assessments, possibly as a result of the financial costs associated with the purchase and set up of appropriate equipment, as were outlined in a study that trialled using digital technology to assess skills-based performance with 15-18 year olds (Penney et al., 2012). Taking an alternative view to how technology could assist in school-based assessment of FMS, Haynes and Miller (2015) highlighted the potential benefits of teachers using hand-held devices (e.g tablets and mobile phones) to assess and analyse performance. These hand-held devices provide several potentially advantageous functions to teachers, such as *in situ* video recording and playback, as well as bespoke app-based tools. O'Loughlin, Chróinin and O'Grady (2013) have evidenced that video can be used to effectively assess primary aged children's skill performance in PE and that providing feedback from the video enhanced children's motivation and improved their skill performance. The use of app-based technology has been trialled in schools (Browne, 2015), with teachers indicating the advantages of using apps within their teaching of PE, including the value of hand held devices in recording and analysing children's performance. Therefore, the

development of app-based technology to assess FMS could be beneficial for primary teachers of PE.

1.2 Rationale for this research programme

As noted above, in May 2013, a team of researchers were commissioned by the YST to evaluate (Youth Sport Trust, 2016) the effectiveness of the BUPA 'Start to Move' teacher training intervention. The effectiveness of 'Start to Move' in improving children's FMS was evaluated using the Bruininks-Oseretsky Test of Motor Proficiency - Second Edition (BOTMP-2) (Bruininks & Bruininks, 2005). However, the report highlighted that this assessment was unsuitable for use by teachers with large groups of children in a school environment and recommended that an FMS assessment intended for teachers to use was needed. In a related study, Morley et al. (2015) suggested that assessing FMS would support teachers' to better understand children's FMS competence, enabling them to deliver a more personalised, differentiated approach to better support their development. The BUPA 'Start to Move' evaluation (Youth Sport Trust, 2016) and subsequent recommendations led to the inception of this PhD research project and a programme of work to develop a teacher-oriented FMS assessment tool.

A request has previously been made for teachers to be included in the development of a FMS assessment (Cools et al., 2008) and there remains a lack of comprehensive and functional assessments of children's FMS currently available (Giblin et al., 2014; Robinson et al., 2015). The limitations of existing FMS assessments for use by teachers in school settings are well reported (Cools et al., 2008; Giblin et al., 2014). Traditional methods for assessing children's FMS were typically designed for physical therapists and researchers to measure movement deficiencies (Cools et al., 2008). The clinical process of these assessments does not suit the authentic teaching environment of a typical PE lesson, deeming them unsuitable for use by teachers of PE in a school setting (Giblin et al., 2014). Furthermore, the composition of existing assessments of FMS

competence, such as the BOTMP-2 (Bruininks & Bruininks, 2005) that assesses fine and gross motor control, leads to limited curricular validity for the PE curriculum of children aged 4-7 years old as they do not contain a component to assess competence of stability skills (Department for Education, 2013). The inclusion of a wide range of skills across existing assessments could be due to the initial purpose of each assessment and the context, and by whom, they are to be administered. For example, the Körperkoordinationstest für Kinder (KTK) (Schilling & Kiphard, 1974) was intended for health professionals to assess gross motor co-ordination, thus does not contain any object control component. Similarly, the intended purpose of the Test of Gross Motor Development (TGMD-2) (Ulrich, 2000) was to identify children who are significantly behind their peers in gross motor skill performance but does not include a component to measure stability. Tompsett et al. (2017) suggest that further investigation is required to define the format and content of a FMS assessment for primary school teachers to use. This planned programme of research seeks to work towards this, by establishing the format and content of a teacher-oriented FMS assessment for children aged 4-7 years old.

In recent years, a selection of FMS assessment tools have been developed with teachers and practitioners in mind as the assessor (Canadian Assessment Movement Skill and Agility [CAMSA]: Longmuir et al., 2015; Motorische Basiskompetenzen [MOBAK]: Herrmann, Gerlach and Seeling, 2015). The CAMSA is intended for children aged 8-14 years and requires children to complete a movement-based course including seven skills that reflect 'real world' abilities. The CAMSA is feasible, reliable and valid for use by secondary school teachers of Year 7 girls PE (Lander et al., 2016; Lander et al., 2017). However, the feasibility and reliability of the protocol when administered by non-specialist teachers of PE in primary schools has not yet been examined. Furthermore, the CAMSA's method of assessment, allowing only one child to be active at a time during the assessment process, poses a potential challenge for a primary teacher to conduct the

assessment whilst managing a class of children and is unlikely to be validated with early primary school aged children due to its level of difficulty. The MOBAK (Herrmann et al., 2015), an FMS assessment designed for teachers, aligns itself to the specifics of the primary PE curriculum, and reports to be a valid and appropriate FMS assessment tool suitable for teachers with children aged 6-7 years (Herrmann et al., 2015). Despite these claims, it is not clear whether the design and validation of the assessment involved consultation with teachers, thus there is little understanding of the appropriateness of the selected assessment method for primary school teachers who have limited PE training and subject understanding. Exploring the challenges and issues faced by teachers to assess FMS in a school setting and gaining their recommendations for their preferred method of assessment would assist in developing a feasible FMS assessment tool that teachers can implement during lesson time.

In summary, it has been recommended that a teacher-oriented assessment of children FMS be provided so that teachers can better understand, and subsequently support children's development of FMS. Existing FMS assessments are unsuitable for use by primary teachers, and up to now there has been limited examination of how teachers should assess and monitor children's FMS competence during lesson time (Cools et al., 2008). A future direction for teacher-oriented assessment could incorporate digital technology to enhance the teacher's application within PE as well as enrich children's learning with video recording and playback.

1.3 Significance of this study

The early years at primary school provide an ideal setting for children to acquire and develop FMS (Morgan et al., 2013). The delivery of a FMS assessment tool that measures and tracks children's FMS competence in PE will provide the teacher crucial information in relation to the child's performance to help plan interventions and better support that child's movement development (Morley et al., 2015). Despite previous calls

(Cools et al., 2008), there remains a need for a feasible FMS assessment for primary teachers to use (Giblin et al., 2014).

As previously discussed, primary school PE is typically taught by generalist teachers, who may lack understanding and confidence in the subject. However, providing teachers with specific resources to support their understanding has been shown to be effective in improving children's performance of FMS (Tompsett et al., 2017). Considering the well reported positive association between children's FMS competence and PA levels (Lubans et al., 2010; Logan et al., 2015; Robinson et al., 2015; Barnett , Lai et al., 2016; Cattuzzo et al., 2016) it is possible that equipping primary school teachers with an assessment that supports the development of children's FMS competence could result in children increasing their PA levels during childhood and as they get older. Furthermore, an assessment tool such as this could also enable fellow researchers to further explore the mechanisms of the development of children's FMS competence levels and PA proposed by Stodden et al. (2008).

Assessment protocols utilising digital technology, particularly app-based software, have the capacity to offer more opportunities for "authentic assessment" to take place. This approach offers opportunities for children to be fully integrated through the establishment of an open environment, with co-created usage of assessment between the teacher and the learner (Hay & Penney, 2009). The ability to share clear learning outcomes via visual demonstrations, alongside verbal instruction and feedback, could help the child understand why or how they made mistakes (Davids, Button & Bennett, 2008), rather than the teacher being seen as the sole beneficiary of the assessment process. Using digital video for feedback and assessment in PE has been shown to enhance children's motivation and improve their skill performance (O'Loughlin et al., 2013) and it has been suggested that analysis of movement from video is beneficial for individuals with lower understanding and knowledge of the movement (Knudson & Morrison, 2002).

This is particularly important considering that primary PE is predominantly taught by teachers who are non-specialists of PE, who may lack confidence and understanding in the subject (Morgan & Bourke, 2008).

Therefore, this study, providing an empirically based, feasible, teacher-oriented assessment of children's FMS will be beneficial to teachers, children and researchers. Up to now, there has been limited investigation of this topic and the findings will provide a detailed examination of how children's FMS can be feasibly assessed by primary teachers, culminating in a resource that will be made available for teachers in the UK. The findings could also help to guide the development of future programmes and interventions for use in education and academic settings.

1.4 Aims and objectives

The aim of this thesis is:

To design and develop a movement assessment tool (MAT) for primary school teachers to measure the FMS of children aged 4-7 years old.

The aim will be achieved through the following objectives:

i. To explore the perceptions of primary school teachers and movement experts regarding the assessment of children's FMS.
ii. To generate, by expert consensus, the framework of a teacher-oriented assessment of FMS for children aged 4-7 years old.
iii. To examine the feasibility of the MAT being used by teachers in the initial years of primary school during PE lesson time.

1.5 Project outline

The research within this thesis was conducted as part of a three-year collaborative project funded by Liverpool John Moores University, Sheffield Hallam University and

the YST. The purpose of the project was to develop an assessment tool for primary school teachers to measure and track the FMS competence of children aged 4-7 years of age. This research involved primary school teachers and academic and practitioner experts from the field of children's movement development, movement assessment and PE teacher education (PETE) to provide a thorough examination of the methods, pedagogical provision and appropriate content of a teacher led FMS assessment for children aged 4-7 years.

An advisory board consisting of ten academics from four universities was brought together to fulfil the requirements of the project, which ran concurrently with my doctoral studies. Alongside my doctoral studies, I was Project Officer and responsible for co-ordinating the collaborative work-streams and reporting between the YST and the advisory board. I led the research process and was responsible for setting and achieving the project milestones agreed between all parties. On a study-by-study basis, I created the initial research design and shared this plan, and a justification of the chosen methods, with the advisory board. A fluid feedback process evolved in which the research methods were critiqued and amended to comprehensively fulfil the aims and objectives of the project. I was the primary researcher in each of the four studies, conducting the data collection, transcription and data analysis. In one instance (Study Two - gaining expert recommendations for the design of a MAT for use by primary school teachers), Professor David Morley facilitated the two expert focus groups, with my role in the focus groups as rapporteur. The analysis of the focus group data in Study Two was a joint process, with Professor David Morley and I collaborating to formulate the thematic framework and report the study findings.

I led the MAT app design process, including the initial storyboard designs, visual schematics and process flow charts. Throughout the evolution of the prototype iterations, communication was maintained between me, the advisory board, the YST to report the

research informed recommendations and discuss necessary amendments for future versions of the MAT.

Upon completion of the project, the Start to Move Assessment (Youth Sport Trust, 2017), was launched in Apple's app store, branded as Movement Assessment Tool.

1.6 Thesis structure

This thesis comprises four studies, each of which are described in the study map below (Table 1.1). Unlike a traditional thesis, that contains an independent chapter for the Literature Review, a review of literature is included within the introduction of each individual study and within Chapter Five, describing the development of the MAT prototype. This approach was selected to draw attention to the topic areas relevant to each study.

Following this introductory chapter, Chapter Two (Study One) outlines the recommendations made by primary school teachers for the design of a MAT that they can use to measure children's FMS competence within PE lessons. Chapter Three (Study Two) sought expert opinion from academics and practitioners from the field of children's movement development, movement assessment and Primary PETE to better understand the dynamics and complexities of primary teacher-led assessment of children's FMS. Chapter Four (Study Three) describes how the Delphi technique was used with an international group of academic and practitioner experts from the field of children's movement development, movement assessment and Primary PETE to establish the content of the MAT. Combining the findings from the previous studies, as well as drawing on existing literature and field work, Chapter Five describes the development process of the MAT prototype. This chapter includes a description and justification of:

i. The selection of assessment criteria for the movement tasks in the MAT.
ii. How the video content was generated and selected for inclusion in the app.
iii. How the app containing the MAT was created.

Chapter Six (Study Four) examines the feasibility of the MAT being used by primary school teachers within their PE lessons with children aged 4-7 years old. Finally, Chapter Seven brings the findings of each study together to consider the effectiveness and suitability of the MAT being used by primary school teachers.

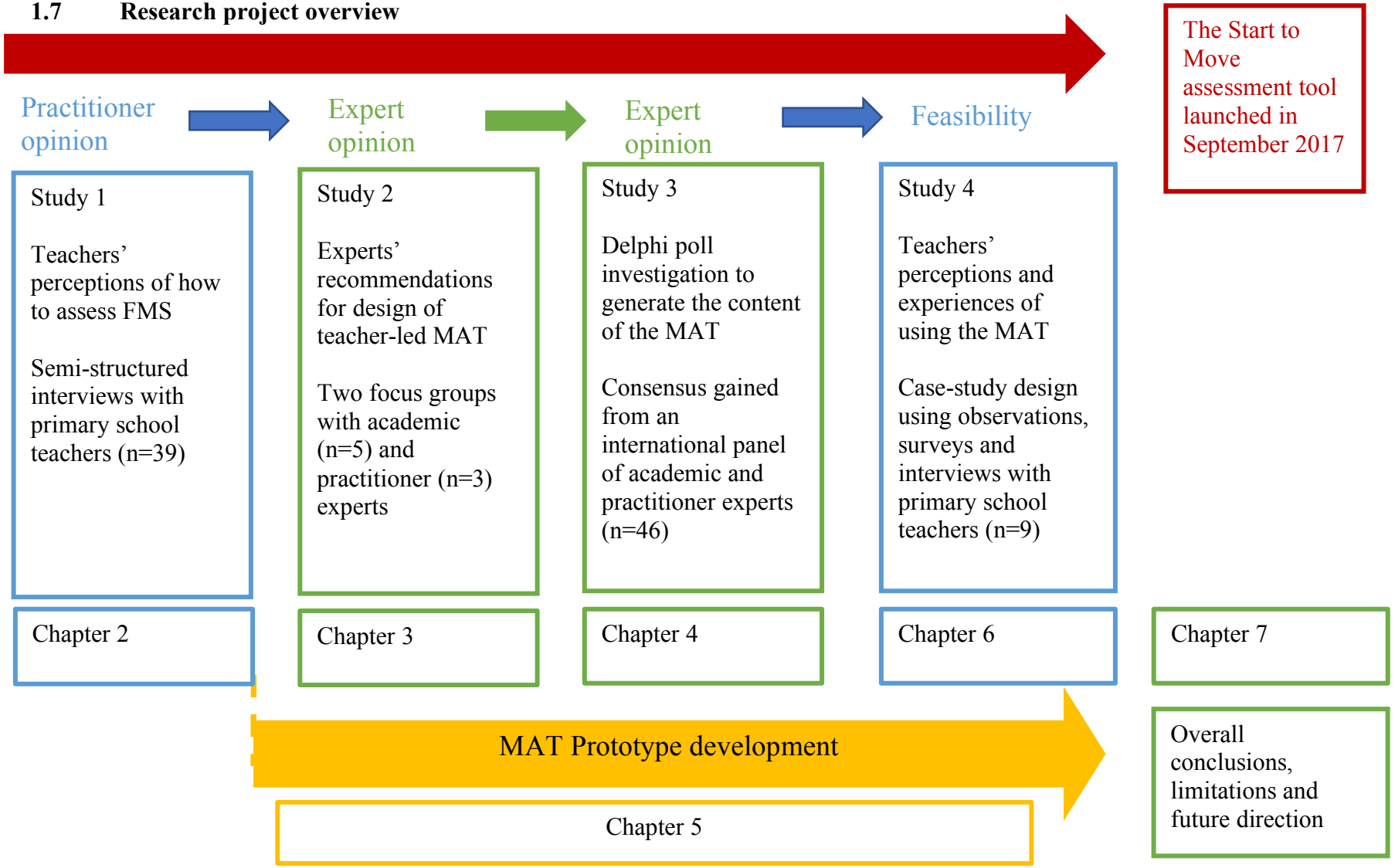
In place of an abstract for each individual study, a modified version of the study map is included within the opening of each of the four study chapters (Chapter Two, Three, Four, Six) to present the key findings from the research project as they arose. Within the thesis, the terms 'movement skill', 'movement task' and 'assessment task' have been used interchangeably. Each term refers to a movement skill that can be performed to measure a component of FMS.

Table 1.1: Thesis Study Map

Study	**Overview**
Study One: Primary teachers' recommendations for the development of a teacher-oriented movement assessment tool to assess children's FMS in primary schools	A qualitative study to explore the perceptions of primary school teachers to establish key recommendations for a teacher-oriented MAT protocol, aligned to the PE curriculum suitable for children aged 4-7 years old.
Study Two: Expert recommendations for the design of a movement assessment tool for use by primary school teachers.	A qualitative study to gain expert recommendations from academic and practitioner experts from the fields of children's movement development and movement assessment design of a MAT for teachers to use in primary schools, with children aged 4-7 years old.
Study Three:	Using the Delphi technique (RAND, 1967) with an international panel of academics and

Delphi poll investigation to gain expert opinion for the content of a teacher-oriented movement assessment tool for children aged 4-7 years old.	practitioners with specialism in children's movement assessment and movement development to establish the content of a teacher-oriented assessment of FMS for children aged 4-7 years.
Study Four: Examining the feasibility of the movement assessment tool being used by teachers of primary school Physical Education	Applying a mixed-methods approach using a revised version of Bowen et al. (2009) feasibility framework to examine primary teachers' experiences of using the MAT within PE lessons of children aged 4-7 years old in the UK.

1.7 Research project overview



1.8 Methodological overview

Within the realm of research, it has been recognised that research in sport gives many dimensional opportunities and a variety of approaches to a topic (Smith, 2010). Throughout this research project, several research strategies have been adopted that involved a shifting of research perspectives aligned with the research design of each study. A way of looking at this is that I have used a dual approach that was interchangeable across each of the four studies. In the nature of their design, Study One and Study Two, involving semi-structured interviews and focus groups, were explorative qualitative research. The aim of these studies was to explore the perspectives of the teacher and experts in relation to how teachers should assess FMS. For these studies, I positioned myself within an interpretivist perspective, not looking for the truth based on one true fact but seeing the features of specific contexts to provide social meaning (Neuman, 2014). Kent (2006) believes that the interpretivist approach allows the researcher opportunities to collect information and reflect on a wide range of reasons, beliefs and motives that individuals have to gain an overall understanding of the background for the research topic. Adopting this approach would allow me to better understand the human context of how teachers and experts feel FMS should be assessed in school. On the other hand, conducting the Delphi poll in Study Three, lent itself to a typical positivist perspective, in which to establish consensus among the participants, only one truth would be identified (Bryman, 2012). In effect, the truth was observable, precise and independent of theory (Neuman, 2014). Finally, in Study Four, I felt I was almost connecting the interpretivist and positivist positions. The interviews and observations provided a subjective context to understand the beliefs, perspectives and actions of the teachers, while the surveys offered an objective based viewpoint on the reality of teachers using the MAT.

Across the research programme, at times I felt I was bridging the gap between the interpretivist standpoint of researchers who are seeking social theoretical insight within education and the positivist work typically found in research in the context of natural science. I feel this combined approach was effective as the interpretivist approach allowed me to explore the perspectives and human interactions of the participants (Black, 2006), whilst the objective rigour of the positivist approach revealed the findings from the Delphi poll independent of any existing knowledge or belief (Hudson & Ozanne, 1988).

CHAPTER 2

STUDY 1

Primary teachers' recommendations for the development of a teacher-oriented movement assessment tool to assess children's FMS in primary schools

Chapter 2: Primary teachers' recommendations for the development of a teacher-oriented movement assessment tool to assess children's FMS in primary schools

2.1 Thesis Study Map: Study One

Study	Key findings
Study One **Primary teachers' recommendations for the development of a teacher-oriented movement assessment tool to assess children's FMS in primary schools**	• **Primary school teachers recognise the need for a movement assessment tool specifically intended for them to assess children's FMS during PE lessons.** • **To meet the requirements of teachers, the movement assessment tool should be developed for use on digital devices, such as an iPad. Use of this technology would provide a quick and simple to use method of assessment, as well as allowing for video content to be included, to support the teacher's understanding of the assessment tasks.** • **Teachers would prefer the assessment to adopt an Assessment for Learning approach, as this would indicate the next steps for a child's development and guide their future learning.** • **Enhancing teachers' understanding of the process of assessing FMS may allow them to better support children's learning and acquisition of FMS.**

2.2 Introduction

Chapter One discussed the importance of developing children's FMS from a young age and established that primary school settings provide an optimal environment for children to learn and acquire these skills. FMS are learned movement patterns that are considered the foundation for more complex, specialised skills (Gallahue et al., 2012) and enable successful participation in a variety of physical activities and sports (Haubenstricker & Seefeldt, 1986; Stodden et al., 2008). FMS also play an important role in the physical and social development of children through adolescence and into adulthood (Clark & Metcalfe, 2002).

Gallahue et al. (2012) proposed an hourglass model outlining the phases and stages of movement development from infancy, through childhood and adolescence (Figure 2.1). As this model portrays, children's progression from the rudimentary movement phase begins at around the age of two years and is initiated as they start to discover how to perform a variety of movements involving stability, object control and locomotor skills. These skills, collectively termed FMS, are learnt and developed during the fundamental movement phase. It is preconceived that children have the potential to be competent in performing FMS by the age of seven years (Payne & Isaacs, 2011; Gallahue et al., 2012), although development of FMS are age-related and not age-dependent (Gallahue et al., 2012; Graham et al., 2013). Despite the initial stage of FMS development occurring naturally through a child's exploration of movement, acquisition and maturation of FMS cannot be expected to happen by a certain age. In fact, if the population is observed, even some adults have not reached a mature stage of development in some FMS (Roberton, 2013). The rate that individuals acquire and become competent in performing FMS is influenced by physical attributes (e.g. height, genetics, maturity) and environmental conditions, such as opportunities for practice, instruction, encouragement and feedback (Robinson & Goodway, 2009). Without these opportunities

to learn and practice, it is very unlikely that an individual will be able to reach a mature stage of a movement skill within the FMS phase.

Individuals who reach a mature stage of FMS development, becoming competent at performing a range of FMS, are considered to exhibit movement competency (Morgan et al., 2013; Barnett, Stodden et al., 2016). Across existing literature, the term 'movement competency' (Morgan et al., 2013; Rudd et al., 2015; Barnett, Stodden et al., 2016) has been used interchangeably with 'movement proficiency' (Seefeldt, 1980; Morley et al., 2015), 'motor coordination' (Lopes et al., 2011; Lopes et al., 2012), 'motor skill proficiency' (Ziviani et al., 2009; Foweather et al., 2014 Myer et al., 2015) and 'motor skill competency' (Stodden et al., 2008; Robinson et al., 2015). The use of each term is constant and correlates to the degree that children can execute movement skills. For consistency, the term 'FMS competence' will be used throughout this thesis to refer to an individual's ability to perform FMS.

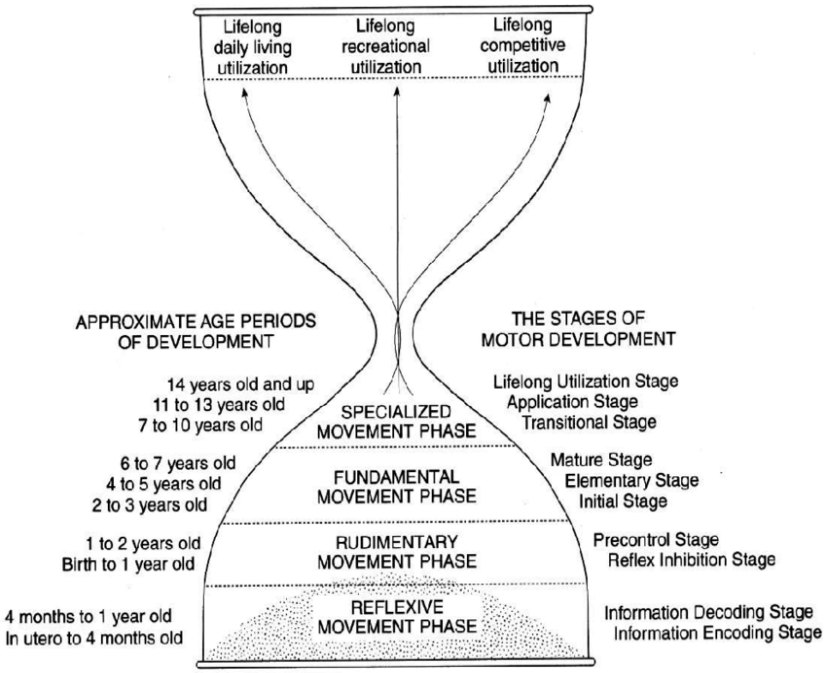


Figure 2.1: The phases and stages of movement development (Gallahue et al., 2012)

Following maturation in the FMS phase, individuals are expected to progress into the specialised movement phase. During this phase, stability, object control and locomotor movements are refined and applied into more specialised and sport specific skills, such as shooting at goal whilst running in football, the triple jump in athletics and the overhead hit in badminton. The consequence for children who do not reach a mature stage of FMS, thus failing to demonstrate FMS competency, is that they will be inhibited in refining and developing more sports specific skills required for participation in a greater variety of activities. This is reflected in the proficiency barrier hypothesised by Seefeldt (1980), that suggests children's participation in PA will be inhibited if they do not achieve a sufficient level of FMS competency. A study involving 326 children (mean age 9.5 years) (De Meester et al., 2018) reported that almost 90% of the children with low FMS competence did not meet guidelines for MVPA. Thus, providing evidence of the likely existence of the 'proficiency barrier', described by Seefeldt (1980).

Chapter One addressed the need to focus on the development of FMS competence within PE during early childhood. From the evidence outlined above there is a clear indication that the primary school years provide an optimal opportunity for children to develop FMS. Morley et al. (2015) recommended that assessing children's FMS would provide teachers with a better awareness of children's FMS competence so that they could better support their development. Roberton and Halverson (1984) state that teaching occurs when a second person (i.e. the teacher) becomes involved in the learning process, taking the role as: i) an observer, ii) an interpreter, and iii) a decision maker. First, the teacher observes the environment and the learner completing the task. Interpreting their observation, the teacher is faced with a number of questions related to how the child performed the task, such as: *was the movement performed correctly? Did the learner perform the movement with ease? Was the movement performed in the most advanced way?* Following this interpretation, the teacher must decide whether they need to

intervene, and if they do intervene, what should they do. The success of this learning process is reliant upon the accuracy of the teacher's observation and their level of knowledge and understanding of the movement so that they can make an appropriate interpretation to promote movement development.

In order to provide challenging and valuable learning experiences, teachers need to gain a holistic perspective of the children they teach (Jess, Carse & Keay, 2016). This could be achieved through the lens of assessing children's FMS development as this captures the stage of development of the child and allows the teacher to design learning plans that are developmentally appropriate to the child. In support of this, teachers who have completed the BUPA 'Start to Move' training (Youth Sport Trust, 2016) acknowledged that the training course increased their awareness of developing children's FMS but they also indicated that they felt they needed more support in assessing children's FMS to inform their teaching. The pivotal role of the teacher in this cycle of assessment-teaching-learning (Roberton & Halverson, 1984; Carroll, 2003; Hay & Penney, 2009), demonstrates that their level of subject knowledge and understanding is influential in the outcome of learning process.

Assessment within education is categorised in two forms: summative assessment and formative assessment (Hay, 2006). Summative assessment is a broader term for the Assessment of Learning (AoL) and is a formal process to measure what has been learned (Hay, 2006). Formative assessment, also recognised as Assessment for Learning (AfL) is a measuring process used by the teacher to provide feedback to children and modify future teaching to address their needs (Hay, 2006; Black & Wiliam, 2010). According to Hay and Penney (2009) assessment within PE should be viewed as a process through which learning can be promoted, with AfL being the principal form of assessment. Further, they state that an integral element of assessment is that it aligns with curriculum and pedagogy. It has long been understood that teacher-led assessment is a key element in the teaching-

assessment-learning cycle (Roberton & Halverson, 1984; Carroll, 2003), and provides a teacher with valuable feedback to improve standards of learning (Black & Wiliam, 2010). Therefore, assessing children's FMS competence could help teachers to support and enhance the development of their pupils (Stodden et al., 2009; Herrmann et al., 2015; Tidén, Lundqvist & Nyberg, 2015).

In the UK, primary school PE can be delivered by generalist class teachers and specialist PE teachers. Generalist class teachers teach across all subjects and receive as little as six hours training to teach PE during Initial Teacher Training (ITT) (Harris et al., 2011), whereas PE specialists have completed a at least a minimum one-year training course for teaching PE and are responsible solely for teaching PE. Less than half of UK primary schools employ a PE specialist teacher, meaning PE lessons are largely taught by generalist class teachers (Department for Education, 2015). Due to the limited amount of PE training allocated to generalist class teachers, it is reported that they lack expertise and confidence in assessing children within a PE setting (Morgan & Hansen, 2007; James et al., 2005; Morgan & Bourke, 2008; Harris et al., 2012; Ní Chróinín & Cosgrave, 2013). Owing to the limited PE training given to generalist teachers, the terms 'generalist teacher' and 'non-specialist' are used throughout the thesis with equal meaning.

Recognising the importance of developing FMS during childhood, it has been suggested (McKenzie, 2007; McKenzie & Lounsberry, 2013; Morgan et al., 2013; Tompsett et al., 2017) that school-based PE provides an optimal environment for teachers to specifically focus on FMS within their teaching. In part, this is because teachers have the widest reach across the young population (McKenzie, 2007), but also, the age period of 4-7 years is critical for children to develop FMS (Payne & Isaacs, 2011). To be effective in their programming and delivery, it is suggested that FMS interventions should be led by specialist PE teachers (Morgan et al., 2013: Tompsett et al., 2017).

There is a raft of FMS assessment tools that have been validated, refined and used

extensively by researchers across the globe to understand the FMS competence of children (Cools et al., 2008). However, as discussed in Chapter One, these assessment tools were not intended to be used by teachers or they are not suitable to assess children within the age of 4-7 years. To provide teachers with a MAT that meets the specific context of PE lessons in the initial years of primary school, I felt it was important to explore their perceptions of assessing FMS competence. Therefore, the purpose of this first study was to examine the perceptions of primary school teachers in order to:

i) Understand their existing practise of assessing FMS competence

ii) Gain their recommendations for a preferred method of assessing children's FMS competence, aligned to the PE curriculum for children aged 4-7 years.

2.3 Methodology

2.3.1 Design

Within this study, semi-structured interviews were conducted to explore primary school teachers' perceptions of assessing FMS within PE. The study was conducted between May and November 2015. Prior to commencing research activity, approval was granted by the ethics committee of Liverpool John Moores University (Research Ethics Committee reference: 15/EHC/027).

2.3.2 Recruitment and participants

A stratified purposeful sampling strategy (Patton, 2002) was used to recruit participants. Schools were identified from Local Authority contact lists of the two participating cities, and from information provided by the research partner (the YST). Invitation packs, containing a letter and participant information sheet (Appendix 1.1), were sent via email to the headteacher of each school (n=104), with a request to share with their teaching staff. As the lead researcher, I asked teachers to respond directly to

me via email or telephone. I made follow up telephone calls to each school if a response was not received from the initial invitation. Upon accepting the invitation, potential participants were asked to sign a consent form (Appendix 1.2) and provide demographic information (length of teaching experience, their role in school and gender). Using this pre-determined stratification criteria, thirty-nine teachers of PE from twenty primary schools based predominantly in two cities in the North of England were recruited to participate. The participant sample comprised: gender (female, n=27, male, n=12), length of teaching experience (Mean 8.1 years, SD = 6.4 years), teaching role (PE specialist, n=8; PE co-ordinator, n=12; generalist teacher, n=19), school location (urban, n=32; and rural, n=7) and school status (state, n=34; and independent, n=5).

Due to early difficulties with recruitment (cited reasons from teachers included a lack of time available, problems caused by examination periods, and absence through illness), the study was divided into two phases separated by the schools' summer holiday period in 2015. Phase One interviews were conducted in June and July and involved 17 primary school teachers located in the North East (n=12) and North West (n=5) of England. Phase Two interviews were conducted between September and November 2015 and involved 22 primary school teachers located in the North East (n=12), North West (n=9) and South West (n=1) of England.

2.3.3 Semi-structured interviews

Previous studies examining teachers' perspectives within the field PE have adopted both quantitative exploratory measures, such as questionnaires (Lander et al., 2015) and qualitative approaches provided by semi-structured interviews and focus groups (Ni Chróinin & Cosgrave, 2013). When adopting a mixed-method approach to explore teachers' perceptions of their PE programs, Morgan and Hansen (2008) felt that semi-structured interviews offered a more detailed insight of teachers' perceptions than achieved by the questionnaires. Thus, for this study, semi-structured interviews were

selected as the open-ended questions could elicit greater detail (Berg, 2009) and provide opportunity for the participant to share unforeseen or unexpected responses (Kvale and Brinkmann, 2009).

The interviews were structured to examine two key research questions:

i. What are primary school teachers' perceptions of assessment within PE?

ii. What do primary school teachers consider the most suitable method of assessing children's movement within PE?

Using the style described by Berg (2009), the interview schedule was constructed around the key conceptual areas of interest that had been identified to investigate the research questions (see Table 2.1 for an outline of the interview stages). The stages of the interview schedule centred on 'essential' questions, with 'informal' questions included at the beginning to build rapport and focus attention on the subject of the interview (Berg, 2009). Probes and prompts, such as 'can you explain in more detail why you think this?', were used to elicit more information if a respondent's initial answer was unclear or incomplete (Gillham, 2005). To assess the effectiveness of the interview schedule, Gillham (2005) recommends conducting pilot interviews with a real sample of participants. Three pilot interviews were conducted with primary school teachers. Analysis of the data from the pilot interviews, and feedback from the pilot participants, resulted in the reduction of the number of scripted questions from sixteen to twelve and amendments to the wording of some questions to language more understandable for teachers. These revisions focused the interview schedule on the areas of most importance and provided additional time for extra non-scripted probing questions to be used to seek additional, unexpected information (Kvale & Brinkmann, 2009).

Table 2.1: Outline of the stages within the interview schedule

Interview stage	**Focus**	**Aim**
Stage 1	Teaching experience	Warm up questions to anchor attention on the subject, build rapport and allow the interviewee to relax.
Stage 2	Assessment in PE	To explore what primary school teachers assess in PE, how they do this and what challenges they face.
Stage 3	Teachers' recommendations for an FMS assessment	To explore how primary school teachers currently assess children's FMS, what would encourage teachers to assess children's FMS and how they want to conduct an FMS assessment.
Stage 4	End of interview	Gain final comments from participant and thank them for their involvement.

Participants were offered the choice of individual interviews or group interviews using the identical interview schedule (See Figure 2.2 for a sample of the interview schedule. See Appendix 1.3 for the complete and final iteration of the interview schedule used in Phase 1). Group interviews were conducted with members of staff from the same school, and allowed multiple participants to be involved at convenient times during their school day (for example, lunch times and after school). To encourage participation within the group setting, participants were informed that they were free to contribute at any point (Fontana & Frey, 2008) and I moderated the discussion to mitigate a dominant voice taking over (Berg, 2009). Fourteen individual interviews (Mean duration = 35mins, range = 34mins) and nine small group interviews (Mean duration = 36mins, range = 39mins) were conducted. Small group interviews comprised two (n=5), three (n=3) and six participants (n=1). Individual and group interviews were conducted face-to-face at the

participant's school (n=33), via Skype with video (n=4) and telephone (n=2). Offering Skype and telephone interviews reduced personal inconvenience, for example, a participant preferred to be interviewed from her home as she worked part time. As previously discussed by Lo Iacono, Symonds and Brown (2016), interviews conducted via Skype with video were deemed as effective as having face-to-face interaction.

Teachers' recommendations for an FMS assessment
*Thanks for the detail there. In the next section I'd like for us to look in a bit more detail at children's movement and how this is best assessed within PE***.**

8. Can you tell me a little bit about how you currently measure the progress of children's movement?
    a. Do you look for any specific skills? Can you expand on how you do this?

9. Can you tell me how you currently support children's movement development in PE?
    a. How do you find this?
    b. Did you receive any support or training to do this? What did this involve?
    c. What difference have you noticed in the children as a result of this?

10. Could you suggest ways of how assessing children's movement could be improved?
    a. Could you explain this in more detail?

Figure 2.2: Sample of the interview schedule used in Phase 1 and Phase 2

Following Phase One data collection, an initial analysis was conducted and key recommendations from teachers for an assessment protocol were formed. Following this analysis, I created a digital storyboard (See Figure 2.3 for a sample of the storyboard, see Appendix 6.2 for the full storyboard) to provide a visual representation of the process and content of the MAT as recommended by teachers in Phase One. Subsequently the storyboard was shown on a laptop computer to teachers during interviews in Phase Two to provide focus and stimulate the discussion (Cross & Warwick-Booth, 2016). The

storyboard was first introduced to participants during Stage 3 of the interviews, which focused on teachers' recommendations for the FMS assessment. The preceding stages of the interview schedule remained unchanged from Phase One to retain consistency between the two phases and to allow comparisons across the interviews (Berg, 2009) (See Appendix 1.4 for the revised version of the interview schedule used in Phase 2). Separating the interviews into two phases and creating the storyboard allowed the data collection in Phase Two to focus participants' attention (Hoepfl, 1997), which encouraged further recommendations for the appropriate design of the MAT.

Figure 2.3: Sample of storyboard of the movement assessment tool based on Phase One interviews.

2.3.4 Data analysis

All interviews were digitally recorded (Sony IC recorder ICD –PX140), transcribed verbatim and subsequently managed within NVivo analysis software.

Employing Saldaña's (2012) notion of first cycle coding, descriptive coding was used to inductively identify topics within the data, which related to the research questions. For example, in relation to the research question 'What do primary school teachers consider the most suitable method of assessing children's movement within PE?' the topic of 'technology' became apparent and mentions of this topic were subsequently coded appropriately. Second cycle 'pattern' coding was then performed, following the principles of the constant comparison method (Morehouse & Maykut, 2002; Saldaña, 2012). During this cycle of coding, I read the transcripts again to assess patterns through the recognition and development of themes formed by the discrete topics as determined within the first cycle of coding. Within this second cycle of coding, the themes were continuously compared and contrasted with each other to form an explanatory framework that revealed the social processes that teachers encountered (Taylor, Bogdan & DeVault, 2015). This hybrid approach of inductive and deductive analysis provided a thorough exploration and analysis of the research questions by comparing existing beliefs around teachers' perceptions of assessment within PE, as determined by the research questions contained within the semi-structured interview schedule, as well as allowing for the development of new themes (Boeije, 2010). Using Nvivo for the two cycles of coding provided a platform to construct the analysis framework in an easy to manage format and allowed the related and opposing topics to viewed. From Nvivo, I extracted all verbatim quotes related to the coding framework and input them to a Microsoft Excel file that could easily be shared with the advisory board.

Verbatim quotes have been included in the discussion section below to provide contextual understanding and interpretation of the participants' experiences and

perceptions (Patton, 2002). Single comments, illustrating the participants' individual connection to the research questions (Braun & Clarke, 2006), have been considered as important as those that were repeated or agreed by others.

2.4 Findings and Discussion

The purpose of this study was to explore primary teachers' perceptions of assessing children's FMS to inform the development of a teacher-oriented FMS assessment. To better understand the context of primary teacher-led assessment of FMS, it was also important to examine how participants perceive assessment within PE and discover how they include assessment within their own teaching. Therefore, the findings are presented under the headings of the two key areas of investigation: i) Primary school teachers' perceptions of assessment within PE; and ii) Primary school teachers' recommendations for a MAT to use in primary schools, which consequently formed the key themes of the analytical framework. Within each of the key themes, participants' experiences and perceptions are discussed within the emergent sub-themes (Table 2.2).

Table 2.2: Thematic content of participants' perceptions of assessing PE and their recommendations related to the assessment of children's FMS by primary school teachers.

Key Theme	**Sub-themes**
Primary school teachers' perceptions of assessment within PE	Subject knowledge and confidence
	The role of assessment in PE
	Access to assessments
Primary school teachers' recommendations for an FMS assessment tool	Available teaching time
	Nature of the assessment
	Assessment functionality

2.4.1 Primary school teachers' perceptions of assessment within PE

This section highlights the experiences of primary school teachers and discusses their current assessment practise within PE. Participants' perceptions of assessment within PE were defined in the following areas: i) subject knowledge and confidence, ii) The role of assessment in PE, and iii) access to assessments.

2.4.1.1 Subject knowledge and confidence

Within this sub-theme, participants reflected upon their own experiences of teaching PE and revealed how their levels of perceived confidence influenced their assessment practise. All participants taught PE, yet their experiences and confidence in the subject ranged greatly, which impacted both positively and negatively on their assessment practise in the subject. Participants who were specialist PE teachers, having graduated with a PE specialism, including four who had previously worked as PE teachers in secondary schools, had well developed PE subject knowledge, enabling these teachers to be more confident assessing within PE, 'I've always been really confident within PE, it's my degree, PE with teacher training' (PE specialist, female, 18 years' experience). In addition, it was common for PE co-ordinators, who were not necessarily specialists in the subject, to receive additional training via training days and access to resources to support their PE subject knowledge:

> *I've been on loads of different courses that I've been sent on. Other staff have been on the same, but as PE co-ordinator I've been sent on more than a lot of people to do with sport, so I've obviously progressed myself. (PE co-ordinator, male, Newly Qualified Teacher [NQT])*

In contrast, non-specialist PE teachers felt under-prepared for the challenges of assessing within PE. This is best expressed by a Year Two teacher (female, NQT) who affirmed that *'it's [PE] difficult. I do find it difficult. It's also difficult because it's hard to know… I don't know where they've [children] come from or where they're going to,*

so what's expected underneath or above, so that's harder as well'. These perspectives are congruent with previous findings that have highlighted the influence that low subject knowledge and confidence have on teacher's experiences of assessment within PE (Faucette et al., 2002; Morgan & Hansen, 2007; Morgan & Bourke, 2008). These comments further highlight that Initial Teacher Training provision for preparing teachers to teach PE is insufficient (Harris et al., 2011). Therefore, considering the varied level of knowledge and experience of teachers who teach PE in primary school, it is imperative that the MAT is designed so that it supports both specialists and non-specialist PE teachers. Furthermore, to enhance teachers' subject knowledge and confidence in preparation for teaching PE and FMS in primary school, Initial Teacher Training programmes need to deliver greater and more varied PE provision.

2.4.1.2 The role of assessment in PE

Teachers in this study recognised the value of assessment to support children's development in PE, yet they were also aware that not all assessment has the same influence, *'I really do want to feel that it's making a difference. I wouldn't want it to become something, sort of just paperwork, and think 'well actually, how much is that going to help?''* (PE specialist, male, 13 years' experience). Participants also recognised the value of assessment for recording children's progress. One participant explained '*we have a tick list with perhaps three different criteria on it, and we just look to see where they are over a few lessons, so to see if they move or if they stay the same'* (Year 2 teacher, female, 3 years' experience). Additionally, it was also recognised that assessment within PE will become more important to justify budgetary spending in the subject, as one participant suggested:

> *We need to get a focus on assessment in PE, again with Sports Premium funding, [OFTSED] want to know how the children are making progress and I think very soon we are going to be answerable for progress'. (PE co-ordinator, female, 30 years' experience).*

In 2013, the UK government allocated PE and Sport premium annual funding to schools to spend solely on "additional and sustainable improvements to the quality of PE" (Department for Education, 2018). Schools are accountable for how this money is spent and are required to monitor and report the impact that funding has on pupil outcomes. However, due to the current absence of formalised or statutory assessment within PE (Department for Education, 2013), participants reported that, currently, the main purpose of assessment was to report to parents at the end of the year. Objective based mark sheets were used by some teachers to assess competence in PE, with participants using AfL strategies to evaluate and monitor children's development. These approaches are best captured by the following teachers (PE specialist and a non-PE specialist):

> *We're really into AfL…, and making those judgements as we're going. We want to respond to what we see - not think about it afterwards, and that's really important to us. (PE specialist, male 7 years teaching experience).*

> *Crucial to observing these things is whether the children are able to do these things, that always tells me as a practitioner that developmentally something isn't right, which sometimes can mean there are actually implications. (EYFS teacher, female, 6 years experience).*

The value placed by participants towards AfL, indicated in the above quotes, suggests that a process-oriented scoring approach, measuring the quality of the child's movement, would be preferred for a teacher-oriented MAT. A number of previous studies have recommended this approach for enhancing children's learning (Black & Wiliam, 2008; Hay & Penney, 2009; MacPhail & Halbert, 2010; Tidén et al., 2015). Specifically, MacPhail and Halbert (2010) reported that secondary school teachers of PE improved the standard teaching, learning and assessment in their PE lessons after implementing AfL within their lessons. However, to be used effectively, this requires the assessor to have prior knowledge of what they are assessing (Tidén et al., 2015). Therefore, as mentioned above in relation to the range of subject knowledge of teachers of primary PE, cautious

steps must be taken when assessments focused on AfL are to be used by teachers who do not have in-depth knowledge of what they are assessing (Tidén et al., 2015). Recommendations of how teachers can be supported when conducting the assessment are discussed further within *assessment functionality* below.

2.4.1.3 Access to assessments

It was indicated by teachers in this study that they use a range of sources to access information to support their PE curricular knowledge, including training and resources offered by their Local Authority, bought in resources (e.g. Real PE, Create Development) and online resources (e.g. Youtube). However, participants reported a shortage of feasible assessment tools that they can access to assess FMS:

> *We've got the PE coach doing a skills assessment at the end of each topic that he does, but in regard to tracking that across the school from Key Stage 2 anyway, or even maybe Key Stage 1, with the exception of Foundation Stage, possibly, I'd say there's something lacking. (Year 4 teacher, male, 3 years' experience).*

> *There is a gap in the market for [a teacher-oriented movement assessment tool], with assessment in general it's got to be simple. It's got to be effective and it's got to be a tool where you go back to it. And you say "yeah great I know that I need to now use that to help me plan". (Year 6 teacher, female, 10 years' experience).*

These results are in agreement with the suggestion made by Giblin et al. (2014) that there are a shortage of FMS assessment tools available to primary school teachers. Morgan et al. (2013) suggested that primary school should provide an optimal environment for children to develop FMS. However, with only a limited number of PE specialists in primary schools, it is imperative that FMS assessment resources are designed for the specific needs of non-specialists of PE. Furthermore, the removal from the curriculum of national level descriptors (Association for Physical Education, 2014), which were a guideline for assessing children's progress, leaves schools and teachers in a position requiring them to create their own assessment framework. These findings

indicate that providing teachers with more guidance and support in assessing PE may encourage more meaningful assessment to take place within the subject.

2.4.2 Recommendations for an FMS assessment tool

The previous findings revealed participants' experiences of assessing within PE, highlighting the need, and desire from primary teachers, for a method of assessing children's FMS. The following section discusses the key recommendations made for an appropriate method of assessing children's FMS in lesson time. This topic is discussed within the three emergent sub-themes that illustrated participants' perspectives for the MAT; i) available teaching time, ii) nature of the assessment, iii) assessment functionality.

2.4.2.1 Available teaching time

A key issue raised by participants was that they feel pressured within school by the shortage of available curricular time for PE, '*time is of a massive issue as our lessons are only 40 minutes long for a single lesson'* (PE specialist, male, 16 years' experience). Typically, other subjects, such as English and Maths, are given higher importance and take priority, *'we track English and maths really well, and we track writing and reading, but then the other things almost fall at the wayside sometimes.'* (Year 4 teacher, female, 3 years' experience). These comments could be a result of assessment within core subjects, unlike PE, being a statutory requirement (Department for Education, 2013). To make assessment more attractive to primary school teachers to include within their current teaching of PE, participants stipulated that the MAT needs to follow a simple process and be quick to administer, with a Year 1 teacher suggesting 'i*t just has to be easy. It has to not be time consuming and it has to tell staff what they are looking for. What they should be doing, what the children should be doing.' (*female, 30 years' experience).

2.4.2.2 Nature of the assessment

The findings presented here describe teachers' recommendations for the process of assessing during the PE lesson. Participants implied that the value of the MAT would be improved if the results positively impacted on their future teaching and the learning experience of their pupils. To achieve this, teachers indicated that they want to be able to record more than just the outcome of the assessment and that just saying 'yes' or 'no' for a child's outcome is not enough.

> *Some sort of generic criteria that says their achievement is at this level, or that they're achieving but their achievement is at a basic level. (PE specialist, male, 18 years' experience).*

In relation to scoring the assessment, participants recommended that the MAT needs to record evidence of what the child has achieved and that it establishes a record of their progress that can be monitored.

> *Things I like are where it's there and it's almost quite clear and you go tick, so you almost have it recorded, you're not having to go away and process it or think about it. It can be within the lesson, it's not too onerous. (PE co-ordinator/Year 5 teacher, female, 9 years' experience)*

Furthermore, it was suggested by participants that they want the MAT to provide valuable feedback that will facilitate a positive influence within their future lesson planning:

> *…. Having an assessment tool that takes that into account – that you're not just looking for the children you know. You're breaking the assessment down. For example, if they can't run straight or backwards, whatever it is, you have that process in place so the teacher can say 'Right, this child can't do this. I know to get them to here they need to do this, this and this'. (Year 4 teacher, male, 3 years' experience).*

This aligns to the principles of authentic assessment in PE outlined by Hay and Penney (2009), indicating that systems within the assessment to support AfL are

necessary to both measure children's competence and inform future teaching. In response to being shown the storyboard of the MAT (See Figure 2.3 for a sample of the storyboard, see Appendix 6.2 for the full storyboard), a participant interviewed in Phase Two of this study supported this notion that a criterion scoring approach would be preferable:

> *I like it being able to just click on the name and say which criteria they've fulfilled so you've got a log next to each child saying what they've done and showing what level they are working at whether its above, at or below. (EYFS, female, 12 years' experience).*

2.4.2.3 Assessment functionality

The interviews provided insight into participants' recommendations of features within the assessment tool that would aid them in assessing children's FMS and be beneficial as a teaching tool. Participants indicated that a lot of the resources that are currently available to them are paper-based. However, many perspectives of this were negative, with one participant reflecting *'we need to get rid of paperwork, and I know that's what we're doing at the moment but we don't have any technological resources to help* us' (Year 1 teacher, female, 1 year experience). This notion of using digital technology was recommended by another participant, who expressed *'it would be so much easier on a tablet for me, because it would be quicker to just sit there and just go through it'* (PE co-ordinator, male, NQT). The potential of using digital technology within PE has previously been recognised by Graham et al. (2013), who suggested that the popularity of tablet devices could revolutionise assessment practises by reducing paperwork and increasing efficiency.

In this current study, it was suggested by some participants that including video demonstrations of the skills to assess would be a valuable support to them. Notably, having the facility to show video clips demonstrating the skill to the children was deemed important, *'you could project that onto a wall or whatever and show the children, so you've got that demo and you can press play, this is your demonstration and everything,*

this is your performance mirrored next to it' (PE specialist, male, 16 years' experience). Participants who were non-PE specialists, suggested that being low in confidence in the subject deterred them from providing demonstrations to their class or that their demonstrations were not adequate. Therefore, including video content in the assessment resource could both support teachers' understanding in effectively administering the assessment, as well as offer an alternative demonstration method so that children can be shown the movement skill performed correctly, thus potentially enhancing their learning opportunities (Chan, Ha & Ng, 2016).

In addition to having a library of video content provided within the assessment tool, participants highlighted that being able to video record the performance would provide visual evidence of what the child has achieved. Participants also recognised the potential benefit of being able to replay the videoed performance back to the child to support the child's development. This was epitomised by one participant's reflection from their teaching;

> *He [the child] knew straight away and he was able to fix it straight away. Whereas I'd said to him a couple of times before, I got the iPad and as soon as he saw it [his movement] on the iPad he sorted it. (Year 5 teacher/PE Co-ordinator, female, 9 years' experience)*

There is already acknowledgement that video recording is a useful tool to enhance learning (Graham et al., 2013), and using digital video for feedback and self-assessment in PE has been shown to enhance children's motivation and improve their skill performance (O'Loughlin et al., 2013). Furthermore, assessing movement skills from video can be simpler for an untrained assessor (Gard & Rösblad, 2009) and the hand-held nature of the tablet enables the teacher to be mobile during the assessment and record the performance from different angles. Research on the use of digital app based technology within schools is limited. However, in a recent study, Browne (2015) indicated the advantages that teachers reported with using tablet applications within their teaching of

PE, including the value of using tablets to record and analyse children's performance. The findings within this theme and the themes discussed earlier, suggest that assessments utilising digital technology would be well received by primary school teachers. The additional functions provided by digital technology to record and capture evidence of children's FMS could encourage teachers to use the movement assessment tool more frequently. This method of assessment could also be adopted for wider curriculum areas within PE, where evaluating performance and recording children's progress is also required.

2.5 Limitations

Limitations of the study exist in the geographical locations where participants were recruited, with participants predominantly teaching in schools in large, northern cities in England. Additionally, as participation was voluntary, it could be contended that only those teachers who were motivated and interested to discuss the topic took part. This notion of 'volunteer bias' is suggestive that the findings reported in the study are only representative of those teachers who chose to volunteer and not representative of all teachers (Salkind, 2015). Teachers who did not accept the invitation to participate may have had different perceptions and experiences that have not been highlighted in this study. Further, it is evident from these findings that although assessment is regularly conducted by teachers in other subjects, the amount of time given to assessment in PE can be minimal, with some teachers reporting that they only occasionally conduct assessment in PE. Therefore, the method of assessment within PE described by teachers may be partly based on what they perceive to be successful, and not based on their actual experiences, due to the lack of available similar resources. This is important to consider for the development of the MAT and subsequent trialing of the prototype, to ensure that the assessment is feasible to use in lesson time and that it continues to meet the needs of teachers.

2.6 Conclusions

These findings indicate that primary teachers recognise the significant role that assessment has in enhancing children's learning. However, due to the shortage of MATs for primary teachers to use, participants in this study relied upon their own, sometimes limited, knowledge and expertise to implement assessment of FMS. In general, there is demand from primary school teachers for a MAT, so that they can enhance the learning environment for children and better support their development of FMS. Teachers recommended that an effective MAT should be simple to use, quick to administer and provide valuable feedback to guide their future teaching and better support children's learning of FMS.

The suggestion from participants to embrace digital technology through the use of tablet devices, such as iPads, supports the recommendations made by Graham et al. (2013) and O'Loughlin et al. (2013), who highlighted the potential advantages of using digital technology to optimise assessment opportunities in PE. Importantly, participants reported that video content would assist teachers who require additional guidance to conduct the assessment and enhance learning opportunities. Furthermore, digital technology allows a simple method of scoring and recording data, and does not demand the same attention after the lesson that would be required to maintain paper-based records. A digital app, providing video content and video capture, may enhance the child's learning experience through the additional support provided to teachers to develop children's FMS.

In populations, such as the UK, where PE lessons are largely delivered by non-specialists of PE, it is realistic to suggest that these recommendations made for a MAT are suitable to be used by teachers with a range of knowledge, understanding and confidence in the subject. Where PE is delivered solely by PE specialists, these recommendations may need to be reconsidered owing to the greater subject knowledge and confidence of these teachers. However, considering the paucity of literature discussing primary teachers' perceptions of assessing FMS and the shortage of feasible for tools for teachers to use in

primary school PE, the findings in this study provide a meaningful perspective of the issues and considerations for teacher-led assessment of children's FMS in primary school.

Participants' recommendations described in this study provide a foundation for the development of a MAT for primary teachers to use in PE lessons. If suitably aligned to the PE curriculum, this MAT could then be used by primary school teachers to enhance the learning environment for children to acquire and develop FMS, providing children with the skills they need to be more physically active throughout childhood and into adolescence (Lubans et al., 2010; Foweather et al., 2015; Barnett, Lai et al., 2016; Cattuzzo et al., 2016; De Meester et al., 2018). Furthermore, with schools being accountable for how they spend the PE and Sport Premium funding, in the absence of other suitable assessment methods, the principles of the MAT outlined here could be valuable for teachers and schools to report the impact of how they allocated the funding by monitoring changes in children's FMS competence.

2.7 Future research

This study has identified a preferred method for assessing children's FMS from the perspectives of primary school teachers. Their collective experiences and thoughts have provided a comprehensive account of the functions and processes of conducting the assessment during lesson time. Due to the perceived low level of primary teachers' understanding and experience of assessing FMS, it would be appropriate to consult with experts of children's movement to better understand the complexities of assessing children's movement and gain their recommendations for the design of a teacher-oriented FMS assessment. Furthermore, considering the shortage of literature discussing teacher-oriented assessment of FMS and the lack of a definitive list of skills required to measure FMS competence in early childhood, seeking the opinion of experts of children's movement to generate the content of the MAT (e.g. the number and type of skills required

to assess FMS) is required to ensure the validity of the assessment in measuring FMS competence.

CHAPTER 3

STUDY 2

Expert recommendations for the design of a movement assessment tool for use by primary school teachers

Chapter 3: Expert recommendations for the design of a movement assessment tool for use by primary school teachers

3.1 Thesis Study Map: Study Two

Study	Key findings
Study One Primary teachers' recommendations for the development of a teacher-oriented movement assessment tool to assess children's FMS in primary schools	• Primary school teachers recognise the need for a movement assessment tool specifically intended for them to assess children's FMS during PE lessons. • To meet the requirements of teachers, the movement assessment tool should be developed for use on digital devices, such as an iPad. Use of this technology would provide a quick and simple to use method of assessment, as well as allowing for video content to be included, to support the teacher's understanding of the assessment tasks. • Teachers would prefer the assessment to adopt an AfL approach, as this would indicate the next steps for a child's development and guide their future learning. • Enhancing teachers' understanding of the process of assessing FMS may allow them to better support children's learning and acquisition of FMS.
Study Two **Expert recommendations for the design of a movement assessment tool for use by primary school teachers**	• **The development of a teacher-oriented MAT needs to consider the multidimensional complexities of assessing children's FMS in relation to the specific context of a school setting.**

	• **Expert perspectives for teacher-led assessment of FMS are conflicted by the mechanisms and purpose of the assessment and the experts' own specialism (i.e. academic or practitioners). The dilemmas poised by the experts are underpinned by three key considerations:** • ***why*** **are we assessing children's movement? For research purposes or to enhance teaching and learning?** • ***how*** **should we do it? Experts suggested that a natural setting (e.g. typical engagement in a PE lesson or playground activity) could provide a more accurate measurement of a child's movement competence. Further, the simplicity of the assessment should allow the teacher to complete it within the normal time of their PE lessons.** • ***what*** **should it look like? Should the detail of the assessment be complex or simple and should the nature of the tasks be static or dynamic?** • **Expert perspectives suggest that the development of a MAT for use by primary teachers of children aged 4-7 years old can mirror existing protocols in terms of the movements assessed. However, such development should initially focus less on reliability and validity of the tool, whilst placing greater emphasis on the feasibility of**

	the MAT being used in the unique context of the school. • **These findings suggest that any future development of a MAT for primary teachers needs to consider the specific purpose and context of the assessment.**

3.2 Introduction

As discussed in Chapters One and Two, there is significant empirical and policy-framed evidence to suggest that the development of children's FMS competence is important for the overall development of the child. However, what is less articulated is the type of assessment that should be used to assess FMS and which environment provides the optimal context for the assessment to take place. A recent systematic review by Morgan et al. (2013) suggests that the school provides an optimal environment for the development of children's movement competence to occur, albeit with the involvement of highly trained or specialist teachers in intervention delivery. Further, there is recent experimental evidence to suggest the use of goal-directed motor skills teaching interventions in primary schools has resulted in significant improvements in children's FMS competence (Cicović et al., 2015; Chen et al., 2016; Platvoet et al., 2016). Other studies demonstrate that, given appropriate training, teachers of children in early years (Robinson & Randall, 2015) and secondary school (Lander et al., 2015) settings can have a positive impact on children's movement competence.

There is a prevalence of non-specialist teachers of PE in primary school (Department for Education, 2015), resulting in teachers with a range of subject knowledge and understanding (Harris et al., 2011; Morgan & Bourke, 2008). Furthermore, findings within Study One indicated that although teachers considered it important to assess children's FMS, participants acknowledged that only a small amount of FMS assessment

is taking place. Thus, despite the recommendations made by teachers in Study One, providing an important perspective to inform the development of the MAT, their understanding of the processes of assessing FMS may be moderated by their limited exposure to measuring children's FMS competence. Thus, it was considered important to consult with experts of children's movement to better understand the complexities of assessing children's movement and gain their recommendations for the design of the MAT.

Previously, expert opinion has been captured through the use of a Delphi poll (RAND, 1967). For example, Ross et al. (2014) used a Delphi poll with experts of movement development to determine which were the most important learning competencies for pre-service primary PE teachers. Expert advisory groups have also been used to assist in the design of a physical literacy assessment framework (Francis et al., 2015). Whilst expert opinion has been sought, to varying degrees, in the development of previous FMS assessment frameworks, there remains a lack of qualitative expert perspectives on the development of such assessments, particularly when targeted towards the specific context of primary school settings. Therefore, this study set out to elicit expert opinion to gather knowledge and understanding on the design of the MAT for use by primary teachers.

3.3 Methods

3.3.1 Design

This study adopted a qualitative approach to better understand and capture expert opinion in relation to the assessment of children's FMS by primary teachers. It was hoped that a qualitative account of experts' opinions, with wide ranging contextual expertise (academic or practitioner) would provide a detailed account of the subject area to corroborate the findings from Study One. In this instance, it was deemed appropriate that the smaller group size and focused discussion that focus groups promote would illicit a

more thorough examination of the topic to inform the development of the MAT (Krueger & Casey, 2009). This was a similar method to that used by Ní Chróinín and Cosgrave (2013) who engaged primary school teachers to explore their perceptions of assessment within PE in primary schools.

The data are derived from two focus groups, conducted with a sample of five expert academics (three female, two male) and three expert practitioners (two female, one male). The intention was to get to 'know well' a few participants rather than 'know a little about many'. The use of focus groups allowed for the construction of meaningful themes, with the subsequent illumination of these themes through the contextual interaction elicited through participation. Philosophically, it is not claimed that the themes constructed from the data are generalisable to all movement assessment experts or practitioners. However, in line with the proposal of Lincoln and Guba (1985), the emerging themes should be afforded time and contextual appreciation based on the level of expertise and depth of conversation provided. The findings of this study have been constructed through interactive dialogue and are presented in a way that demonstrates the evolution of the conversation. The experiences and deliberations shared by the academic and practitioner experts have assisted in providing a collective understanding of the assessment of FMS by primary teachers that considers the similarities and differences posed by the context of their prospective situations.

The research was granted ethical approval by the Research Ethics Committee of Liverpool John Moores University (Ref. 15/EHC/027).

3.3.2 Recruitment and participants

As the study aimed to consider expert opinions on the design of a movement assessment framework for primary school teachers, it was deemed appropriate to include practitioners with experience of primary school education programmes, as well as academics with expertise in children's movement development, in a similar way to other

studies in this field (Ross et al., 2014; Barnett et al., 2015; Rudd et al., 2015; Francis, et al., 2016). The involvement of primary school teachers in Study One ensured that a full and rich insight was provided into the development process of the MAT. Participants located in the UK and Ireland who met the criteria detailed below for each group (practitioner or academic) were purposefully selected (Patton, 2002) to take part.

Practitioner experts. For the purpose of this study, practitioner experts were defined as such if they had significant experience in a senior, developmental role within primary PETE programmes and children's movement development. In the absence of quantifiable metrics used to define academic experts (e.g. peer-reviewed outputs; see Table 3.1), the way that practitioner experts have been defined highlights the significance of experience and is substantiated within the conceptual framework of a community of practise (CoP) (Lave & Wenger, 1991). CoPs involve the generation and sharing of knowledge, skills and understanding within a specific context. As the participants had fulfilled a number of senior roles within the primary school PE CoP over a significant period of time, their status as a practitioner expert is confirmed (see Table 3.1).

Table 3.1: Experience of participants in the 'practitioner experts' focus group

Participant	Experience (years) of children's movement development/ assessment	Experience (years) of primary school PE teacher training	Current and previous roles
P1	20	10	School sport strategy manager, PE programme manager, resource developer, Head of school PE department
P2	18	8	Children's movement curriculum designer and lead advisor for national organization, international children's coaching lead
P3	28	17	PE teacher trainee programme leader, Head of school PE department, resource developer, Regional primary school sports co-ordinator

Academic experts. Academic experts were identified and recruited if they had explored the assessment and/or development of children's movement competence in the UK through: (i) publications in peer-reviewed papers; (ii) published textbooks (author or chapter) examining the assessment and/or development of children's movement competence; and/or (iii) delivery of movement development within PETE programmes.

Prospective participants for the academic experts' group were identified and shortlisted via online databases using the search terms 'movement competence', 'fundamental movement skills' and 'movement skill assessment'. Invitations included an introductory letter, participant information sheet (Appendix 2.1) and consent form (Appendix 2.2), which were sent via email to an initial list of 12 participants. One prospective participant did not respond and six declined to participate. See Table 3.2 for a description of the academic experts focus group participants sample.

Participants were informed that their involvement would be anonymous throughout the study and signed informed consent was obtained from each participant prior to commencement.

Table 3.2: Expertise of participants in the 'academic experts' focus group

Participant	Years in academia	Number of peer-reviewed articles involving children's movement assessment/ development	Number of textbooks and chapters involving children's movement assessment/ development
A1	14	13	4
A2	9	8	0
A3	10	6	0
A4	32	16	16
A5	11	5	1

3.3.3 Focus groups

Each focus group was independently conducted with practitioners or academics. Retaining homogeneity within the two focus groups gained the perspectives of participants with practitioner and academic expertise, without the discussion being influenced by their different experiences afforded by their role (Krueger & Casey, 2009). Similarly, I wanted to avoid the potential for participants' contribution within the focus groups to be influenced by their perceived importance in relation to other participants (Krueger and Casey, 2009), as could have been caused by combining practitioners and academics.

The practitioner experts focus group was conducted first, allowing the model of the assessment to be developed based on the recommendations of participants who have experience working closely with schools and teachers. Subsequently, these recommendations for a best fit assessment model for teachers were shared with the group of academic experts to evaluate the accuracy and reliability of this proposed assessment.

As the primary aim of this research was to inform the development of a MAT for primary school teachers, I felt that practitioners' perspectives were an important starting point to achieve such an aim as they work closely with the targeted end-users. Furthermore, the vast majority of work in the field of assessing children's movement competence is conducted by academics with the aim of either establishing baseline movement competence or evaluating the efficacy of movement development interventions. Therefore, ensuring that the end-user was prominently positioned in the sequencing of data capture was crucial in challenging the status quo of existing research in this field.

The practitioner experts focus group took place at a university in the North of England and the academic experts focus group was hosted at a university in Ireland. These locations were selected for the convenience of the participants taking part in the relevant focus group. Each focus group was segmented into approximately three sessions of ninety minutes, lasting a total of five hours in duration, yielding a total of ten hours of data captured across the two focus groups. Both focus groups were led and moderated by my Director of Studies, Professor David Morley, who was experienced in managing focus groups, and I took the role of facilitator. Both focus groups were digitally recorded (Sony IC recorder ICD –PX140) and transcribed verbatim. To protect their anonymity, participants have been given an identifying code during the reporting and discussion of the results.

3.3.4 Data collection and analysis

Prior to the focus groups, I created a framework of activities to guide the focus group sessions. The formation of topics and questions were guided by the recommendations drawn from Study One and existing literature examining children's movement assessment (Cools et al., 2008; Giblin et al., 2014; Hermann et al., 2015). As the focus groups were scheduled to last a long period of time (4.5 - 5 hours), maintaining engagement of all participants was deemed important. Scenario-guided focus groups

require the completion of activities that actively engage participants (Krueger and Casey, 2009). Colucci (2007) suggested that scenario-guided focus groups encourage engagement in the discussion and maintain interest throughout the session. Furthermore, scenario-guided focus groups have been adopted to explore topics of working practises with nurses, which had previously not been studied in any depth (Church and Ekberg, 2013). Activity-led discussion was implemented to explore the participants' experiences more widely, as well as providing an environment to gain perspectives from both practitioner and academic experts (Colucci, 2007). Thus, adding a descriptive account to the limited empirical research involving movement experts in discussing movement competence assessment. A multi-phase data collection process was implemented (see Figure 3.1) that allowed a period of time following the first focus group for analysis to take place to inform the second focus group.

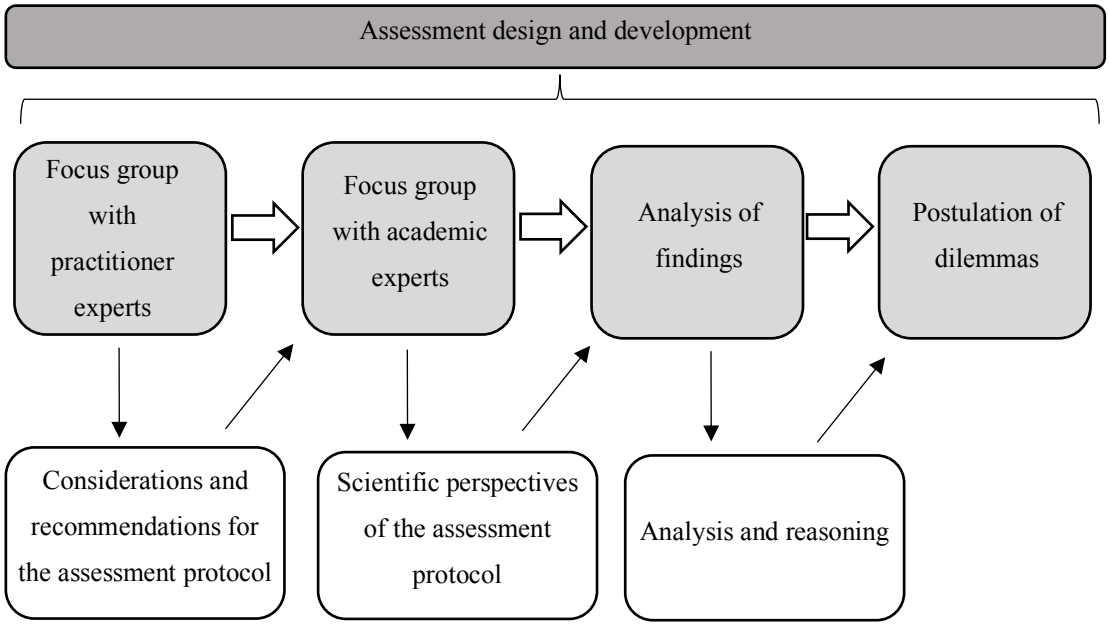


Figure 3.1: Diagram of multi-phase data collection and analysis process

3.3.4.1 Practitioner experts' focus group procedure

The first focus group, conducted with practitioner movement experts (n=3), was established to answer the following research questions from the perspective of a teacher:

i. What are the key issues that need to be considered for the development of a teacher-oriented movement competence assessment of children aged four-seven years old?

ii. How can these issues be resolved in the creation of a teacher-oriented movement competence assessment?

Initially, participants were asked to create a list of the key issues arising for teacher-led assessment of the movement competence of children aged 4-7 years (See Appendix 2.3 for the focus group schedule). Subsequently, participants were asked to rank these issues in the order of priority that they felt most important and offer solutions on how these issues could be resolved. The storyboard model of the assessment tool created from the findings of Study One (See Figure 2.3 for a sample of the storyboard, see Appendix 6.2 for the full storyboard) was shared with the practitioners during the focus groups. This was done to focus the attention of participants and stimulate the discussion in ways that may not have occurred during conventional focus groups (Cross and Warwick-Booth, 2015). Concluding the focus group, participants were asked if there was anything they would like to add, that had not previously been discussed during the session.

3.3.4.2 Data analysis one: Practitioner experts' focus group.

Immediately following the focus group, I met with Professor David Morley and we collated our written notes and summarised the key issues highlighted from the discussion. I then transcribed verbatim the audio recordings of the focus group. Following this, I read the transcripts of the focus group and made notes in the margin

and underlined portions of the text to highlight specific sections of the discussion that considered the participants' recommendations for the assessment protocol. This inductive approach was used to draw out additional information that may have been overlooked from our notes taken within the focus group. Professor David Morley and I then met again to develop a thematic framework (Braun & Clark, 2006) based on our initial notes and the highlighted transcripts. We both then individually re-read the transcripts, simultaneously annotating the text in-line with the thematic framework as well as looking for additional categories or themes to emerge, to produce a final framework considering the recommendations for the assessment protocol. Finally, I read each transcript again, considering the revised framework of emergent themes and subthemes that then formed the critical considerations and recommendations for the design of the assessment protocol.

3.3.4.3 Academic experts' focus group procedure

The second focus group, conducted with academic movement experts (n=5), took place eight weeks after the first focus group. The purpose of the focus group was to:

i. Gain expert opinion to understand how to manage the critical considerations and their solutions posed by practitioner experts to create an accurate and reliable teacher-oriented assessment of children's movement competence.
ii. Establish the most effective protocol for teachers to accurately and reliably assess children's movement competence.

Scenario-guided activities (Colucci, 2007) were implemented within the session to engage the participants to address issues related to the accuracy and suitability of teacher-led assessment of children's movement competence (see **Error! Reference source not found.** for an example of one of these activities). Within these activities, participants were asked to critique the storyboard and describe how appropriate the model

was for primary school teachers (See Appendix 2.4 for the focus group schedule). Again, the storyboard model of the assessment tool created from the findings of Study One was shared within the focus group to guide the activities and stimulate discussion.

Activity one

You have been asked by a Primary school to assist in re-designing assessment of PE within the school.

The school has invested in new iPads and you go looking for an app for the teachers to use to assess children's FMS, starting at Foundation stage and continuing as children progress through school.

What features do you want this tool to contain?

Figure 3.2: Example of scenario-guided activity

3.3.4.4 Data analysis two: academic experts' focus group

The data analysis for the academic experts' focus group followed the same process as for the practitioner experts' group described in Section 3.3.4.2 above. Building on the recommendations for the assessment protocol made by practitioner experts in the first focus group, the discussion in the academic experts' focus group focused on the scientific perspectives of the assessment. Central to this was gaining clarity of how the assessment should be constructed for primary teachers.

After analysis of the transcripts from the academic experts; focus group had been completed, I met again with Professor David Morley to review the themes and supporting quotations from both focus groups. This process allowed similar themes to be collapsed, thus establishing, by consensus, the major themes to be reported. Adopting this multi-phased research process delivered a collaborative perspective from practitioner and

academic experts, to understand the challenges posed for developing and implementing an assessment of children's movement competency for teachers to administer.

3.4 Findings and discussion

The aim of this study was to examine movement experts' perceptions of the most effective movement assessment framework for teachers to use in primary schools, with children aged 4-7 years. The thoughts of primary school teachers, sought in Study One, were positioned within a wider debate to explore the perceptions of academics and practitioners that typically operate in a setting where assessing FMS competence is conducted for research purposes with the end-user being, predominantly, stakeholders within interventions. The primary aim was to bridge across these disparate, albeit symbiotically, connected domains in grappling with a solution that would meet the needs of teachers and researchers simultaneously. The focal point of the discussion was the development of the MAT but it was, perhaps unsurprising, that the perspectives of what the tool needed to achieve was significantly different between the two groups of participants.

During the focus group discussions, a number of dilemmas emerged in relation to the development of a teacher-oriented assessment of children's movement competence. The way that these dilemmas emerged and were subsequently framed by participants provides an interesting characterisation of the data capture process and is useful in understanding the more detailed and specific comments regarding the dilemmas, that followed. As such, the 'framing of dilemmas' is presented as a precursor to the presentation of the dilemmas themselves, with these being: (a) why are we assessing children's movement?; (b) how should we do it?; and (c) what should it look like?

3.4.1 The framing of dilemmas

As previously mentioned, there is limited evidence that provides an understanding of how to effectively design and develop a movement assessment framework for use by teachers in primary schools. There is, however, a plethora of studies that have used movement assessment frameworks to measure children's movement competence. These studies are typically cross-sectional in nature and rarely involve the teacher in the assessment in a way that supports the teacher's ability to use any resulting assessment data to have a consequential positive impact on the development of children's movement. In considering this situation, when asked to respond to tasks concerning the design of such a MAT, it seemed the participants were confronted with a series of dilemmas. Proposals for the potential design of a MAT were often mooted, only to be counteracted by other participants voicing the need for a more balanced approach. These competing notions of what constituted an effective MAT were generally contrasted between the needs of the researchers in capturing FMS competence data, as defined by the bulk of the existing research, and the needs of the educational context, as defined by the developmental needs of children and how teachers could meet these needs.

Previous studies in sports-related fields (e.g. Harvey, Cushion & Sammon, 2015) have conceptualised participants' dilemmas using Windschitl's (2002) dilemmas heuristic of: (a) pedagogical; (b) cultural; (c) political; and (d) conceptual dilemmas. Whilst participant responses from this study can be framed around some of Windschitl's (2002) themes to compare and contrast these findings with previous similar studies, the overarching use of such a framework is limited within this particular study for two reasons. Firstly, participants are experts, rather than teachers, and are being tasked to envisage the complexities of a movement assessment framework in PE, to be used by a primary school teacher. As the framework was designed to interpret the dilemmas teachers themselves face during their teaching, the use of third party perspectives, as

provided by experts, is limiting. Secondly, whereas Windschitl (2002) presented dilemmas within particular frames of reference (i.e. pedagogy, cultural), it became obvious that dilemmas articulated by experts in this study became increasingly framed as dichotomous to each other. For example, a dilemma emerged as to whether the assessment setting should be naturalistic or engineered (Table 3.3). ten Cate (2015) suggests that the emergence of this method of framing the argument in such an either-or manner is not without flaws; there is the potential for a false dichotomy to emerge, in which alternative solutions are crowded out by the offer of strongly polarised perspectives. Indeed, he suggests that such false dichotomies are not useful and, furthermore, could prove detrimental in achieving any intended goal.

It is plausible to suggest that the use of certain parameters when shaping the focus groups could have caused these dilemmas to emerge in this way. Simply by constructing expert perspectives around the subsequent production of a MAT could have influenced the focus groups as they were designed to elicit conclusive responses to inform this production. However, there was also a sense that the experts were coming to terms with a field of discussion that they would not typically engage in and this level of uncertainty was also a potential cause for their polarised responses. Participants were, perhaps, making sense of the debate by positioning themselves at either ends of the spectrum and not fully considering alternative options that existed between the polar ends. Table 3.3 represents these dilemmas:

Table 3.3: Considerations related to the development of a children's (4-7 years) MAT to be used by primary school teachers.

Dilemma	**Condition**	**Dichotomy**	
		For research purposes	**For educational purposes**
Why are we assessing children's movement?	Rationale/ outcome	Measuring children's movement competence	Relating assessment to teaching and learning
How should we do it?	Assessment setting	Engineered	Natural
What should it look like?	Level of detail	Complexity	Simplicity
	Nature of tasks	Static	Dynamic

3.4.2 Why are we assessing children's movement? Is it to measure children's competence or improve teaching and learning?

One of the main dilemmas rationalised by experts related to why the assessment was being conducted and what the intended outcomes of such an assessment were. Within this dilemma, there emerged a clear distinction between the assessment of children's FMS competence for research purposes or to inform pedagogy and, therefore, have an impact upon children's learning within PE. An academic expert exemplified an example of these competing intentions, when they reflect upon the proposed use of a less structured approach to movement assessment than is currently offered by the majority of movement assessment frameworks:

> *I think what's happened there is that you're losing control as a researcher... It will not be the same movements each time if I don't know the [assessment] dimensions...The motor control fraternity is now coming in and saying 'OK, that reliability is going to be confusing... (A3)*

In response, A2 added further weight to the dilemma:

> *And that's where I'm making the differentiation from a research study, with a research hat on, to actually being in the setting as a teacher who is actually worried or concerned about the development of some kids. (A2)*

Whilst the suitability of the majority of existing FMS assessment frameworks is based on the establishment of the assessment's reliability and validity, it seems experts here were proposing that there are wider criteria for establishing the usefulness of a FMS assessment for use by primary teachers. Herrmann et al. (2015) claim that the implementation of their assessment fulfils the functions of both 'system monitoring' (information on the educational system's performance) and 'school development' (reports on pupils' performance affecting internal reform for quality measures). Whilst there is no empirical evidence within their study to support this claim, it is interesting that the authors rationalise their outcomes around how children's FMS assessment could be used as a way to measure both the school's and children's progress.

Whilst most experts believed that the quantification of a child's FMS competence is an important rationale for assessing children, the link to assessment, pedagogy and learning proposed by Hay and Penney (2009) seems equally strong. Hay and Penney (2009) suggest that authentic assessment readily involves the child in the assessment process, in order to ensure AfL, and a practitioner expert related to this notion:

> *That's the key... Even from infant school, children are becoming really proficient at knowing what their own and each other's strengths and weaknesses are… If they know, in very simple terms, what those [movement] criteria are, they're almost going to be harder on each other than the teachers are. (P2)*

The discussion developed around how the MAT would be perceived by children as part of their learning, rather than solely for assessment purposes. In response to the notion that the MAT would be established as a stand-alone component of a lesson, an academic expert replied:

But that's what you don't do though, I don't think you have to, because the assessment isn't an assessment per se, it's within a lesson…It's getting that balance, isn't it, with a formal assessment, that within that, actually we're developing the balance. (A4)

3.4.3 How should we do it?

3.4.3.1 Should the assessment setting be 'natural' or 'engineered'?

The previous section presented scientific challenges concerned with the 'purpose' and 'rationale', when considering the development of an app to assess children's FMS competence in a primary school. When talking to experts in the field of children's movement, it became clear that there were other more detailed dilemmas that required consideration. This section will discuss the challenge of establishing an optimal setting for the MAT to be conducted and section 3.4.4 will consider how to achieve a balanced perspective between a sufficiently detailed (or complex) assessment and an assessment that is simple enough to achieve the desired outcome and to be used by teachers.

Most existing FMS assessments involve an 'engineered' setting in that the assessment is specifically manufactured to capture data related to children's FMS competence. In these types of assessments, participants typically perform a series of movement tasks, or a single task, in a specific order, in a circuitous manner (TGMD-2 and BOTMP-2 are examples of this manner of assessment method). Constraints are placed on how the participant performs the task in the way that they must respond to an assessor's instructions. However, this environment is not typical for children, performing in a 'natural' setting, as they are used to freely expressing their FMS competence within more free-flowing PE or playground activities. Experts in this study suggested that a natural setting could provide a more accurate measurement of a child's movement competence.

P2: 'I think that we should look at a more natural environment to assess. So a play kind of environment to assess.'

Interviewer: 'Why is that?'

P2: Because I think all these generic underpinnings things that we're talking about here are all required for everyday life, and I think the natural environment that we live in, by the nature of it, encourages those basic skills to be developed. '

It seems that this dilemma is borne out of what Windschitl (2002) refers to as a conceptual dilemma; conceptual dilemmas reflect the participant's understanding of learning, involving their ideologies and assumptions. This form of assessment is clearly at odds with more recognised FMS assessments that usually involve the establishment of rigorously administered movement tasks, using strict guidelines that ensure reliability (Cools et al., 2008). It seems that this dilemma also questions the authenticity of a FMS assessment protocol that is attempting to capture the FMS competence of children in a structured and, therefore, unnatural way. Hay and Penney (2009) would perhaps suggest that an engineered form of assessment would fall short of an authentic, integrated assessment in PE, due to its lack of connectedness with the real world.

McEvilly et al. (2013) have raised similar concerns around the use of structured forms of FMS assessment frameworks and note the potential discord that could result in using such engineered assessment with young children. It seems that the dilemma portrayed here emanates from a certain ideology that entails the capture of a child's FMS competence in as natural a setting as possible. However, the challenge in assessing FMS in such a free-flowing, unstructured, naturalistic setting is encapsulated by A2's comments:

During free play you can't dictate. You can't tell the child exactly what skill you want them to do; therefore, you can't box it. So which box do you tick on? Do I tick on the running, or do I tick on the hopping, when the kid's actually doing a bit of both in this particular game in the playground?

The issue with assessing FMS competence within a 'natural setting is whether children would actually perform the types of movements required to assess their FMS

competence. Some assessments, such as the CAMSA (Longmuir, 2015), have moved towards more free-flowing activities to measure FMS competence using uninterrupted, sequential, completion of movement tasks and have been subsequently validated. However, even within this assessment, children are still constrained by the order of the tasks they are required to complete and there is a timed-element to the assessment which may intensify the pressure of constraints on the child. Therefore, further challenges remain in establishing a setting in which children can exhibit their FMS potential and do not feel constrained in their performance by the pressures found in engineered settings.

3.4.4 What should it look like?

3.4.4.1 What is the appropriate balance between simplicity and complexity?

Simplicity, in this context, was generally described as a FMS assessment framework that could be used to assess children's FMS competence within the confines of a typical PE lesson, by a non-PE specialist teacher, in a timely manner. Furthermore, it has previously been reported that primary school teachers lack knowledge (Morgan & Hansen, 2007) and confidence (James et al., 2005; Harris et al., 2011) of assessing within PE, suggesting that simplicity is even more paramount within this specific environment. Complexity, more often than not, related to the amount of FMS assessment information needing to be captured to form a valid and reliable perspective of a child's movement competence. Hermann et al. (2015) reflect this dilemma in their development of the MOBAK movement assessment framework by stating 'The goal is to develop a valid test instrument whose tasks ensure a simple and practical evaluation' (p.81) and the following dialogue characterises this succinctly:

> *A2: Is it compulsory for the primary school teacher to assess PE in the UK?*
>
> *Interviewer: No.*

> *A3: So then it goes back to that. It has to be simple, otherwise they don't want to do it. It has to be so engaging they can't not want to do it [sic].*
>
> *I think we just have to be mindful of whatever we put out there - particularly for a non-specialist teacher at primary - has to be really, really basic and simple, as basic as you can make it, but still effective. (P1)*

For some experts, simplicity also entailed the amount of time the assessment would take and whether this could be configured to the typical duration of a PE lesson. Longmuir et al. (2015) justified the estimated assessment time of one and a half to two minutes per child to complete the CAMSA by comparing it to the typical time required for fitness protocols currently used for population surveillance (Tremblay et al., 2007). A stronger justification would perhaps need to entail the ability of a teacher to effectively assess the children within the constraints of a PE lesson. The time taken to complete the use of the MAT for all children was often presented as a dilemma:

> *I think there needs to be something that's easily measurable, but also easily done by a large number of people at the same time. I was just thinking about it being a teaching class, in a class situation, if you've got 30 children, you don't want to be going through a whole batch of tests. (P3)*
>
> *I think really, while trying to develop something that no-one's ever done before, it's being very realistic about what we want this tool to do, without trying to create something so unwieldy and actually we end up with something very complex that doesn't really do what we need it to do (P1)*

Requiring children to perform skills in isolation, as typically found in the majority of FMS assessments (Ulrich, 2000; Bruininks & Bruininks, 2005), is time and resource intensive and requires a significant amount of expertise on the part of the assessor. In comparison to the CAMSA, the TGMD-2 (Ulrich, 2000) takes 15-20 minutes per child; an unrealistic length of time for a PE lesson considering the timetabled duration of lessons being no more than 60 minutes and a typical class size of 30 children.

3.4.4.2 Should the tasks be static or dynamic?

This dilemma emerged as a complex, often sequentially framed, construct relating to the nature of tasks recommended by experts for assessing children's movement by primary teachers. The discussion related to the best way to assess the progression of the child's FMS competence, using static tasks, more dynamic and free flowing demonstrations of FMS competence, or a combination of both. It seemed that the age range of the intended users of the MAT had an influence on responses with a synonymous escalation into increasing the demands of the task. This meant that the task would have to initially challenge the child's FMS in isolation, before progressing to more dynamic modes of movement:

> *I'd prefer to assess the dynamic elements of balance, more than the static elements. I look at both, but really, in a way, I think, concentrating on one doesn't give you the full picture… that kind of period of destabilising your body. (P1)*

Whilst there was an initial discussion around the suitability of skills in isolation as opposed to the ability to demonstrate FMS competence in more dynamic situations, other experts went further in their understanding of dynamism by referring to the potential for use of an obstacle course setting to assess FMS competence, as captured by the following interaction:

> *P3: For something like an obstacle course you would have to set it up in such a way that they had to perform the moves you want them to, but you don't tell them, so they would have to do that. I think there would have to be some form of structure because otherwise some of these [movements] they may never do.*
>
> *P2: It would be really good to have an 'in context' movement thing, and then a test situation. I think that's a fab idea. Brilliant idea.*

The use of more dynamic, contextually-relevant, forms of FMS assessment has

gained prominence in recent years (Logmuir et al., 2015; Francis et al., 2016). The CAMSA developed by Longmuir et al. (2015) involves an obstacle course setting to assess the FMS competence of children aged 8-12 years. The authors used a Delphi poll to ascertain expert opinions to inform the construction of CAMSA and opinions were diverse in relation to use of an obstacle course to assess FMS competence. Of the seven experts in motor skill development and competence, only two strongly believed that determining skill quality should be the sole purpose of the assessment, and that children should complete the obstacle course without the potentially negative impact of time pressure. The remaining five expert participants supported the obstacle course as a complete measure of motor skill. Longmuir et al. (2015) rationalised the use of their development of a dynamic obstacle course by suggesting that static testing of isolated skills does not reflect the static and dynamic physical activity environments typically found in childhood. Furthermore, it could be contended that requiring children to perform skills in isolation, as typically found in the majority of FMS assessment frameworks (See Cools et al., 2008 for a review of FMS assessments), is time and resource intensive (Longmuir et al., 2015).

CAMSA (Longmuir et al., 2015) is targeted at pre-adolescent children aged 8-12 years and, as such, involves children on the cusp of a movement development stage, as purported by Gallahue et al. (2012), in which children develop from fundamental to complex and then onto functional movement competencies. Experts advising on the development of CAMSA (Longmuir et al., 2015) reached consensus in rationalising the inclusion of speed in the movement assessment task as a child with greater physical literacy would be able to select the appropriate speed for optimal skill performance, whilst their less able peers would perform them more slowly or too fast. The dilemma emerging here is around the necessity to create a meaningful, authentic assessment that is connected to the child's real world, whilst recognising the potentially developmentally inappropriate

introduction of time-pressured (speed) elements to the assessment with children at an early stage of movement development.

3.5 Limitations

The limitations of this study are characterised by the relatively small number of participants in each focus group (n=5 academics, n=3 practitioners). However, the smaller group size focused discussion and allowed participants the opportunity to engage in detailed and descriptive conversation. Additionally, there was not an equal balance of participants in each focus group and it could be suggested that the disparity in participant numbers between the two focus groups may have resulted in a narrower range of perspective being gained from the practitioners. However, the participants within the practitioners focus group had substantial experience in this field (mean 22 years' experience) and the duration of the focus groups permitted descriptive and in-depth discussion. Similar to Study One, participation in the focus groups was voluntary, thus there is the potential for 'volunteer bias' (Salkind, 2015) in the findings as only individuals who wanted to contribute their time to the design of a new movement assessment protocol may have taken part. Additionally, the perspectives of non-specialists of PE and primary teachers in role who would be using the proposed assessment tool were not sought. It is possible that their recommendations for the design of a movement assessment tool could differ to those proposed by experts. Furthermore, the dilemmas posed by the experts do not provide a categorical framework of a MAT for teachers to assess the FMS of children aged 4-7 years old. Consequently, further research would be necessary to confirm the feasibility of the MAT being used by teachers.

3.6 Conclusions

These findings suggest the development of a MAT for use by primary teachers needs to consider the multidimensional complexities of assessing children's FMS

competence in relation to the specific context in which the assessment will be conducted. Although they do not present a categorical outcome for the design of the MAT, the postulated dilemmas presented as a result of this study provide a substantive base of understanding of how the MAT should be developed, considering it is intended for use by primary teachers. However, that development of the MAT for primary teachers needs to consider the specific purpose and context of the assessment.

It is clear from the findings that experts believe that there are dilemmas that need resolving in order to design a MAT for primary teachers to assess children's FMS. Given the wide-ranging nature of these dilemmas there is uncertainty whether existing FMS assessment frameworks, predominantly designed and used by researchers, offer a reliable basis for the design and development of a FMS assessment framework to be used by primary school teachers. Participants from both practitioner and academic backgrounds in this study constantly question the purpose of the assessment; a tangible tension exists in the differing perspectives offered, with practitioners arguing for a simple tool that will inform future learning and academics questioning the reliability and validity of such a tool in terms of accurately assessing children's movement in a way typically achieved through the use of existing protocols.

These findings suggest that any future development of a MAT for primary teachers needs to consider the specific purpose and context of the assessment. The storyboard of the MAT that was shared with participants is reflective of an assessment protocol that could be used by primary teachers to assess the FMS of children aged 4-7 years. Fundamentally, experts in this study believe that a teacher-led MAT needs to be easy to use, provides information for subsequent teaching and learning and take place in an environment that permits children's FMS competence to be captured.

3.7 Future research

Further investigation is required to generate appropriate content within the MAT to assess the FMS competence of children aged 4-7 years old. Furthermore, considering the dilemmas posed by experts in this study, teachers should continue to be involved throughout the development and testing process of the MAT to ensure that it meets their specific needs and is suitable for use within the context of a PE lesson.

CHAPTER 4

STUDY 3

Delphi poll investigation to gain expert opinion for the content of a teacher-oriented movement assessment tool for children aged 4-7 years old

Chapter 4: Delphi poll investigation to gain expert opinion for the content of a teacher-oriented movement assessment tool for children aged 4-7 years old

4.1 Thesis Study Map: Study Three

Study	Key findings
Study One Primary teachers' recommendations for the development of a teacher-oriented movement assessment tool to assess children's FMS in primary schools	• Primary school teachers recognise the need for a movement assessment tool specifically intended for them to assess children's FMS during PE lessons. • To meet the requirements of teachers, the movement assessment tool should be developed for use on digital devices, such as an iPad. Use of this technology would provide a quick and simple to use method of assessment, as well as allowing for video content to be included, to support the teacher's understanding of the assessment tasks. • Teachers would prefer the assessment to adopt an AfL approach, as this would indicate the next steps for a child's development and guide their future learning. • Enhancing teachers' understanding of the process of assessing FMS may allow them to better support children's learning and acquisition of FMS.
Study Two Expert recommendations for the design of a movement assessment tool for use by primary school teachers	• The development of a teacher-oriented MAT needs to consider the multidimensional complexities of assessing children's FMS in relation to the specific context of a school setting. • Expert perspectives for teacher-led assessment of FMS are conflicted by the

	mechanisms and purpose of the assessment and the experts' own specialism (i.e. academic or practitioners). The dilemmas poised by the experts are underpinned by three key considerations: • *why* are we assessing children's movement? For research purposes or to enhance teaching and learning? • *how* should we do it? Experts suggested that a natural setting (e.g. typical engagement in a PE lesson or playground activity) could provide a more accurate measurement of a child's movement competence. Further, the simplicity of the assessment should allow the teacher to complete it within the normal time of their PE lessons. • *what* should it look like? Should the detail of the assessment be complex or simple and should the nature of the tasks be static or dynamic? • Expert perspectives suggest that the development of a MAT for use by primary teachers of children aged 4-7 years old can mirror existing protocols in terms of the movements assessed. However, such development should initially focus less on reliability and validity of the tool, whilst placing greater emphasis on the feasibility of the MAT being used in the unique context of the school. • These findings suggest that any future development of a MAT for primary teachers needs to consider the specific purpose and context of the assessment.

Study Three **Delphi poll investigation to gain expert opinion for the content of a teacher-oriented movement assessment tool for children aged 4-7 years old.**	• **Expert consensus established that a total of 14 tasks were required to assess children's FMS competence at 4-7 years. The assessment should be composed of 4 stability, 5 object control and 5 locomotor tasks** • **The tasks, in the sequential order within each category of movement that experts established the tasks should be introduced in the assessment, are listed below:** • **Stability → One foot balance, walk forwards along a line, sideways roll and front support.** • **Object control → Two handed catch, underarm throw, overarm throw, kicking a ball, dribbling a ball with alternate hands while stationary.** • **Locomotor → Running, hopping forwards, horizontal jump, sidestepping and skipping** • **A developmental stage approach was preferred over an age based approach, indicating experts agreement with Gallahue et al., (2012) that FMS are age related but not age dependent.** • **Differentiating the scoring criteria for the developmental stage of the children, is preferred over a method of differentiating the tasks for their developmental stage.** • **There was strong consensus agreement from the expert panel that the assessment should not be differentiated for gender.** • **In general, experts believe that a process-oriented scoring approach, evaluating**

	how the skill has been performed, is most appropriate in a teacher-oriented assessment.

4.2 Introduction

Chapter One discussed the need for a MAT designed for primary teachers to assess the FMS of children aged 4-7 years old. Teachers in Study One indicated that they placed a high value on the use of assessment, but that their use of assessment within PE was limited due to the shortage of available resources. The findings of Study One and Two presented recommendations for how teachers should assess children's FMS during primary PE lessons. However, as discussed in those studies, further investigation was needed to generate appropriate content for the MAT to assess the FMS competence of children aged 4-7 years old by teachers.

There are a range of assessment tools available that are designed to assess children's FMS (See Burton & Miler, 1998 and Cools et al., 2008 for a review of existing FMS assessments). However, as previously discussed in this thesis, these traditional movement assessments were typically developed to assess movement deficiencies (Burton & Miller, 1998; Cools et al., 2008) or do not align to the primary PE curriculum (Ulrich et al., 2000; Giblin et al., 2014). For example, the intended purpose of the TGMD-2 (Ulrich, 2000) was designed to identify children who are significantly behind their peers in gross motor skill performance and does not include a component to measure stability. Therefore, the assessment lacks validity to promote children's learning of FMS as outlined in the PE curriculum for 4-7 years in the UK (Department for Education, 2013).

One method to establish the validity of assessment methods is through content validity, which is defined by Burton and Miller (1998, p364) as "the extent to which a measurement is judged to reflect the meaningful elements of a construct of domain and not any extraneous elements". For example, to what extent do the movement tasks in the

MAT represent a suitable measure of FMS for 4-7 year olds, within the components of stability object control and locomotor? These judgements are usually made by individuals with expertise in the content area related to the assessment and this process has been used to initially determine the validity of the content and structure of FMS assessments. Content validity was established for the TGMD-2 (Ulrich, 2000) by reporting agreement between a small group of movement development experts that the skills within the assessment were representative of FMS (although only object control and locomotor skills were included in the assessment). Similarly, the Movement Assessment Battery for Children – Second Edition (MABC-2) (Henderson, Sugden & Barnett, 2007) established content validity with the input of an expert panel. The MABC-2 also reports that face validity was obtained through feedback from a wide range of professionals who had experience of using the assessment.

Despite there being a lack of consistency in the overall content of existing FMS assessment, what remains constant is the manner of how object control and locomotor skills are assessed. For example, in my review of existing FMS assessments, object control was commonly assessed by movement tasks involving throwing, catching and kicking, and locomotor was commonly assessed through the movements of running, jumping, hopping and galloping. However, in relation to assessing the component of stability, this was either not assessed (TGMD-2) or, in the assessments that included a measure of stability, these type of movement tasks were not widely represented across the range of assessment tools. The most common tasks to measure stability were the one leg balance (static balance) and walking along a line (dynamic balance).

Existing FMS assessment tools cover a broad range in the age of children that can be assessed within their specific remit. For example, the TGMD-2 (Ulrich, 2000) is intended for children aged 5-10 years, the MABC-2 (Henderson et al., 2007) covers the age range of 3-16 years and the BOTMP-2 (Bruininks & Bruininks, 2005) is intended to

assess individuals aged 5-21 years. Due to the rate of development through childhood and the ease in which FMS can be learnt, it has been recommended that age categories for movements within an FMS assessment be limited to 6 months (Cools, et al., 2008). For example, the BOTMP-2 (Bruininks & Bruininks, 2005), has been reported as containing movement components too difficult for children aged 4-6 years (Cools et al., 2008). The MABC-2 acknowledges the expected differences of children at different ages by grouping the tasks into three age categories: 3-6, 7-10 and 11-16 years. There are obvious challenges and problems associated with developing assessments with narrow age categories when they are intended to be used in schools which have an academic year lasting 10-11 months. An alternative approach that is considered to be appropriate is categorising FMS competence based on developmental stages instead of age categories (as used in the 60 Mins FMS club [60 Minute Kids Club, 2018] and Physical Literacy Assessment for Youth [PLAY] [Canada Sport for Life, 2013]). This approach acknowledges that FMS are not age-dependent (Gallahue et al., 2012; Graham et al., 2013) and that children develop at different rates.

Roberton and Halverson (1984, p5) defined the developmental stages of movement as being "a characteristic way of behaving within an action system that is noticeably different from previous or later ways of behaving". The levels of each stage form a developmental continuum across the life span. In relation to FMS, this could apply to the body action and body control of the child as they complete the movement skill. Since the 1970s, researchers have analysed the intra-skill components of a variety of FMS and began to plot a model of the stages of development that are exhibited during early childhood for these movements (Seefeldt, 1972; Seefeldt & Haubenstricker, 1976; Halverson & Roberton, 1979). Further work was conducted to establish developmental sequences for a number of these FMS (Seefeldt and Haubenstricker, 1976; Roberton, 1978). Roberton (1978) described some of these movements by their separate

components and this method is known as Component Stage Theory. The Component Stage Theory states that each body component develops at its own rate and should be assessed independently from each other. For example, Roberton (1977) showed that in regards to the overarm throw, the arm action will develop independently of the leg and trunk actions and that the patterns will vary between children. On the other hand, Seefeldt and Haubenstricker (1976; 1982a; 1982b) assigned an overall stage classification score (stage 1 to stage 5) and this method is known as a Whole Body Approach. The approach outlines that all body components (e.g. arms, legs, trunk) develop together as the individual becomes more competent at the skill and is described by stages of development.

Adopting elements of both the Component Stage Theory and Whole Body Approach, Gallahue and Donnelly (2007) provided a system for classifying FMS in three stages during early childhood; initial, elementary and mature. Although not all movement patterns fit precisely into this three-stage progression, Gallahue et al. (2012) explained that the model is advantageous because it provides an easy to use, practical and reliable observational instrument. Recent FMS assessment tools designed for practitioners in Canada (PLAY [Canada Sport for Life, 2013]; 60 Mins FMS club [60 Minute Kids Club, 2018]) were based on a similar developmental staged model but introduced a fourth stage of development. These assessments provide an easy to use framework with appropriate descriptions of how each movement would be performed, corresponding to the appropriate stage of development. These assessments were intended to assess children aged 4-16 years old. The introduction of a fourth stage allows an additional level of classification over that proposed by Gallahue and Donnelly (2007), possibly to accommodate the wider age range of children that the assessments would be used with.

Existing FMS assessments utilise product- or process- oriented scoring criteria, or a combination of both (Burton & Miller, 1998; Cools et al., 2008). A product-oriented

assessment evaluates movement based on the outcome achieved (e.g. recording the number of times a child caught the ball, or distance recorded for a horizontal jump). The MABC-2 (Henderson et al., 2007) and BOTMP-2 (Bruininks & Bruininks, 2005) contain product-oriented scoring criteria. This style of assessment requires little or no prior assessor knowledge of the skill, but as it involves no consideration to how the movement was achieved, it provides limited support for children's movement development (Stodden et al., 2008). On the other hand, a process-oriented assessment evaluates movement based on the completion of pre-defined behavioural criteria (e.g. two handed catch = arms are extended and held in front of the body). This process requires the test administrator to have prior knowledge and understanding of the movement skills undertaken but provides the teacher with a greater indication of which aspects of the movement each child may need to develop (Tidén et al., 2015). An example of a process-oriented assessment would be the TGMD-2 (Ulrich, 2000). This style of scoring is also synonymous with the Component Stage Theory and Whole Body Approach, evaluating how the movement is performed. In a study investigating process- and product- oriented scoring, Logan et al. (2017) reported differences in children's FMS competence when measured with each approach for the same skills, suggesting that there is no perfect model for scoring and that the purpose and context of the assessment is an important consideration. The purpose of the assessment tool being developed in this research project is for it to be used by teachers to guide AfL. This style of assessment is characterised by using the evidence gained to address the needs of the student (Black & Wiliam, 2010), indicating that a process-oriented assessment would be most suitable. However, with non-specialist teachers of PE lacking subject knowledge (Morgan & Hansen, 2007) the reliability and feasibility of teachers using a process-oriented assessment could become an issue. Therefore, opinion of the academic and practitioner experts will be decisive in establishing the most appropriate scoring style for the teacher-oriented assessment.

While traditional FMS assessments were designed with minimal input from teachers (Burton & Miller, 1998), to the author's knowledge, no study has gained consensus from a wider panel of experts bringing together academics alongside practitioners with teaching and teacher-training expertise to generate the content of a teacher-oriented assessment of FMS. One method of doing this would be through the use of a Delphi poll (RAND, 1967). The Delphi poll draws upon the expertise of invited participants through numerous polling rounds to reach consensus agreement (Sumsion, 1998; Okoli & Pawlowski, 2004) and is a recognised method of gaining consensus from experts for the design of new interventions programmes (Okoli & Pawlowski, 2004). This method is acknowledged to be a valuable tool in initially establishing content validity of performance measurement tools (Robertson, Burnett & Cochrane, 2014) and it has been previously been used during the development of assessments related to children's FMS competence and physical literacy (Rudd et al., 2015; Francis et al., 2016). Strengths of the Delphi poll are that it allows a large number of people to be contacted (Bowling, 1997) and avoids conflict, as the participants do not meet face to face (Patton, 1997). Avoiding contact between participants ensures that responses are kept confidential and participants do not lose credibility based on their level of experience (Patton, 1997).

In light of the shortage of comprehensive discussion describing how teachers should assess FMS of 4-7 year olds, this study aimed to generate consensus for the content and format of the MAT from academic and practitioner experts from the fields of children's movement assessment and primary school PETE. The findings also provide a much needed perspective from international experts as to which movement tasks should be included in an assessment of FMS for children aged 4-7 years old, as well as the scoring approach to use considering the target user being a primary school teacher.

4.3 Methodology

4.3.1 Design

The Delphi poll (RAND, 1967) was used to collate expert perspectives to establish the content of the assessment tool. The overall purpose of the Delphi poll was to explore expert opinion around the format and content of an assessment of movement for children aged 4-7 years old to be conducted by a teacher in a school setting. The ethics committee of Liverpool John Moores University approved the research study (15/EHC/027), which was conducted between February and April 2016.

4.3.2 Recruitment and participants

Two groups of experts were identified for participation in the study: (i) academics with a background in children's movement development, and (ii) practitioners with experience of developing movement-based resources and/or assessments for children. Similar to other studies in the field (Ross et al., 2014; Barnett et al., 2015; Rudd et al., 2015; Francis et al., 2016) it was deemed important to include the voice of academics and practitioners with expertise in children's movement development. Specifically, this helped to balance the scientific rigor of developing assessment protocols and the practical requirements of administering PE assessments in school settings (Giblin et al., 2014; Herrmann et al., 2015;). According to Cantrill et al. (1996, p.69), an expert is defined as "any individual with relevant knowledge and experience of a particular topic". Therefore, no minimum length of experience was set for inclusion within this study.

A search of electronic databases (SPORTDiscus, EBSCOhost, and Science Direct) was conducted to identify academic experts who had: (i) authored peer-reviewed papers, and/or (ii) published textbooks (editor or chapter). The search was directed with the keywords 'movement competence', 'motor proficiency', 'fundamental movement skills' and 'movement skill assessment'. An additional list of contact details for leading

academics who did not appear in the search was provided by a member of the advisory board.

Practitioner expertise was defined if individuals had; (i) worked with children in movement development contexts, (ii) delivered movement development within PETE programmes, (iii) developed movement-based resources, and/or (iv) developed PE resources for primary school settings. Participants from practitioner backgrounds were not detectable through a public search, therefore, suitable contacts were provided by the research partner, the YST. A 'snowball' method (Streeton, Cooke & Campbell, 2014) was applied to recruit practitioner participants. Participants who were initially recruited were asked for the names and contacts of associates meeting the inclusion criteria. Participants who made recommendations for prospective participants, were given no confirmation of successful recruitment of their contacts, thus maintaining the anonymity of participants. It is acknowledged that participants may have communicated to each other about their involvement.

A minimum of 30 participants were targeted for this study to sufficiently meet the recommendations for a Delphi panel size (Okoli & Pawlowski, 2004; Sitlington & Coetzer, 2015). Considering the response rate to earlier studies (Sitlington & Coetzer, 2015 = 62%; Francis et al., 2016 = 50%) a list of 75 potential participants to invite was created. This number also accounted for potential attrition during the three rounds of the Delphi. In a three round Delphi poll consisting of movement experts (Francis et al., 2016) only 65% of participants completed the study (29 participants took part in round one and only 19 completed all three rounds).

All identified experts were invited via a personalised email (academics, n=34; practitioners, n=41). An online search engine (Google Inc, CA, USA) was used to locate the professional email addresses of invitees in the academic group. Email addresses for prospective participants with practitioner experience were provided by either the research

partner (YST), or the contact who recommended them. Participants were informed that their involvement would be anonymous and their individual responses would remain confidential, with overall agreement scores being reported between each round. Signed informed-consent was obtained from participants prior to commencement. All communication with participants was conducted via email and participants were informed that they were free to withdraw from the study at any time.

4.3.3 Delphi process

Although three to five rounds are considered appropriate (Sumsion, 1998), a maximum of three rounds was selected prior to beginning this study to reduce the potential fatigue and attrition caused by repeated rounds (Walker & Selfe, 1996). Each round of questions was designed to take no more than 10 minutes to complete and was administered via a web-based survey site (SurveyMonkey Inc, CA, USA). Each poll remained open for two weeks and reminder emails were sent two days prior to the poll ending.

A steering group of four members of the advisory board oversaw the creation and implementation of the Delphi poll. The primary role of the steering group was to complete a pilot of each round of the Delphi prior to it being released to participants. The steering group had the greatest input in establishing the first round of the Delphi as future rounds of the poll were determined by the responses of the participants. Rounds two and three were completed by the steering group prior to it being shared with participants to test that the formatting and reporting of the poll were functioning correctly.

4.3.3.1 Round one

Round One consisted of nine questions associated to the development of the assessment tool. The primary aim of this round of the poll was to determine the most important tasks to assess the movement competency of children aged 4-7 years. A list of

movement skills was composed following a review of existing movement assessments for children. Participants were presented with the list of movement skills (Table 4.1), which was sub-grouped into the three categories of FMS (stability, object control and locomotor) (Gallahue et al., 2012). Participants were asked to rate the importance of each task to demonstrate FMS competency of children aged 4-7 years within that category using a Likert scale (1 = very unimportant to 5 = very important). Participants were also asked to quantify the minimum number: of i) stability, ii) object control and iii) locomotor tasks to assess children's FMS. Participants were then asked to determine if the assessment should be differentiated by chronological age, and, if so, to indicate the distinction between age categories (1 year, 2 years, school year, other). Finally, participants were asked if the tool should be differentiated between genders. Space was included at the end of each question for participants to explain their selection or add further information. A guidance sheet containing additional information regarding the stability tasks was provided to participants in support of this round of questions (see Appendix 3.3). Forty-six participants completed round one. De Meyrick (2003) states that consensus between participants can be measured through the attainment of a pre-defined level of agreement to each question. Examples of accepted levels of agreement from previous Delphi studies include: 51% (Okoli & Pawlowski, 2003), 67% (Robertson et al., 2017), 75% (Francis et al., 2016) and 80% (Putman et al., 1995). Prior to commencement of the polling, it was determined that for the Likert-scale questions, consensus would be achieved if a minimum of 67% of participants rated the item as 'Important' or 'Very Important'. This was closest to the median value for consensus used in previous studies and represented agreement from two-thirds of participants. However, after polling was completed in round one, only three stability tasks met the 67% agreement level for selection as 'Important' or 'Very Important'. This figure was fewer than the response of participants that a minimum of four (Mean = 4.16) stability tasks are required to measure

stability within an assessment of FMS. Thus, for the selection of stability tasks in this question only, the consensus level was reduced to a lower level of acceptance of 51% (Okoli & Pawlowski, 2003). Tasks falling below the defined agreement levels were eliminated for future rounds. To establish the number of the tasks to be included within each category of movement, the mean score was calculated and rounded to the nearest whole number. For the remaining questions regarding differentiation of the assessment, 67% agreement was required for an item to achieve consensus. There was clear agreement from 78% of participants that the assessment should not be differentiated for the gender of the child, but no consensus was achieved to determine if the assessment should be differentiated for the age of the child. The additional comments provided by participants as part of this question suggested that a developmental stage approach should also be considered, which was in line with Gallahue et al. (2012) portrayal of FMS within a developmental stage-based model. Therefore, in round two this question was returned to participants to determine if the assessment should adopt an age or stage-based approach to differentiate the tasks within the assessment.

Table 4.1: List of tasks within each category of movement.

Stability	**Object control**	**Locomotor**
One leg balance	Rolling a ball underarm	Step up
Walking forwards along a beam	Underarm throw	Hopping forwards
Walking backwards heel to toe	Overarm throw	Hopping sideways
Doral raise	Trapping a ball with feet	Running
Forward roll	Kicking a ball	Galloping
Sideways roll	Catching a ball with two hands	Leaping

Plank hold	Catching a ball with one hand	Side-stepping
Front support	Dribbling a ball with alternate hands while stood stationary	Horizontal jump
Back support	Dribbling a ball while moving (using hands)	Vertical jump
	Dribbling a ball while moving (using feet)	Skipping
	Striking off a tee	Rope skipping
		Cross overs
		Agility run

4.3.3.2 Round two

Round two consisted of five questions, focusing on: i) differentiation of the assessment, and ii) the order that tasks should be learnt/introduced within the assessment. Responses from round one were inconclusive in establishing whether the assessment should be differentiated by age, however, some of the qualitative comments suggested that a developmental stage approach should be taken. This supports the developmental stages of FMS acquisition described by Gallahue et al. (2012). Therefore, the question of differentiating the assessment was deconstructed and returned to participants, specifically asking:

i. Should the scoring criteria of each task be differentiated for the developmental stage or chronological age?

ii. Should the assessment be differentiated by task for the developmental stage or chronological age?

The tasks that met the consensus agreement level in round one were presented to the participants in order of importance and listed alongside the percentage of participants that rated that task ‘Important’ and ‘Very Important’. Participants were asked to rank the

tasks in order that they should be learnt (1 = first, 2 = second, etc). Consensus was accepted at 51% agreement between participants (Sumsion, 1998; Okoli & Pawlowski, 2003). For the ranking tasks, the mean ranking score was calculated for each score, with the ascending scores indicating the order that tasks should be learnt.

4.3.3.3 Round three

Round three consisted of seven questions, focusing on: i) the number of developmental stages to be included in the FMS assessment for children aged 4-7 years old, ii) the final selection of tasks, and iii) the scoring approach for a teacher-oriented assessment of FMS. Firstly, participants were asked to indicate an appropriate number of developmental stages to include within the FMS assessment. Next, the most important tasks in round one that fell within the minimum number of tasks required to assess each component of FMS (e.g. the 4 most important stability tasks) were returned to the participants in the order established in round two that they should be learnt. From these lists of tasks, participants were asked to indicate whether a product-oriented, process-oriented or hybrid scoring approach, combining product- and process- oriented scoring should be used. Participants were also asked to determine between two tasks in each of the object control and locomotor categories to include in the assessment that were deemed of equal importance in round one. Finally, participants were asked to indicate the number of process-oriented criteria within a teacher-oriented assessment of FMS. Consensus was accepted at 51% agreement between participants. In some questions, consensus agreement level was not reached. As this was the third and final round, responses were not returned to participants for further consideration. It is accepted that consensus does not have to be achieved for each question and the data can be used to identify the extent that participants agree on a topic (Mullen, 2003). Considering the paucity of research discussing the development of children's movement assessment, the data generated are an important addition of knowledge to the field.

4.4 Findings

4.4.1 Participant responses

Of the 75 experts invited to take part in the three-round Delphi process, 6 did not respond, 11 declined to take part and 58 agreed to take (academics, n=27; practitioners, n=31). This acceptance rate of 77% was higher than that seen in previous studies (Sitlington & Coetzer, 2015; Francis et al., 2016; Robertson et al., 2017) and presented a larger group of participants than is typically seen for a Delphi poll. A total of 46 participants provided responses (79% response rate) to round one, consisting of 25 academics and 21 practitioners. See Table 4.2 for characteristics of participants who completed round one. Of the 46 participants who responded in round one, 42 completed round two. This 91% response rate from the previous round was higher than seen in previous studies (79% = Francis et al., 2016; 71% = Robertson et al., 2017). Of the 42 participants who responded in round two, 36 completed round three (86% response rate, 79% retention rate from round one). This overall retention of 79% was significantly higher than the threshold of 70% described by Walker and Selfe (1996) for the findings to be valid.

Table 4.2: Characteristics of participants who completed round one of the Delphi poll

Characteristic	**Descriptor**	**Total (n)**
Current role	Lecturer	14
	Professor	7
	Academic researcher	4
	PE practitioner	21
Area expertise	Published papers in the subject area of movement competence/assessment	19
	Published papers in the subject area of PE in primary school settings	14
	Developed movement assessments	28
	Developed movement-based interventions	29

	Developed PE resources for primary school setting	35
Years of experience researching in the field of children's movement competence/assessment	1-4	8
	5-9	7
	10-14	7
	15+	3
Years of experience in PE settings with children aged 4-7 years old	1-4	9
	5-9	9
	10-14	10
	15+	11

A primary aim of this study was to establish the content of the assessment and determine which skills were most important for teachers to assess the FMS of children aged 4-7 years old. Table 4.3 presents the results of the questions related to the content of the assessment that spanned the three rounds of the Delphi poll.

Table 4.3: Results indicating consensus agreement from round one, two and three related to the most important movement tasks for teachers to assess FMS of children aged 4-7 years old

		Round one (n=46)			**Round two (n=42)**		**Round three (n=36)**		**Scoring approach**					
Category of movement	**Task**	**Number of tasks to assess FMS (Mean)***	**Importance to assess FMS of children aged 4-7 years old**		**Sequential order for tasks to be learnt**		**Most important to assess FMS****		**Product-oriented**		**Process-oriented**		**Hybrid**	
			Mean*	**% responses rated 'Important' or 'Very Important'**	**Mean* ranking**	**Order**	**n**	**%**	**n**	**n%**	**n**	**%**	**n**	**%**
Stability		4.16												
	One leg balance		4.89	89	1.85	1			16	44.5	12	33.5	8	22
	Walking forwards along a beam		4.09	83	2.98	2			9	25	17	47	10	28
	Walking backwards toe to heel		3.65	57	4.07	5								
	Dorsal raise		3.37	52	4.67	6								
	Forward roll		3.33	46										
	Sideways roll		3.85	70	3.69	3			4	11	27	75	5	14
	Plank hold		3.39	44										
	Front support		3.72	63	3.74	4			12	33.5	17	47	7	19.5
	Back support		3.54	48										

Object control		4.78											
	Rolling a ball underarm	4.09	74	3.07	3	6	16.5	5	14	24	66.5	7	19.5
	Underarm throw	4.43	87	2.67	2			5	14	25	69.5	6	16.5
	Overarm throw	4.41	89	3.98	4			5	14	21	58	10	28
	Trapping a ball with feet	3.63	61										
	Kicking a ball	4.32	85	4.38	5			4	11	21	58	11	31
	Catching a ball with two hands	4.67	98	2.36	1			7	19.5	17	47	12	33.5
	Catching a ball with one hand	3.78	70	7.17	8								
	Dribbling a ball with alternate hands while stood stationary	3.96	74	5.55	6	30	83.5	7	19.5	14	39	15	42
	Dribbling a ball while moving with hands	.67	59										
	Dribbling a ball while moving with feet	3.63	61										
	Striking off a tee	3.78	70	6.83	7								
Locomotor		5.02											
	Step up	3.72	57										
	Hopping forwards	4.41	94	3.80	2			6	16.5	21	58.5	9	25
	Sideways hop	3.65	52										
	Running	4.74	96	1.07	1			6	16.5	23	64	7	19.5
	Galloping	4.11	78	6.19	8								
	Leaping	4.17	80	5.89	7	9	25	5	14	24	66.5	7	19.5

	Sidestepping	4.20	80	5.05	5	27	75	4	11	25	69.5	7	19.5
	Horizontal jump	4.41	85	3.83	3			4	11	23	64	9	25
	Vertical jump	4.15	76	5.02	4								
	Skipping	4.35	94	5.14	6			5	14	24	66.5	7	19.5
	Rope skipping	3.26	35										
	Cross overs	3.30	39										
	Agility run	3.74	66										

* Mean rounded to 2 decimal points.

** These questions were included in round three to establish consensus agreement as their importance to assess FMS was rated equal in their respective domains in round one.

The mean average calculated for the responses in round one indicate that 4 stability, 5 object control and 5 locomotor skills should be included within an assessment of FMS for children aged 4-7 years. Within the three components of FMS (stability, object control and locomotor), the importance of each movement task to assess within its respective sub-set of movement tasks was established. On an individual task basis, consensus shows that the one leg balance (89% responses rated 'Important' or 'Very Important'), catching a ball with two hands (98%) and running (96%) were the most important tasks to assess stability, object control and locomotor, respectively. Tasks that did not meet the threshold of consensus for importance to assess FMS in round one were excluded from the further rounds of questions. Within round two, the sequential order that tasks should be learnt was established. Experts judged that balancing on one leg, catching a ball with two hands and running should be the first tasks to be learnt within their respective components of FMS. In round three, process-oriented scoring was the preferred approach for all but two movement tasks. For these two tasks, 44.5% of participants felt that the one leg balance should be assessed using a product-oriented scoring approach, compared to 33.5% who felt that a process-oriented scoring approach should be used. In relation to dribbling a ball with two hands, 42% of participants felt that a hybrid approach would be best, with 39% selecting a process-oriented approach.

Table 4.4: Results from questions in round one related to differentiating the assessment

Differentiation approach	**Yes**	**No**	**Neutral**
Chronological age	37%	46%	17%
Gender	9%	78%	13%

There was strong consensus from the responses in round one that the assessment should not be differentiated by gender. Responses in round one were inconclusive if the

MAT should be differentiated for the chronological age of the child. This question was re-formulated and returned to participants in round two.

Table 4.5: Results from questions in round two related to the method of differentiation within the assessment

Method of differentiation	**Developmental stage**	**Chronological age**	**Do not differentiate**
Scoring criteria	63%	14%	21%
Task	52.5%	14%	33.5%

Responses in round two established consensus that the MAT should be differentiated by the developmental stage of the child. There was strong consensus (63%) that this method should be used to differentiate the scoring criteria, and mildly weaker, but still above a 51% consensus threshold, that the tasks should be differentiated in this way (52.5% agreement).

4.5 Discussion

The aim of this study was to gain consensus agreement from experts to generate the content of a MAT for primary teachers to use to assess the FMS of children aged 4-7 years. To provide a comprehensive view of how FMS should be assessed in early childhood by teachers, experts from academic and practitioner settings with specialism in children's movement development and primary school PE were invited to take part. These findings present a method that primary teachers can use to assess the FMS of children aged 4-7 years old.

The responses in the Delphi poll have provided a definitive list of movement tasks for teachers to assess the FMS of children age 4-7 years old (Table 4.6). This table allows a teacher or practitioner to identify the order in which the movement tasks should be introduced to children in each component of FMS. For example, within the subset of

locomotor skills, running should be looked at before hopping, which should be mastered before skipping. Similarly, the table indicates that children should be given the opportunity to progress to different skills within each component of FMS as they become more competent in that subset. For example, a child may be more competent in performing stability skills than object control, therefore the child could be introduced to the four stability skills, whilst still having a focus on and two-handed catch and underarm throw.

Focusing on the movement tasks in isolation, the results of this study (presented in Figure 4.3) comprehensively demonstrate which are the most important for children aged 4-7 years and the order in which they should be learnt. For instance, 98% of participants in round one felt that the two-handed catch was 'Important' or 'Very Important' for teachers to assess the FMS of children aged 4-7 years, establishing this as the most important skill within the object control component of FMS. Similarly, the one leg balance (89%) and running (96%) were deemed to be the most important movement tasks within the stability and locomotor components of FMS, respectively. This knowledge is beneficial to a teacher or practitioner who is planning a programme of learning around FMS, as it allows them to design activities to include the movement tasks that are judged to be the most important within this age range. For example, there was consensus from 98% of participants that catching a ball with two hands was 'Important' or 'Very Important' to assess object control competence, whereas the consensus from participants for dribbling a ball with hands while moving was only 59%.

Of note, in round one, skipping was ranked highly as an important task to assess locomotor competence (94% of participants rated it "Important" or "Very important", ranked 3rd equal within the 11 locomotor sub-set of tasks) yet in round two, participants ranked it as the 6th skill in sequential order to be learnt. Hopping forwards was deemed to be of equal importance as skipping (both rated 94% 'Important' or 'Very important'), yet

the results in round two suggest that hopping forwards should be the second locomotor task to be learnt, being introduced well before skipping. This is supported by Roberton and Halverson's (1984) description of skipping as a complex skill involving a step and a hop on the same foot, that is also observed to be one of the last locomotor skills to develop in childhood (Payne & Isaacs, 2011; Gallahue et al., 2012). The importance given by experts to the task of skipping indicates that it is a vital skill for children to learn but it should not be introduced to children until other related FMS have been developed, e.g. running and hopping. These findings indicating the importance of each task, and the order that they should be introduced, will be helpful for teachers to plan their schemes of learning and support children's development of FMS along a suitable continuum.

Table 4.6: The number and type of movement task to assess children's FMS competence at 4-7 years old

Task number	**Stability**	**Object control**	**Locomotor**
1	One leg balance	Two handed catch	Running
2	Walk forwards along a beam	Underarm throw	Hopping forwards
3	Front support	Overarm throw	Horizontal jump
4	Sideways roll	Kicking a ball	Sidestepping
5		Bouncing a ball with alternate hands while stood stationary	Skipping

The combined findings of round one and round two in relation to the differentiation of the assessment are interesting as the experts agreed that the movement tasks (63% agreement) and the assessment criteria (52.5% agreement) should be differentiated using a developmental stage approach. This approach is less common in

existing FMS assessments that were designed for health professionals and physical therapists that either do not differentiate (e.g. BOTMP-2 [Bruininks & Bruininks, 2005]) or differentiate the task by the age of the child of the participants (e.g. MABC-2, [Henderson et al., 2007]). The preference of a developmental stage approach by academics and practitioners in this study recognises the theory behind children's movement development that FMS is not age dependent (Gallahue et al., 2012) and that other factors such as peers, opportunities for practise and physical development can influence development of FMS (Robinson & Goodway, 2009). However, it is unusual for school-based assessments to consider the developmental stage of the child, and normal practise in school is for children to be assessed against expected levels for their age. The responses for academics and practitioners were amalgamated during data collection and there was no way to separate the two groups within this research design. It would have been noteworthy to analyse the responses from these two groups separately, to observe if there were any differences in their agreement. Based on the recommendations of Jess et al. (2016), adopting a developmental stage approach would assist the teachers by providing a holistic perspective of the child's development and not be restricted by age. This would enable the teacher to provide precise and appropriate support to each child, specific to their stage of development.

The practicalities of how the MAT could be differentiated, in regards to both the scoring criteria and task, for the development stage of the child will require consideration. The classification system proposed by Gallahue and Donnelly (2007) presented a model consisting of three developmental phases. This method is similar to the Whole Body Approach that indicates that within the performance of a task, all body components develop together. Developmental sequences for a number of movement tasks have been validated using this format (Seefeldt and Haubenstricker, 1982a, 1982b), however, the implications for assessment purposes are that multiple aspects of the movement have to

be observed at one time (i.e. arms and legs), making assessment more difficult. Conversely, the TGMD-2 (Ulrich, 2000) adopts a style of scoring that is more synonymous with the Component Stage Theory to measure how the movement was performed. Using this method, proposed by Roberton (1977), it is understood that each part of the body develops at its own rate and should be assessed independently from each other. Thus, the movement task can be broken down into observable moments.

In relation to modifying the task, by their nature, some tasks can not be made harder without changing the task. The movement task of running can be altered by changing the speed, or direction, but the dynamics of the movement remain the same. The principle of changing speed would be indicative of a product-oriented assessment, in which distance travelled could be measured. This would also be more representative of a test of fitness, and not FMS.

Round three addressed the scoring approach that should be adopted for each movement task within the assessment. As indicated in Table 4.3, process-oriented scoring was the preferred approach for all but two movement tasks. The consensus agreement for process-oriented scoring may be indicative of the association between this style of scoring and AfL, in which the assessment can be used as a guide to provide information to support subsequent teaching and instruction (Stodden et al., 2008; Tidén et al., 2015). As a tool to be used for assessment purposes, process-oriented scoring helps a teacher to understand where a child's competence is on the developmental continuum for that particular skill. This would be critical to inform the teacher of the future direction for learning (Halverson & Roberton, 1984) within the assessment-teacher-learning cycle as it would aid the teacher in identifying which aspect of the skill they need to work on with that child. This does have implications for the development of the assessment as primarily non-specialists deliver PE in primary schools, as it has been discussed previously in this thesis that process-oriented scoring requires the assessor to have a greater level of knowledge and

understanding to assess accurately. Therefore, consideration would be required to acknowledge the support needed for non-specialists using the assessment. Chapter One and Chapter Five outline the potential benefits of using digital technology for the assessment of FMS. In this instance, being able to video record the child would allow the assessor to view the performance multiple times, as well as play the video in slow motion. Knudson and Morrison (2002) suggest that assessing from video in this way can be particularly beneficial for assessors with a lower level of knowledge and understanding.

4.6 Limitations

The strength of consensus gained in single rounds of polling suggest that the components of FMS and the emphasis on the skills that demonstrate FMS competence, do not vary greatly between geographical locations. However, the differences in the respective National Curriculum frameworks of participants in each location may have influenced their decisions considering the assessment was intended for use by teachers. Thus, although it could be said that the MAT would be suitable for use in multiple locations, it's curricular validity in locations where significant cultural differences exist may be moderated. In this instance, the assessment content should be modified to meet the specific requirements of that region's National Curriculum policy and cultural preferences.

A general limitation of a Delphi poll is that the results are specific to the panel of experts taking part and a different group of participants may not produce the same responses, reflecting their individual experiences and backgrounds. However, any differences of opinion of the individuals and their collective areas of expertise (i.e. academic or practitioner) in this study are mitigated by the large participant sample. Despite the steps taken to recruit an equal number of academics and practitioners, the final sample was controlled by the willingness of participants to respond and complete the poll (see Table 4.2). In this study, the responses from academics and practitioners

were collated together and it was not possible to distinguish responses from the respective groups. To better understand the choices of each group of experts, the responses of each group could have been analysed independently. This would have provided a unique perspective of the differences and similarities in how academics and practitioners view the assessment.

Typically, Delphi polls are conducted over three and five rounds until consensus agreement is reached. In this instance, only three rounds were conducted due to the time-frame of the study and the level of commitment required from participants. Participant responses for each question in the final round of questions did not all reach a consensus level of 51% (e.g. Question 3 - product-oriented, process-oriented or hybrid approach-see Table 4.3). However, the results of a Delphi poll do not have to reach consensus and the responses can be used to indicate the strength of the agreement between participants, which remains a valuable finding of the study. In fact, the responses from the questions in round three relating to the scoring approach suggest strong agreement, with 14 out of 16 tasks receiving a consensus level of over 40%. Due to the level of drop off rate experienced from round two to round three in this Delphi poll, it was felt that conducting a fourth round had the potential to continue the attrition of participants due to participant fatigue. This was particularly concerning as Walker and Selfe (1996) recommend a minimum response rate of 70% should be maintained across the Delphi rounds for the findings to be deemed valid. If a similar drop off rate from the previous rounds had been experienced in a fourth round, then the responses would have fallen below the 70% threshold.

In this particular study, an additional final round of questions could have been provided to participants to establish conclusive consensus agreement for the assessment scoring style. As discussed above, the decision to not use this additional round was taken to prevent participant fatigue and reduce the rate of attrition. Furthermore, at the time of

recruitment, participants were informed that only three rounds would be conducted. Similarly, a model of the final assessment demonstrating the content and format conceived by participants through the Delphi poll could have been shared for a final round of opinion and to clarify if the model reflected the participants' beliefs and input. However, again, this additional round of questions could have led to further rounds until consensus was finally met.

4.7 Conclusions

It has been discussed in Section 1.2 and 4.2 of this thesis that despite the availability of a range of FMS assessments, further work was necessary to provide a comprehensive description of which movements constitute FMS, and specifically, which movement tasks should be used to assess FMS competence of children aged 4-7 years old. The findings of this Delphi poll have provided a quantifiable perspective from experts to establish the content of an assessment for teachers to assess the FMS of children aged 4-7 years old. By gaining the consensus agreement of academic and practitioner experts of children's movement development, these findings establish content validity for the composition of movement tasks within the MAT. Therefore, signifying that the MAT would be a valid measure of FMS for children aged 4-7 years. To the author's knowledge, this is the first study to compile a definitive list of FMS to be assessed by teachers during early childhood and goes some way to answering the call by Tompsett et al. (2017) to determine which movements constitute FMS.

As well as informing the development of the MAT, these findings are valuable to researchers, teachers and practitioners who want to better understand children's FMS competence and support their development as they could help to guide the development of future programmes and interventions for children of a similar age. The emphasis of the MAT design has been on UK settings, however, the transferability of the findings of this Delphi poll are guaranteed internationally as this study was conducted with a group of

participants spanning four continents. FMS, encapsulated within the 'physical competence' construct of Physical Literacy (Whitehead, 2013), also has prominence in PE curriculums globally (Ontario Ministry of Education, 2015; Australian Curriculum, Assessment and Reporting Authority, 2016; Society of Health and Physical Educators America, 2016). Standardising assessment methods would also enhance the measurement of FMS across disciplines (e.g. schools, health practitioners) and national and international populations to evaluate the impact interventions and benefit programme planning.

4.8 Future research

This Delphi poll has provided a robust and definitive description of the content and format of a teacher-oriented assessment of FMS for children aged 4-7 years old. The content of the assessment generated in this study will be integrated alongside the recommendations from Study One and Study Two to create the prototype of the MAT. The findings of this study have established the arrangement of movement tasks to be included within the assessment and that a process-oriented scoring approach would be most suitable for the majority of the skills within the assessment. Therefore, further work will be required to establish developmentally appropriate assessment criteria for each movement task within the assessment. Furthermore, the assessment model should be taken into school and provided to teachers to use to explore the feasibility and value of the assessment being used by teachers. Further examination is then required to objectively establish the construct validity (i.e. convergent and discriminant) and reliability (test re-test and inter- and intra- rater reliability) to confirm the strength of the MAT in relation to existing assessments of FMS.

Children are capable of reaching FMS competence by the age of 7 years (Gallahue et al. 2012), but many do not achieve this (Bryant et al., 2015; Foulkes et al., 2015; Foweather et al., 2015; Morley et al., 2015; De Meester et al., 2018). Therefore, an independent programme of research could be conducted to generate the content of a similar

assessment for teachers to employ with children aged over 7 years, specifically in Key Stages 2 and 3, to promote and encourage children's development of FMS across their school life.

CHAPTER 5

An overview of the development phases

of the movement assessment tool

Chapter 5: Development of the movement assessment tool prototype

5.1 Introduction to the development of the movement assessment tool

Study One, Two and Three of this thesis sought the perceptions and agreement of primary teachers and experts (academics and practitioners) of children's movement assessment and development to establish the content and format of a MAT for primary teachers to use with children aged 4-7 years. Initially, in Study One, the recommendations from primary teachers indicated that embedding the assessment on a digital technology platform would be beneficial to them. Participants suggested that the features and functions provided by digital technology (for example, library of video content and video recording) could enhance the assessment process and improve their understanding and confidence in assessing children's FMS. The perspectives of academic and practitioner experts who participated in Study Two indicated that digital technology could provide advantages to teachers, particularly, non-specialists of PE who would benefit from the inclusion of video content to better understand the specific assessment tasks. These findings are in line with recommendations (Penney et al. 2012; Graham et al., 2013; O'Loughlin et al., 2013) that digital technology and video content could revolutionise assessment practises in PE.

Combining the findings from the previous studies, as well as drawing on existing literature and field work, each in this chapter is related to the process undertaken to create the prototype of the app which contained the MAT. This process involved engagement with the YST, as the research partner for the project, as well as multiple external contractors who were employed to undertake specialist work (for example, software development of the app). Following a chronological sequence from inception to creation, this chapter will:

i. Provide an examination of the use of digital technology for assessment in PE.

ii. Present the assessment criteria for each task and justify their selection.

iii. Describe how the video content was generated and validated for inclusion in the app.

iv. Describe how the app containing the MAT was created.

v. Present the final version of the MAT prototype.

5.2 Role of technology for assessing movement competence within PE

This section explores the use of digital technologies for the assessment, recording and monitoring of children's FMS competence within PE. Across a child's schooling, it is the responsibility of schools and teachers to develop their own systems and processes to assess and monitor attainment. Whilst it can be suggested that children's assessment within PE will be varied, what is less certain is the prevalence of technology within this environment and how technology is being used to enhance our understanding of children's FMS competence. In recent years, a small number of studies have demonstrated the effectiveness of adopting technology within assessment in PE (Penney et al., 2012, O'Loughlin et al., 2013). Penney et al. (2012) demonstrated the positive effects of using digital technologies to assess skills-based performance with 15-18 year olds. In their study, it was found that digital technologies (in this instance, video recording) could feasibly be used to assess both the practical and theoretical aspects of PE within a range of activities. Similarly, O'Loughlin et al. (2013) showed that video technology could be used to effectively assess primary aged children's skill performance in PE, Further, the students involved in these studies felt that the use of self-assessment using video was more engaging (O'Loughlin et al., 2013) and the authentic nature of the assessment tasks allowed them to provide a better demonstration of their achievement (Penney et al., 2012).

In recent times, the proliferation of digital technologies has led to the growing availability and technological advancement of hand held devices, such as tablets, phablets

(a smaller tablet than, perhaps, an iPad) and mobile phones. Learning the functional uses of this technology, such as video capture and playback, touch screen magnification and focus, swiping and multi-screen viewing is now as commonplace as those skills that have dominated human behaviours previously; such as reading, writing and talking. This increasing availability and usage has meant that both teachers and children are more familiar with the routine usage of technology in their day-to-day lives and what could previously be regarded as a barrier to using technology in enhancing learning has likely been reduced. In light of this change in learned behaviours, it is appropriate that this technology is considered to be used to benefit the assessment of children in PE. Given the sustained emphasis on developing the FMS competence of children, using technology to enhance our understanding of children's movement competence through assessment seems appropriate.

Assessment protocols utilising digital technology, particularly app-based software, have the capability to offer more opportunities for "authentic assessment" to take place. Authentic assessment is defined as 'assessment for learning' (Hay & Penney, 2009), offering opportunities for children to be fully integrated through the establishment of an open environment, with co-created usage of assessment between the teacher and the learner. The ability to share clear learning outcomes via visual demonstrations, alongside verbal instruction and feedback, offers the potential to fully engage the child in the learning process and enhance their learning (Davids et al., 2008), rather than the teacher being seen as the sole beneficiary of the assessment process.

Using digital video for feedback and assessment in PE has been shown to enhance children's motivation and improve their skill performance (O'Loughlin et al., 2013). It is suggested that analysis of movement from video is beneficial for individuals with lower understanding and knowledge of the movement, as they are able to view the performance multiple times as well as play the video in slow motion (Knudson & Morrison, 2002).

The importance of this is magnified within a process-oriented assessment, where the repeated viewing of the video from different angles could support untrained assessors to evaluate the quality of the movement. A previous study involving PE teachers who have used video technology for assessment, demonstrated that the ability to highlight aspects of performances was a major benefit, as it benefited students to identify key learning points (Weir & Connor, 2009). The hand-held nature of the tablet would also enable the teacher to be mobile during the assessment and record the performance from different angles.

In response to the unique challenges and environment that primary teachers contend with, as previously articulated, it is suggested that technology can be used appropriately to better support teachers' subject knowledge and application of teaching within PE (Graham, Holt/Hale & Parker, 2013). Browne's study (2015), gaining teachers' perceptions of using app-based software to teach PE, highlighted that technology had a future in the subject but indicated that consideration is needed to understand how the software aligns with teachers' knowledge and professional development.

The recommendations made by teachers and experts in Study One and Study Two advocate the use of introducing digital technology for the purposes of assessing children's FMS competence. The findings of Study One outlined that the perceived benefit to teachers of using an app-based assessment would be the simplicity it would provide to record children's assessment scores, the capability to include video content for demonstrations, capture video evidence of the child and monitor progress from within the app (removing the necessity for keeping paper files). Currently, there is no such app-based software available to assess children's FMS, so this development will be unique in being the first piece of technology of its kind to be developed and made available for teachers to assess children's FMS.

5.3 Overview of the development process from conception to creation

The design of the MAT prototype was based on the recommendations and findings obtained in Study One, Two and Three. The development of the prototype was a multi-stage process. Initially, a digital storyboard of the MAT was designed based on the recommendations of teachers' and movement experts in Study One and Study Two. Based on this storyboard, the design brief for the MAT was created considering:

i. Use of technology. These considerations included the functions provided by digital software and the use of video.
ii. Pedagogical considerations.
iii. Appropriate assessment criteria for each movement task.
iv. Validity of the demonstration video content.

Primary teachers and experts of children's movement development and assessment were involved throughout this development phase to evaluate the suitability of functions and features within the app and strengthen the validity of the assessment criteria and selected video content of the demonstration videos. The final prototype was presented to teachers within Study Four to examine the feasibility of the MAT being used by primary teachers in PE lessons.

5.4 Model and justification of the assessment scoring criteria / revisions

As described in Study Three, a Delphi poll was conducted with an invited group of international academic and practitioner experts, from the fields of children's movement assessment and development and primary school PE, to establish the most important movement tasks to include in a teacher-oriented FMS assessment for children aged 4-7 years old. This study was vital to fulfilling the second objective of this research project; *to generate, by expert consensus, the framework of a teacher-oriented assessment of FMS for children aged 4-7 years old.*

Traditional FMS assessment tools display similarities in their content, in that they contain tasks that measure components of stability, object control and locomotor skills (Burton & Miller, 1998). However, as reported earlier in this thesis, these assessments were not developed with teachers in mind as the assessor, thus did not consider the requirements of the PE curriculum for the children they were intended to be used with. Furthermore, as discussed by Tompsett et al. (2017) in a systematic review of FMS interventions, there remains no standardised list of tasks that should be assessed to measure FMS competence. Therefore, the findings of Study Three not only provide a framework for the content of the MAT within this research project, but by presenting an agreed definition of which tasks should be assessed at age 4-7 years old, they also offer a consistent guide for other researchers and practitioners in developing future FMS measurement tools, programmes or interventions with similar aged children.

As previously reported in Study Three, Table 5.1 below presents the composition of tasks to be included within the FMS assessment for children aged 4-7 years old.

Table 5.1: Movement tasks included in the assessment to assess FMS of children aged 4-7 years old

Task number	**Stability**	**Object control**	**Locomotor**
1	One leg balance	Two handed catch	Running
2	Walk forwards along a beam	Underarm throw	Hopping forwards
3	Front support	Overarm throw	Horizontal jump
4	Sideways roll	Kicking a ball	Sidestepping
5		Bouncing a ball with alternate hands while stood stationary	Skipping

5.4.1 Assessment criteria

The finding of Study Three provided a consensus from participants that the teacher-oriented MAT should adopt a process-oriented scoring approach. A process-oriented assessment evaluates the movement being performed based on the completion of pre-defined behavioral criteria (e.g. two handed catch = arms are extended and held in front of the body) (Burton & Miller, 1998). This style of scoring aligns to Knudson and Morrison's (2002) definition of qualitative assessment being "the systematic observation and introspective judgement of the quality of human movement for the purpose of providing the most appropriate intervention to improve performance". On the other hand, quantitative assessment methods involve measuring the product or outcome of the performance. The scoring in these assessments is based on what has been achieved, such as the number of successful catches or distance jumped. Quantitative, or product-oriented, assessments, are useful for comparing children against their peers and screening for movement deficiencies, but the test outcomes are not great for informing teaching programmes as they do not provide direct information about the proficiency of the performance (Branta, Haubenstricker, & Seefeldt, 1984). Therefore, considering the rationale of this research project to design a MAT for primary teachers to use, it is understandable why the experts in Study Three determined that a process-oriented scoring, as a qualitative assessment, was most appropriate.

In a discussion of how FMS competence can be assessed, Hands (2002) described two main approaches to qualitative measurement - a Whole Body Approach and a Component Stage Theory. The Whole Body Approach, which is associated with Seefeldt and Haubenstricker (1982a; 1982b) states that all body components (e.g. arms, legs, trunk) develop together as the individual becomes more competent at the skill and is described by stages of development (e.g. initial, elementary and mature). This model is used by Gallahue at al. (2012) to describe the developmental sequences for a range of

FMS. On the other hand, the Component Stage Theory, proposed by Roberton (1977) states that each body component develops at its own rate and should be assessed independently from each other.

The Whole Body Approach has historically been used to describe the developmental sequences for a large number of FMS (Seefeldt and Haubenstricker, 1982a, 1982b; Gallahue at al., 2012). However, this approach has not appeared in formal methods of assessing children's FMS by researchers or teachers. On the other hand, a number of commonly used FMS assessments (e.g. TGMD-2 [Ulrich, 2000]; MABC-2 [Henderson et al., 2007]) use a version of Component Stage Theory, identifying the key actions of the main body parts in the competent form of an action. The scoring criteria within these assessments do not represent a developmental sequence nor fully describe an instructional sequence but comprise certain key aspects for a competent performance. For example, in the TGMD-2 (Ulrich, 2000), the assessor records the key components of the skill being demonstrated by the performer, meaning those components that are not demonstrated, such as "arms bent at elbows and swing forward on take off" can become the focus for future interventions by the teacher.

In accordance with the findings of Study Three, a process-oriented scoring approach was adopted for the MAT. The Component Stage Theory model proposed by Roberton (1977) was used to frame the assessment criteria for each task around the key body parts involved in performing the task. Segmenting the movement tasks by the main body components benefits the assessment in two ways:

i. It breaks the movement task down into observable moments for the teacher/assessor to observe.
ii. It informs the teacher (or assessor) which specific components of a movement task an individual needs to practise.

As an assessment tool to be used in educational settings, a developmental approach, provided by process-oriented scoring, helps a teacher to understand where a child's competence is on the developmental continuum for that particular skill (Hands, 2002). Thus, aiding the teacher to identify what aspect of the skill they need to work on with that child. For example, if a child only demonstrates a one-footed skip, the teacher may then intervene and instruct the child to practise hopping on the foot that is missing the hop during the skipping action. Subsequent to the intervention, the teacher will then be able to observe if the child has progressed to perform the skill more competently.

A negative aspect of qualitative assessment is that it requires the assessor to have a prior knowledge and level of understanding of the movement tasks undertaken. In-line with the recommendations of teachers in Study One and academic and practitioner experts in Study Two, video demonstrations of the assessment tasks were included within the MAT to support teachers' understanding of the behavioural criteria for each task.

5.4.1.1 Justification of the scoring criteria

The assessment criteria for each of the 14 movement tasks within the MAT are listed below. The criteria for each task are accompanied with a justification for its validity to use within the MAT based on literature and existing FMS assessments.

Stability tasks

1. <u>One leg balance</u>

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Legs	• Standing leg is unstable • Other foot is lifted	• Standing leg is stable • Other foot is lifted	• Standing leg is stable • Other leg is held in the air with knee bent at approximately 90 degrees (knees close)

Arms	• Arms frequently moving	• Both arms held out to the side (not in T position), • Occasional movement of arms.	• Both arms held out to the side in T position with minimal movement
Head/ body	• Trunk unstable (leaning sideways or forward)	• Trunk held upright • Head moving or not looking forwards	• Trunk and head upright and still

The one leg balance is one of the most commonly used measures of static balance. The criteria for the one leg balance have been adopted from the developmental sequences described by Gallahue et al. (2012) which were based on observations during performance investigations. Their developmental sequences have not been validated, nor was a validated developmental sequence found for the skill.

2. Walking forwards along a line

- Tape (6 cm wide) measured out 3m long on the floor, with start and stop markers measuring 50cm at each end marked out on the floor (Figure 5.1)

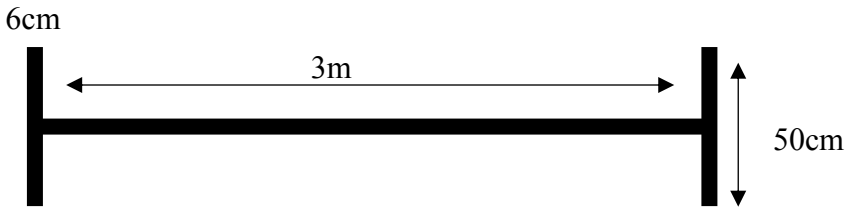


Figure 5.1: Layout of tape on the floor for walk along a line

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Stepping	• Frequently steps off the line • Sometimes walks heel-to-toe	• Sometimes steps off the line • Heel-to-toe walking not always maintained	• Consistently walks with heel-to-toe contact along the line

Arms	• Arms frequently moving	• Arms held out to side (not in T position) • occasional movement of arms	• Both arms held out to the side in T position with minimal movement
Trunk	• Trunk unstable (leaning sideways or forwards)	• Trunk upright and stable • head and eyes looking at line	• Trunk and head held upright

At the time that the MAT criteria were created, there was limited published research around the developmental sequence of waking along a line. However, Gallahue et al. (2012) had provided unverified developmental sequences for walking along a line based on observational assessments of multiple children. Walking forwards on a line is used in one existing FMS assessment (Physical Literacy Assessment for Youth [PLAY] [Canadian Sport for Life, 2013]). The chosen criteria have been adapted from the developmental sequences described by Gallahue et al. (2012) and the criteria within PLAY.

3. Front support

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Arms/ hands	• Hands flat on floor • Arms not vertical	• Hands and fingers flat on floor • Arms vertical	• Hands and fingers flat on floor pointing forwards • Arms vertical and straight
Legs	• Legs lifted but stable position not seen	• Legs lifted with occasional movement	• Legs lifted and held still
Body	• Hips lifted but not held in line with shoulders and heels	• Hips lifted in line with shoulders and heels • No straight line between shoulders and heels	• Hips lifted and position maintained with straight line from head to heels maintained

Because of the body control required to perform the front support, it is classified as a stability movement task (Gallahue et al., 2012). There is a limited amount of published literature around this movement task and no published developmental sequences for the front support have been located. In their study to establish appropriate measures of stability with the FMS model, Rudd et al. (2015) proposed that the back support was a suitable task to assess stability and body control. Rudd et al., (2015) discussed that the front support and back support were very similar skills, measuring the same performance, and elected to only include the back support as it was a greater test of torso strength and posture stability. Considering that Rudd et al. (2015) tested the selected skills with children aged 6 to 10 years (older than the intended age of children being assessed with the MAT), it could be hypothesised that the experts in Study Three selected the front support due to strength having a less dominant influence in performing the skill.

Due to the shortage of published developmental sequences for the front support, these criteria have been adapted from the back support criteria proposed by Rudd et al. (2015).

4. Sideways roll

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Arms	• Starting position with arms straight • Arms bend during roll	• Arms remain straight throughout the roll	• Arms remain straight throughout the roll • Palms open and hands together throughout
Legs	• Legs straight in start position • Legs bend during the roll	• Legs held straight throughout the roll • Legs separate during the roll	• Legs held straight and remain together throughout the roll
Body	• Start position with arms and legs extended in straight line with body (from	• Arms and legs extended in straight line with body (from fingers to toes) for	• Arms and legs extended in straight line with body (from

	fingers to toes) but alignment not seen during roll	some of the roll but not all	fingers to toes) throughout the roll

Although there is a locomotor element in the sideways roll, (i.e. travelling through space), this movement is classified as a stability movement because of the body control required to perform it (Gallahue et al., 2012). Developmental studies of body rolling are limited (Gallahue et al., 2012) and little research has been completed around this movement task. However, Rudd et al. (2015) evidenced that body control movements, of which the sideways roll is one, can be used as a valid measured of FMS in children. Rudd et al. (2015) videoed an elite gymnast performing the sideways roll and, seeking further guidance from a group of movement experts, identified the key components required to execute the movement. The criteria identified by Rudd et al. (2015) have been adopted and modified to create the developmental sequences described for a child in the early through to late stages of development. Rudd et al. (2015) deemed that keeping the legs off the floor throughout the roll added further challenge. This element has not been included in the criteria for the MAT, with the focus instead centred on posture control by keeping legs and arms straight throughout the roll.

Object control tasks

1. Two handed catch

Equipment needed:

- Basketball

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Arms	• Arms straight and held out in front of body	• Arms bent and held out in front of body • Arms move to flight of ball	• Arms bent with hands at waist height • Arms move to flight of the ball

Hands	• Ball is scooped against the body using arms and hands	• Ball is caught using arms and hands	• Ball is caught using hands only
Body	• Feet together • Feet turned away from the position of the thrower	• Feet hip width apart facing thrower • Eyes focused on the ball	• Eye remain focused on the ball • Feet and body adjust to the ball in flight

The developmental sequences for the two-handed catch, based on a total body approach, have been validated within a mixed longitudinal study of children aged up to 8 years (Haubenstricker, Branta & Seefeldt, 1983), deeming them appropriate to adopt to use within these criteria for the MAT. There are similarities in the hand and arm position found in the total body approach (Haubenstricker et al., 1983) and segmented body approach proposed by Roberton and Halverson (1984).

It has been described that at the most developed stage of catching, the performer will adjust their entire body to enable them to catch the ball in their hands only (Payne & Isaacs, 2011). This full body adjustment is recognised in the developmental sequences put forward by Roberton and Halverson (1984), which describes that upon reaching the third, and final, stage of development, "the feet, trunk and arms all move to adjust to the path of the oncoming ball.

The developmental sequences of catching are specific only to the conditions under which the performance takes place (Haywood & Getchell, 2009). For example, the size and shape of the ball may require adjustments in the catching technique.

2. Underarm throw

Equipment needed:

- Tennis ball

	Stage 1 (Emerging)	Stage 2 (Developing)	Stage 3 (Established)
Arms	• Minimal backswing and follow through • Ball released in line with, or behind, body	• Some backswing and follow through • Ball released in front of body with palm up	• Arm extended during backswing • Ball released in front of body and arm follows through in direction of target
Legs	• Hips and feet facing direction of target • Feet remain stationary during throw	• Stood with split stance with opposite foot to throwing hand in front • May step forward with same foot as throwing hand	• Forward step by opposite foot to throwing arm (right arm throw, left foot step)
Trunk	• Head facing direction of throw • Trunk held upright	• Slight forward trunk lean in direction of target	• Forward trunk lean in direction of target

Literature for the underarm throw is limited, with the focus centred on the overarm throw. These criteria for underarm throw are adapted from the developmental sequences described for the overarm throw and guided by the criteria for the underarm throw in two existing assessment tools (TGMD-2, [Ulrich, 2000]; Dragon Tracker [Sport Wales, 2013]) that incorporates this movement task.

3. Overarm throw

Equipment needed:

- *Tennis ball*

	Stage 1 (Emerging)	Stage 2 (Developing)	Stage 3 (Established)
Arms	• Minimal backswing • Throwing arm extends forward to release ball	• Throwing arm moves backwards behind shoulder during backswing • Throwing arm extends forwards to throw ball with elbow straight	• Throwing arm rotates and straightens behind the head during backswing • Upper arm and elbow lead the arm action forwards • Ball is released with elbow straight

Legs	• Hips and feet facing direction of target • Feet remain stationary during throw	• Stood with opposite foot to throwing arm in front (right arm throw, left foot lead • Body weight shifted onto front foot	• Forward step with opposite foot to throwing arm (right arm throw, left foot step)
Trunk	• Trunk faces direction of throw • Hips and shoulders do not rotate	• Hips and shoulders rotate together during backswing and throwing action	• Hips and shoulders rotate separately during backswing and throwing action (hips first then shoulders) • Trunk rotates across the body after the ball release

The developmental sequences for the overarm throw were first described by Wild (1938) who observed children aged 2 - 2 years. Since then, several more developmental sequences for the overarm throw have been offered (Seefeldt, Reuschlein & Vogel, 1972; Roberton, 1977). The trunk and arm action of these developmental sequences have been validated (Roberton & Langendorfer, 1980), thus these MAT criteria are closely associated with those previously validated developmental sequences.

A common feature of all the developmental sequence models is that stage 1 arms involves forward movement of the arm only, with no backswing. In addition, the length of step is an indicator of a more competent, or advanced, thrower. Escamilla at al. (1998) found that advanced throwers step a distance of 80% or more of their standing height. Roberton and Konczak (2001) reported similar results in a longitudinal study of children aged 6 to 13 years. Thus, reference to a step forward is made in the Stage 3 "Leg Action' of the MAT. Asking teachers to measure the distance of the child's step would be unsuitable within the MAT, thus no acknowledgment is given to the length of the step. The studies of Escamilla et al. (1998) and Roberton and Konczak (2001) both observed participants much older than the upper target age of the MAT, where performers would

have had a greater opportunity to develop their skill with age (Gallahue et al., 2012), thus demonstrating a more advanced skill and a large step.

Haywood and Gretchell (2009) provided detailed descriptive images of the developmental sequences involved in different components of the overarm throw. These illustrate the greater hip and trunk rotation seen in the later developmental stages of the skill.

In a study evaluating the reliability of the TGMD-2, Barnett et al., (2014) reported that three components of the process-oriented scoring criteria for the overhand catch within this assessment were problematic for observers, with a lower level of agreement between assessors for these components than across the other 6 object control skills. These three criteria were:

i. Windup is initiated with downward movement of hand/arm.
ii. Rotates hip and shoulders to a point where the non-throwing side faces the wall.
iii. Weight is transferred by stepping with the foot opposite the throwing hand (not just transferring weight) .

Existing assessments (TGMD-2, [Ulrich, 2000]; Get Skilled Get Active, [Get Skilled Get Active, 2000]) containing process-oriented criteria for the overarm throw allow a child who flings the ball with a straight arm, in a similar action to a discus throw, to fulfil most of the specified components for the skill, despite this action being incorrect. The TGMD-2 does not contain a scoring component that specifies that the throwing arm must undergo flexion at some point of the overhand throw. Somewhat better is the criteria contained within Get Skilled: Get Active that includes a component stating the ‘arm moves down and back’. However, even this does not fully account for flexion of the throwing arm at any point in the throwing action. It is the flexion at the elbow which differentiates a throw from a ‘sling’ and it is this specific action that is included by

Roberton and Langendorfer (1980) in their validated development sequences for the overarm throw.

No reference has been found describing the action of the non-throwing arm in the developmental sequences, thus this component is omitted from the criteria.

4. Kicking a ball

Equipment needed:

- Football

	Stage 1 (Emerging)	Stage 2 (Developing)	Stage 3 (Established)
Feet	• Feet remain stationary and kicking foot reaches for the ball	• Approaches ball with small step forwards	• Large step (or leap) forwards to place non-kicking foot next to or just behind the ball
Legs and hips	• Limited leg backswing and/or follow through	• Leg bends at the knee and then extends to kick ball	• Hips extend to begin kicking action • Kicking leg bends during backswing and extends as ball is kicked
Arms	• Arms held by sides • No swing of arms	• Small amount of arm swing	• Arms are held out to sides and swing in opposition to legs

Kicking involves striking a stationary ball with the foot. This is different to punting, that involves striking the ball in the air with the foot (Payne & Isaacs, 2011). Kicking is seen in a number of process-oriented FMS assessments (TGMD-2 [Ulrich, 2000];, PLAY [Canadian Sport for Life, 2013]; 60 Mins FMS Club [60 Minute Kids Club, 2018]). As such, existing criteria are available to describe this movement. These criteria have been used to guide the MAT criteria here. In addition, a number of developmental sequences have been proposed for kicking (Haubenstricker et al., 1981; Gallahue et al., 2012). According to the validated developmental sequences of Haubenstricker et al., (1981), the key identifiable differences between an early stage of development and a later

stage of development are the performer travelling towards the ball; a more pronounced backswing; leg flexion and extension during the kicking action and arm swing in opposition to legs. These subtle, yet significant, differences were reflected in the criteria for each stage of development.

5. Dribbling ball with alternate hands while stood stationary

Equipment needed:

- Basketball

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Arms	• Minimal change in angle of arms before or after contact with ball	• Elbow bends and extends as ball is pushed to the floor	• Arms bend and then straighten as hand contacts ball at waist level
Hands	• Hand contacts ball with quick, slapping action	• Palm and fingers push ball to floor • Contact time is short	• Fingers mainly used to push ball • Extended contact time between hand and ball (not slapping action)
Trunk/ head	• Slight forward lean from the hips (head held behind ball)	• Forward lean from the hips and trunk (head held out over ball)	• Forward lean from trunk only (hips upright and ball close to body)

There are no validated developmental sequences for dribbling a ball. However, Gallahue et al. (2012) have suggested developmental sequences for dribbling based on the work of Wickstrom (1983) and their own observations of children. Wickstrom (1983) observed that a child in the early stage of development of the dribbling the ball with their hands had little extension of the elbow, slapped at the ball and quickly retracted their hand after contact with the ball. A child in the later stages of development had a slower hand action, maintaining contact with the ball for longer and the dribbling arm flexed and extended to push the ball to the ground.

Locomotor tasks

1. Running

	Stage 1 (Emerging)	Stage 2 (Developing)	Stage 3 (Established)
Arms	• Limited arm bend; arms may swing across body	• Arms bent and alongside body • Limited arm swing in opposition to legs	• Arms swing by side in opposition to legs (right leg lead, left arm lead) • Arms bent at approximately 90 degrees
Legs	• Both feet are off the floor at the same time • Minimal heel lift during recovery swing	• Leading leg is almost straight at take-off • Heels remain below knee height during recovery swing	• Leading leg extends at take-off • Heels brought close to buttocks during recovery swing
Feet	• Whole foot strikes floor	• Feet strike floor facing forwards • Heel or ball of foot strikes floor first most of time but not always	• Heel or ball of foot always strike floor first

Running is one of the earliest locomotor skills to develop after a child begins walking; normally occurring before the age of 2 years (Payne & Isaacs, 2011; Haywood & Getchell, 2009). The developmental sequences of running have been described in a segmented body approach (Roberton & Halverson, 1984) and a total body approach (Seefeldt & Haubenstricker, 1982a). These two approaches provide a similar description for the developmental sequences of the arms and legs. In the early stages of running development, the performer will demonstrate a limited arm swing; arms being held in a high guard. As the performer becomes more advanced, the arms are flexed at 90 degrees and both arms swing alongside the body in opposition to the legs. The leg action starts with a short stride, indicative of low knee lift. As the child becomes developmentally

more advanced, their flight time increases, a result of having greater knee flexion during flight and an extended thrust leg on take-off.

Differences between the two approaches are seen in the description of foot fall in the later stages of development. Seefeldt and Haubenstricker (1982b) describe that foot contact is heel first, whereas Roberton and Halverson (1984) state that foot the strikes with the heel *or* ball of the foot first. Both developmental sequences described by Seefeldt and Haubenstricker (1982[b]) and Roberton and Halverson (1984) illustrate the importance of the footfall being in line with the direction of travel. The TGMD-2 (Ulrich, 2000) includes running as an assessment task. The assessment criteria within the TGMD-2 for running recognises a competent performer as having a heel or toes first foot strike. This dual option has been adopted for the MAT as both styles of foot strike are recognised as being appropriate for a performer reaching a late stage of development for running.

2. Hopping forwards

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Arms	• Arms held high with inconsistent movement	• Arms bent and pump up and down at the same time	• Arms bent and swing by side of body in opposition to legs (right leg lead, left arm lead)
Legs	• Hopping leg is bent • Non-hopping leg is bent and inactive	• Some extension of hopping leg at take-off • Non-hopping leg pumps up and down but does not swing	• Hopping leg bends on landing and straightens at take-off • Non-hopping leg swings forward and then backwards during fight
Body	• Body in upright position	• Slight forward trunk lean • Head facing down	• Forward trunk lean from hips at take off • Head facing forwards

Halverson and Williams (1985) observed children aged 2-5 years to determine the developmental sequences for the arm and leg action when hopping. A later study on hopping by Haubenstricker et al. (1989) provided a total body approach to the skill. This approach referenced the placement of the trunk and position of the hips in relation to the supporting leg during take-off as developmentally important. The forward trunk lean, positioning the hips in front of the support leg on take-off, enables greater horizontal distance as opposed to vertical height during the hop Haubenstricker et al. (1989). The swing of the support leg also helps to generate force to move forwards (Haywood & Getchell, 2009). Both Halverson and Williamson (1985) and Haubenstricker et al. (1989), observed that children perform hopping better on their preferred foot, as opposed to their non-preferred foot.

3. Horizontal jump

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Arms	• Arms held at side with minimal swing to aid take-off	• Arms swing behind body swing then partially swing forward to initiate take off	• Arms extend behind body then swing forwards reaching above head at take-off • Arms brought down by side at point of landing
Legs – take off	• Take off from one foot • Legs bent at take-off	• Ankles, knees and hips bend partially before take-off • Take off from both feet together	• Ankles, knees and hips bend before take-off (crouch position) • Legs and hips fully extended at take-off
Legs - landing	• Lands on one foot first • Uncontrolled landing	• Land on both feet at same time • Ankles, knees and hips partially bend at landing	• Ankles, knees and hips bend at landing (bum sinks to knee level)

A number of developmental sequences for the horizontal jump have been proposed (Haubenstricker, Seefeldt & Branta, 1983; Roberton & Halverson, 1984; Clark & Philips, 1985, Gallahue et al., 2012). However, only the earliest sequences proposed by Haubentricker, Seefeldt and Branta (1983) have been validated in anyway. This involved almost 2000 primary school aged children under 9 years. Due to the similar age of the children involved in the validation process, the criteria for the MAT have been founded upon these developmental sequences.

Key differences seen between performers in the early and late stages of development of the horizontal jump are during the preparatory phase (Payne & Isaacs, 2011). The movements that a more competent performer will demonstrate are a crouch (flexion at the hips, knees and ankles) and a backward swing of the arms (Payne & Isaacs, 2011) prior to take-off. The complexity of taking off on two feet, as opposed to a single foot, is increased due to the off-balance position the performer is put in at take off. This off-balance position is heightened with a greater forward lean (Roberton & Halverson, 1984). When unbalanced, a child in the earlier stages of development may step out with one foot to prevent falling forwards (Roberton & Halverson, 1984). Thus, one of the key indicators for emerging development of the horizontal jump would be the take-off from two feet.

4. Sidestepping

	Stage 1 (Emerging)	Stage 2 (Developing)	Stage 3 (Established)
Arms	• Frequent and inconsistent movement of arms or held down by side	• Arms bent and held out slightly to the side	• Both arms straight and held out to the side in T position
Legs/ feet	• Trail leg sometimes crosses and lands in front the lead leg	• Trail leg sometimes lands behind lead leg	• Trail leg consistently remains behind lead leg

Trunk/ head	• Hips and shoulders facing direction of travel	• Hips and feet on side-on to direction of travel • Shoulders facing direction of travel	• Shoulders, hips and feet side-on to direction of travel • Minimal body elevation (feet remain close to ground)

Sidestepping is similar to the gallop, except that the performer is always moving sidewards (Gallahue et al., 2012). However, sidestepping is more challenging to perform because the child is required to move in a sideways direction while facing straight ahead. It is an important movement skill to develop as it is applied in many different sports (e.g. tracking the baseline in tennis, tracking an opponent in football). Sidestepping emerges with the preferred-foot leading the movement several years before the non-preferred foot (Payne & Isaacs, 2011).

Due to the similarities between the gallop and sidestepping, developmental sequences for galloping can also be applied to sidestepping (Gallahue et al., 2012). The criteria for the MAT have been adapted from the validated sequences for galloping described by Sapp (1980) and the criteria included for the same task in the TGMD-2 (Ulrich, 2000).

5. Skipping

	Stage 1 (Emerging)	**Stage 2 (Developing)**	**Stage 3 (Established)**
Arms	• Arms do not swing (held by side or pump up and down together)	• Some arm swing in opposition to legs • Both arms in front of body at some point	• Arms swing by side of body in opposition to legs (right leg lead, left arm lead)
Legs	• Step and hop action is segmented (exaggerated)	• Step and hop with both feet • Landing is on whole foot	• Step and hop with both feet • Heels raised during foot contact with floor

	• Step and hop with both feet not always seen		
Body	• Rhythm of movement is inconsistent	• Movement from step to hop is sometimes smooth and rhythmical	• Movement from step to hop is smooth and rhythmical

Skipping is considered to be a "double-task pattern" (Roberton & Halverson, 1984), meaning it combines a step and hop on the same foot, before repeating the sequence with the opposite foot. As such, it is considered to be more advanced or complex, and it is one of the last locomotor skills to develop in childhood (Roberton & Halverson, 1984; Payne & Isaacs, 2011; Gallahue et al., 2012).

The developmental sequences of skipping were hypothesised by Roberton and Halverson (1984) but not validated at the time. A subsequent study (Roberton, 2013) that incorporated longitudinal and cross-sectional data of children aged 3 to 16 years, tested the validity of Roberton and Halverson's (1984) proposed sequences. Roberton (2013) showed that the sequences were generally supported but recognised that further work was required to accurately validate the sequences. However, Roberton (2013) included children up to age 12 years, and it was the more advanced movements hypothesised by Roberton and Halverson (1984) to appear in the last stage of development that were largely not reached by the children (only 30% of children aged 12 reached the final stage of development [Roberton, 2013]). Thus, the criteria for the MAT have been adapted from the developmental sequences proposed by Roberton and Halverson (1984), with the criteria focusing comprehensively on the movements expected to be developed in the initial two stages (of three). This reflects the age of the children observed by Roberton (2013), who had seen that by the age of 8, 80% of children demonstrated the criteria for stage 2 of the arms and legs movement when skipping.

For these MAT criteria, the arm action was given further consideration because of work by Wickstrom (1987), who observed and described the movements of 65 children aged 2.5-6 years performing the skip. Wickstrom (1987) observed that a number of children moved their arms minimally as they skipped, holding them at their sides. This "early" action is not mentioned in the sequences proposed by Roberton and Halverson (1984) or Seefeldt and Haubenstricker (1982b), who defined an "early" arm action as the "arms pumping up bilaterally". However, during the validation study, Roberton (2013) also observed and noted the frequency of this minimal arm movement during the skip and it was observed in less than 5% of children. However, these occurrences were observed in the children aged under 8 years old, so this action has been reflected in the early stages of development within the criteria for the MAT.

Seefeldt and Haubenstricker (1982b) provided developmental sequences for skipping using a total body approach. In their description of the hop, they referenced the rhythmical transfer of weight as an important observation in later stages of development.

5.5 Creation of the video content

5.5.1 Overview

Study One and Two highlighted that teachers and experts feel that a potential benefit of an app-based assessment of children's FMS would be the possibility to include video demonstrations of the assessment tasks. Teachers felt that the video content would provide a useful visual guide of how each task should be performed. It was also suggested that teachers with low confidence or competence in performing the movement task could show their class of children the video as a demonstration of how to perform the task. The consensus from experts in Study Three deemed that the assessment should adopt a developmental stage approach using process-oriented scoring criteria. Barnett et al. (2014) and Tidén et al. (2015) have previously discussed the difficulty of non-specialists of PE, using process-oriented scoring, due to their limited understanding of the

complexities of the movement. However, Knudson and Morrison (2002) suggest that video content can help support non-specialists to better understand the movement tasks within an assessment. Therefore, based on the recommendations of teachers and movements experts made in Study One and Two, video content was considered to be an important component of the MAT to provide clear and accurate demonstrations of the assessment tasks.

This section of the thesis will describe the process taken to record and select the video content used within the MAT. Firstly, this process involved filming children performing the movement tasks in a studio. Secondly, I observed the recorded videos and identified the time segments of the children's performance that demonstrated an emerging, developing or established performance for each movement task. I cropped, edited and packaged the clips into Microsoft Powerpoint presentations so that they could be easily viewed alongside the written scoring criteria for each developmental stage. I then met with the members of the advisory board and invited academics who were experienced in assessing children's FMS to view the Microsoft Powerpoint presentations and select which video clips were most suitable to use. Finally, a post production video editing company were employed to create the final versions of the videos that would be used within the assessment as the demonstration clips.

The creation of the video content was considered to be an important phase of the development of the app of the MAT as this would be used to demonstrate each assessment task to the user, as well as provide visual examples of children at each stage of development for each task.

5.5.2 Ethical Approval

Ethics approval was granted by the Research Ethics Committee of Liverpool John Moores University to create the video content to be used in the MAT (Ref: 15/EHC/027).

5.5.3 Filming location

A filming studio was hired in Leeds for one day in September 2016 for the video content to be recorded. This venue was sought as the university could not provide a suitable facility for children to be recorded. Prior to booking this venue, I researched a number of studios and selected this venue due its size (sufficient space for the children to perform the movement tasks) and availability to book (a full weekend day was available). Figure 5.2 provides images of the studio space and the camera equipment used for recording. The studio cost was jointly funded by the project budget and the YST.

Permission granted for the use of these images

Figure 5.2: Set up of the filming studio and recording equipment

5.5.4 Participants

A total of 9 children aged 4-8 years old attended the filming studio on the day. The children who took part in the filming were associated to members of the advisory board and recruited through word of mouth. This was deemed appropriate as it meant the researchers had knowledge of the competency of the children to perform the movement

tasks and the children would likely feel more comfortable performing in front of the camera with the presence of people they were familiar with. Participant information sheets were provided to the children (Appendix 4.1) taking part and their parents (Appendix 4.2) to describe the filming process, the purpose of the videos and how the images would be used. Additional care was taken to point out that at any time in the future the parent or child could request for their images not to be used. Informed assent was provided by a parent for each child prior to being filmed (Appendix 4.3). Children were brought to the studio by their parents, who then supervised them during the filming. Children were provided with a plain blue T-shirt to wear on the day of filming.

5.5.5 Filming process

Filming took place on a Saturday over the course of 6 hours and children were allocated a 2 hour time slot to attend the studio (10am – 12pm, 12pm-2pm and 2pm-4pm). This prevented overlap of too many children being in the studio as the venue size was not suitable for large groups and only allowed one child to be filmed at one time. For each of the 14 movement tasks, I created a storyboard sheet (See Appendix 4.4) that described the camera positions to film from and listed the assessment criteria for each stage of development. Each task was filmed with a camera in front, to the side and overhead the child. As only one child could be filmed at one time, I designed a schedule of the clips to be filmed and attached this to the storyboard sheet for each movement task. Between filming each movement task, the filming area was set up for the task being filmed, for example, tape was placed on the floor to the specific measurements as required for *walking forwards along a line.* On the day of filming, I was joined by a member of the advisory board who had substantial experience of working with children in primary schools and was experienced in assessing children's movement. Prior to being filmed, each child was led through a warm up and familiarisation of each movement task by the other researcher and I. During filming, each movement task was performed by each child

5-10 times. We observed the child and made a note of their competency level on the storyboard sheet. This process ensured that videos were captured of a child in each stage of development. On occasion, a researcher gave teaching points to the children to modify how they performed the task to meet the assessment criteria.

5.5.6 Initial identification of movement sequences

Initially, I observed each of the video files of the three camera positions and noted the time stamps of every movement task performed by each child. From this reference sheet, I made a note of the video clips that involved the child completely fulfilling the criteria for an emerging, developing or established stage of development for each of the 14 tasks. From this list of clips, I cross-referenced the recordings to check that the recorded clip had been captured from each recording position and that it captured the whole movement. For example, 'approaching the ball', 'kicking the ball' and 'following through with the kicking leg' were required for the 'kicking a ball' task.. Some of the performances were not fully captured in the video as the child moved out of the range of the view or executed the task in a way that the video did not capture the distinct movement requirements of the assessment criteria, for instance, their body obscured the view of their throwing arm

5.5.7 Validation of movement sequences

From the complete list of video clips that matched the assessment criteria and developmental stages, a two stage process was undertaken to select and validate the movement sequences that would be used for the video content in the MAT.

Stage 1: I met with the members of the advisory board who were experienced in assessing children's FMS to view the movement sequences and select the clips that most accurately demonstrated the assessment criteria for each movement task. This session shortlisted the

movement sequences to between one and four options for each developmental stage for each movement task. Stage 2 of the validation process was based upon this final shortlist of tasks.

Stage 2: Four academics who were experienced in assessing children's FMS were invited to view and score the shortlisted tasks. I created a Microsoft Powerpoint file containing each of the shortlisted movement sequences and the assessment criteria, which was emailed to each of the assessors. After scoring each movement task, they were asked to return the completed scoring sheets and to suggest which video was the best representation for each stage of development for each movement task. The assessors responses for each movement sequence were collated and compared for consensus in their responses. In instances where multiple movement sequences were validated for the same task and stage of development, I discussed with my supervisors which video to use. This process considered the representation of gender and age of the children in the other selected videos.

This process involving experts of children's FMS assessment established face validity of the assessment criteria and the video content, as it established agreement from the experts that the content and the criteria were accurately matched. Further, within Stage 1 and Stage 2 of the video validation process, the advisory board and experts also gave their approval for the suitability of the assessment criteria for each movement task. Although establishing face validity is formed by a subjective judgement by experts, it has been used to initially determine the validity of the content and structure of other FMS assessments, such as the TGMD-2, that has gone on to be validated using more objective methods (Ulrich, 2000).

5.5.8 Post production

A third-party video editing company (Little Motel) produced the video clips that were embedded within the app. I provided the company with the original video files and an excel spreadsheet that listed the time-stamps for the start and end point of each movement sequence to be cropped and edited into the final edit of the videos. The video files contained the images from each filming position. The editing company cropped and stitched these together and were instructed to create the videos in two styles:

Style 1: Demonstration videos of the 14 individual movement tasks alongside the assessment criteria for the established stage of development. These videos were incorporated at the first landing page when selecting the movement task in the app (Figure 5.3 is an example of the demonstration video for a task).

Style 2: Developmental stage demonstration clips, which were created for each of the movement tasks (See Figure 5.4 for a still image of an example of the developmental stage video). For each task, three videos (one for each developmental stage) were embedded on the assessment page for each movement task, allowing the teacher to view an example of a child at each stage of development performing the movement task. A total of 42 developmental stage clips were created.

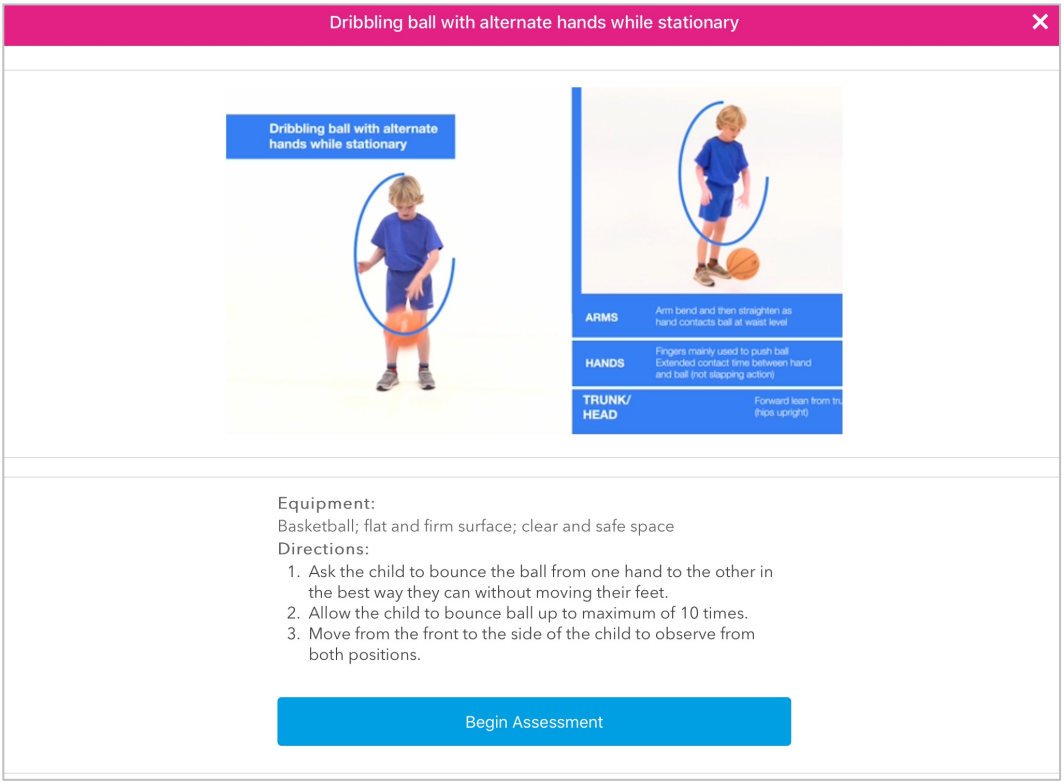


Figure 5.3: Example of the video demonstration for a movement task

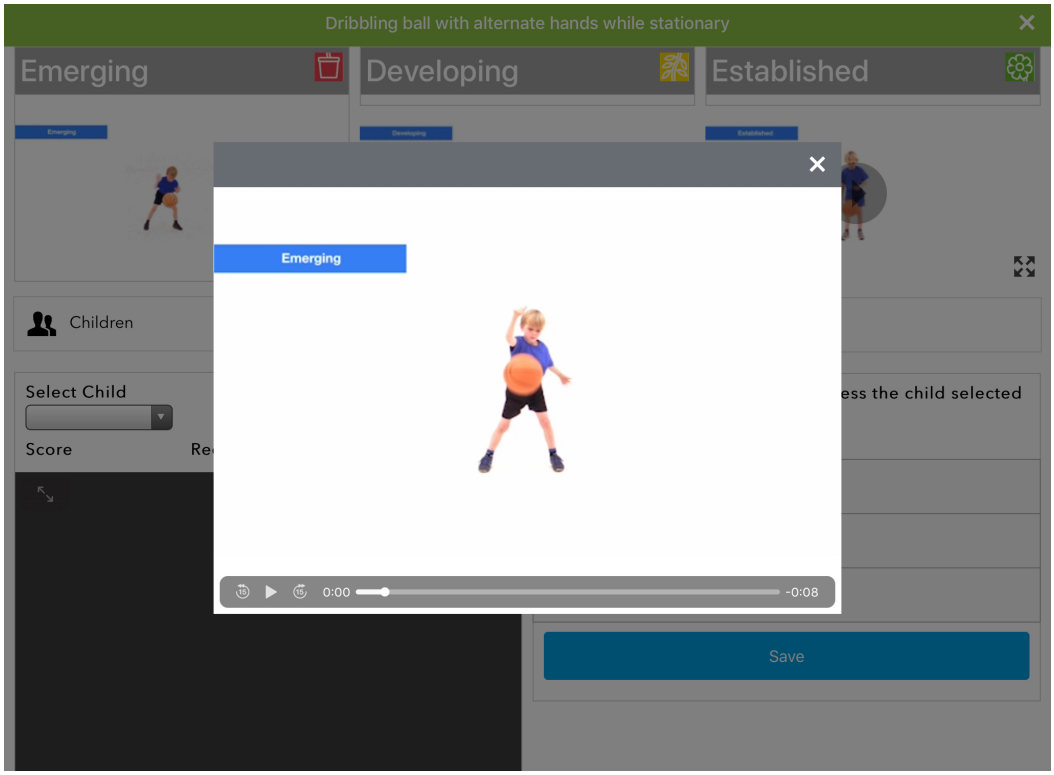


Figure 5.4: Example of developmental stage demonstration video

During this post production phase, the editing company balanced and enhanced

the colour of the video clips so that the lighting contrast was consistent in each video, as would be expected in a commercial product. Prior to the final processing of the video clips, I visited the office of the video editing company to view and certify the correct clips had been identified and cropped correctly. When processed, the video files were shared electronically and stored on a password protected external hard-drive.

5.6 Initial MAT prototype design

Initially, based upon the recommendations and findings from Study One, Two and Three, I created a visual representation of the features and functions of the MAT prototype using a simple electronic graphics programme. I then presented this design to the research partner, the YST and the software developer. See Appendix 6.1 for an illustration of the prototype design.

Based on the visual representation of the MAT and a flow chart depicting the main pages, functions and sequences within the app, the software developer created the model of the prototype of the MAT app.

5.7 MAT prototype app

The MAT prototype was created as an app to be used on an iPad. The following images illustrate the main pages on the app, including the movement task demonstration page (Figure 5.5), the movement task scoring page (Figure 5.6) and the child's profile page with a record of their assessment scores (Figure 5.7).

Thanks to the commercial agreement in place with the Youth Sport Trust, the assessment, branded as the Movement Assessment Tool, is available to download from the Apple App Store for a minimal cost of £2.99.

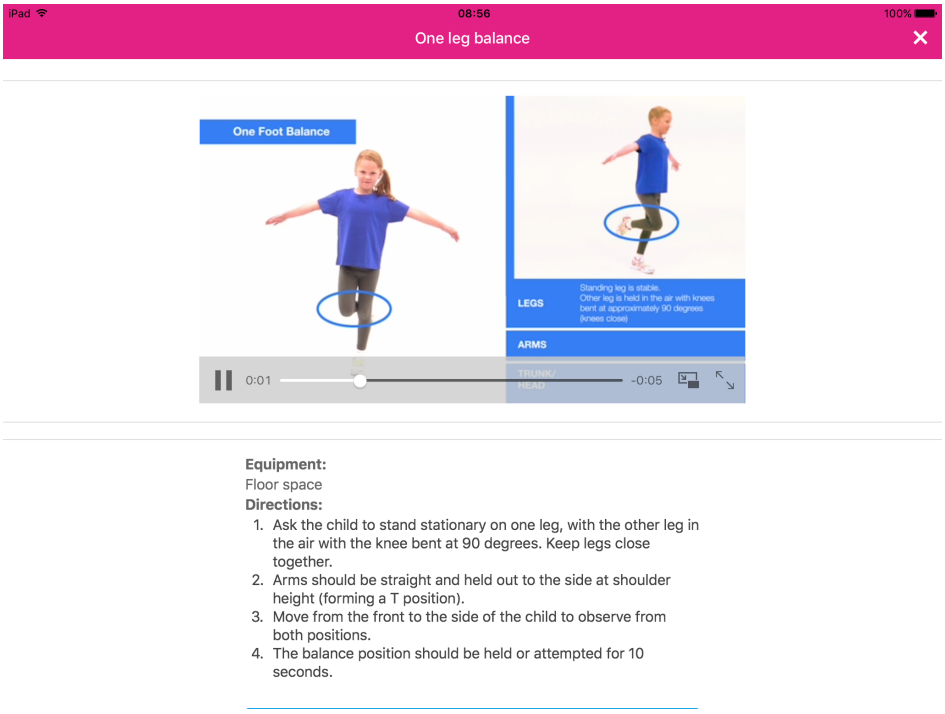


Figure 5.5: MAT movement task demonstration video page

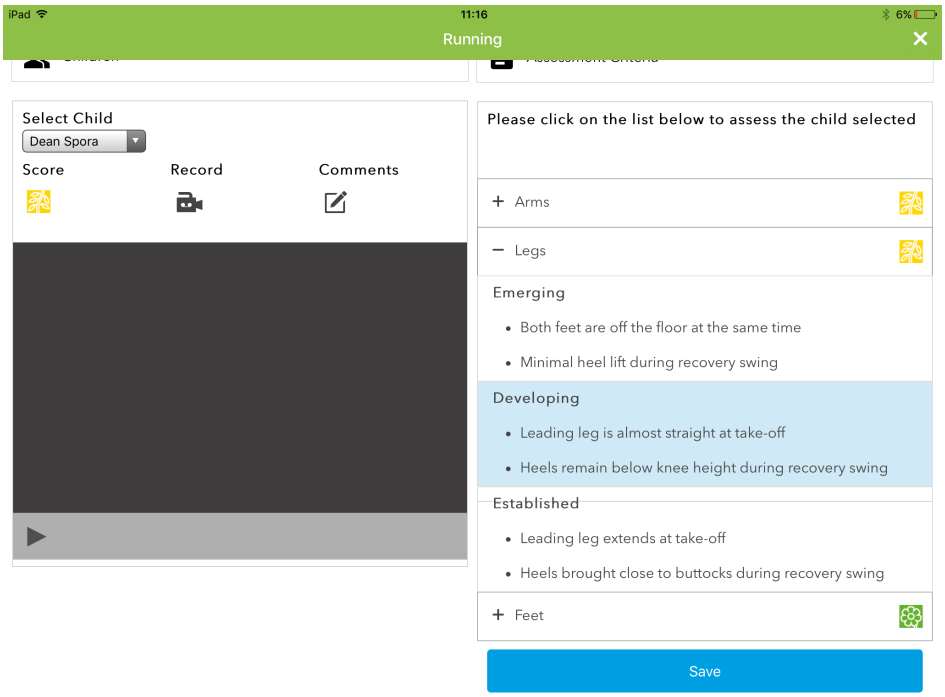


Figure 5.6: MAT movement task scoring page

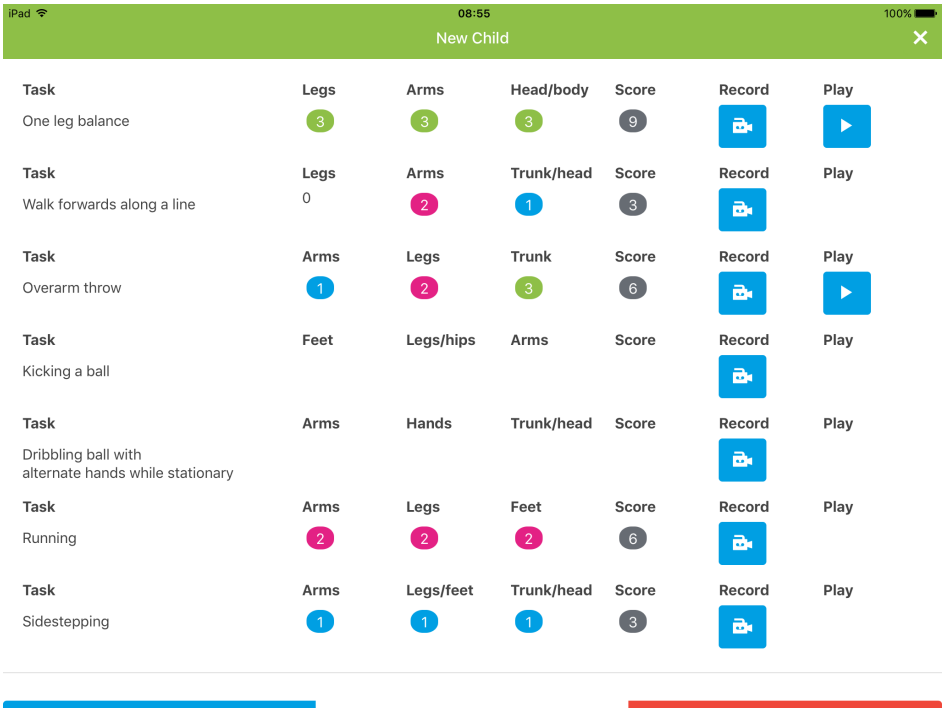


Figure 5.7: MAT profile page with a record of child's assessment scores

5.8 Safeguarding

A crucial point that had to be considered was the need for the safe and ethical collection and storage of data. The establishment of digital technology opens up the possibilities for video and still images to be recorded and saved. The General Data Protection Regulation (European Union, 2018) states that the use of such data within education settings must be secure and taken with the knowledge and agreement of those involved. To manage the security of the data collected within the app of the MAT, Terms of Use are included that each user has to agree to when accessing the app for the first time to create their account. These Terms of Use include reference to the appropriate collection of data, requiring the consent of the school's headteacher, and give permission for the children's assessment scores to be uploaded to a database accessed by the research organization and developers of the app. To protect children's personal information, their assessment data is anonymised when uploaded to the main database.

School devices tend to have heightened security controls, and it is advisable to use a school-owned device when possible. As a minimum, it is recommended that devices used to collect children's assessments are password protected. This protects against unauthorised users accessing the children's assessment scores and personal information, as well as protecting the privacy of the owner of the device. To further protect the video content recorded by the user, the MAT app was configured so that all images are saved solely on the user's device. Video images are only accessible via the device they are recorded on, and are not uploaded or stored online. These images remain the sole possession of the owner/user of the device. It has been mentioned above about the benefit of app-based assessment allowing engagement and involvement of children within the process. If the children are handling the device during the lesson, the teacher must take steps to monitor and control their own personal data that is stored within it.

CHAPTER 6

Study 4

Examining the feasibility of the Movement Assessment Tool being used by teachers of primary school PE

Chapter 6: Examining the feasibility of the movement assessment tool being used by teachers of primary school PE

6.1 Thesis study map: Study Four

Study	Key findings
Study One Primary teachers' recommendations for the development of a teacher-oriented movement assessment tool to assess children's FMS in primary schools	• Primary school teachers recognise the need for a movement assessment tool specifically intended for them to assess children's FMS during PE lessons. • To meet the requirements of teachers, the movement assessment tool should be developed for use on digital devices, such as an iPad. Use of this technology would provide a quick and simple to use method of assessment, as well as allowing for video content to be included, to support the teacher's understanding of the assessment tasks. • Teachers would prefer the assessment to adopt an AfL approach, as this would indicate the next steps for a child's development and guide their future learning. • Enhancing teachers' understanding of the process of assessing FMS may allow them to better support children's learning and acquisition of FMS.
Study Two Expert recommendations for the design of a movement assessment tool for use by primary school teachers	• The development of a teacher-oriented MAT needs to consider the multidimensional complexities of assessing children's FMS in relation to the specific context of a school setting. • Expert perspectives for teacher-led assessment of FMS are conflicted by the

	mechanisms and purpose of the assessment and the experts' own specialism (i.e. academic or practitioners). The dilemmas poised by the experts are underpinned by three key considerations: • *why* are we assessing children's movement? For research purposes or to enhance teaching and learning? • *how* should we do it? Experts suggested that a natural setting (e.g. typical engagement in a PE lesson or playground activity) could provide a more accurate measurement of a child's movement competence. Further, the simplicity of the assessment should allow the teacher to complete it within the normal time of their PE lessons. • *what* should it look like? Should the detail of the assessment be complex or simple and should the nature of the tasks be static or dynamic? • Expert perspectives suggest that the development of a MAT for use by primary teachers of children aged 4-7 years old can mirror existing protocols in terms of the movements assessed. However, such development should initially focus less on reliability and validity of the tool, whilst placing greater emphasis on the feasibility of the MAT being used in the unique context of the school. • These findings suggest that any future development of a MAT for primary teachers needs to consider the specific purpose and context of the assessment.

Study Three Delphi poll investigation to gain expert opinion for the content of a teacher-oriented movement assessment tool for children aged 4-7 years old.	• Expert consensus established that a total of 14 tasks were required to assess children's FMS competence at 4-7 years. The assessment should be composed of 4 stability, 5 object control and 5 locomotor tasks • The tasks, in the sequential order within each category of movement that experts established the tasks should be introduced in the assessment, are listed below: • Stability → One foot balance, walk forwards along a line, sideways roll and front support. • Object control → Two handed catch, underarm throw, overarm throw, kicking a ball, dribbling a ball with alternate hands while stationary. • Locomotor → Running, hopping forwards, horizontal jump, sidestepping and skipping • A developmental stage approach was preferred over an age based approach, indicating experts agreement with Gallahue et al., (2012) that FMS are age related but not age dependent. • Differentiating the scoring criteria for the developmental stage of the children, is preferred over a method of differentiating the tasks for their developmental stage. • There was strong consensus agreement from the expert panel that the assessment should not be differentiated for gender. • In general, experts believe that a process-oriented scoring approach, evaluating how the skill has been performed, is most appropriate in a teacher-oriented assessment.

Study Four **Examining the feasibility of the movement assessment tool being used by teachers of primary school Physical Education.**	• **The MAT can be implemented by teachers within primary PE lessons using a variety of methods.** • **Teachers felt that the content of the MAT was appropriate for the age of the children and that they could understand the data it generated to support children's development of FMS.** • **As well as being a measure of children's FMS, the MAT was an instructional tool. Over the course of the trial period teachers' confidence, understanding and awareness of assessing FMS increased as a result of using the MAT.** • **Embedding the MAT within digital technology was liked by teachers and they felt that children's engagement increased during the lessons that the MAT was used.** • **Being able to record video and use this to feedback to children was regarded as a practical way to provide feedback and motivate children to help improve.** • **The initial set up of the app can be time demanding, requiring children's details to be input, but participants' suggested that greater synchronisation between the MAT and the school database would alleviate this.** • **Overall, the MAT had high acceptance by teachers, with all participants indicating that they would recommend the MAT to other primary teachers.**

6.2 Introduction

Study One of this thesis indicated the demand from primary school teachers for a method of assessing children's FMS that they could use within PE lessons. The recommendations made by teachers and experts in Study One and Two revealed that an assessment of FMS to be used by teachers should be simple to administer and provide information to the teacher to inform future learning delivery. Study Three involved an international group of experts of children's movement assessment and development to generate the content of a teacher-oriented assessment of FMS for 4-7 year olds. Subsequently, based upon the findings of these initial three studies, a prototype of an app-based version of the MAT was developed for use on an iPad. As highlighted in Chapter 5, literature supports the findings in Study One and Two that digital technology could optimise assessment in PE. Specifically, the functions provided by digital technology to record and capture evidence of children's FMS could encourage and enhance use of the MAT in education settings (Graham et al., 2013; O'Loughlin et al., 2013).

The Delphi poll used in Study Three established content validity of the movement tasks within the MAT and gaining the perspectives of experts to select the video content established face validity for the assessment criteria and video content. Whilst the need for assessments to be valid and reliable is important (Burton & Miller, 1998), their usefulness as a tool for practitioners and researchers is reduced if they are not feasible or practical (Robertson et al., 2014). In light of the recommendations made by Tompsett et al. (2017) that resources and programmes of Continuing Professional Development (CPD) related to FMS interventions should be conducted by PE specialists, or designed specifically for the needs of teachers, it is clearly important to investigate the practicality and acceptability of the MAT being used by teachers. Specifically, Longmuir et al. (2015) recommended that the feasibility and reliability of FMS assessments when administered by assessors with less movement analysis experience should be evaluated.

The FMS assessments tools that are currently available have been validated, refined and used extensively by researchers across the globe to understand the FMS competence of children (see Burton & Miller, 1998 and Cools et al., 2008, for a review of FMS assessment frameworks). However, up to now, only a small amount of research has been conducted with teachers as the assessment administrator. Chen et al. (2016) and Hermmann et al. (2015) involved teachers in the assessment of children's FMS competence, rather than solely using trained researchers. Although teachers underwent training to administer the assessment in the Chen at al. (2016) study, they failed to measure the reliability, feasibility or validity, making it difficult to assess the efficacy of the teachers' assessments. Hermann et al. (2015) developed the MOBAK, a FMS assessment specifically to be used by teachers and aligned to the PE curriculum. The authors reported that "'the testing procedure is fast, the test items are easy to evaluate, and the results are interpretable without a standard table and statistical distribution. Participating teachers reported a high acceptance of this battery" (Hermann et al., 2015, p89). However, the mechanisms used to collect and evaluate teachers' acceptance were not reported, thus providing only a limited understanding of the suitability of the assessment method for teachers.

The validity and reliability of the testing procedure can be influenced by the method in which the assessment is administered (Burton & Miller, 1998). The movement tasks within the MAT require verbal instruction or demonstration. This creates the potential problem of results being influenced by the experience or skill level of the test administrator and the ability of the child to remember instructions (Yoon, Scott & Hill, 2006; Giblin et al., 2014). The test administrator's prior knowledge and understanding of the components of the movement task can also affect the reliability of the assessment (Yoon et al., 2006; Giblin et al., 2014). The importance of this is highlighted due to the process-oriented scoring approach used within the MAT, as Tidén et al. (2015) indicated

that reliable process-oriented scoring is reliant upon a good level of understanding by the assessor. As discussed in Chapter One and Two, some primary teachers feel under-prepared to assess FMS due to their limited knowledge and understanding of the subject. In order to mitigate the potential influence of the teachers' understanding, knowledge and competence in performing the skill affecting the assessment outcome, video demonstrations and clear, written teaching points have been included for each movement task within the MAT. As described in Chapter Five, the use of digital technology has made this possible and the additional instruction and guidance it allows may enhance the child's learning experience (Davids et al., 2008) and engagement (Penney et al., 2012).

Despite the commonplace of iPads and similar tablet devices in use by the general population, and in schools by teachers, what is not understood at this stage, is how feasible the MAT is for teachers to administer. Therefore, the purpose of this study is to highlight the suitability of the MAT being used in PE lesson time, identify if the MAT supports teachers' needs and explore the level of acceptance of the MAT by primary teachers. As PE in primary school is typically delivered by non-specialists of PE, it was felt necessary to include both non-specialist and specialist PE teachers.

6.3 Methodology

6.3.1 Research design

A mixed-methods research (MMR) approach combining quantitative (surveys) and qualitative (observations and semi-structured interviews) data was used to investigate the feasibility of the MAT being used by primary school teachers in PE lesson time. In this study, I wanted to focus on the individual experiences of the participants using the MAT. Gaining their personal reflections would indicate the suitability of the MAT being used in PE lesson time and its projected impact on the assessment and teaching of children's FMS. Consequently, for this study, my epistemological stance shifted back towards interpretivist research, capturing meanings in the human interaction (Black,

2006) of how teachers responded to the MAT. In line with Neuman's (2000) representation of interpretivist research, it was understood that the findings would uncover and explain the deeper meaning behind the experiences and perspectives of this group of participants, rather than allow generalisations about the whole population.

A MMR design was implemented as the combination of methods in tandem are greater than either qualitative or quantitative research on their own (Creswell & Plano Clark, 2007). Further, it is acknowledged that MMR produces more complete knowledge necessary to inform theory and practise (Smith, 2010). Gorard and Makoploulou (2012) note that the use of MMR in the field of PE and sport pedagogy is limited, with a predominance of studies published in this field using qualitative or quantitative methods. They also report that studies purporting to use MMR, have a tendency to deal with the data separately, thus, are not truly 'mixed' methods. Morse (2010) defines these studies that involve two or more different methods run independently and reported separately as using a "multiple-methods design". Therefore, to implement a genuine MMR design, consideration must be given to how the different methods are designed and how the findings are integrated (Morse, 2010; Sparkes, 2015).

Creswell (2003) describes a number of different procedures for the timing and ordering of MMR. In this study, I used a concurrent triangulation strategy, in which data from the observations, surveys and semi-structured interviews were collected in the same phase of research and analysed alongside each other (Creswell, 2003). The nature of the data collection procedure meant that the observations were conducted in advance of the surveys and interviews. In light of this, it could be suggested that a "sequential exploratory strategy" (Morse, 2010) was used involving multiple phases of research and analysis. However, a sequential strategy would typically involve analysis of the findings in the first phase to inform the data collection in the second phase (Morse, 2010). This was not the case, with the results of each method being analysed concurrently,

triangulated and integrated in a visual form suggested by Sparkes (2015). The findings have been integrated and reported in a visual joint display (Guetterman, Fetters, & Creswell, 2015) which has the effect of "bringing the data together through a visual means to draw out new insights beyond the information gained from the separate quantitative and qualitative results" (Fetters, Curry, & Creswell, 2013, p.213). Without a fully integrated approach to report the findings, it has been suggested that the yield of data from MMR is equivalent to conducting independent quantitative and qualitative studies (Bryman, 2007; O'Cathain, Murphy, & Nicholl, 2010), thus falling into the category of multiple-methods described above.

The surveys were implemented to provide a snapshot of opinion from the group of participants (Hastie & Hay, 2012). The data derived from semi-structured interviews and observations provided a more in-depth description of these participants' perspectives and a greater understanding of the situation and the interactions that occurred in that context (Patton, 2002; Creswell, 2003). The semi-structured interviews allowed a deeper level of enquiry and generated more detailed responses from the participants, thus, providing a greater understanding of their meaning, and assisting in explaining their experiences.

The findings from the surveys, observations and interviews were used to evaluate the feasibility of the MAT alongside a modified version of a feasibility framework proposed by Bowen et al. (2009) (see Table 6.1). The framework was developed by Bowen et al. (2009) in response to the shortage of recognised standards to guide the design and evaluation of feasibility studies. These standards were originally drawn up to evaluate the effectiveness of new interventions in public health settings which focus on changeable behaviours or outcomes. Although predominantly used to evaluate programmes and interventions in public health settings, a modified version of the

framework was recently used in education settings to evaluate a new teacher-led intervention (Lander et al., 2016).

The original framework proposed by Bowen et al. (2009) consists of eight dimensions; acceptability, demand, implementation, practicality, adaptation, integration, expansion and efficacy testing. The latter, efficacy testing, requires the collection of longitudinal data to measure the success of the new intervention in achieving its purpose. This was deemed to be beyond the remit of this study and was not included within the research design.

The study was granted ethical approval by the Research Ethics Committee of Liverpool John Moores Research Ethics (reference: 16/ELD/024). All data were collected between February and July 2017.

Table 6.1: Description of the modified version of the feasibility framework (adapted from Bowen et al., 2009)

Dimension	Area of interest	Sample outcome
Acceptability	Examines how participants react to the programme	Satisfaction, intent to continue use, fit within organisation
Demand	Documents the frequency of use or estimated use of the programme	Actual use, intention to use, perceived demand
Implementation	Focuses on the extent and manner in which the programme can be implemented as planned	Degree of execution, success or failure of execution, factors affecting execution
Practicality	Explores the extent that the programme can be delivered when resources, time and/or commitment is constrained in some way	Positive/negative effects on target participants, ability of participants to execute the programme

Adaptation	Focuses on changing the programme content or procedures to be appropriate in a new infrastructure	Degree to which similar outcomes are obtained in new format
Integration	Assesses the level of system change needed to integrate the programme in to existing infrastructure	Perceived fit within infrastructure, perceived sustainability
Expansion	Examines the potential success of the programme with a different population or setting	Positive/negative effect on organisation, fit with organisational goals and culture

6.3.2 Participant recruitment and sample

Invitation packs containing a letter and participant information sheet (Appendix 5.1) explaining the study, were sent via email to the PE co-ordinator in the schools who took part in Study One and had expressed an interest in being involved in future research (n=6) and the headteacher of a new group of schools (n=10). Inviting new participants was considered to be important to remove the potential for bias from participants who had provided recommendations for the development of the MAT. This sample of new participants were recruited from schools identified from local authority contact lists and information provided by the research partner (YST). Follow up telephone calls were made to each school if a response was not received from the initial invitation. Following acceptance of the invitation to participate, I communicated, via email and telephone, with the PE coordinator in the school. A snowballing technique (Streeton, Cooke & Campbell, 2004) was used to recruit teachers in each school. This involved the PE co-ordinator or headteacher circulating the study invitation to teachers who taught PE in EYFS or Key Stage 1. Participants were informed that their involvement would be confidential and anonymous throughout the study. Signed informed consent from each participant

(Appendix 5.2), and gatekeeper consent from the headteacher of each participating school, was received prior to the study commencing.

A total of fifteen teachers from eight primary schools initially gave consent to take part in the study. Two schools, containing six participants who had provided consent to take part in the study, dropped out before providing any data. No reason was provided for their withdrawal from the study. Later, two more participants from separate schools withdrew from the study; one of these participants was on long term absence due to illness, and the other had found employment at another school. Therefore, the final sample consisted of six schools and nine participants, with the following characteristics: gender (female, n=5, male, n=4), length of teaching experience (Mean 10.4 years, SD = 7.1 years), teaching role (PE specialist, n=3; EYFS teacher = 1, Year 1 teacher = 3, Year 2 teacher - 2), and school status (state, n=8; and independent, n=1). Three schools and four teachers were new recruits and were not involved in Study One. All schools were located in England; four were in the North East of the country, one in the North West and one in the South West.

6.3.3 Procedure

The usage period for each participant trialling the MAT lasted six weeks. During this period, participants were asked to include the MAT within at least one of their PE lessons each week. Prior to the commencement of the trials, I visited the participants in school and provided training on how to use the MAT (see below for further detail).

6.3.3.1 MAT pilot phase

Prior to beginning the trials, a pilot phase was conducted in which I visited a participating school on two occasions, separated by one week, to observe two teachers individually using the MAT. The purpose of this pilot phase was to determine whether the MAT software functioned correctly on a device supplied by a school and to determine

that the key features within the MAT (scoring, video recording, video playback) could be used by a teacher during lesson time. Therefore, the key areas of interest were:

i. Correct playback of the library of video content.

ii. Registering of the assessment scores for each task to the children's profile.

iii. Video recording and correct storage of images to the children's profile.

The two pilot participants underwent the same initial training on how to use the MAT as the study participants detailed below. For the convenience of the teacher, I input the children's names into the MAT from a class list supplied by the teacher. In the first visit, I shadowed and worked collaboratively with each teacher to assess the children. During the second visit, each teacher was the principal user and I was a passive observer of the lesson from the side of the sports hall but available to answer any questions the teacher had.

The survey and semi-structured interview schedule were piloted with these participants. Feedback from the pilot participants, resulted in the reconstruction of the interview schedule, with an emphasis on the acceptance and demand of the MAT being addressed in the early stages of the interview, and concluding with questions focusing on expansion and integration of the MAT. A detailed description of changes made to the survey are described below in section 6.3.4.2.

The pilot phase indicated that the assessment scores inputted for two of the tasks (sideways roll and hopping) did not register on the children's profile page. No further problems were encountered. One teacher suggested that a function to allow the user to insert a text comment alongside the assessment score would be beneficial. They felt that this would allow a teacher to record what feedback they had given to the child or state future assessment targets for individuals. The issue with the registering of assessment scores and the teacher's recommendation for the text comment box were shared with the

app developer who subsequently released an updated version of the MAT that was used for the trials.

6.3.3.2 Initial training and app familiarisation

Participants were required to provide an iPad that they would have access to for the duration of the trial period. Immediately prior to the trial starting, I visited each school to upload the MAT to each iPad and provided training to the participants to explain how to set up and use the MAT. During the training, participants were initially guided through the registration process on the MAT app. The main functions and features of the MAT, including inputting children's details, accessing the task assessment page, entering assessment scores, recording children's videos, and viewing child assessment scores, were then explained to the participants and instruction provided in how these worked. Participants had 10-15 minutes at the end of the sessions to familiarise themselves in using the app. One training session was delivered in each participating school and they each lasted between 45 and 60 minutes. At the end of each session, each participant verbally confirmed that they were confident in setting up and using the MAT. Following the familiarisation session and during the trial period, participants were able to contact me via email and telephone to discuss any questions or issues that they had using the app. In one instance, a group of participants at one school had difficulty accessing the app. After investigation, it was apparent that this was due to an issue with the security settings on the app caused by the software used to upload the prototype version of the MAT. The problem was resolved with the help of the school's IT department and the app developer. This issue will not occur when accessing the commercial version of the app from the App store as the download process is more robust from this platform. No other participants reported any problems.

The PE curriculum in the UK provides a framework of the learning content and standards that children should meet but schools and teachers have the freedom to develop

their own schemes of learning and configure the lesson content. It was felt that giving teachers the autonomy to decide how to incorporate the MAT in lessons would provide a greater insight of the potential methods of how the MAT could be used and highlight pedagogical issues that may arise. Therefore, no guidance was provided on how to incorporate this within their schemes of learning or how to practically implement the assessment during the lessons.

6.3.3.3 MAT trial

The trials took place in each school over a six-week period, convenient for the participant, between February and June 2017. Four schools chose to conduct the trials during the early spring term, between February and April, and the remaining two schools conducted the trials in the late spring term between April and June. These periods were chosen by the participants as most suitable for the MAT to fit in with their planned PE learning programmes and they opted to conduct the trials within a half term block, not spanning a holiday. During the course of the trial period, each participant was asked to use the MAT in at least one PE lesson each week. Timetabled PE lessons are typically limited to two per week in the UK and the lesson focus and objectives within learning programmes are designed in advance, often at the start of the school year. Therefore, to reduce the disruption to the participants' planned learning programmes, they were not required to include the MAT in every lesson.

6.3.4 Measures

6.3.4.1 Observations

Simpson and Tuson (2003) suggest that observations provide an in-depth understanding of the intended research and allow the researcher to see participants in their natural environment. For this study, I conducted direct observations (Yin, 2018) of the participants using the MAT in PE lessons to provide contextual understanding about how

participants used the MAT. Direct observations are comparable to the non-participant observational method described by Angrosino (2007), in which the researcher is not involved in the area or activities of where the research is taking place. Angrosino (2007) cautions that observations by a researcher can affect the research space as they are in view of the individuals who may adjust their own behaviour under surveillance. Similarly, Simpson and Tuson (2003) warn that individuals, especially teachers, feel extra pressure when being observed. The direct observations allowed me to remain passive and keep the environment as natural as possible so that the teachers and children were encouraged to act as if I, the researcher, was not present. To minimise the potential impact of me observing the lesson, I positioned myself at the side of the observation area and made no verbal or physical input during the lesson. Prior to the observation, I explained to the participants that the observations were taking place to help me understand how they implemented the MAT and the involvement of the students during the lesson. It was made clear that no appraisal or judgement was being made of the participant during the observation.

The observations focused on the "*implementation"* dimension of the feasibility framework (Bowen et al., 2009) to yield information about how the participant used the MAT within the lesson. Observation activities can range from casual to formal data collection methods. Yin (2018) states that formal methods involve detailed observational instruments that objectively monitor the occurrence of certain types of behaviour and permit quantitative analysis, whereas casual methods are more descriptive and based on reflective field notes. In this study, I made field notes detailing how the teacher implemented the MAT and the actions of the teacher and the children during the lesson. As indicated by Patton (2002), these informal methods are suggestive of how the participants behave in the research environment and the data can be used to support evidence from interviews and surveys.

I observed one participant from each school deliver a PE lesson which incorporated the MAT. Five observations lasting the length of one PE lesson (45-60 minutes) were completed at a pre-arranged date and time agreed with the participants. Observations did not take place at one school due to the geographical distance between the school and the researcher. In hindsight, observations at this school could have been made via video, however the ethical approval granted for the study did not cover this alternative research method that would have required recording images of children. Further, observations via video only provide a selective data set restricted by the view of the camera (Öhman & Quennerstedt, 2012) and may not have provided accurate data.

Creswell (2003) warns that a negative aspect of observations is that the data is subject to the opinion of the researcher, calling into question the credibility of the research. The risk of this was negated in this study, as the observations were just one method within the MMR design, with the triangulation of data of each method maintaining the validity of the findings (Creswell, 2003).

6.3.4.2 Surveys

At the end of the MAT trial stage, each participant completed a survey to provide a quantifiable and generalised perspective of their experiences of using the MAT (Creswell, 2003; Smith, 2010). Neuman (2014) states that surveys provide an accurate and reliable method of finding out about participants' behaviours, attitudes and expectations. Within the MMR design of this study, the survey responses would provide an insight of participants' perspectives to compare with the interview and observation data. Surveys consist of open or closed questions, or a combination of both (David & Sutton, 2011). Open questions are explorative and provide the responder with freedom to respond in their own words, whereas the possible responses for closed questions are pre-determined (Gillham, 2008). Due to the standardised response options for closed questions, they are typically quicker to complete and the responses are simpler to analyse

(David & Sutton, 2011). Neuman (2014) suggests that the questions in a survey should flow smoothly from one to another, be clear and not confuse the respondent. In this study, the survey was made up of closed questions and scaled responses (David & Sutton, 2011), allowing quantitative analysis of the participants' experiences. As the survey was being used alongside semi-structured interviews in the MMR design, closed questions and scaled responses were deemed by the researcher to be more suitable than open questions that would have permitted more detailed responses (David & Sutton, 2011; Neuman, 2014). In this way, the quantifiable responses from the surveys were compared alongside the detailed qualitative responses from the semi-structured interviews and observations in the joint visual display (Guetterman et al., 2015).

The survey contained 18 items, including introductory questions to gather factual information from the participant (class they teach, number of occasions that they administered the MAT and number of children involved) and scaled response statements based on a Likert scale of 0-10. The scaled response statements were constructed within the seven dimensions of the modified feasibility framework (Bowen et al., 2009) (acceptability, demand, implementation, practicality, adaptation, integration and expansion). The questions requiring factual information were positioned at the beginning of the survey as they were easier to answer and did not require much consideration, unlike responses exploring the participants' beliefs and opinions that Neuman (2014) recommends to include later in the survey. Following the introductory questions, scaled responses (Gillham, 2008) were required from participants to indicate their agreement with statements measuring their experiences and attitudes to the MAT. See Figure 6.1 for a sample of the scaled response questions in the survey, see Appendix 5.4 for the full survey. A reported weakness of scaled response is that, generally, they do not provide the researcher an explanation of *why* that response was chosen (Gillham, 2008). One method suggested by Gillham (2008) to overcome this within surveys would be to include

"routing questions" (e.g. if you answered *strongly disagree* or *disagree* to this statement please provide a reason). In this study, the inclusion of semi-structured interviews following completion of the survey allowed the comparison of data between the survey and the interview responses to examine all beliefs and experiences of the participants (Kvale & Brinkmann, 2009), meaning that the participants' feedback could be understood in greater detail.

A pilot of the survey was conducted with the two teachers who also piloted the MAT before the trials. Following the survey pilot, one question was removed and the scale to answer statements was increased from 0-5 to 0-10. The scaled response '*Before using the MAT, I felt a need for more support in assessing children's FMS'* was removed from the survey as the participants felt it was too similar to the statement '*I am confident in my ability to assess children's FMS'.* Furthermore, participants indicated that they felt the small scale of 0-5 limited the strength of feeling in their responses. Similarly, Bandura (2006) suggests that using a larger scale would provide greater sensitivity and is more reliable in measuring participants responses than a smaller scale.

Below are a number of statements regarding your experience of using the movement assessment tool (MAT). Please circle the appropriate number on the scale to indicate to what extent you agree or disagree to each statement (1 = strongly disagree, 10 = strongly agree)

Statement	Strongly disagree			Neutral →							Strongly agree
I was able to integrate the MAT within my lessons without disruption to learning	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
I could understand the data generated by the MAT	0	1	2	3	4	5	6	7	8	9	10
The data provided by the MAT helped me to understand how to develop children's FMS	0	1	2	3	4	5	6	7	8	9	10
The MAT engaged students	0	1	2	3	4	5	6	7	8	9	10
The content of the MAT was inappropriate to the PE curriculum at EYFS and Key Stage 1	0	1	2	3	4	5	6	7	8	9	10
The MAT has increased my confidence in assessing children's FMS	0	1	2	3	4	5	6	7	8	9	10
The MAT will enhance my teaching of FMS	0	1	2	3	4	5	6	7	8	9	10
I will continue to incorporate the MAT within my PE lessons	0	1	2	3	4	5	6	7	8	9	10
I would recommend the MAT to other primary school teachers	0	1	2	3	4	5	6	7	8	9	10

Figure 6.1: Sample of the scaled responses used in the survey

6.3.4.3 Semi-structured interviews

Semi-structured interviews were used with each participant to explore their thoughts and experiences of using the MAT (Berg, 2009; Kvale & Brinkmann, 2009). The open-ended style of questioning provided by this method of interview created the opportunity for the interviewee to direct their answer based upon their own experiences (Kvale & Brinkmann, 2009). Furthermore, this allowed me, the interviewer, to probe participants' responses and draw out a greater depth of detail to corroborate and compare with the quantitative data collected in the surveys.

The interview schedule (Appendix 5.3) was created with input from my supervisors and the advisory board. The questions were constructed around the same seven dimensions of feasibility (Bowen et al., 2009) that informed the survey design. Using the semi-structured style described by Berg (2009), the interview schedule contained 'essential' questions, with 'informal' questions, such as "what are you teaching at the moment in PE lessons?", included at the beginning to focus attention on the subject of the interview and encourage the participant to relax (Berg, 2009). Probes and prompts, such as "can you explain in more detail why you think this?", were included to elicit more information if a respondent's initial answer was unclear or incomplete (Gillham, 2005). Participants were offered the choice of individual interviews or group interviews with members of staff from the same school. Group interviews allowed multiple participants to be involved at convenient times during their school day (for example, lunch times and after school). To encourage participation within the group setting, participants were informed that they were free to contribute at any point (Fontana & Frey, 2008) and the discussion was moderated by the researcher to mitigate a dominant voice taking over (Berg, 2009). Four individual interviews, lasting between 25-40 minutes and two small group interviews, one lasting 36 minutes (two participants) and the other 37 minutes (three participants), were conducted. I conducted the individual and one group interview

face-to-face with at the participants' school. I conducted the other group interview via Skype with video due to the geographical distance between myself and the participants' school. As discussed by Lo Iacono et al. (2016), interviews conducted via Skype with video have been deemed as effective as having face-to-face interaction. All interviews were digitally recorded (Sony IC recorder ICD –PX140).

6.3.5 Data analysis

The survey responses were analysed using standard descriptive statistics, collated and tabulated to align with the seven dimensions of the modified version of Bowen et al. (2009) feasibility framework (acceptability, demand, implementation, practicality, adaptation, integration and expansion) (see Table 6.1). I transcribed verbatim all of the interviews. To systematically code each transcript, I constructed a coding table within Microsoft Word containing rows with the headings for each of the seven feasibility dimensions. I read each transcript and verbatim quotes that I felt aligned to one of the dimensions of the feasibility framework were extracted and copied into the appropriate dimension in the coding table. For example, *"*I use the videos in the lesson now as well, so instead of me showing them I try to use a different way of doing it" was coded under '*implementation*'. Upon completion of the analysis of each of the interview transcripts, I shared the transcripts and coding table with my supervisors to check and corroborate the coding patterns. During the analysis process, some codes converged across multiple dimensions of the feasibility framework. In these cases, the position of 'best fit' for the discussion of these results was discussed with my supervisors and the quotes were designated accordingly.

In accordance with the procedure of the concurrent triangulation strategy (Creswell, 2003) that was used for the research design, analysis of the findings from each method took place at the same time. Constant comparison methods (Boeije, 2010) were implemented whilst interpreting the data and piecing the findings together. The findings

of each method were integrated and converged in a joint visual display (Guetterman et al., 2015). In combination with the concurrent triangulation strategy, these two approaches helped to determine similarities and differences between the findings of the interviews, survey data and observations and demonstrated potential relationships between the data. Corroborating the findings in this way mitigated the risk of the survey data absorbing the perspective of the individual participant into a group (Hale and Graham., 2012) and integrating the findings in a visual format has been reported to strengthen the validity of MMR studies (Sparkes, 2015).

6.4 Findings

The case-study profile of each participant is provided to illustrate the uniqueness of the individuals, taking into account their knowledge, understanding and confidence of teaching PE, as well as their experiences and interactions of using the MAT. This has provided an in-depth examination of the individual cases of the participants and the descriptive case study examples will be used to consider the feasibility of the MAT for use by primary teachers with varying PE specialism and teaching experience.

The survey responses, interview data and observation notes were assembled together for analysis. A joint visual display (Guetterman et al., 2015), revealed in Section 6.4.2, was created to present the survey responses and interview data alongside the modified version of the feasibility framework (Bowen et al., 2009). Direct quotes from interview responses have been provided as examples of particular points. Appendix 5.5 presents the complete survey responses. As the observations focused on the *implementation* dimension only, these findings are interwoven within the discussion section to add further description of how teachers used the MAT within the lesson setting.

6.4.1 Participant profiles

The participant profiles in Table 6.2 below provide a brief description of each participant (pseudonyms have been used) and accounts for their use of the MAT. A * denotes that the participant also took part in Study One, providing recommendations for the MAT. Retaining some of the participants from Study One in this final study provided an opportunity for the original participants to voice their agreement with the final assessment tool and to establish if the assessment tool functioned as they had intended. The inclusion of a new sample of participants with no prior involvement in the research project provided the opportunity for new and potentially different perspectives around how primary teachers perceive FMS should be assessed during PE lessons. Moreover, the addition of new participants reduced the potential for participant bias in evaluating the feasibility of the MAT.

The information in the profile was gained through conversations between the researcher and the participants before and during the trials, as well as their responses to the survey and interview questions.

Table 6.2: Case study participant profiles

Participant	Profile	PE Specialist	Years teaching experience	Number of occasions using the MAT
Neil*	Aged 44 years, head of PE and taught PE in Year 1 and Year 2. Neil believed that quality PE is fundamental in helping children develop and pushed for greater variety of PE opportunities in school.	Yes	12	12
Vince	Aged 24 years, was in his first year of teaching as an NQT and taught PE in both Year 1 and Year 2. He was	Yes	1	8

	initially employed as a PE technician in the school and continued to work there after his teacher training.			
Louise*	Aged 34 years, EYFS teacher with 5 years teaching experience. Louise was passionate about the role of PE as a vehicle for the holistic development of children from a young age. As a student, Louise was a coach of the youth team at a large football club and assisted with city wide coaching projects. Louise was PE Co-ordinator but did not define herself as a subject specialist as she had no formal qualification for teaching PE.	Yes	5	16
Rick*	Aged 45 years, Rick had been teaching PE for 19 years after graduating with a degree in PE. He was head of department and taught PE from EYFS up to Year 6.	Yes	19	12
Jose	Aged 35 years, Jose had 8 years teaching experience in PE. As well as teaching PE in EYFS, Year 1 and Year 2, Jose was a Learning Leader and delivered PE CPD training to teachers within their local school partnership.	Yes	8	18
Linda*	Aged 43 years, Linda taught in Year 2. Throughout her teaching career, Linda had developed knowledge and understanding of PE, but felt that as trends in PE are changing, she needed more support to keep up to date. She acknowledged that she was lower in confidence teacher PE than other subjects.	No	10	7

Jenny	Aged 39 years, Year 1 teacher, 5 years teaching experience. Jenny felt confident teaching PE but did not perceive herself as having PE expertise or specialism.	No	5	9
Zoe*	Aged 45 years, had 20 years experience of teaching in primary school. She was assistant Headteacher, and taught part time in Year 1, leading two lessons of PE each week.	No	20	8
Lisa	Aged 22 years, was in her first year at the school as a teaching and learning apprentice. She delivered PE lessons in EYFS and Year 1.	No	1	21

6.4.2 Teachers' experiences and perspectives of using the MAT

Table 6.3: An integrated joint visual display of teachers' experiences and perspectives of using the MAT

Dimension	Survey	Interview data
Demand	8 of 9 participants felt confident in their ability to assess children's FMS. Linda gave a neutral response, indicating she was neither confident nor unconfident.	"As a non-specialist in PE I think this is good for those who want a bit more direction in what you're doing. I've been teaching a long time but it's still not my area of expertise, but I think this does focus you in on it." *Linda* "I think it would be really powerful because as they've gone away from levels across the board in schools, they are at power to assess how they like, I think just something like that almost gives ownership to schools doing it their own way" *Jose* "I think if we have this from the beginning of the year, it will be better, as it will be built into our program, so when you have PE you know that this is what you will be doing." *Linda* *"*I've only been teaching 5 years and I would never have thought of assessing them as fine tuned as that. It's much tighter. I might have just gone for a more holistic approach and said "yeah they can do that" or "yeah they can throw and catch" but its not until you look at it more specifically that you can go "actually they are not as competent and accurate or skilled as I thought they were". With that you can look at it and you can see where exactly they are." *Jenny* *"*I think that'll help with that as some do think they are perfect, but at least when it's a piece of writing you can show them where they've gone wrong, but in PE actually its very hard to show them where they need to improve, but the video will do that.*" Zoe* *"*I think the app will help with that to get teachers thinking more about skills rather than games. It's the same with planning for maths, it's getting people away from thinking what they're teaching and instead focus on how they're teaching it and thinking more about the objectives and how they are teaching those objectives. And I think that's where PE lacks and the app will help" *Louise*
Acceptability	All participants agreed that the data generated in the MAT helped them to	"It's given me a better understanding of how in-depth I need to go at teaching the skills" *Lisa* "I think it helps me to look at the children more as individuals." *Jenny*

	better understand children's FMS. 6 participants strongly agreed with this statement. All participants agreed that the MAT engaged students during the PE lessons. 5 participants agreed strongly with this statement.	*"*The visual-ness of it is really good. and then obviously [the children] can watch themselves played back as well so there was a bit of a WOW factor for the kids as well, so it's not just us standing there with an iPad, I found it very engaging for them as well, which was nice. It was an interactive thing, it wasn't just the teacher standing with an iPad, making notes and stuff. The actual child could be involved." *Jenny* *"*That's brilliant because then you can differentiate lessons, you can set up stations for children that need to work on something in particular, that's great." *Lisa* *"*Yes, their motivation is also improved. They are concentrating more because they want to do their best" *Neil* "I like the videos, and the children like the videos. So the children enjoyed watching the demonstration videos and then assessing themselves from it. Ours are only very young but it was a really good skill to learn." *Jenny* *"*The videos and the photos helped, they were a prompt and made me think of different things that I wouldn't have normally looked for in the skills. Rather than just looking at the obvious things, it was like the time on the balances and things as well." *Louise* "I noticed a change in their movement skills and I also noticed a change in their attention and concentration span, because they know they are being videoed they know something is going on so they are concentrating more and they want to get the best score they can, they want to be the best so you've got more focus and they love being videoed." *Neil* *"*It's helped upskill them (other teachers) in physical literacy because that's the other angle, you start with physical literacy in some schools and they are not sure what it actually is. They think its going to be active English lessons." *Jose* *"*When it came to the throwing I was able to give them those descriptions from the app. That was my main teaching points, which I hadn't used previously when we first started doing it. So that just gave me three easy bits of criteria to use with them, they could understand as well." *Rick* "I think they [children] have risen their game to it as well because they know you have it there, if you can show them that this is what you are looking for, I mean I only showed them on the little iPad and

		it would be better if we could connect to a big screen, but then I do think that they want to get to that" *Zoe* *"*I noticed that there were children within my class when I was using it that were way more interested in PE than ever would have been as they wanted to know what I was doing and they wanted to join in. You saw Sky, she's not the most engaged child in PE, but she wanted to be involved and she loved the video and I think for some children it helps to draw them in a bit more, and keep them focused and on task. It doesn't work for all of them, but some of them it did." *Jenny*
Implementation	8 participants felt that they could administer the MAT within PE lessons without assistance. 1 participant (Linda), a non- PE specialist gave a neutral response. 8 participants strongly disagreed that the video was a distraction within the MAT. Linda, gave a neutral response. All participants agreed that they could understand the data generated within the app, with 7 participants strongly agreeing with this statement.	"They were working in small groups as well it enabled me to see each child work at that particular station because they were moving around 8 different stations looking at different skills looking at different skills so when they got to that station I was there with the iPad and I was able to video them. I had to stop them just because of the nature or getting back into the video bit, finding their name." *Rick* *"*I've got lots of different things set up and whatever skill you want to look at, then if it's balance you can wait there and when the group of children come to you, you're there with the video and you can assess them on that but they are also doing other things as well at the other stations." *Rick* *"*We did a mini Olympic session that incorporated mini target practice, jumping, running and it was much easier to assess the throwing action by them actually doing a practical skill," Jose "It's been made simple, it's got the criteria, which are straight forwards and easy to understand and easy to manage on the app as well." *Neil* *"*We looked at what the lesson intention was and then we looked to put the app into that, so for instance when it was our balance, it was easy because we could use the one legged balance and we'd set up three groups and we'd have an assessment group and then the other two groups would be doing an activity in and around balancing so then all of a sudden you have three groups and then you just keep on rotating so that everyone is having a go at all three different ones." *Neil* "As I teach the younger years, it's very early development of what they're doing and I guess I'm more thorough, as literally everything that comes out of my mouth I have to be accurate. I'm looking and explaining it in a lot more detail than I was before" *Lisa*

	7 participants felt that they could integrate the MAT into their lessons without disrupting children's learning. Of these, 4 participants strongly agreed with the statement. 2 other participants (Jenny and Linda) gave a neutral response to this statement.	"When we have that second lesson that week, if we change the lesson a bit to see if we can get an improvement, because we have 2 lessons a week , if for instance they were a bit woeful at that, in the next lesson we'd look to see what we could do to make them better at it we would try and do that, so we might try and tweak the 2nd lesson depending on how good their ability was, if they were a really good ability then we have to extend them, if they weren't so good then we need to lower our learning expectations for them." *Vince* *"*You have those stations so you know the other children are working relatively on task and you can be doing the filming, and you can be looking and seeing what they're doing as you're clicking [scoring], and that's easy to do." *Rick* "I think it might be easier to have a bit more instruction on how to use the functions within the app to do it in a less time consuming way. So maybe record it and then just add the objectives after it." *Louise* *"*I liked how easy it was to access the videos and see the skills and see how easy it was to correct from those, to correct the children from those as well." *Louise* *"*I would have looked at different workstations, like a circuit, and things like that but then also different apparatus as well, it just depends." *Linda* *"*I think I will use that overview when we are pairing up or putting them into Caroline's, to be a little bit more savvy about who should work together. You might then have two children working together who can then help each other, you might put a child who is really good to work with someone who is not as good and then say to that child "I need you to help". You can use them as a coach, which I don't currently do." *Zoe* *"*The visual-ness of it is really good. and then obviously they can watch themselves played back as well so there was a bit of a WOW factor for the kids as well, so its not just us standing there with an iPad" *Jenny* *"*They might do it twice and I'll look at the arms and legs then I'd get them to go again and do the next one. It sort of worked as well but obviously with a class of 30 it was quite hard, year 1's because they have so much energy, it was quite a challenge. It was just the scoring." *Vince* *"*To be honest it was quite hard at first, because trying to have the tablet in your hand and then you're trying to score as well as teach. Whereas myself, I like to use my hand when I'm teaching PE and I like

	to move around, be a bit crazy. And I think it sort of stopped the way I teach, but at the same time it was still useful, so it helped me with getting, like, pointing out like "she's done it well" and getting the points that what she's doing right and what she's doing wrong and the videos actually show this is how you're supposed to do it and things like that" *Vince* *"*For example, Thomas was a bit wobbly on some of the balances, similar to the demonstration videos, so I scored him through that and then showed him "this is what you're at the moment", I took him to one side, told him "this is what you're at the moment and showed him the video and told him this is what we're trying to achieve next" and just showed him "this is your target"". *Vince* *"*I use the videos in the lesson now as well, so instead of me showing them I try to use a different way of doing it, so getting it on the board and trying to get different ways of doing it." *Vince* *"*I love the three clips of the development stages. I've still not got that in my mind and even if I've got it on paper, I've gone with that, I've judged them on those stages." *Zoe* "I would look at what skill I wanted to assess that lesson and then try and build it in in different ways. So if it was in the warm up and it was a balancing activity, I would get the children moving around and then I would rattle a tambourine and they would have to do a specific balance, like standing on one foot for 5 seconds, and then I'd make a note of who could do it and then work on that skill further in the lesson, so every opportunity if they were using big equipment I would stop them every so often and get them to do the skill again and then get the TA to look at ones who were wobbling and try correct them using the videos." *Louise* "Instead of changing my lessons around the assessment, I added the assessment into what I was already going to do because my PE lessons are quite free flowing anyway." *Louise* "We've almost used it as interventions, in the sense that there will be a lesson going on and then the second adult in the group will take our children to do the assessment with, we've used the second adult from a distance, isolating individuals within an activity and videoing that and then using the assessment from the video." *Jose* *"*Up to now we've just used the videos for our assessment, that would be the next stage to try and bring the videos in. the way our PE schemes work, we always return to topics later on that half term so what

		we'd do is use it for ourselves and then the next time we'd use their videos they've done on the big screen and say "look , this is how you do it" or "this is where you need to improve" *Neil* *"*I've used it when I support in other schools with their PE curriculums or physical literacy programs to upskill them in what movements look like. So it's been quite handy from a CPD delivery angle as well as its enabled me to work in a different angle with subject leaders or school leaders and kind of demonstrated to them within the physical literacy side of things to look at the different competencies of movements. This has been a really good example of a simple assessment structure in place to show them, which has drummed up interest straight away with other schools." *Jose*
Practicality	5 participants strongly agreed that the MAT can be conducted within PE lesson time, 3 participants agreed that the MAT can be conducted in lesson time, 0 participants felt the MAT could not be conducted in PE lesson time.	"The only downside to that obviously it is a little bit more time consuming, but again, the more competent we become with it, the quicker we'll be able to do things. I found I was having to wait as I was having to go back into a page to find video, or to take video, which I know I mentioned on my feedback form to you." *Zoe* *"*Once we get it working regularly, then we can come to it and get more proficient at using it and more confident at using it, because I still feel a little bit unsure with it." *Linda* *"*I think the scoring it took a bit too long because you've got your legs, arms and you're scoring on different ones. I think if they had an overall target, so instead of having them in separate categories it might be like "a bit wobbly with their arms and legs" as one category and then "stable with their legs but not their arms" , just have more or smaller sections .so instead of having arms and legs separate, I think the scoring took too long because you're trying to do your scoring as then as they're getting bored, trying to wait for you to get all your scoring down, so I think shorten the things or putting them in bullet points all together." *Vince* "Think I would have found it hard filming them individually running, just because of the large group so getting them to run one at a time I've got 33 other children absolutely mucking about so I could set them all off on a run and maybe just film one individually," *Rick* "The videos are really, really good and some of the explanations were good, some were a bit interesting but the only thing I didn't like was you couldn't click quickly on them to say where there are, it's a long process to go through on each one." *Neil*

		"It ranks them and the simplicity is great as it doesn't take a long time to show them how to do it and for them to have a go with it." *Jose*
Adaptation	All 9 participants strongly disagreed that the content of the MAT is inappropriate for to the PE curriculum at EYFS and Key Stage 1, indicating that in fact, teachers perceive the content of the MAT to be highly suitable for children aged 4-7 years old.	"We've basically been applying it to the core curriculum areas, so for striking and fielding games, we've broken it down into the fundamental specific skills you'd need to be successful at striking and fielding and then just a brief description of how that skill would look, for emerging. Developing or established performer" *Jose* "I think the Key Stage 1 team found was that there wasn't enough challenge with some of the skills. That they found a lot of the children could master those skills quite easily but then I think that because there was only a sample of some of the skills." *Louise* *"*It's made me think about the finer details of skills, like I think before I would just see the big picture and I wasn't focused on the smaller things, unless they were really obvious. So it's made me think about all the aspects of the skills and not just the skill as a whole part. Breaking skills down in to smaller components to improve it, rather than just thinking about whole skills." *Zoe* "I think it will make your teaching a lot more focused and I think it will make your teaching better." *Louise* "I think it helps me to look at the children more as individuals." *Jenny* "If you look at the national curriculum statements its really open to interpretation so I think it will fit." *Zoe*
Integration	7 participants strongly agreed with the statement that they will continue incorporate the MAT within PE lessons, 1 participant (Vince) agreed with this statement, and 1 participant (Jenny) gave a neutral response.	"The way I see this being used is the more we introduce it into schools, so like when we introduce anything, we have to pick up the pieces, and catch up, technically the way I see it being used for us, is most of this being done in reception and then building up the children's portfolio's in reception, and when they come to us [year 1] we're then going through and can cherry pick as not all the children are going to be starting off from day 1, so we're going to be able to look at that and decide who's going to need to do ABC - the children who haven't got great co-ordination skills – so I've been using it and starting from scratch," *Jenny* "We've developed a new PE scheme, the ABC scheme that we introduced, we'll now be able to build this into it." *Jenny*

	All 9 participants would recommend the MAT to other primary school teachers. Of these, 7 participants, strongly agreed with the statement.	"I also really like the transferability of it, so if I was ever to teach another class I could pick that up and use it even if I don't know the children very well, I could go down to reception to teach a PE lesson and know how to use it" *Jenny* "I'd try and get a slot at a staff meeting because we're looking at assessment through the school as well in terms of how they get measured in other areas so obviously they have other tests which are similar to SATs." *Rick* "Something simple, and easy to understand. That's it really. I don't know whether its' possible, but I'm just thinking then with having an upload button so you can upload your class register instead of having to type each name of the children." *Vince* "Showing the parents the assessment that we use. Because they won't know anything about it and they'll go "wow, this is really good, what else are you doing?" *Neil* "Then obviously in schools we have Pupil Premium, and OFSTED want to look at how these children progress, so you might need to have a section with just a Pupil Premium graph, and a gender graph, and also somewhere with date of birth, so it could look at summer borns compared to September borns. For OFSTED these are the things they look at, so you could use these graphs to document them." *Neil*
Expansion	All teachers felt that the MAT had increased their confidence in assessing children' FMS. Of these, 4 participants strongly agreed that the MAT had increased their confidence. All participants felt that the MAT would enhance their teaching of FMS. 6 participants strongly agreed with this statement.	"I've used it when I support in other schools with their PE curriculum or physical literacy programs to upskill them in what movements look like. So it's been quite handy from a CPD delivery angle as well as its enabled me to work in a different angle with subject leaders or school leaders and kind of demonstrated to them within the physical literacy side of things to look at the different competencies of movements. This has been a really good example of a simple assessment structure in place to show them, which has drummed up interest straight away with other school. They think it's brilliant and can't wait to get it when it comes out." *Jose* "If I was sat at parents evening and wanted to give them evidence of where there child was at, then there you go - show them the app, because they won't come to look at a PE lesson, but has a video of them throwing. So then at home they can practice with them throwing with these corrections. I would find this massively useful because I could then say, "look this is what I'll be doing with them in their lesson" I think it just makes us look like we're analysing everything we're doing as well and it's a lot more professional." *Rick*

	"And showing the parents the assessment that we use. Because they won't know anything about it and they'll go "wow, this is really good, what else are you doing?"" *Neil* "It's definitely increased my knowledge and confidence in my ability to judge, so before I didn't know what level to assess children for balancing, but now with the app I've got more knowledge on saying if they're a beginner and what they should do to improve. Its built my confidence on that side of knowing the different levels on different topics." *Vince* "You want to be able to push a button and it print out a report and it shows you which children have made progress straight away" *Jenny* "I don't know whether it's possible, but I'm just thinking then with having an upload button so you can upload your class register instead of having to type each name of the children." *Vince* "It's giving you that guidance because you can be thinking, "they're a Kath, so how do I get them to a Caroline" you've got that guidance to help you with that. That's really useful for non-PE specialists more than anything. Because you know they're [child} not quite right, but you don't know how to help it not be right." *Zoe* *"*In schools we have Pupil Premium, and OFSTED want to look at how these children progress, so you might need to have a section with just a Pupil Premium graph, and a gender graph, and also somewhere with date of birth, so it could look at summer borns compared to September borns. For OFSTED these are the things they look at, so you could use these graphs to document them." *Neil* *"*For me I'd like to put it on SIMS or something, so when they have a PE score I could just put "Assessment target reached", "assessment target working towards" or "assessment target working above and beyond". That would be quite useful." *Rick* *"*For the teachers that don't teach PE, if they were to video and have that evidence it would be good to have activities within the app to help them know what they should be doing." *Lisa* *"*It was mainly just the ease of getting the names on there and grouping children on the app. If you could make some link with SIMS, so the kids come onto there automatically, that would be amazing!" *Louise*

	*"*I've changed the words on the PE bit in my report to reflect their agility, balance and co-ordination and talk about how they've become more aware of their own body and how to use their bodies more. Which I don't think we would have done before without using something like this [the app]." *Jenny*

6.5 Discussion

This study aimed to evaluate the feasibility of the MAT being used by primary teachers in PE lessons. The results of the post-trial surveys indicated that all but one teacher felt confident in their ability to assess FMS. Linda, who gave a neutral response explained during the interview that:

> *As a non-specialist in PE I think this [the MAT] is good for those who want a bit more direction in what you're doing. I've been teaching a long time but it's still not my area of expertise.*

Overall, the experiences of specialists and non-specialist teachers of PE were similar, with the MAT being acknowledged as being feasible and highly acceptable by both groups of teachers. This is important considering that primary school PE is typically delivered by non-specialists who are reported to have limited confidence and understanding in assessing FMS (Morgan & Bourke, 2008; Harris et al., 2011). The survey responses indicate that 8/9 participants felt they could implement the MAT without assistance. Linda gave a neutral response in the survey, and in the interview she explained that she had initially used the MAT infrequently as she shared her timetabled PE lessons with another member of staff and due to events in school, a number of her PE lessons were disrupted, meaning there was less opportunity for her to use the MAT in PE lessons. This infrequent use of the MAT could be a reason for Linda's perceived low confidence in using the MAT. The survey responses from participants who used the MAT on a greater number of occasions, had greater confidence in using the MAT during lessons times. One teacher suggested that the MAT was initially tricky to understand, however, the ease of which it could be understood throughout the course of the trials was recognised by teachers.

Vince said that he initially struggled to get to grips with the technological aspect of the app and felt that having the iPad in his hands was a distraction during the lesson.

However, over a short period of time Vince adjusted his teaching to include the MAT; *"I use the videos in the lesson now as well, so instead of me showing them I try to use a different way of doing it, so getting it on the board and trying to get different ways of doing it."*

Previously, assessment of children's FMS has involved clinical measuring in an engineered setting. These more traditional assessments require the child to perform a range of skills (typically between 8 and 16 skills depending on the assessment battery being used) in a circuitous manner whilst being observed by the assessor. There is little, or no feedback given to the child during the assessment. Experts in Study Two proposed that in the context of a FMS assessment being delivered by teachers, there was reason to consider assessing children performing skills in a more natural environment. The CAMSA (Longmuir et al., 2015) is a recently introduced assessment of FMS that creates a more natural environment during the assessment as the children travel between the activities within the assessment. During the trials of the MAT, teachers had the freedom to implement the MAT within the lesson using any method they wished. Some direction is provided within the MAT as the 14 movement tasks are grouped within the sub-categories of FMS (stability, object control and locomotor) and listed in the order that they should be learnt. Yet participants in the trials could create their own lesson plans and design the format of how they assessed children performing the movement tasks. This was a key focus of my observations during the trials as I wanted to leave teachers to direct the most effective ways of implementing the MAT. My observations revealed that teachers maintained the activity levels of children during the lessons when the MAT was being used. Of the 5 lessons I observed, the teacher had designed the lesson with multiple stations, each with a different movement skill focus, allowing themselves to move between the stations and observe children.

In regards to implementation of the MAT within lessons, Rick felt time pressured with a large class of 34 children and struggled to assess all children within the lesson*: "I was able to go from there really and it enabled me to get through most of the class. It was only time I ran out of really within the session."* He also discovered that focusing on one individual during the assessment meant that the other children in the class were disruptive. As a solution to this, Rick suggested to organise a group or whole class run and assess the children individually whilst they were all running*:"I think I would have found it hard filming them individually running, just because of the large group so getting them to run one at a time I've got 33 other children absolutely mucking about so I could set them all off on a run and maybe just film one individually".*

All teachers agreed that the MAT had increased their confidence in assessing children's FMS and that it would enhance their teaching of FMS. Participants provided a number of insightful recommendations when asked how they would modify the MAT to better suit their needs. A recurrent suggestion from several teachers was to improve reporting features within the MAT. It would be beneficial if these charts could show progress made by individuals over time, as well as show trends in selective populations, such as gender, age group or Pupil Premium. This enhanced feature would improve reporting of children's data and would provide evidence to formal bodies such as OFSTED, parents and to pass on to teachers as children transition up through the school at the end of each academic year. It was further suggested that the initial use of the MAT could be improved by incorporating a function to upload children's data from a school database, such as SIMS. This would circumvent teachers having to manually input children's data (name and date of birth) prior to the initial use of the assessment. This is particularly important considering the time involved in this process, when time for PE is already limited.

Despite some distraction caused by the video content in the early use of the MAT, participants felt it greatly supported their understanding and expectations of how children should perform each movement task at each stage of development. Furthermore, the experience captured by this teacher summarises the key benefit that other teachers also reported:

> *It helped me with getting, like, pointing out like "she's done it well" and getting the points that what she's doing right and what she's doing wrong and the videos actually show this is how you're supposed to do it and things like that" Vince*

This aligns with the findings of Weir and Connor (2009) who also found that using video for assessment within PE aided student learning as it allowed the teacher to provide visual feedback and highlight the key learning points.

There are currently no statutory assessments or attainment measures for primary school PE within the UK. As such, schools are tasked with sourcing, or devising, their own assessments for measuring children's progress. With the recent commitment made by the government to continue providing PE and Sport Premium in England through to 2019 (Department for Education, 2018), schools remain accountable for how that money is invested to improve their provision of PE and sport. All teachers in this study indicated that the MAT provided data that helped them to better understand children's FMS. The potential value that teachers in this study positioned on the data recorded within the MAT to evidence children's progress was encapsulated by Neil, who commented in the interview that:

> *OFSTED want to look at how children progress, so you might want to have a section with just a pupil premium graph, and a gender graph, and also somewhere with date of birth….. For OFSTED these are the things that they are looking for*

The responses from teachers using the MAT indicate that as well as being a suitable method of assessment, the MAT is an instructional tool that can directly develop

teachers' knowledge and understanding. Jose, a subject lead for PE, suggested that the MAT could be expanded to be used as a training tool to expand PE CPD to teachers in schools. Further consideration could focus on modifying the MAT to include features and activities to enhance training opportunities and support teachers in developing their knowledge. The Start to Move e-learning resource has been developed and sits alongside the MAT as a holistic package to develop teachers' confidence and understanding. This package could be more widely advertised and promoted. Keay, Carse & Jess (2018) suggest that teachers' professional learning requires a re-think, with traditional forms of training delivery (i.e. courses and manuals), perhaps being less impactful. All participants agreed that the MAT had increased their confidence and their understanding and awareness of assessing FMS and the findings of this study suggest that providing teachers with the use of digital technology had been advantageous. Overall, the MAT has demonstrated to be effective in improving teachers' understanding of children's FMS, as well as increasing their confidence in assessing FMS. Increasing teachers' awareness of children's FMS would subsequently enable them to better support their development (Morley et al., 2015).

6.6 Limitations

Due to the relatively small number of participants within this study and the qualitative component of MMR, it is recognised that the findings are not generalisable for the whole population. However, the depth of detail and understanding gained from the perspectives of each participant and the lessons learned from each individual may be applicable in a variety of situations (Bennett, 2010). In this respect, the findings provide evidence from teachers of the acceptability and suitability of the MAT, as well as highlight any recommendations to modify the MAT to better suit teachers (Yin, 2018).

Due to the time-frame of the development of the prototype of the app, the trial period of this study was conducted mid-way through the school year. Teachers reported

that they had to adjust their schemes of learning to accommodate the MAT within their lessons and they felt it was not always possible to plan their teaching around using the MAT in the lesson. As such, some teachers felt they did not implement the MAT as frequently as they would have liked during the trial period. It was suggested that integrating the MAT when programmes of learning are being designed, such as from the start of the academic year, would reduce disruption, as the medium and long-term learning plans could be developed in-line with the skills in the MAT.

6.7 Conclusions

The findings of this study demonstrate that the MAT is feasible for primary teachers to implement within PE lessons and that there is acceptability from teachers to continue using it. Teachers within this study reported improvements in their understanding and awareness of assessing children's FMS competence as a result of using the MAT over the relatively short 6-week trial period. Furthermore, children's engagement increased during the lessons in which the MAT was used. This suggests that upon its launch, specialist and non-specialist teachers of PE will have access to a MAT that has the potential to enhance their teaching of FMS in early childhood education settings. This has the potential to positively impact on children's learning and development of FMS during this critical period of their physical development. Furthermore, considering the positive association between FMS competence and PA from childhood, and continuing through adolescence (Lubans et al., 2010; Logan et al., 2015; Barnett, Lai et al., 2016; Cattuzzo et al., 2016), the MAT could be a successful mechanism in promoting PA levels of the population.

CHAPTER 7

Conclusions

Chapter 7: Conclusions

7.1 Summary of the research programme

The importance of developing FMS in early childhood is clear with a relationship being demonstrated between increased FMS competence and PA and reduced obesity levels (Stodden et al., 2008; Lubans, et al., 2010; Barnett, Lai et al., 2016; Cattuzzo et al., 2016). Primary schools provide an optimal environment for children to develop FMS and it has been recommended that teachers become more involved in assessing children's FMS so that they can enhance their learning (Morgan et al., 2013; Morley et al., 2015). However, existing FMS assessments are unsuitable for use by teachers. Therefore, the aim of this thesis was to design and develop a MAT for primary school teachers to assess the FMS competence of children aged 4-7 years. To fulfil this aim, the objectives of this research programme were:

1. To explore the perceptions of primary school teachers and movement experts regarding the assessment of children's FMS.
2. To generate, by expert consensus, the framework of a teacher-oriented assessment of FMS for children aged 4-7 years old.
3. To examine the feasibility of the MAT being used by teachers in the initial years of primary school during PE lesson time.

These objectives were examined across four studies. This chapter will highlight the overall findings of each study, and consider their contribution to existing knowledge, limitations, direction for future research and overall conclusions.

7.2 Summary of findings of Study one

Up to now, there has been limited research examining the development of a FMS assessment tool specifically for primary school teachers to use. Study One explored the perceptions of primary school teachers regarding the assessment of children's FMS competence. The recommendations provided by teachers indicated that an effective MAT should be simple to use, quick to administer and provide valuable feedback to guide their future teaching and better support children's learning of FMS. Teachers in Study One highlighted the importance of adopting a process-oriented scoring style for the movement tasks. This is in agreement with Hay and Penney (2009) who believe that assessment in PE should be focused on AfL, providing feedback to the teacher to promote learning. This style of scoring would capture how the child performs the skill. This type of feedback is critical to provide individual feedback to the teacher to inform future learning. In the UK, primary PE is taught by specialist and non-specialists of PE, with some teachers lacking confidence and understanding in the subject (Morgan & Bourke, 2008; Harris et al., 2011). Therefore, it was imperative that the MAT was designed taking into account primary teachers' varied level of knowledge and understanding of FMS. This was also important because Tidén et al. (2015) indicated that reliable process-oriented scoring is reliant upon a good level of understanding by the assessor. Teachers in this study suggested that using digital technology, such as iPads, for the MAT would provide a number of beneficial functions for the assessment, including video content, video recording and simple, time-efficient recording features. Video content would assist teachers who require additional instruction and guidance to conduct the assessment and video recording may enhance the child's learning experience through the additional focus and feedback opportunity (Davids et al., 2008). These findings support the recommendations made by Graham et al. (2013) and O'Loughlin et al. (2013) who had previously highlighted that digital technology could optimise assessment in PE. In

general, there was demand from primary teachers for a MAT that they can use in lesson time that would enhance the learning environment for children and better support their development of FMS.

Study Two included academic and practitioner experts from the field of children's movement development and assessment to gain their perspectives for a primary teacher-oriented assessment of FMS. The findings of this study indicated that a number of multidimensional complexities of assessing children's FMS exist in relation to the specific context in which the assessment will be conducted. These considerations were indicative of the opposing views that were debated by participants during the focus groups, often forming an either-or-argument, for example, should the assessment be conducted in a natural or an engineered environment? These postulated dilemmas provided a framework for developing the initial MAT design. Expert perspectives suggested that when designing a MAT for specific contexts and settings, in this case primary school PE lessons, consideration revolving around these specific circumstances should be addressed before issues relating to validity and reliability are addressed.

Study Three adopted a novel approach for research in education by conducting a Delphi poll with an international group of experts to generate the content of a teacher-oriented assessment of FMS competence of children aged 4-7 years old. Using a quantifiable approach to establish the content and format of the assessment established content and face validity for the MAT. There are currently a large number of assessments that claim to assess FMS but these include a wide variety of skills and scoring methods (product or process oriented). Tompsett et al. (2017) have discussed the difficulties caused by the non-existence of a standardised FMS assessment, such as unreliable comparisons of children's FMS competence scores between different assessments. The content and format of the assessment agreed by experts in Study Three provides a much-needed understanding as to what movements should be included in an assessment of FMS

for 4-7 year olds and the scoring method to be used. Thus, this knowledge should make it possible for standardised models of assessment to be implemented. The potential for the MAT to better equip teachers to support children's movement is considered. This is the first time that international experts have provided a shared prospective for the development of a FMS assessment. It can be foreseen that it would work because of the contribution of teachers and experts (academics and practitioners) to develop the MAT and the research driven process to establish the assessment content. The true value of the MAT will only be revealed if it achieves the objective of being feasible for teachers to use.

Study Four provided an in-depth exploration of the experiences and perceptions of primary teachers using the MAT during PE lessons. The positive experiences recounted by teachers indicate that there is high acceptability for the MAT and that it is feasible to administer during PE lessons. Overall, the experiences of specialist and non-specialist teachers of PE were similar, with the MAT being acknowledged as being feasible and highly acceptable by both groups of teachers. This is important considering that primary school PE is typically delivered by non-specialists who, as discussed above, are reported to have limited confidence and understanding in assessing FMS. The reported positive outcomes from teachers of using the MAT over a 6-week trial period included an improvement in their confidence in assessing children's FMS, a better understanding of their children's FMS competence, as well as an increase in children's engagement in their learning. Although changes in children's actual FMS competence were not measured in this study, increasing teachers' awareness of children's FMS could subsequently enable them to better support their development and enhance their learning (Morley et al., 2015). Considering the positive outcomes and acceptance of the MAT when delivered by teachers during this trial period, it is reasonable to predict that the

MAT would be welcomed by teachers as a resource to facilitate the assessment of children's FMS and subsequently having a positive impact on children's learning.

In addition to it being a tool for teachers to assess children's FMS competence, the MAT is also important as it could help teachers (and senior leaders in school) to paint a picture of children's competence and progress within the physical dimension of physical literacy. Whilst there are assessments available that measure physical literacy as a whole (e.g. PLAY), the MAT presented here is more specific and would provide measurable information and specific guidance to support children's development of FMS. In relation to the personal development dimensions of physical literacy (motivation, confidence, knowledge and understanding), Henderson, May and Umney (1989) demonstrated that children who are competent in FMS, such as running, throwing, skipping and balance are more likely to have higher self-esteem and self-confidence. As discussed earlier in this thesis, more recent evidence has demonstrated that promoting children's FMS competence could have positive implications on their participation in PA during childhood and adolescence (Lubans et al., 2010; Logan et al., 2015; Barnett, Lai et al., 2016; Cattuzzo et al., 2016). In turn, this may promote the development of children's physical literacy due to the positive association between increased FMS competence, increased PA levels and enhanced motivation, perceived competence and self-esteem (Stodden et al., 2008; Robinson et al., 2015).

7.3 Contribution made by this thesis

Up until now, there has not been a FMS assessment tool appropriate for primary teachers to use to assess 4-7 year old children during lesson time. The early years of childhood are a critical period for children to develop FMS and primary schools provide an optimum environment for children to learn and develop FMS. The MAT that has been developed as a result of this research programme will enable teachers to assess children's FMS competence and better support their development.

Despite the high level of acceptance of the MAT by teachers in Study Four, the challenging issue is how to engage all teachers of children in the early years of primary school to incorporate the MAT within their teaching. Currently, teachers have the freedom to select the resources and learning programmes that they include in their teaching of PE, providing an excellent opportunity for the MAT to be promoted for teachers to use. Promotion of the MAT will need to consider the benefits of the MAT for teachers, in order for them to be motivated to use it. Study One revealed that teachers do not give PE the same level of importance as other key subjects, such as Maths and English, and that teachers are time-pressured delivering PE. Both of these issues result in some teachers providing limited time and emphasis on PE. Therefore, a key advantage of the MAT highlighted by teachers in Study Four is the ease in which the MAT can be picked up and implemented.

Initially providing teachers with an instructive, mechanical way of assessing FMS may assist in developing their confidence and competence to assess, allowing them to modify their engagement and usage of the MAT over time. In this way, teachers would maintain their freedom to exhibit and develop their professional practice. This aligns with the notion of assessment in PE being authentic (Hay & Penney, 2009), enabling teachers to customise and refine how they incorporate the MAT within their teaching to suit their children and the environment that they work within. Providing teachers with the professional autonomy to regulate how they implement the MAT within their teaching could deepen their knowledge and understanding to support children's development of FMS. This resonates with the conceptual framework proposed by Keay et al. (2018) that suggests teachers' long-term professional learning needs more attention and creative thinking than training courses and manuals.

As well as launching the MAT for teachers to use as a result of this research, the individual findings of each study provide a detailed examination of teacher-oriented

assessment of children's FMS. Until now there was not a definitive list of FMS for researchers or practitioners to follow and because of the differences between existing FMS assessments, comparisons between these tools assessments was impractical and unreliable. The results of Study Three provide a much needed understanding of how FMS should be assessed at age 4-7 years by teachers. This knowledge is beneficial to teachers, practitioners and academics to design assessment programmes or interventions to better support children development of FMS.

7.4 Limitations

Several limitations have been identified and considered in each study of this thesis. However, there are three that warrant the most consideration.

Firstly, the participation of teachers in each study was voluntary, therefore only teachers that were interested and motivated in the topic took part. Teachers who did not volunteer to take part may have had alternative perceptions towards the design of the MAT and their interactions and experiences of using the MAT during the feasibility trials may have differed. It is acknowledged that the observational research conducted in Study Four is not generalisable across a population, and that the findings are only representative of the teachers involved. However, within the group of participants, a representative sample of primary teachers were recruited to take part in the study (specialists and non-specialists of PE, range of years teaching experience, range of class they teach).

Next, within the scope of this research, measuring the feasibility of the MAT was deemed more important to fulfil the research aim. There are already assessments available that have been validated to assess the FMS competence of children in early childhood (for example, TGMD-2 [Ulrich, 2000]; BOTMP-2, [Bruininks & Bruininks, 2005]) so adding another assessment to this field, without first considering its use by teachers, would not be a unique contribution. The aim of this research was *to develop a MAT for teachers* to use. Therefore, due to the specific context of primary teachers assessing FMS

in a PE lesson it was considered more important that the feasibility of the MAT was examined before its validity and reliability. This is considered a limitation due to the need for assessment tools to be valid and reliable (Burton & Miller, 1998).

Finally, the relatively short duration of the Study Four meant that some of the participants used the MAT more frequently than others. Those participants who used it on the least number of occasions reported the most problems with the length of time it took to implement the assessment. They confirmed that point by stating that their competence and confidence using the MAT increased the more times they used it. A longer trial phase may have allowed all participants to become more familiar with using the MAT and may have generated a better understanding of the longer-term engagement and integration of the MAT within lessons.

7.5 Future directions

The MAT has been developed in response to a call for a teacher-oriented assessment of children's FMS. Study Four of this thesis has established that the MAT has a high level of acceptance from primary teachers and that it can feasibly be used in PE lesson time. As such, it is imperative that the MAT be promoted to schools and teachers as a resource that up to now has not been available and that can help them better support children's development of FMS. Considering the relationship between increased FMS competence, PA and reduced obesity levels, future research involving teachers using the MAT could take place to longitudinally track the influence of the MAT on increasing PA and reducing obesity in childhood. This research could also include academic achievement as this knowledge could be influential in encouraging schools and local authorities to introduce the MAT to their teachers. Furthermore, additional research could take place with teachers to longitudinally track the perceived benefits of the MAT on their teaching of FMS. In contrast to the feasibility study conducted in this thesis, a larger scale quantitative study could be favourable to examine the attitudes and behaviours of a larger

sample size of primary teachers using the MAT. Again, this would offer further insight from a representative sample of primary teachers, as well as provide further knowledge of how to modify and promote the MAT specifically for teachers. Future research could look at the impact of the assessment on teacher-led assessment and the consequential evolution of teaching practice and patterns of change in children's FMS competence.

The acceptance and recognition of the MAT by researchers to assess children's FMS will be reliant upon the strength of its measured validity. Currently, content and face validity of the MAT have been established by gaining the perspectives of experts in Study Three to generate the content of the assessment and the rigorous process undertaken to select the assessment criteria. Future research establishing the construct validity of the MAT would evaluate if the assessment does measure children's overall FMS competence and that the individual movement tasks are suitable measures within their respective movement categories (stability, object control and locomotor). This could be achieved by using a convergent validity approach, in which an existing FMS assessment protocol (for example, TGMD-2, [Ulrich, 2000]) that has been previously validated is used alongside the MAT to compare its accuracy in assessing aspects of children's FMS competence. Furthermore, issues of reliability remain with questions around whether a teacher can accurately assess children's FMS competence, in relation to a set of criteria within a unique and challenging context, with limited training and support. Therefore, further testing should also take place to examine the test-retest, inter- and intra-rater reliability of the MAT being used in a primary school setting.

In line with the research aims, this thesis has focused on the use of the MAT as a tool for teachers to assess children's FMS, with little consideration given to how the information obtained from the assessment should be used in a way that subsequently supports the child's learning or informs pedagogy. As identified by experts in Study Two, the importance of involving the child in the assessment of their own FMS, as part of AfL,

seems justified (Hay and Penney, 2009; Tolgfors and Öhman, 2016). However, Study Four also raised questions of how both non-specialists and specialists of PE interpret the assessment results and how they would plan programmes of learning in response to the specific needs of each child. As such, further research which considers pedagogical strategies to optimise the learning and development of FMS is encouraged.

If there is evidence of long term acceptance of the MAT by teachers, future research should be conducted to generate the content of a similar MAT for teachers to employ with children aged over seven years of age, specifically in Key Stages 2 and 3, to promote and encourage children's development of FMS across their school life. Additionally, further research should consider including developmentally more difficult or complex tasks within the existing MAT for children who reach an *established* stage before the age of 7 years, so that there is not a limit on their attainment level. Given the evidence that shows that other domains outside of schools (e.g. health professionals, sports clubs, parents) can positively enhance children's FMS competence (Tompsett et al., 2017), it could be beneficial to explore the feasibility, validity and reliability of the MAT being used in these domains in support, or addition, to the continued use of the MAT by teachers.

7.6 Closing summary

In these closing comments, I'd like to return to the very beginning and restate the aim of this research project, which was:

"To design and develop a movement assessment tool (MAT) for primary school teachers to measure the FMS competence of children aged 4-7 years old."

The systematic research conducted in Study One, Two and Three established a framework and content of a MAT for teachers to assess the FMS competence of children

aged 4-7 years old. The findings of Study Four revealed that the MAT can be implemented by primary teachers in PE lessons. Subsequently, teachers using the MAT developed a better understanding of children's FMS competence and felt the MAT would enhance their teaching.

Upon completion of this research, the MAT was branded as the Start to Move Assessment (Youth Sport Trust, 2017) and launched in Apple's app store for teachers to access in the UK. The app was awarded a 5* review by the Educational App Store, providing endorsement of its effectiveness and suitability for teachers. Testament to the scope and global acknowledgement of this research, there is now work underway with international stakeholders to refine the MAT for populations in Singapore, Hong Kong and Australia. The feasibility framework used in Study Four is being adopted to evaluate the use of the MAT by teachers in these countries to identify modifications that may be required to integrate the MAT in those populations. An extension of this work will examine the convergent validity of the tool and its reliability. This will address some of the recommendations for future research highlighted above.

This is the first FMS assessment that has brought together teachers, researchers and practitioners on an equal basis to gain perspectives and generate content. This research has provided a deeper knowledge and understanding of teacher-led assessment of children's FMS that is useful for teachers, researchers and practitioners. Hopefully the MAT will continue to be adopted by primary teachers to enhance their teaching of FMS and the findings will contribute to a greater focus being placed on addressing children's FMS competence across the population.

CHAPTER 8

References

Chapter 8: References

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Appendices

LIVERPOOL JOHN MOORES UNIVERSITY
PARTICIPANT INFORMATION SHEET

Project Title: Designing a Fundamental Movement Skills assessment tool for children aged 4-7 years

Principal Researcher: Tom van Rossum, School of Education, Leisure & Sport Studies, Liverpool John Moores University

You are being invited to take part in a research study. Before you decide it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not.

1. What is the purpose of the study?

To develop a web/app-based tool to support the assessment and on-going support of children's movement proficiency. The assessment tool will be designed to be used by teachers in a school setting. The interviews will help us to discover teachers' thoughts and perception about the assessment of children's movement. The information received from the interviews will aid in the design of the assessment tool.

2. Do I have to take part?

No. It is up to you to decide whether or not to take part. You have been invited to take part because you have met one of the inclusion criteria of the study listed below:

1. Newly qualified teacher.
2. Teach Physical Education (PE).
3. 1-3 years teaching experience.
4. 4-7 years teaching experience.
5. 7 years and above teaching experience.
6. PE curriculum co-ordinator.
7. State school.
8. Private school.

If you do decide to take part you will be given this information sheet and asked to sign a consent form. You are still free to withdraw at any time and without giving a reason.

3. What will happen to me if I take part?

Your willingness to take part in the study will involve the completion of a face-to-face, Skype or telephone interview with a member of the research group. This will be arranged at a time of your convenience and will take place within the school that you work. You will be asked about your thoughts and perceptions about the assessment of movement across school and in Physical Education.

The results from the sample of interviews being completed will be used to aid in the development of a tool to aid in the reliable and valid assessment of children's motor proficiency within PE lessons.

4. Are there any risks / benefits involved?

There are no expected physical and psychological risks involved.
A benefit of taking part in the study is having the opportunity to influence the development of the assessment tool, which you may subsequently use. Also, your school will be provided with a bag of PE equipment provided by the Youth Sport Trust, as a gesture of good will for you giving your time to participate in the interview.

5. Will my taking part in the study be kept confidential?

If you consent to take part in this research, the information you provide will be kept strictly confidential. The information you provide will be anonymous and no association to your personal information will be traceable within the study. Personal data, including name and email address, will be stored according to the Data Protection Act (1998) and only the research team will have access to this. Data held electronically will be stored on a password protected computer. Paper copies of personal data will be stored in a locked filing cabinet. Personal information will be stored for five years.

This study has received ethical approval from LJMU's Research Ethics Committee

Contact Details of Researcher
Tom van Rossum - Project Officer
PhD Student
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Liverpool John Moores University**,** Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD

Dr David Morley, PhD
Principal Investigator
Professor of Physical Education & Youth Sport

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Liverpool John Moores University, IM Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD

If you any concerns regarding your involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk and your communication will be re-directed to an independent person as appropriate.

Appendix 1.2 : Study 1 consent form

LIVERPOOL JOHN MOORES UNIVERSITY CONSENT AND NON-DISCLOSURE OF INFORMATION FORM

Project Title: Designing a Fundamental Movement Skills assessment tool for children aged 4-7 years

Principal Researcher: Tom van Rossum, School of Education, Leisure & Sport Studies, Liverpool John Moores University

1. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights	☐
3. I understand that any personal information collected during the study will be anonymised and remain confidential	☐
4. I agree to take part in an interview for the above study	☐
5. I understand that the interview will be audio recorded and I am happy to proceed	☐
6. I agree to maintain confidentiality of information shared in the interview`.	☐

Name of Participant	Date	Signature
Name of Researcher	Date	Signature

Appendix 1.3: Phase 1 Teacher interview schedule

Designing a Fundamental Movement Skills (FMS) assessment - Teacher Interview Schedule – Phase one

Introduction

- Introduce self by name and role as researcher on the project.
- Thank the participant for agreeing to attend and participate in the interview.
- Purpose of the project:
  The project team is designing a valid assessment of children's Fundamental Movement Skills to be used within PE in schools. The ideas, thoughts and experiences discussed within the interview will aid in the design of the prototype and final assessment tool. The assessment will sit within 'Skills2achieve2, the Youth Sport Trust's larger assessment framework of Physical Literacy.
- Emphasise the importance of their perspectives - there is no right or wrong answer. Any information they share will help in the assessment design, to make it user friendly for teachers, such as themselves.
- Set out the structure of the interview. Remind the participant that the interview will be recorded and that they have the choice to opt out any time.
- Inform the participant that you will be sharing some images with them during the interview and will ask for their comments about these.

Warm up questions - teaching experience	**Interviewer probes:**
1. First of all, can you tell me a little bit about your experience of teaching PE in school?	Are you involved in the planning of units of work? How do you plan your own PE lessons?
2. What is your current involvement of PE in school?	Do you use supported schemes of work?
3. What PE training have you completed?	Do you specialise in any particular activity areas? Are you involved in extra-curricular activities?

Assessment in PE

The assessment tool we are developing is specifically to be used in PE. I'd like to start by talking generally around assessment across all subjects in school then would like to concentrate specifically on your experience and perceptions of assessment within PE. This will help us in the design and function of the assessment tool..

NB. Second level questions are probes and prompts to elicit further information based on the participants' responses to the numbered questions.

4. Could you describe how you currently assess children in school?
   i. What aspects of these assessments do you find work well?
   ii. In which ways could this be improved?
   iii. Is this the same in all subjects?

5. What do you feel makes an effective assessment?

6. Could you tell me what you currently assess for in PE?
    i. Could you describe how is this done?

7. What aspects of these assessments do you find work well?
    i. Could they be improved in any way?

Teachers' recommendations for an FMS assessment

Thanks for the detail there. In the next section I'd like for us to look in a bit more detail at children's movement and how this is best assessed within PE.

8. Can you tell me a little bit about how you currently measure the progress of children's movement?
    i. Do you look for any specific skills? Can you expand on how you do this?

9. Can you tell me how you currently support children's movement development in PE?
    i. How do you find this?
    ii. Did you receive any support or training to do this? What did this involve?
    iii. What difference have you noticed in the children as a result of this?

10. Could you suggest ways of how assessing children's movement could be improved?
    i. Could you explain this in more detail?

11. If you were designing an assessment to assess children's FMS, what features and functions would it include?
    i. How would this help you assess children's FMS?

Finishing points

12. Given what has been discussed today, is there anything else you'd like to add that I've not asked you about?

Appendix 1.4: Phase 2 Teacher interview schedule

Designing a Fundamental Movement Skills (FMS) assessment

Introduction

- Introduce self by name and role as researcher on the project.
- Thank the participant for agreeing to attend and participate in the interview.
- Purpose of the project:

  The project team is designing a valid assessment of children's Fundamental Movement Skills to be used within PE in schools. The ideas, thoughts and experiences discussed within the interview will aid in the design of the prototype and final assessment tool. The assessment will sit within 'Skills2achieve2, the Youth Sport Trust's larger assessment framework of Physical Literacy.
- Emphasise the importance of their perspectives - there is no right or wrong answer. Any information they share will help in the assessment design, to make it user friendly for teachers, such as themselves.
- Set out the structure of the interview. Remind the participant that the interview will be recorded and that they have the choice to opt out any time.
- Inform the participant that you will be sharing some images with them during the interview and will ask for their comments about these.

Warm up questions - teaching experience	**Interviewer probes:**
1. First of all, can you tell me a little bit about your experience of teaching PE in school? 2. What is your current involvement of PE in school? 3. What PE training have you completed?	Are you involved in the planning of units of work? How do you plan your own PE lessons? Do you use supported schemes of work? Do you specialise in any particular activity areas? Are you involved in extra-curricular activities?

Assessment in PE

The assessment tool we are developing is specifically to be used in PE. I'd like to start by talking generally around assessment across all subjects in school then would like to concentrate specifically on your experience and perceptions of assessment within PE. This will help us in the design and function of the assessment tool.

NB. Second level questions are probes and prompts to elicit further information based on the participants' responses to the numbered questions.

4. Could you describe how you currently assess children in school?
   - i. What aspects of these assessments do you find work well?
   - ii. In which ways could this be improved?
   - iii. Is this the same in all subjects?

5. What do you feel makes an effective assessment?
   - i. Can you expand on why you think this?

6. Could you tell me what you currently assess for in PE?
    i. Could you describe how is this done?

7. What aspects of these assessments do you find work well?
    i. Could they be improved in any way?

Teachers' recommendations for an FMS assessment

Thanks for the detail there. In the next section I'd like for us to look in a bit more detail at children's movement and how this is best assessed within PE.

8. Can you tell me a little bit about how you currently measure the progress of children's movement?
    i. Do you look for any specific skills? Can you expand on how you do this?

9. Can you tell me how you currently support children's movement development in PE?
    i. How do you find this?
    ii. Did you receive any support or training to do this? What did this involve?
    iii. What difference have you noticed in the children as a result of this?
10. Could you suggest ways of how assessing children's movement could be improved?
    i. Could you explain this in more detail?

As I explained prior to the start of the interview, we are designing an FMS assessment for teachers to use. Based on earlier interviews with teachers, a storyboard of the assessment has been created to illustrate what the assessment could look like.
Here is the storyboard (show images on laptop). Spend a few minutes to look at the images and then I'd like to ask your thoughts about it.

11. What are your thoughts about this assessment you've seen?
12. Is there anything you would add or remove from the assessment presented here?
    i. Can you explain why would make these changes?
    ii. Which of these features are most important?
    iii. How would this assessment and these features help you assess children's FMS?

Finishing points

13. Given what has been discussed today, is there anything else you'd like to add that I've not asked you about?

LIVERPOOL JOHN MOORES UNIVERSITY PARTICIPANT INFORMATION SHEET

Project Title: Designing a Fundamental Movement Skills assessment tool for children aged 4-7 years

Principal Researcher: Tom van Rossum, School of Education, Leisure & Sport Studies, Liverpool John Moores University

You are being invited to take part in a research study. Before you decide it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not.

1. What is the purpose of the study?

To develop a web/app-based tool to support the assessment and on-going support of children's movement proficiency. The assessment tool will be designed to be used by teachers in a school setting. The advisory focus groups will aid the research team in discovering the complexities and requirements that a tool to assess children's movement within a school setting must overcome. Your knowledge and experience of children's movement assessment and development will aid in the design of the assessment tool.

2. Do I have to take part?

No. It is up to you to decide whether or not to take part. You have been invited to take part because you have met one of the inclusion criteria of the study listed below:

1. Published peer-reviewed papers examining the motor proficiency of children.
2. Published textbooks examining the motor proficiency of children.
3. Designed assessments for the motor proficiency of children.
4. Involved in the development of movement assessments for children.
5. Headteacher of a primary or secondary school.
6. Senior Leadership Team of a primary or secondary school.

If you do decide to take part you will be given this information sheet and asked to sign a consent form. You are still free to withdraw at any time and without giving a reason.

3. What will happen to me if I take part?

Your willingness to take part in the study will involve attending and taking part within a focus group meeting containing other experts in the field of children's movement. The focus groups will take place at a pre-arranged location or via webinar. The date and time will be pre-arranged, lasting no more a day. You will be invited to talk about the motor proficiency of children, how it's assessed, and physical activity. Then, we will discuss how this can ideally be assessed in a school setting considering the limitations of PE lessons.
The results from the sample of interviews being completed will be used to aid in the development of a tool to aid in the reliable and valid assessment of children's motor proficiency within PE lessons.

4. Are there any risks / benefits involved?

There are no expected physical and psychological risks involved.
A benefit of taking part in the study is having the opportunity to influence the development of the assessment tool. This will be subsequently trialed and used in schools in the United Kingdom. You will be financially remunerated for your attendance to the sum of £350.

5. Will my taking part in the study be kept confidential?

If you consent to take part in this research, the information you provide will be kept strictly confidential. The information you provide will be anonymous and no association to your personal information will be traceable within the study. Personal data, including name and email address, will be stored according to the Data Protection Act (1998) and only the research team will have access to this. Data held electronically will be stored on a password protected computer. Paper copies of personal data will be stored in a locked filing cabinet. Personal information will be stored for five years.

This study has received ethical approval from LJMU's Research Ethics Committee dated 19th February 2015.

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Principal Investigator: Dr David Morley
Professor of Physical Education & Youth Sport, Liverpool John Moores University
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IM Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD

If you any concerns regarding your involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk **and your communication will be re-directed to an independent person as appropriate.**

Appendix 2.2: Study 2 consent form

LIVERPOOL JOHN MOORES UNIVERSITY CONSENT AND NON-DISCLOSURE OF INFORMATION FORM

Project Title: Designing a Fundamental Movement Skills assessment tool for children aged 4-14 years

Principal Researcher: Tom van Rossum, School of Education, Leisure & Sport Studies, Liverpool John Moores University

1. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights ☐

3. I understand that any personal information collected during the study will be anonymised and remain confidential ☐

4. I agree to take part in the focus group for the above study ☐

5. I understand that the focus group will be audio recorded and I am happy to proceed ☐

6. I agree to maintain confidentiality of information shared in this focus group. ☐

Name of Participant Date Signature

Name of Researcher Date Signature

Appendix 2.3: Practitioner's focus group schedule

Designing a Fundamental Movement Skills (FMS) assessment

Movement Experts Focus Group

Introduction

- Introduce self by name and role as researcher on the project.
- Thank the group for agreeing to attend and participate.
- Purpose of the project:

The study aims to design an accurate and informative school-based assessment of children's Fundamental Movement Skills (FMS). The ideas and topics discussed within the focus group will be used to aid in the design of the assessment. As well as speaking to yourselves today, we are also conducting interviews with teachers with the purpose of helping us to understand their thoughts and perceptions around the assessment of children's movement within PE. The completed assessment will be integrated within 'Skills 2 Achieve', the Youth Sport Trust's larger assessment framework of Physical Literacy.

- Inform the group that the discussion will be recorded and that that this will only be available to the research team and used only for research purposes.
- Emphasise the importance of their perspectives and encourage them to discuss their ideas freely– there is no right or wrong answer.
- Emphasise Non-Disclosure of Information – ask the participants to keep any information shared within the group confidential.
- Emphasise confidentiality – remind the group that their names will not be used in any subsequent correspondence unless they state otherwise.
- Ensure that each participant has had the opportunity to read the participant information sheet and has signed the Consent and Non-Disclosure form.

Schedule

Activity 1

Following an apocalyptic event you are part of a surviving group. As a supporter of sport and Physical Activity you intend to develop a fit and healthy nation of sporting champions. To achieve this you set out to understand the motor proficiency of the surviving children.

1. What movement components would you assess?

2. How would the assessment be conducted?

Presentation 1: Recommendations for the use of an FMS assessment by teachers

Activity 2

An old government document is uncovered that outlines key recommendations for the design of an assessment of children's FMS to be used by teachers.
Considering these recommendations you have been asked to design an assessment to be used by teachers across all schools to measure the FMS of children aged 4-7 years old.
What would this look like?

Presentation 2: YST and Skills to Achieve

Lunch

Activity 3
Considering the detail provided about the intended use of the movement assessment. Revisit your current assessment design.
What revisions are needed?

Presentation 3: Teacher targeted assessments

Activity 4
We've now seen a selection of some of the assessments that are available to teachers.
Considering everything that has been discussed today and the recommendation made for the practical design of the FMS to be used by teachers we'd like you to create a final prototype.

Summary
Following everything that has been discussed today is there anything else that you would like to aid in the design of an assessment of children's FMS aged 4-7 years old to be used by teachers?

End of session
Thanks the group for their time today and contribution today.
Remind them of the confidentiality of the discussion today.

Appendix 2.4: Academic's focus group schedule

Designing a Fundamental Movement Skills (FMS) assessment

Movement Experts Workshop

Introduction

- Introduce self by name and role as researcher on the project.
- Thank the group for agreeing to attend and participate.
- Purpose of the project:

The study aims to design an accurate and informative school-based assessment of children's Fundamental Movement Skills (FMS). The ideas and topics discussed within the focus group will be used to aid in the design of the assessment. As well as speaking to yourselves today, we are also conducting interviews with teachers with the purpose of helping us to understand their thoughts and perceptions around the assessment of children's movement within PE.

- Inform the group that the discussion will be recorded and that that this will only be available to the research team and used only for research purposes.
- Emphasise the importance of their perspectives and encourage them to discuss their ideas freely– there is no right or wrong answer.
- Emphasise Non-Disclosure of Information – ask the participants to keep any information shared within the group confidential.
- Emphasise confidentiality – remind the group that their names will not be used in any subsequent correspondence unless they state otherwise.
- Ensure that each participant has had the opportunity to read the participant information sheet and has signed the Consent and Non-Disclosure form.

Activity 1

You have been asked by a primary school to assist in re-designing assessment of PE within the school.

The school has invested in new iPads and you go looking for an all-singing, all-dancing app for the teachers to use to assess the motor proficiency of the children.
What features do you want this tool to contain?

Presentation 1: Critical considerations for the use of an FMS assessment by teachers

Activity 2

An old government document is uncovered that outlines key recommendations for the design of an assessment of children's motor proficiency to be used by teachers.

What features should be incorporated within the assessment tool to help manage these recommendations?

Presentation 2: Skills2Achieve

Presentation 3: Teacher targeted assessments

- What the assessment process could look like
- Examples of existing assessments

Purpose: To pinpoint the sequential stages that will go into the app
To learn how the assessment will be set up and what is needed to set it up
To discover what information needs to be presented to the teacher and how
To begin to formalize a scoring system

LUNCH

Presentation 4: Storyboard Presentation

Activity 3

As you were unable to find a suitable assessment tool to introduce into your school for the start of the new year, you instruct a design team to produce what you want.

Create a brief for the design team that includes:

1. How you want the activities to be scored?
2. How the scoring will be displayed within the app?

Activity 4

The design company have sent you their first draft of the assessment tool.
How does the tool meet your expectations to use as a teacher?
What improvements can be made?

Conclusion

Revisit and review previous ideas. Having looked at everything today, is there anything we have missed or need to consider for the app?

Appendix 3.1: Study 3 Participant Information Sheet

LIVERPOOL JOHN MOORES UNIVERSITY
PARTICIPANT INFORMATION SHEET

Project Title: Designing a Fundamental Movement Skills assessment tool for children aged 4-7 years old
Principal Researcher: Tom van Rossum, School of Education, Leisure & Sport Studies, Liverpool John Moores University

You are being invited to take part in a research study. Before you decide it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not.

1. What is the purpose of the study?

The purpose of the study is to develop a web/app-based tool to assess the motor proficiency of children aged 4 – 7 years old. The assessment tool will be used by teachers in a school setting. The poll you have been invited to take part in will aid the research team in identifying and selecting valid movement skills to include in the assessment of children's movement. Your knowledge and experience of children's movement assessment and development will aid in the design of the assessment tool.

2. Do I have to take part?

No. It is up to you to decide whether or not to take part. You have been invited to take part because you have met one of the inclusion criteria of the study listed below:

7. Published peer-reviewed papers examining the motor proficiency of children.
8. Published textbooks examining the motor proficiency of children.
9. Involved in the development of movement assessments for children.
10. Physical Education (PE) consultant to primary schools.
11. Develop PE resources for primary schools.
12. PE teacher educator.

If you do decide to take part, you are asked to sign and return the consent form. You are still free to withdraw at any time and without giving a reason.

3. What will happen to me if I take part?

Your willingness to take part in the study will involve taking part in a series of online questionnaires. You will be sent a link to complete the questionnaire online. The total time to complete the three questionnaires will be no more than 30 minutes. You are free to complete them at a time convenient to you before a designated date. The results of each round of questionnaires will be analysed and a subsequent questionnaire will be provided (maximum of 3).
The results from the poll will be used to determine the movement skills to include in the assessment of motor proficiency.

4. Are there any risks / benefits involved?

There are no expected physical and psychological risks involved.
A benefit of taking part in the study is having the opportunity to influence the development of the assessment tool. This will be subsequently trialled and used in schools.

5. Will my taking part in the study be kept confidential?

If you consent to take part in this research, the information you provide will be kept strictly confidential. The information you provide will be anonymous and no association to your personal information will be traceable within the study. Personal data, including name and email address, will be stored according to the Data Protection Act (1998) and only the research team will have access to this. Data held electronically will be stored on a password protected computer. Paper copies of personal data will be stored in a locked filing cabinet. Personal information will be stored for five years.

Contact Details of Researcher

Project Officer: Tom van Rossum
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Principal Investigator: Dr David Morley
Professor of Physical Education & Youth Sport, Liverpool John Moores University
IM Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD
Telephone: *removed*
Mobile: *removed*
Email: *removed*

If you have any concerns regarding your involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk **and your communication will be re-directed to an independent person as appropriate.**

Appendix 3.2: Study 3 consent form

LIVERPOOL JOHN MOORES UNIVERSITY CONSENT AND NON-DISCLOSURE OF INFORMATION FORM

Project Title: Designing a Fundamental Movement Skills assessment tool for children aged 4-7 years

Principal Researcher: Tom van Rossum, School of Education, Leisure & Sport Studies, Liverpool John Moores University

1. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights	☐
3. I understand that any personal information collected during the study will be anonymised and remain confidential	☐
4. I agree to take part in the Delphi poll for the above study	☐
5. I agree to maintain confidentiality of information shared in this Delphi poll.	☐

Name of Participant	Date	Signature
Name of Researcher	Date	Signature

Appendix 3.3: Guidance sheet provided to participants in round one of the Delphi poll

Designing a Fundamental Movement Skills

assessment tool for children aged 4-7 years old

Delphi poll guidance sheet

This guidance sheet offers support in answering Question 1 of the first round of the Delphi poll. Additional information is provided to explain the following tasks:

- Dorsal raise
- Front support
- Back support
- Sideways/log roll

Question 1: Stability movement tasks
Dorsal raise

Steps

1. Lie face down on the ground with arms out straight overhead and on the ground, and legs out straight behind.
2. Keeping arms and legs straight, raise chest and legs up off the ground. Keep neck in a neutral position

Front support

Steps

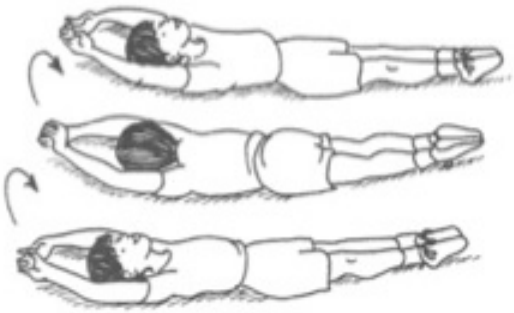
1. Position body with chest facing down, hands directly below shoulders supporting weight. Keep arms straight.
2. Keep legs and back in a straight line, and neck in neutral position

Back support

Steps

1. Position body with chest facing upwards, hands directly below shoulders supporting weight. Keep arms straight.
2. From a seated position, elevate the hips, keeping back and legs in a straight line and neck in neutral position.

Sideways roll



Steps

1. Start lying down horizontally on back with body outstretched.
2. Rotate onto side and complete a full rotation, keeping parallel to floor

LIVERPOOL JOHN MOORES UNIVERSITY
CHILD INFORMATION SHEET

Project Title: Development and validation of a movement assessment for children aged 4 – 7 years old

Principal Researchers: Tom van Rossum and Professor David Morley, School of Sport Studies, Leisure and Nutrition, Liverpool John Moores University

You are being invited to take part in a research study. Before you decide, it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not.

What is the aim of the study?

The aim of this project is to create an app that teachers can use during your Physical Education (PE) lessons.

The app will give information to teachers to help you improve your sports skills that you use in lots of different sports and games. Examples of the skills in the app are throwing, catching, running and jumping.

Do I have to take part?

No - if you'd prefer not to, that's no problem. You can stop taking part at any time.

What will you do in the project?

You will be video recorded performing different sport skills (e.g. catch a ball, hopping, running). The videos will be used in the app to show the teacher using it an example of each skill.

What will I be asked to do in the videos?

The sport skills will be similar to things you already do in your PE lessons in school, such as throwing a ball, jumping, running and hopping. Each sports skill

will be explained and shown to you before you are asked to perform it.
We will show the videos to you after you have been filmed. These videos will be used in the app and teachers and children in other schools will be able to see them.

Confidentiality

Any information we collect about you, as part of the research project, will be kept confidential. This means your name will be taken off, and nobody will know it was you.

What are the benefits of you taking part?

- By taking part in this project you will be helping us to create an app that will be used by teachers across England to improve the quality of PE.
- Your video will be included in the app to show teachers and other children how to perform the movement skills.
- Teachers will use the app to improve children's movement skills. This will help children become more active and healthier.

What will happen next?

Our researchers will arrange a day and a time for the filming to take place.

Got any more questions?

If you would like to ask any questions about the study you can call Tom van Rossum on *removed*.

THANK YOU!

LIVERPOOL JOHN MOORES UNIVERSITY
PARENT INFORMATION SHEET

Project Title: Development and validation of a movement assessment for children aged 4 – 7 years old

Researcher: Tom van Rossum, School of Sport Studies, Leisure and Nutrition, Liverpool John Moores University

This project has received ethical approval from LJMU's Research Ethics Committee (Reference: 15/EHC/027, approved on 19th February 2015)

Your child is being invited to take part in a research project. Before you decide it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want your child to take part or not.

1. What is the purpose of the study?

This study is being carried out by Liverpool John Moores University in collaboration with the Youth Sport Trust to develop an assessment of children's fundamental movement skills. These basic sport skills, such as running, throwing, catching, kicking and jumping, are the building blocks that are needed to allow children to take part in a wide variety of sports in childhood, and as they get older. Research shows that the primary school years are an important time for children to develop these sports skills and the more competent they become, the more likely they are to be physically active, have better levels of fitness and have reduced levels of obesity. We see this as an important resource to provide to teachers, as there is currently nothing similar available for use in schools within the United Kingdom.

The purpose of this project is to create the video content that will be included in the teacher-oriented assessment tool. An important function within the tool is to provide teachers with video demonstrations of the movement skills being performed by children. This will support teachers in understanding how each movement skill is to be set up and performed, providing consistency between users.

2. Does my child have to take part?

No. It is up to you to decide whether or not you want your child to take part. If your child does want to take part, then you will be asked to sign the consent form that is included in this pack. Your child is still free to withdraw at any time and without giving a reason. A decision to withdraw will not affect your child's rights/any future treatment/service you receive.

3. What will happen to my child if they take part?

Filming session

On the day of filming, we will ask that children are brought to the filming venue in Pudsey (studio address to be provided in confirmation pack). You are welcome to join the

children during the day and observe the filming session, although this is not compulsory. The filming session will last 1-2 hours. Refreshments will be provided.

A total of 14 movement skills will be contained within the app with video clips demonstrating each skill being included. During the filming session a video production company will record video clips of all of the movement skills being performed. Your child will be filmed performing the movement skills, although they may not have to perform all 14 of them. Examples of the type of skills to be filmed are running, catching a ball, hopping and balancing on one leg. Full instructions and demonstration of the movement skills will be provided to the children by the research team. We will show the videos to the children after they have been recorded.

The video clips will be included within the app, which will be used by teachers across the United Kingdom.

4. Are there any risks / benefits involved?

The research team does not envisage any physical or psychological risks involved by taking part.

The potential benefits of your child taking part are for them to be involved in the development of a resource that will be made available to teachers to use across the United Kingdom and internationally. The resource will assist teachers in tracking and supporting children's development of fundamental movement skills. There is currently no other app-based product, such as this, available.

5. Will my child's taking part in the study be kept confidential?

Children's performance in the videos is entirely anonymous and confidential; no acknowledgement of the child's name or the sports club will be made within the resource. All personal data will be stored according to Data Protection Act (1998). Electronic data will be stored on a password protected device. Paper copies of data will be kept in a locked facility and stored for 5 years.

6. I'm interested in my child taking part in the project, what should I do next?

If you are interested in your child taking part in this exciting project then you should follow the steps below:

1) You as the parent/carer/guardian should fill in the **Consent Form** within this pack.
2) You and your child should fill in the **Assent Form** within this pack. You can verbally read this out to your child and tick the boxes on their behalf.
3) You as the parent/carer/guardian should fill in the **Medical Form**.

What will happen next?

Having received your completed consent form a member of the research team will liaise with your child's sports club to arrange a suitable date for the filming session.

Thank you for taking the time to read this pack. We hope you would like your child to take part in our project and look forward to hearing from you.

Contact Details of Researchers

Project Officer: Tom van Rossum
PhD Student Liverpool John Moores University
IM Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD
Mobile: *removed*
Email: *removed*

Principal Investigator: Dr David Morley
Professor of Physical Education & Youth Sport, Liverpool John Moores University
IM Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD
Telephone: *removed*
Mobile: *removed*
Email: *removed*

If you have any concerns regarding your involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk **and your communication will be re-directed to an independent person as appropriate.**

Appendix 4.3: Movement task filming: Parent assent form

LIVERPOOL JOHN MOORES UNIVERSITY
PARENT/GUARDIAN CONSENT FORM

Project Title: Development and validation of a movement assessment for children aged 4 – 7 years old

Principal Researchers: Tom van Rossum, School of Sport Studies, Leisure and Nutrition, Liverpool John Moores University

1. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ☐

2. I understand that my child's participation is voluntary and that they are free to withdraw at any time, without giving a reason and that this will not affect my legal rights. ☐

3. I understand that any personal information collected during the study will be anonymised and remain confidential ☐

4. I understand that my child will be filmed performing the movement skills with audio / video recording equipment and I am happy to proceed ☐

5. I give permission for the video and still images to be used for marketing materials described ☐

6. I agree for my child to take part in the above study ☐

Name of Participant

Name of carer providing consent	Date	Signature
Name of Researcher	Date	Signature
Name of Person taking consent (if different from researcher)	Date	Signature

Appendix 4.4: Movement task filming: Example of the storyboard sheet for the sideways the roll

Sideways roll

	Stage 1 (Emerging)	Stage 2 (Developing)	Stage 3 (Established)
1 Arms	Starting position with arms straight, arms bend during roll	Arms remain straight throughout the roll, palms open but hands not together throughout	Arms remain straight throughout the roll, palms open and hands together throughout
2 Legs	Legs straight and together in start position, legs bend during the roll	Legs straight throughout the roll; legs splay apart during the roll	Legs straight and held together throughout the roll
3 Body /roll	Start position with arms and legs extended in straight line with body (from fingers to toes) but not aligned during roll	Arms and legs extended in straight line with body (from fingers to toes) for most of roll but not all	Arms and legs extended in straight line with body throughout the roll (from fingers to toes)

Equipment

- Mats

Filming

- Front view (inline with hands to feet)
- Go-pro birds eye view

Completed filming

Child	Stage 1	Stage 2	Stage 3	Comments

LIVERPOOL JOHN MOORES UNIVERSITY
PARTICIPANT INFORMATION SHEET

Project Title: Development and validation of a movement assessment for children aged 4 – 7 years old.

Principal Researchers: Tom van Rossum, School of Sport Studies, Leisure and Nutrition, Liverpool John Moores University

This project has received ethical approval from LJMU's Research Ethics Committee (16/ELS/024)

You are being invited to take part in a research study. Before you decide, it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not

1. What is the purpose of the study?

This study is part of a wider project being carried out by Liverpool John Moores University in collaboration with the Youth Sport Trust to develop an assessment of children's fundamental movement skills. These skills, such as running, throwing, catching, kicking and jumping, are the building blocks that are needed to allow children to take part in a wide variety of sports in childhood, and as they get older. This study aims to test the functionality and practicality of a prototype of the assessment tool that we have developed with guidance from primary school teachers and experts from the field of children's movement. The assessment tool is web/app based and has been designed to work on a tablet device (e.g. iPad). Therefore, we would like to test that the software works correctly and is suitable for teachers to use in school. This will involve teachers observing children in their PE lesson, but the observations of children will be anonymous and the research does not involve assessing children's physical activity.

Research shows that the primary school years are an important time for children to develop these sports skills and the more competent they become, the more likely they are to be physically active, have better levels of fitness and have reduced levels of obesity. We see this as an important resource to provide to teachers, as there is currently nothing similar available for use in schools within the United Kingdom.

2. Do I have to take part?

No. It is up to you to decide whether or not to take part. You have been invited to take part because you teach children aged 4-7 years old (i.e. Early Years Foundation Stage, Year One, Year Two). This is the target age range for children taking the assessment.

If you do decide to take part, you will be given a copy of this information sheet and asked to sign a consent form. You are still free to withdraw at any time and without giving a reason. A decision to withdraw will not affect your rights/any future treatment/service you receive.

3. What will happen to me if I take part?

If you decide to take part in this study, the research team will visit your school at a pre-arranged date and time on two occasions to conduct trials of the prototype of the assessment tool. During the first visit, a member of the research team will be present to provide instruction on using the tool and to support you administering the assessment with your class of children. During the second visit, you will conduct the assessment without support from the research team. Both trials will take place in the school, during your timetabled PE lesson.

During the two trials using the assessment, the child will complete up to 14 different movement skills. These skills (e.g. running, hopping, catching a ball, kicking a ball) have been selected as

being appropriate for children aged 4-7 years old. During the assessment, you will score children's performance of the skill alongside pre-defined criteria of how the movement skill should be performed. The purpose of these trials is to test the functionality and practicality of the assessment tool. The children's assessment scores will not be used for research purposes, nor will they be disseminated in research publications.
A function within the assessment tool allows video recording of the children performing the skills. As such, your child may be recorded during the session. All videos will be deleted from the tablet device at the end of the session and no recorded images will be saved.
Shortly after the trial lesson, you will take part in a focus group with other teachers involved in the study from your school. The focus group will take place in your school at a pre-arranged time on the day of the trials. The focus group will last around 45 minutes. The purpose of the focus group is to find out about your experience of using the app. You will be asked to discuss how you found using the assessment, what challenges you encountered and what could be improved. If you are not able to attend the focus group, a member of the research team will arrange an individual interview with you. The interview will last 15 minutes and take place in a quiet place within the school and your responses will be confidential and anonymous. Your experience of using the app will help to refine and improve the app for future use.

4. Are there any risks / benefits involved?

The research team does not envisage any physical or psychological risks involved by taking part. A benefit of taking part in the study is having the opportunity to support the development of this resource that will be available to primary school teachers. Developing this assessment tool will support teachers in supporting the progress of children's fundamental movement skills assessment and help them to better understand where children may need extra help. The tool may also be used in future research to better understand children's development of fundamental movement skills. In addition, your school will also be provided with access to the assessment tool to allow ongoing monitoring of children's progress in developing their fundamental movement skills.

5. Will my taking part in the study be kept confidential?

If you consent to take part in this research, the information you provide will be kept strictly confidential. The information you provide will be anonymous and no association to your personal information will be traceable within the study. Personal data will be stored according to the Data Protection Act (1998) and only the research team will have access to this. Data will be held electronically and stored on a password protected computer. Paper copies of personal data will be stored in a locked filing cabinet. Personal information and data will be stored for five years.

I'm interested in taking part in the project, what should I do next?

If you are interested in taking part in this exciting project, then you should sign and complete the consent form and return it to the research team.

What will happen next?

Having received your completed consent form a member of the research team will liaise with you to arrange a suitable date for the study to take place. A member of the research team will visit you in school prior to the assessment study taking place to explain the research process and provide training on the use of the assessment tool. We intend to conduct this study during the Autumn term, 2016.

Thank you for taking the time to read this pack. We hope you would like to take part in our project and look forward to hearing from you.

Contact Details of Researchers

Project Officer: Tom van Rossum
PhD Student Liverpool John Moores University
IM Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD
Mobile: *removed*
Email: *removed*

Principal Investigator: Dr David Morley
Professor of Physical Education & Youth Sport, Liverpool John Moores University
IM Marsh Campus, Barkhill Road, Aigburth, Liverpool, L17 6BD
Telephone: *removed*
Mobile: *removed*
Email: *removed*

If you have any concerns regarding your involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk and your communication will be re-directed to an independent person as appropriate.

Appendix 5.2: Study 4 consent form

LIVERPOOL JOHN MOORES UNIVERSITY CONSENT FORM

Project Title: Development and validation of a movement assessment for children aged 4 – 7 years old

Principal Researchers: Professor David Morley, School of Sport Studies, Leisure and Nutrition

1. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights. ☐

3. I understand that any personal information collected during the study will be anonymised and remain confidential ☐

4. I agree to take part in the above study ☐

5. I understand that the assessment and interview may be audio recorded and I am happy to proceed ☐

Name of Participant	Date	Signature
Name of Researcher	Date	Signature
Name of Person taking consent	Date	Signature

Appendix 5.3: Study 4 Interview schedule

Interview schedule - Teachers

Purpose:

To explore the experiences of primary school teachers using the Movement Assessment Tool (MAT) app.

Interview process:

Following the completion of the lesson in which the MAT has been trialed, the teacher will be asked to complete a short survey about their experiencing of using the assessment. After completing the survey, all of the teachers in each school involved in the trials of the MAT will take part in a focus group/interview (if only 1 teacher at a school) to talk about their experiences of using the MAT. A semi-structured interview style will be used based on the outline of questions below, as well as their individual responses from the survey.

Set out the structure of the interview and remind the participant that they have the right to opt out at any time.
The importance of their perspectives will be emphasised and it will be explained that there is no right or wrong answer.
The confidentiality and anonymity of the interview will be emphasised - their name will not be used in any subsequent correspondence.

<u>Remind the participants that reference to the MAT means both the assessment process and the digital app.</u>

Interview schedule

Feasibility focus area **linked to survey**	**Introduction / Warm up. (**NB**.** The purpose of these warm up questions are to ease the participant in to thinking about the subject of the interview as I have already built up a relationship with each of the participants on previous visits to the school as part of this study	
Demand	1. Could you please tell me about your current role in school? 2. Could you describe your background of teaching PE please?	
	Experience and perceptions of using the MAT In the following questions, I would like to understand how you used the MAT within your lessons and explore your experiences of using the MAT	**Prompt**
Implementation Integration Practicality	3. Could you tell me what age group you were using the assessment tool with? 4. Thinking of a specific lesson, can you tell me in as much detail as possible how you used the MAT during your lesson?	Did you achieve your aims in the lesson? Could you have done

		anything better?
Practicality Integration Implementation	5. How has your use of the MAT changed over time?	Could you tell me more about this please? Do you feel this is the most effective way to use MAT?
	I now want to focus on your perceptions of the MAT as I am interested in seeking feedback on the usability and effectiveness of the MAT	
Acceptability Demand Implementation	6. What was your reaction when using the MAT for the first time? a) How did this change over time?	**If positive,** Could you explain this in more detail?
		If negative, Did these problems exist in all classes? Can you describe anything that you put in place to manage these?
Practicality Implementation	7. What would you say are the most positive features of the MAT?	Did these always work well? If no, what did you do to improve them? how could they be improved?
Practicality	8. Did you encounter any problems with the MAT?	Did these occur everytime you used the MAT? What did you do to improve them? Can you describe how this could be improved in the MAT?
	Confidence and understanding This is a change in tack in the interview as I'd now like to ask you a few questions about your experiences of teaching and assessing fundamental movement skills (FMS).	

Expansion	9. Can you explain whether using the MAT has changed your approach to teaching and assessing FMS?	In what ways has your confidence changed?
Expansion	10. How has using the assessment altered your awareness or understanding of children's FMS?	
	In this next phase of questions, I'd like to explore the affect that using the MAT had on the children.	
Integration	11. How did the children respond to the MAT being used in lessons?	In what ways did this change? Can you give me a specific example of this?
	Adoption and future use Finally, I would like to understand your feelings towards using the assessment in the future	
Adoption	12. If you were given the existing MAT, would you be happy using it again in your lessons?	How likely are you to continue using the MAT in the future? Can you explain your answer further? How could the assessment tool be made more attractive to you to use?
Adoption Practicality	13. If there was only ONE thing you could improve to the MAT, what would it be?	
	Conclusion	
	14. Is there anything else you would like to add that we have not discussed?	Can you explain this in more detail?
	Finishing points Thank them very much for their input.	

Appendix 5.4: Study 4 Post-trial survey

Post-trial survey

Sheffield Hallam University

Name: …….
Role in school: …….
Number of year's teaching experience: …….
Number of occasions (lessons) that you have used the MAT during the trials: …….
Total number of children assessed using the MAT: …….

Below are a number of statements regarding your experience of using the Movement Assessment Tool (MAT). Please circle the appropriate number on the scale to indicate to what extent you agree or disagree to each statement (1 = strongly disagree, 10 = strongly agree)

Statement	**Strongly disagree**				**Neutral** →						**Strongly agree**
I feel confident in my ability to assess children's Fundamental Movement Skills (FMS)	0	1	2	3	4	5	6	7	8	9	10
The MAT can be conducted within PE lesson time	0	1	2	3	4	5	6	7	8	9	10
The video content was a distraction within the lesson	0	1	2	3	4	5	6	7	8	9	10
I was able to administer the MAT without assistance in the lesson	0	1	2	3	4	5	6	7	8	9	10
The MAT scoring system was a distraction from supervising my class	0	1	2	3	4	5	6	7	8	9	10
I required additional instruction or support to use the MAT	0	1	2	3	4	5	6	7	8	9	10

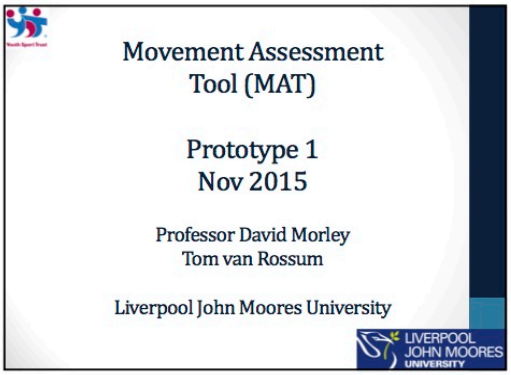
I was able to integrate the MAT within my lessons without disruption to learning	0	1	2	3	4	5	6	7	8	9	10
I could understand the data generated by the MAT	0	1	2	3	4	5	6	7	8	9	10
The data provided by the MAT helped me to understand how to develop children's FMS	0	1	2	3	4	5	6	7	8	9	10
The MAT engaged students	0	1	2	3	4	5	6	7	8	9	10
The content of the MAT was inappropriate to the PE curriculum at EYFS and Key Stage 1	0	1	2	3	4	5	6	7	8	9	10
The MAT has increased my confidence in assessing children's FMS	0	1	2	3	4	5	6	7	8	9	10
The MAT will enhance my teaching of FMS	0	1	2	3	4	5	6	7	8	9	10
I will continue to incorporate the MAT within my PE lessons	0	1	2	3	4	5	6	7	8	9	10
I would recommend the MAT to other primary school teachers	0	1	2	3	4	5	6	7	8	9	10

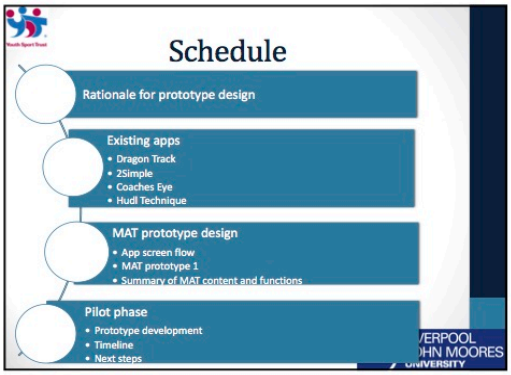
Thank you for taking the time to complete the survey. Your responses will remain anonymous and confidential.

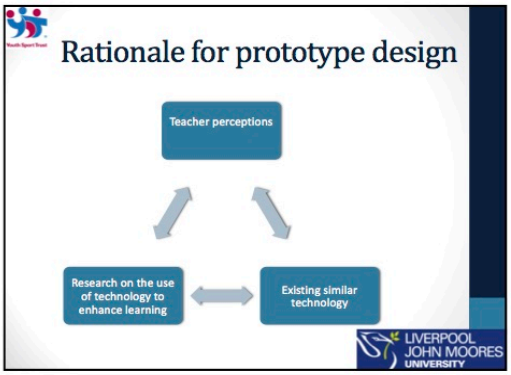
Appendix: 5.5: Table of survey results for Study 4

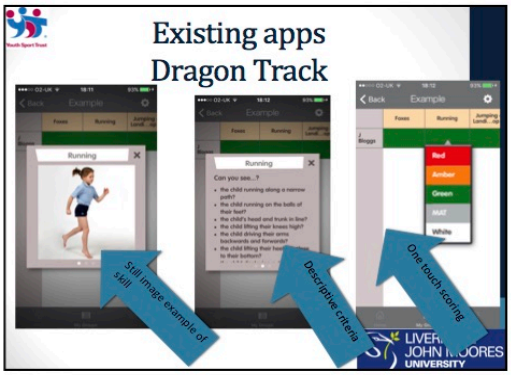
Feasibility dimension	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Demand	I feel confident in my ability to assess children's Fundamental Movement Skills (FMS)	5	4	1		
Implementation	I was able to administer the MAT without assistance in the lesson	6	2	1		
	The video content was a distraction within the lesson			1		8
	I could understand the data generated by the MAT	7	2			
	I was able to integrate the MAT within my lessons without disruption to learning	4	3	2		
Practicality	The MAT can be conducted within PE lesson time	5	3	1		
	The MAT scoring system was a distraction from supervising my class	3	1	4		1
	I required additional instruction or support to use the MAT	7		2		
Acceptability	The data provided by the MAT helped me to understand how to develop children's FMS	6	3			
	The MAT engaged students	5	4			
Adaptation	The content of the MAT is inappropriate to the PE curriculum at EYFS and Key Stage 1					9
Expansion	The MAT has increased my confidence in assessing children's FMS	4	5			
	The MAT will enhance my teaching of FMS	6	3			
Integration	I will continue to incorporate the MAT within my PE lessons	7	1	1		
	I would recommend the MAT to other primary school teachers	7	2			

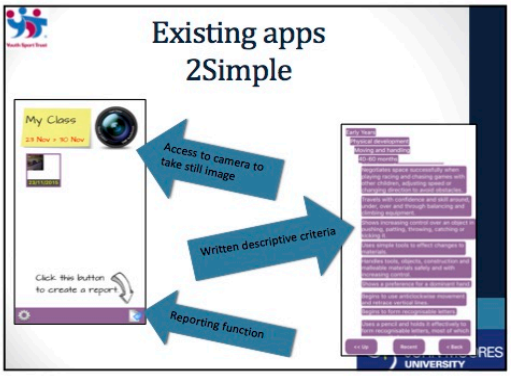
Appendix 6.1: Initial MAT prototype design

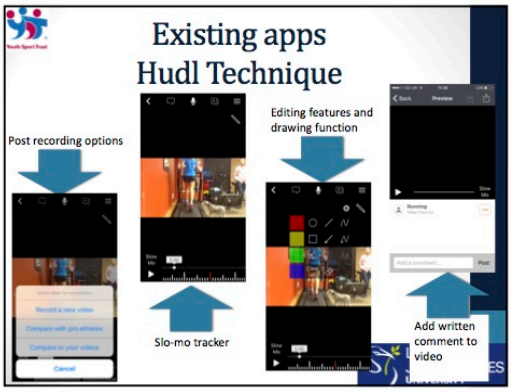


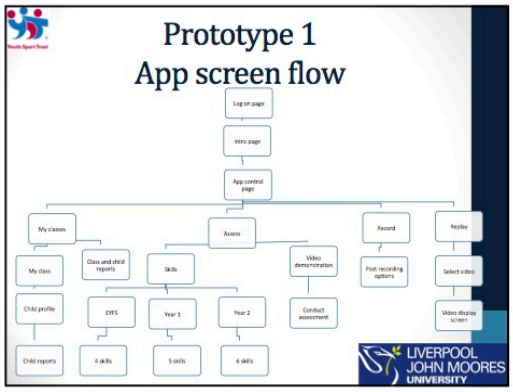


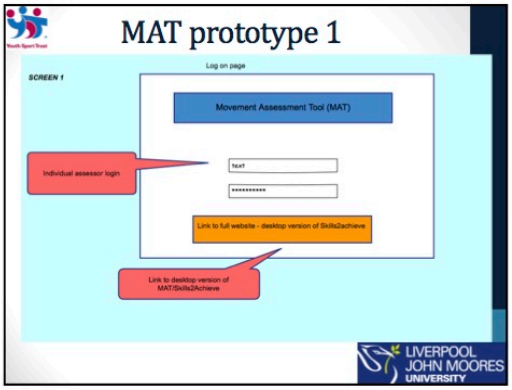


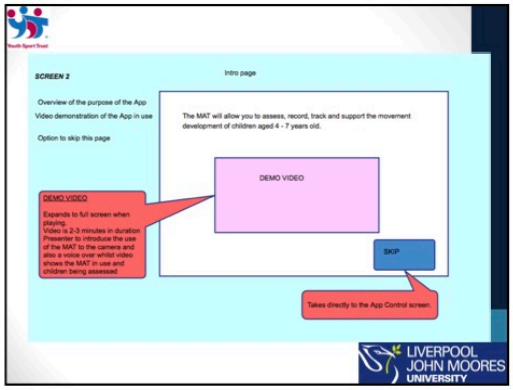


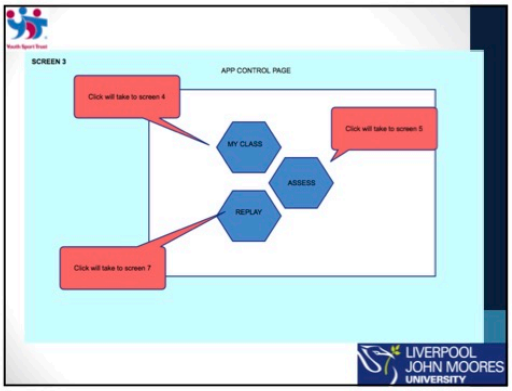


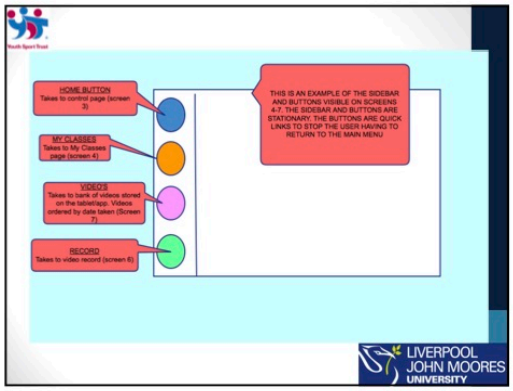

Existing apps
Hudl Technique
Post recording options
Slo-mo tracker
Editing features and drawing function
Add written comment to video

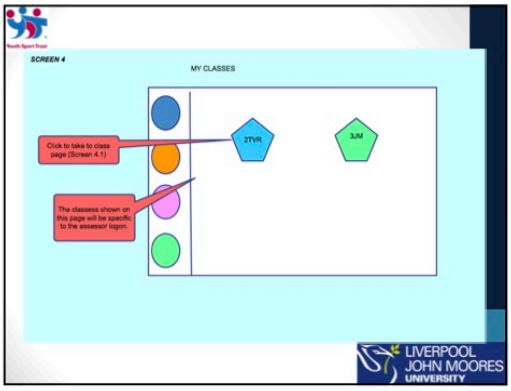

Prototype 1
App screen flow


MAT prototype 1
SCREEN 1
Log on page
Movement Assessment Tool (MAT)
Individual assessor login
Link to full website - desktop version of Skills2achieve
Link to desktop version of MAT/Skills2Achieve


SCREEN 2
Intro page
Overview of the purpose of the App
Video demonstration of the App in use
Option to skip this page
The MAT will allow you to assess, record, track and support the movement development of children aged 4 - 7 years old.
DEMO VIDEO
SKIP
Takes directly to the App Control screen.


SCREEN 3
APP CONTROL PAGE
Click will take to screen 4
MY CLASS
ASSESS
REPLAY
Click will take to screen 5
Click will take to screen 7


HOME BUTTON
MY CLASSES
VIDEO'S
RECORD
THIS IS AN EXAMPLE OF THE SIDEBAR AND BUTTONS VISIBLE ON SCREENS 4-7. THE SIDEBAR AND BUTTONS ARE STATIONARY. THE BUTTONS ARE QUICK LINKS TO STOP THE USER HAVING TO RETURN TO THE MAIN MENU


SCREEN 4
MY CLASSES
Click to take to class page (Screen 4.1)
2TVR
3JM
The classes shown on this page will be specific to the assessor logon.
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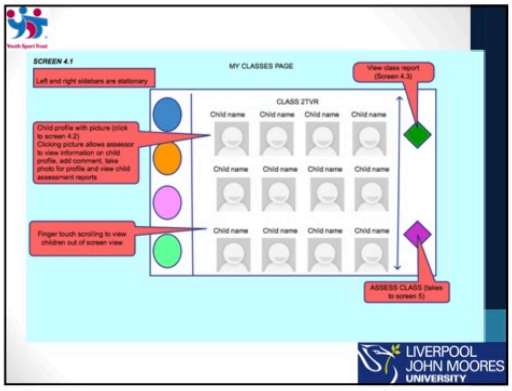
SCREEN 4.1
MY CLASSES PAGE
Left and right sidebars are stationary
View class report (Screen 4.3)
CLASS 2TVR
Child name
Child profile with picture (click to screen 4.2) Clicking picture allows assessor to view information on child profile, add comment, take photo for profile and view child assessment reports
Finger touch scrolling to view children out of screen view
ASSESS CLASS (takes to screen 5)
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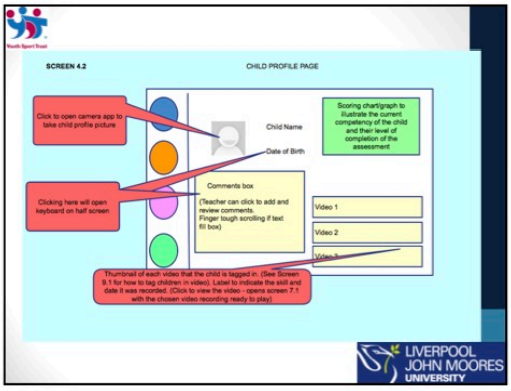
SCREEN 4.2
CHILD PROFILE PAGE
Click to open camera app to take child profile picture
Child Name
Date of Birth
Scoring chart/graph to illustrate the current competency of the child and their level of completion of the assessment
Clicking here will open keyboard on half screen
Comments box
(Teacher can click to add and review comments. Finger tough scrolling if text fill box)
Video 1
Video 2
Video 3
Thumbnail of each video that the child is tagged in. (See Screen 9.1 for how to tag children in video). Label to indicate the skill and date it was recorded. (Click to view the video - opens screen 7.1 with the chosen video recording ready to play)
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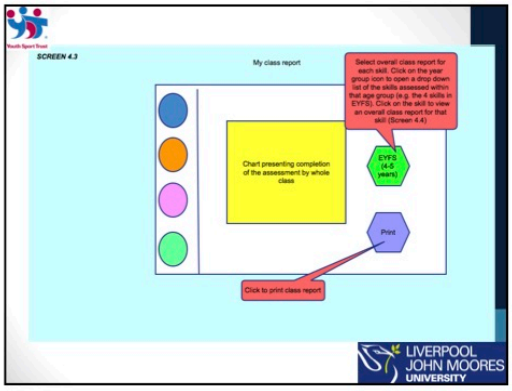
SCREEN 4.3
My class report
Select overall class report for each skill. Click on the year group icon to open a drop down list of the skills assessed within that age group (e.g. the 4 skills in EYFS). Click on the skill to view an overall class report for that skill (Screen 4.4)
Chart presenting completion of the assessment by whole class
EYFS (4-5 years)
Print
Click to print class report
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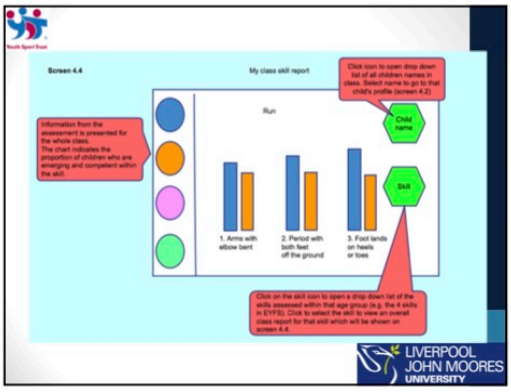
Screen 4.4
My class skill report
Click icon to open drop down list of all children names in class. Select name to go to that child's profile (screen 4.2)
Information from the assessment is presented for the whole class. The chart indicates the proportion of children who are emerging and competent within the skill.
Run
Child name
Skill
1. Arms with elbow bent
2. Period with both feet off the ground
3. Foot lands on heels or toes
Click on the skill icon to open a drop down list of the skills assessed within that age group (e.g. the 4 skills in EYFS). Click to select the skill to view an overall class report for that skill which will be shown on screen 4.4.
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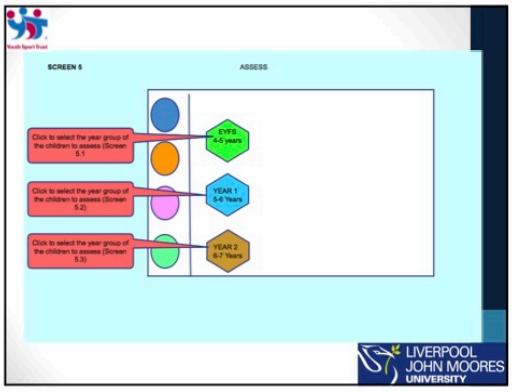
SCREEN 5
ASSESS
Click to select the year group of the children to assess (Screen 5.1
EYFS (4-5 years)
Click to select the year group of the children to assess (Screen 5.2)
YEAR 1 (5-6 Years
Click to select the year group of the children to assess (Screen 5.3)
YEAR 2 (6-7 Years
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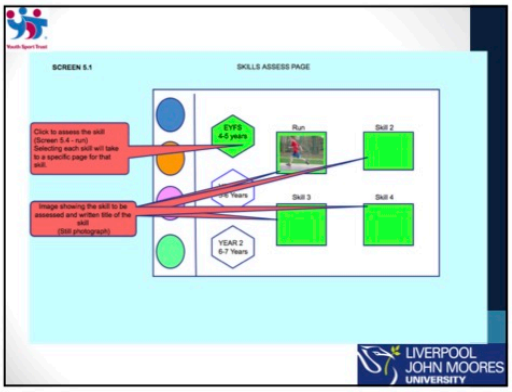
SCREEN 5.1
SKILLS ASSESS PAGE
Click to assess the skill (Screen 5.4 - run) Selecting each skill will take to a specific page for that skill.
Image showing the skill to be assessed and written title of the skill (Still photograph)
EYFS 4-5 years
Run
Skill 2
YR1 Years
Skill 3
Skill 4
YEAR 2 6-7 Years
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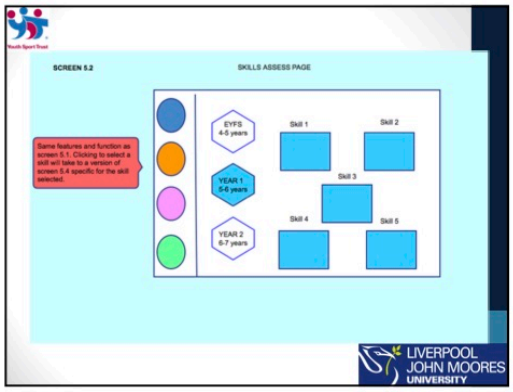
SCREEN 5.2
SKILLS ASSESS PAGE
Same features and function as screen 5.1. Clicking to select a skill will take to a version of screen 5.4 specific for the skill selected.
EYFS 4-5 years
Skill 1
Skill 2
YEAR 1 5-6 years
Skill 3
Skill 4
Skill 5
YEAR 2 6-7 years
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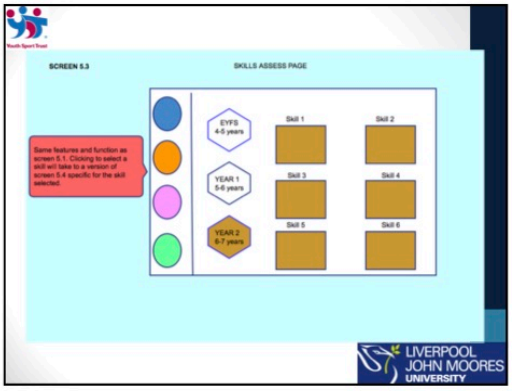
SCREEN 5.3
SKILLS ASSESS PAGE
Same features and function as screen 5.1. Clicking to select a skill will take to a version of screen 5.4 specific for the skill selected.
EYFS 4-5 years
Skill 1
Skill 2
YEAR 1 5-6 years
Skill 3
Skill 4
Skill 5
Skill 6
YEAR 2 6-7 years
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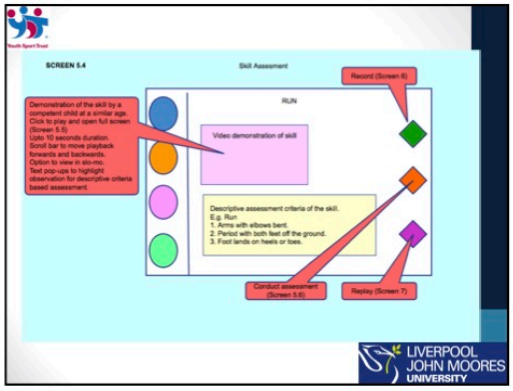
SCREEN 5.4
Skill Assesment
Record (Screen 6)
Demonstration of the skill by a competent child at a similar age. Click to play and open full screen (Screen 5.5) Upto 10 seconds duration. Scroll bar to move playback forwards and backwards. Option to view in slo-mo. Text pop-ups to highlight observation for descriptive criteria based assessment.
RUN
Video demonstration of skill
Descriptive assessment criteria of the skill. E.g. Run
1. Arms with elbows bent.
2. Period with both feet off the ground.
3. Foot lands on heels or toes.
Conduct assessment (Screen 5.6)
Replay (Screen 7)
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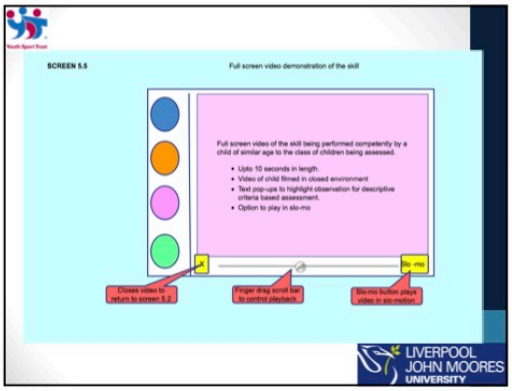
SCREEN 5.5
Full screen video demonstration of the skill
Full screen video of the skill being performed competently by a child of similar age to the class of children being assessed.
Upto 10 seconds in length.
Video of child filmed in closed environment
Text pop-ups to highlight observation for descriptive criteria based assessment.
Option to play in slo-mo
Slo-mo
Closes video to return to screen 5.2
Finger drag scroll bar to control playback
Slo-mo button plays video in slo-motion
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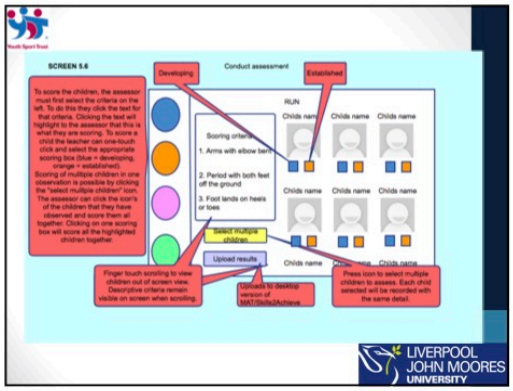
SCREEN 5.6
Developing
Conduct assessment
Established
To score the children, the assessor must first select the criteria on the left. To do this they click the text for that criteria. Clicking the text will highlight to the assessor that this is what they are scoring. To score a child the teacher can one-touch click and select the appropriate scoring box (blue = developing, orange = established). Scoring of multiple children in one observation is possibe by clicking the "select multiple children" icon. The assessor can click the icon's of the children that they have observed and score them all together. Clicking on one scoring box will score all the highlighted children together.
RUN
Childs name
Scoring criteria
1. Arms with elbow bent
2. Period with both feet off the ground
3. Foot lands on heels or toes
Select multiple children
Upload results
Finger touch scrolling to view children out of screen view. Descriptive criteria remain visible on screen when scrolling.
Uploads to desktop version of MATdata2Achieve
Press icon to select multiple children to assess. Each child selected will be recorded with the same detail.
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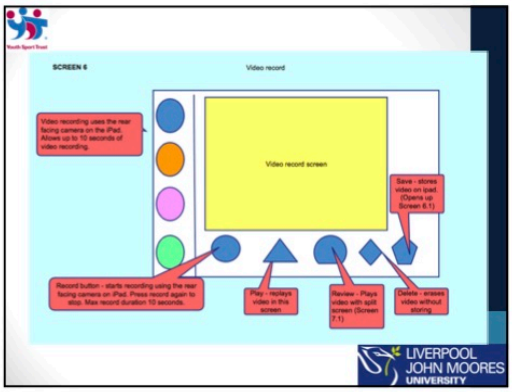
SCREEN 6
Video record
Video record screen
Record button - starts recording using the rear facing camera on iPad. Press record again to stop. Max record duration 10 seconds.
Play - replays video in this screen
Review - Plays video with split screen (Screen 7.1)
Delete - erases video without storing
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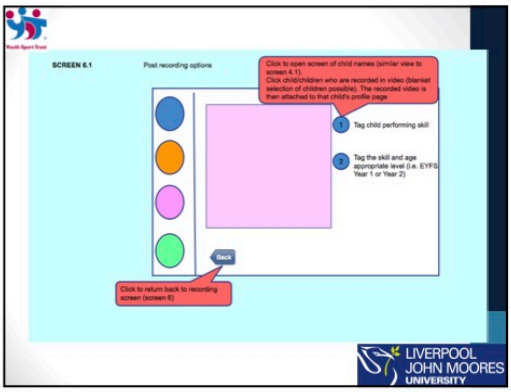
SCREEN 6.1
Post recording options
Tag child performing skill
Tag the skill and age appropriate level (i.e. EYFS, Year 1 or Year 2)
Back
Click to return back to recording screen (screen 6)
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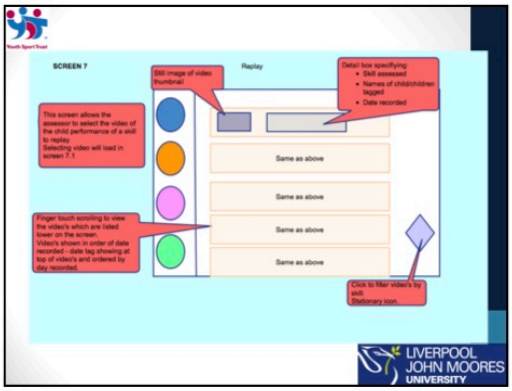
SCREEN 7
Replay
Same as above
Same as above
Same as above
Same as above
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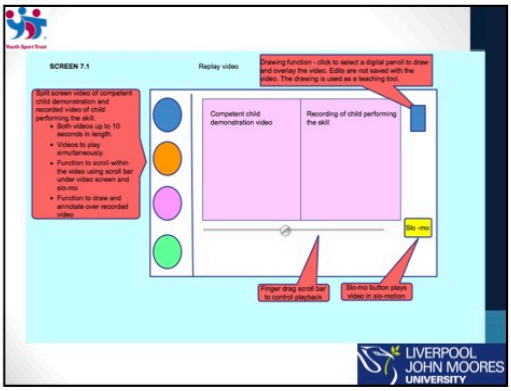
SCREEN 7.1
Replay video
Competent child demonstration video
Recording of child performing the skill
Slo -mo
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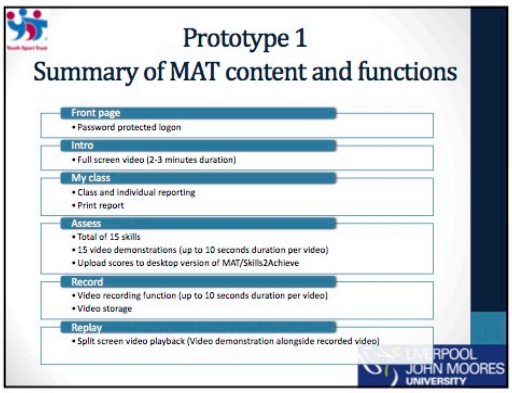
Prototype 1
Summary of MAT content and functions
Front page
• Password protected logon
Intro
• Full screen video (2-3 minutes duration)
My class
• Class and individual reporting
• Print report
Assess
• Total of 15 skills
• 15 video demonstrations (up to 10 seconds duration per video)
• Upload scores to desktop version of MAT/Skills2Achieve
Record
• Video recording function (up to 10 seconds duration per video)
• Video storage
Replay
• Split screen video playback (Video demonstration alongside recorded video)
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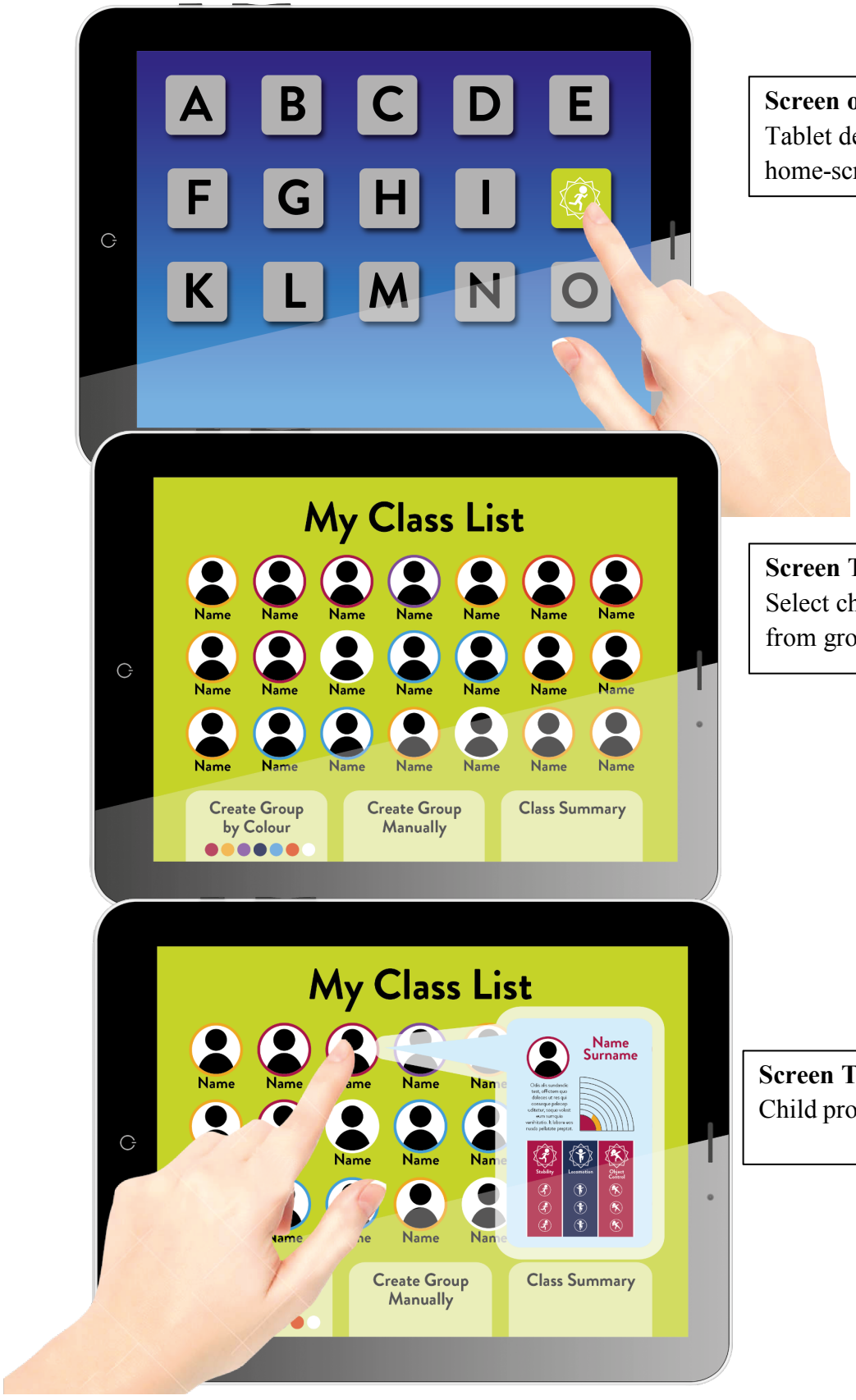
Appendix 6.2: Storyboard of the MAT



Screen one
Tablet device home-screen

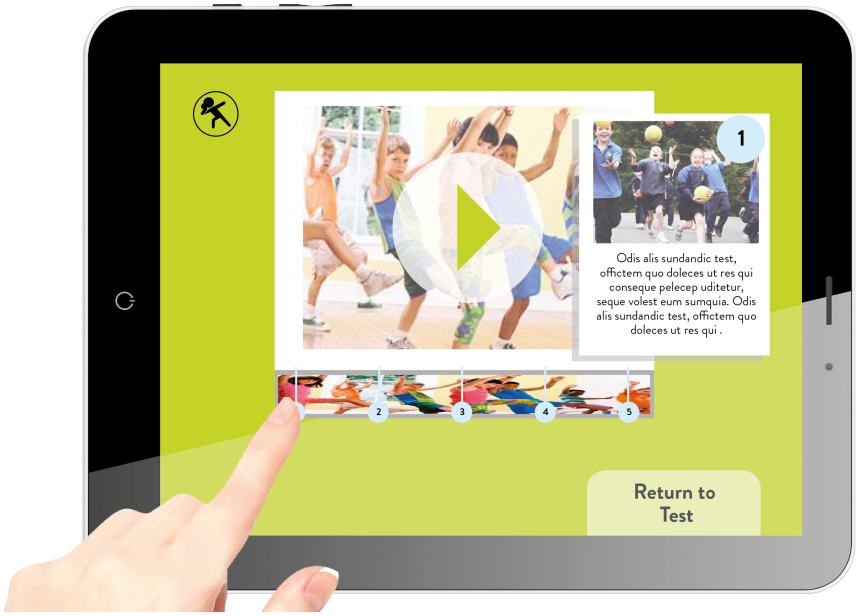
Screen Two
Select child from group

Screen Three
Child profile data

Screen Four
Select task to assess

Screen Five

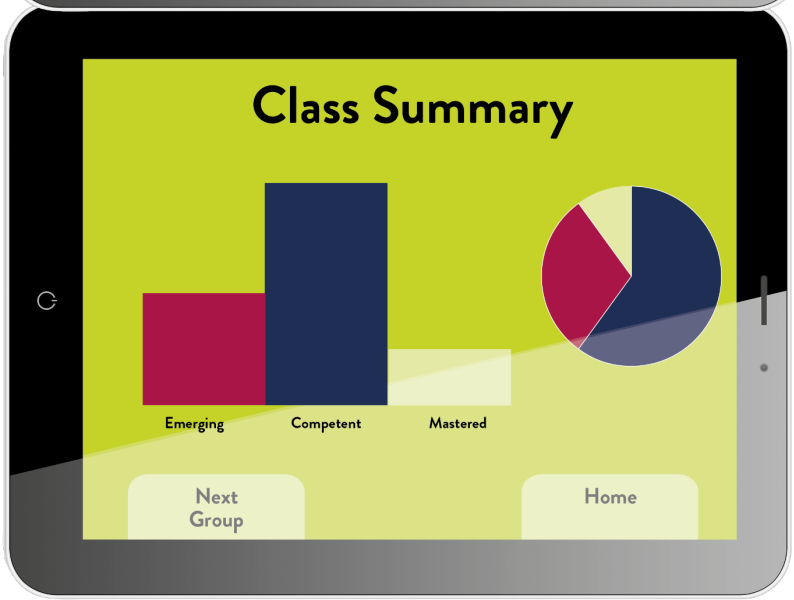
Task information (video demonstration and assessment criteria)



Screen Six
Full screen video demonstration of task (video playback control)

Screen Seven
Task assessment page

Screen Eight
Task scoring summary for individual profile



Screen Nine
Overall scoring summary per task for whole class