The Efficacy of a Task-Orientated Group-Intervention Programme for Children with Specific Learning Disorder with Co-morbid Developmental Coordination Disorder

by

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Declaration

I, Roché Crafford, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree at this or any other university. I authorise the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

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Abbreviations

ADHD = Attention Deficit Hyperactivity Disorder

ASD = Autism Spectrum Disorder

CAPS = Curriculum Assessment Policy Statement

CO-OP = Cognitive Orientation to Daily Occupation Performance

DCD = Developmental Coordination Disorder

DCD/ADHD= Developmental Coordination Disorder with co-morbid Attention Deficit Hyperactivity Disorder

DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, 5th Edition

EACD = European for Childhood Disability

EQ-5D-Y = European Quality of Life 5-Dimensions questionnaire for Youth

HRQOL = Health-Related Quality of Life

LD = Learning Disorder

LSEN = (School for) Learners with Special Education Needs

MABC-2 = Movement Assessment Battery for Children 2nd Edition

NCS = National Curriculum Statement

NTT = Neuromotor Task Training

QOL = Quality of Life

SDQ = Strengths and Difficulties Questionnaire

SLD = Specific Learning Disorder

SLD/ADHD = SLD with co-morbid ADHD

SLD/DCD= SLD with co-morbid DCD

SLI = Specific Language Impairment

WCED = Western Cape Education Department

Abstract

Background:

Specific Learning Disorder (SLD) is described as a neurodevelopmental disorder affecting academic performance and/or activities of daily life including reading, writing or calculation skills during formal years of schooling. There is strong evidence that Developmental Coordination Disorder (DCD), presenting as a disorder affecting motor skills, may be co-morbid with other neurodevelopmental conditions, including SLD. Children with SLD and co-morbid DCD (SLD/DCD) are considered a unique group. Learners with SLD/DCD experience a significant, negative impact on daily tasks such as self-care, play, leisure and schoolwork. Neuromotor Task Training (NTT), a form of intervention, has been reported to be effective in reducing the activity limitations in children with DCD. However, information regarding the most effective treatment to improve function and behaviour in learners with SLD/DCD, who attend special schools, has not yet been investigated. The aim of this study was to evaluate the efficacy of task-orientated NTT group intervention programme on motor performance, behavioural profile and health related quality of life (HRQOL) of children with SLD/DCD attending a School for Learners with Special Education Needs (LSEN) in Cape Town, South Africa.

Method:

A quantitative, quasi-experimental design with pre- and post-tests was used. Learners were included if they presented with a primary or secondary diagnosis of SLD plus DCD (scoring at or below the 16th percentile on the Motor Assessment Battery for Children 2nd Edition (MABC-2) and a functional motor problem, as identified by the MABC checklist), aged between 6–10 years and grade 1-4. Learners were allocated to either NTT (n = 18) or Usual Care (n = 18) groups. The Usual Care (UC) group continued with normal activity, but did not receive physiotherapy. The MABC-2, parent and teacher Strengths and Difficulties Questionnaire (SDQ) and self-reported European Quality of Life 5-Dimensions questionnaire for Youth (EQ-5D-Y) were used to assess performance pre- and post -intervention. The NTT program was implemented for nine weeks, with two 45-60 minute sessions per week.

Results:

There was a significant difference in Total Standard Score (TSS) between NTT and UC groups (***p=0.048***). In the NTT group, the mean TSS (***p < 0.001***) and Balance score (***p= 0.02***) significantly improved over the intervention period. The control group did not show any significant changes over the intervention period while receiving UC. The intervention group did not show any significant changes in Behavioural Profile (SDQ) over the intervention period while receiving NTT, according to

teachers. The results indicate that the intervention group showed a significant change in Behavioural Profile (SDQ) in the Behaviour/Conduct domain (***p=0.01***) over the intervention period while receiving NTT, according to parents. There was no significant change in HRQOL according to the self-report EQ-5D-Y.

Conclusion:

The results of this study showed that a task orientated programme (NTT), presented in small groups, has a positive effect on motor performance in learners SLD/DCD.

Glossary

Developmental Coordination Disorder (DCD)

DCD occurs when a delay in the development of motor skills, or difficulty coordinating movements, results in a child being unable to perform common, everyday tasks. By definition, children with DCD do not have an identifiable medical or neurological condition that explains their coordination problems.

Attention Deficit Hyperactivity Disorder (ADHD)

ADHD is one of the most common mental disorders affecting children. Symptoms of ADHD include inattention (not being able to keep focus), hyperactivity (excess movement that is not fitting to the setting) and impulsivity (hasty acts that occur in the moment without thought).

Specific Learning Disorder (SLD)

SLD is characterised by academic functioning that is below the level that would be expected given the child's age, Intelligence Quotient (IQ) and grade level in school. This interferes significantly with the child's academic performance and/or daily life activities that require reading, writing or calculation skills during formal years of schooling.

SLD and co-morbid DCD

Children with SLD may also present with DCD. These learners may perform poorly in academic tasks as well as academic tasks where motor skills are required.

DCD and co-morbid ADHD

Children who present with DCD and ADHD present with higher rates of problems in selective language functioning, learning abilities and social skills. They may struggle to pay attention to motor-based tasks, especially if they involve handwriting or other manual skills. They often purposely avoid tasks that require motor skills. They also often appear to be clumsy, due to inattentiveness. When hyperactivity is present, learners struggle to focus on the task at hand, impacting on motor skills and function.

(Definition adapted from American Psychological Association (APA), www.apa.org, DSM-5 and CanChild, www.canchild.ca)

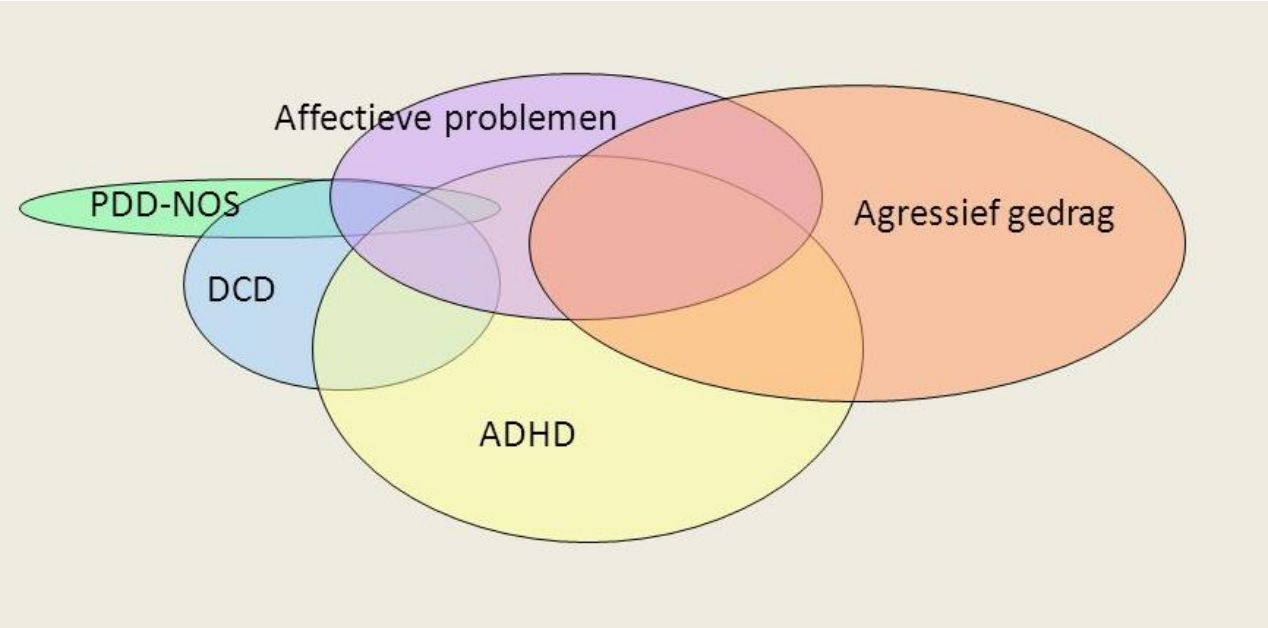
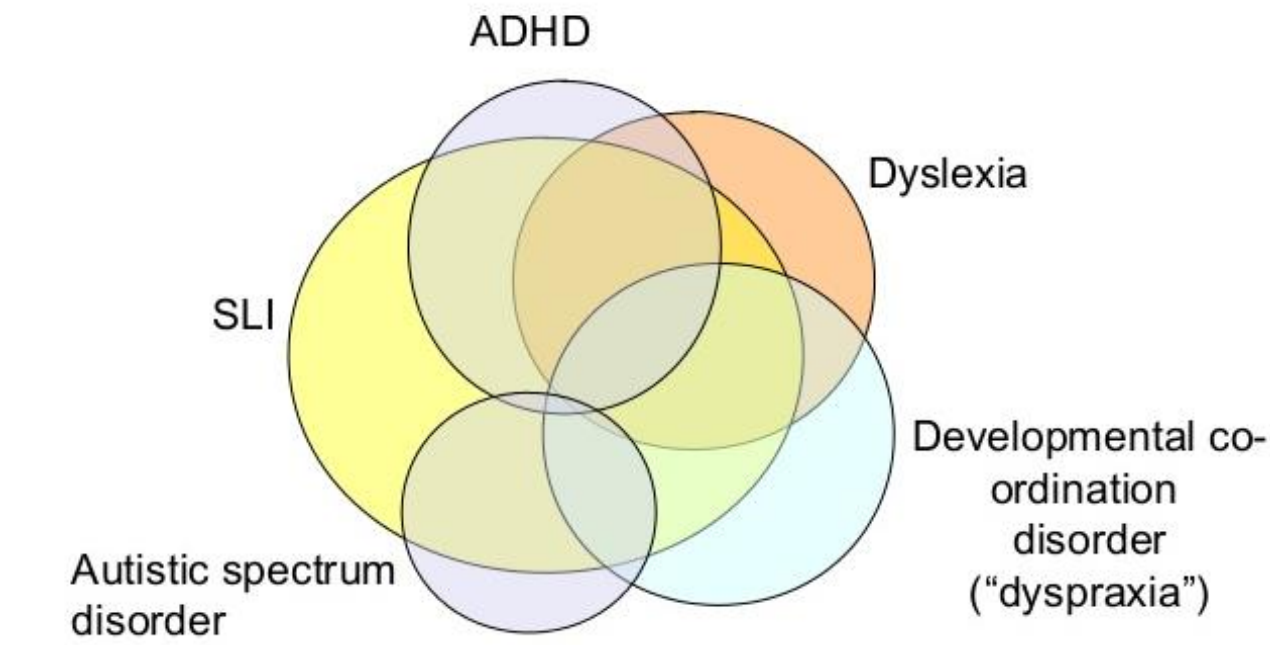


Figure 1: Co-morbidity

Figure in Dutch. Buitelaar (2011)



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Rutter et al. (2008) Neurodevelopmental disorders: Conceptual Approaches

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1. Introduction

Specific Learning Disorder (SLD), according to the DSM-5 published by the American Psychiatric Association (2013), combines the previously used terms of "learning disorders" (LD) and "academic skills disorders", and affects about 2–10 per cent of the school-age population (Margari et al., 2013). There is evidence that apart from the poor academic functioning, children with SLD also have motor problems (Capellini, Coppede, & Valle, 2010; Margari et al., 2013). However, the exact nature of motor problems in children with SLD with co-morbid DCD (SLD/DCD) in terms of severity and frequency is not well documented in the literature. SLD is characterised by academic functioning that is below the level that would be expected given the child's age, Intelligence Quotient (IQ) and grade level in school. This interferes significantly with the child's academic performance and/or daily life activities that require reading, writing or calculation skills during formal years of schooling (American Psychiatric Association, 2013; Margari et al., 2013), resulting in the child experiencing chronic poor school performance (Karande, 2012). According to the NSCH (2007) in the United States, the current incidence of learning disabilities among children aged 3–16 years in 2007 was 7.8 per cent, with 3.7 per cent rated as mild and 4 per cent rated as moderate or severe. According to other literature, learning disorders affect about 2–10 per cent of the school-age population worldwide (Al-Mamari, Emam, Al-Futaisi, & Kazem, 2015; Margari et al., 2013). A report published by United Nations Children's Fund (UNICEF) indicated that almost 70 000 children in South Africa present with intellectual or learning disabilities (UNICEF, 2012). However, very little is known about the prevalence of SLD specifically, in South Africa. Statistics on learning disabilities in South Africa are limited and unclear, but the most recent data (taken from three sources: the 2001 Census, the 2007 Community Survey, and the 2009 Annual General Household Survey), estimates that approximately 10–30 per cent of children in South Africa present with learning difficulties (Nel, & Grosser, 2016). As a result of limited resources available to meet the requirement that a DSM-5 SLD diagnosis should be confirmed by individually administered standardised achievement measures and comprehensive clinical assessment (Kriegler, 2015), SLD often remains undetected in the South African context. Cultural, economic and social barriers as well as stigma impact the diagnosis of SLD (Waterfield & Whelan, 2017), which is also true in the South African context. Considering the global prevalence of SLD among the school-aged population is about 2–10 per cent, it is plausible that the true prevalence of SLD in South Africa can be as high as 30 per cent (Normand, 2011). According to the Western Cape Education Department (WCED), there are 77 LSEN (Learners with Special Education Needs) schools in the Western Cape, offering a range of services for learners experiencing barriers to learning, including services for learners with SLD (Department of Basic Education, 2012).

Neurodevelopmental disorders (NDD) such as SLD often co-occur or overlap with other NDDs. Among children who present with SLD, there is frequent co-occurrence of other disorders such as ADHD (Fliers et al., 2008; Gray & Climie, 2016) and Developmental Coordination Disorder (DCD) (Lingam et al., 2010). The co-occurrence of these disorders results in a mixed presentation of symptoms and variable functional limitations.

DCD is a primary motor coordination disorder in which the acquisition and execution of coordinated motor skills is substantially below expectation, given the individual's chronologic age and previous opportunities for skill learning and use (American Psychiatric Association, 2013). According to the American Psychiatric Association (2013) 5–6 per cent of school-aged children aged 5–11 years have movement difficulties. In a study by Lingam, Hunt, Golding, Jongmans, and Emond (2009), the prevalence of DCD in the UK in children aged 7–8 years, was determined to be 1.7 per cent. Children with DCD can encounter difficulties in self-care tasks, getting dressed, using cutlery and eating independently (Magalhães, Cardoso, & Missiuna, 2011). Difficulty with participation in physical activities, difficulty in relating to peers and poor playground interaction, and avoidance of structured and unstructured physical activities, are some other features of this group also described in the literature (Kaplan, Dewey, Crawford, & Wilson, 2001; Mandich, Polatajko, MacNab, & Miller, 2001). Children with DCD often experience difficulties in school work and have a tendency to use disruptive behaviour to deflect attention away from motor coordination deficits (Cairney, Veldhuizen, & Szatmari, 2010). In addition to disruptive behaviour in the classroom, learners may also experience problems with social skills and psychological issues (Magalhães et al., 2011). Importantly, evidence suggests that DCD often co-occurs with one or more of the other neurodevelopmental and neurobehavioral disorders, including SLD, Specific Language Impairment (SLI), Autistic Spectrum Disorder (ASD), and developmental dyslexia or reading disability (Blank, Smits-Engelsman, Polatajko, & Wilson, 2012).

When compared to learners with DCD, learners who present with SLD/DCD experience greater difficulty to perform manual dexterity tasks, balance tasks and perceptual-motor tasks that form part of various daily motor activities and require fast, goal-directed movements needing balance while moving around (Jongmans, Smits-Engelsman, & Schoemaker, 2003).

ADHD is one of the most commonly diagnosed neurodevelopmental disorders in childhood, affecting approximately five per cent of school-aged children worldwide (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007). Children with ADHD present with a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development, resulting in impairment in social or occupational functioning, including home and school environment (American

Psychiatric Association, 2013). ADHD has been shown to have a significant association with SLD (Fortes et al., 2016; Margari et al., 2013; Masi, 2015).

1.1. Evidence of motor coordination problems in children with SLD and the impact on activity and participation

Evidence shows a strong association between learning disorders, executive function problems and motor development problems in children (Haapala, 2013; Hillman, Erickson, & Kramer, 2008). The link between SLD and DCD can possibly be attributed to the deficits in executive functioning (EF) abilities that are common to both conditions (Houwen, van der Veer, Visser, & Cantell, 2017; Leonard, 2016). According to literature (Abdelkarim et al., 2017; Bernardi, Leonard, Hill, Botting, & Henry, 2018; Houwen et al., 2017; Leisman, Moustafa, & Shafir, 2016), the same areas in the brain responsible for cognitive function is also responsible for motor function. Neuroimaging studies has shown that regions important to motor and cognitive performance, such as the cerebellum, dorsolateral prefrontal cortex, and the basal ganglia, are co-activated during motor and cognitive tasks (Houwen et al., 2017). Therefore there is an overlap in the areas of the brain when motor and cognitive tasks are performed. Research has shown that learning difficulties can be a result of a deficit in one or more areas of EF (Rosenzweig, Krawec, & Montague, 2011). There is also evidence to suggest that impairments in motor function (DCD) can be as a result of deficits in EF (Houwen et al., 2017; Leonard, 2016). Working memory specifically has been identified as an area of deficit in both learners with learning difficulties and those with motor problems (Abdelkarim et al., 2017; Houwen et al., 2017). The overlap between learning difficulties and impairment in motor function can possibly be linked to the high co-morbidity of DCD in learners with SLD as in both groups as the same higher cognitive processes and functions are impaired.

It has been suggested that at least 50 per cent of children with learning difficulties have a co-morbid motor coordination development disorder (Fortes et al., 2016). These additional motor problems warrant as much attention as the learning difficulties, as the motor problems have a significantly negative impact on activities of daily living such as self-care, play, leisure and schoolwork (Sugden, 2006). Furthermore, studies have shown that learners with motor coordination problems often experience reduced participation in social, physical and leisure activities (American Psychiatric Association, 2013; Preston et al., 2016). Participation is fundamentally important to children's development as it enables them to develop the social and physical abilities required to thrive, as well as providing social-emotional well-being, sense of meaning, and purpose in life (Law et al., 2006). Although it is known that children with SLD present with motor problems, the severity and extent of

motor problems and the effect of these motor problems on various areas in this special group, is less well understood.

1.2. Impact of motor problems on behaviour and psychosocial well-being

Children with movement problems are also at risk for problems with attention, learning, psychosocial adjustment and behavioural difficulties over time (Dewey, Kaplan, Crawford, & Wilson, 2002). It has further been suggested that impairments in motor skills during childhood are significant risk factors for poor psychosocial, emotional and behavioural outcomes (Cummins, 2005; Piek et al., 2004; Rasmussen & Gillberg, 2000; Skinner & Piek, 2001). High levels of ADHD and internalising problems (emotional and peer relations) among children with poor motor coordination have been reported (Cairney, Veldhuizen, & Szatmari, 2010; Green, Baird, & Sugden, 2006) and it has been found that approximately 30 per cent of learning disabled children have behavioural and emotional problems (Sahoo, Biswas, & Padhy, 2015). Research has also shown that learners with DCD have high levels of emotional and behavioural problems (Crane, Sumner, & Hill, 2017). However, no research has been done to investigate the heavy burden carried by learners with SLD/ DCD in terms of functional and behavioural problems. Behavioural profile is defined as the summary of the characteristic traits and behaviour patterns of an individual (Nugent, 2013). The Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997) looks at the behaviour profile in terms of emotional symptoms, conduct problems, hyperactivity, peer and relational problems, and pro-social (positive) behaviours. In a study by Green et al. (2006) parents completed the SDQ. It was found that 62 per cent of children with DCD showed clinical levels of emotional and behavioural difficulties with a further 85 per cent showing significant difficulties in at least one of the sub-scales of the SDQ.

1.3. Impact of motor problems on Quality of Life (QOL)

The impact of learners' health status on general functioning can be evaluated by examining their Quality of Life (QOL). Health-related QOL (HRQOL) is a multidimensional construct, defined as the impact of health status (including disease and treatment) on physical, psychological (adjustment and self-esteem), and social functioning (family and peer relationships) (Eiser, 2004). HRQOL can be measured using various instruments including the European Quality of Life Five Dimensions (EQ-5D), the Short Form (36) Health Survey (SF-36), and the World Health Organization Well-Being Index (WHO-5). The quality of life (QOL) of children with DCD is largely unknown, but evidence suggests that multiple QOL domains can be affected by the disorder (Zwicker, Harris, & Klassen, 2013).

Studies have reported psychological and social concerns in children with DCD as physical, psychological, and social QOL domains can be affected in children with DCD (Zwicker et al., 2013). Very little research has been done to determine the quality of life in children with DCD/ADHD/SLD. In one study involving children with ADHD and DCD and their parents, overall quality of life was rated as significantly lower than that of typically developing children, with manifestations in the domains of autonomy, motor, cognitive and psychosocial functioning (Flapper, 2008). Karande (2012) also found that children with newly diagnosed SLD perceive their psychosocial, physical, and overall HRQOL to be significantly compromised. A study by Flapper (2013) found that children with SLI and DCD differed from children with SLI without DCD by significantly lower mean overall, motor, autonomy, and cognitive domain QOL scores. A study by Klassen, Miller, and Fine (2004) found that ADHD has a significant impact on multiple domains of HRQOL, including social limitations as a result of emotional-behavioural problems, self-esteem, mental health and general behaviour. There is a need to establish the HRQOL of this unique population. Previous studies in the DCD/ADHD and SLD/ADHD populations have been done among Dutch (Flapper, 2008) and Indian (Karande, 2013) populations. No research investigating the effect of DCD/ADHD/SLD on HRQOL has been performed in the South African context.

1.4. Interventions for children with motor coordination problems

It has been established that SLD and motor coordination problems often co-exist. However, very little attention has been paid to how learners with SLD can improve motor skills. Learners with SLD/DCD/ADHD are considered a unique group, thus interventions designed for children with motor coordination problems only (such as DCD), may not be suited to this population. This is due to the additional characteristics of SLD and ADHD, e.g. inattentiveness, hyperactivity, executive functioning and impulse control deficits, impulsivity, and difficulty following instructions (Gray & Climie, 2016). Learners with SLD also present with weakened memory skills as well as difficulties with executive functioning and cognitive monitoring skills (Graham, 2016) which may impact on the way they learn new motor skills. In South Africa, many children with SLD/DCD/ADHD attend Special Education Needs (LSEN) schools. Generally, LSEN schools enrol children with various neurodevelopmental and physical disabilities. Children attending these schools tend to receive therapeutic services within the school system. According to the World Health Organisation (WHO), therapeutic approaches should aim to reduce impairments, improve functional activity and reduce participation restrictions (WHO, 2015). Although therapy services are offered to learners at LSEN schools, the degree to which therapy is provided and to what degree it meets the aim to reduce impairments, improve functional activity and reduce participation restrictions varies among schools. Depending on different

constraints and contextual factors, physiotherapy services are often limited to children with significant impairments. Children with SLD, DCD and ADHD are not always referred for physiotherapy as their motor coordination problem is often not viewed as severe or significant enough. In addition, educators are often unaware of the impact and burden of motor coordination problems in this group, as there is often a tendency to consider only their learning disability or inattention. It is therefore very important to establish whether a cost-effective intervention can be implemented in this setting to offer therapy services to this special group of learners.

Since outcomes may be different in this special group, it is important to establish the efficacy of existing interventions. Two approaches that are used by therapists to meet these aims include process-oriented and task-oriented approaches (Smits-Engelsman et al., 2013). In a combined systematic review and meta-analysis, Smits-Engelsman et al. (2013) found that approaches from a task-oriented perspective yield stronger effects, while process-oriented approaches are not recommended for improving motor performance in DCD. Task-oriented approaches tend to focus on motor performance, i.e. on learning particular motor skills, with attention to specific aspects of task performance that are causing the child difficulty (Smits-Engelsman et al., 2013).

Leading examples of task-oriented approaches are neuromotor task training (NTT) (Niemeijer, Smits-Engelsman, & Schoemaker, 2007; Schoemaker, Niemeijer, Reynders, & Smits-Engelsman, 2003; Schoemaker, Smits-Engelsman, Sugden, & Chambers, 2005) and cognitive orientation to daily occupation performance (CO-OP) (Anderson, Wilson, & Williams, 2017; Sugden, 2007). Evidence suggests that for task-oriented approaches, individual and group programmes are both effective ways of teaching motor skills in the DCD population. Smits-Engelsman et al. (2013) also found that most of the effective intervention programmes were longer than ten weeks, and the frequency of intervention was mostly once a week. Researchers have also found a nine-week task-oriented intervention programme to be effective (Ferguson, Jelsma, Jelsma, & Smits-Engelsman, 2013; Niemeijer et al., 2007). Although it is clear that this intervention yields good results, what is not known is whether a task-oriented NTT-based nine week group-based intervention will have an effect on motor performance in learners with SLD/DCD.

1.5. Research study setting

The research study was conducted in a school for Learners with Special Education Needs (LSEN) located in Cape Town, South Africa. The school receives funding from the Western Cape Education Department (WCED). The school offers facilities to roughly five hundred children from the age of three, in the pre-primary section, to the age of eighteen in Grade 12. Learners at this school

represent various socio-economic status (SES) groups (low, middle and high). They are enrolled based on their need to attend a special school. Socio-economic status is commonly conceptualised as the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation. Examination of socio-economic status often reveals inequities in access to resources, as well as issues related to privilege, power and control (American Psychiatric Association, 2013). Although the school is located in a middle to upper SES area, learners come from a wider catchment area. The school provides bus transport for learners from various areas, including a large number of children from low-income areas.

The school offers a multidisciplinary team approach to support the holistic education of the children. The team includes speech therapists, occupational therapists, physiotherapists and psychologists. Children are accepted into the school if they have certain physical or learning barriers to learning. Learners are categorised according to their primary, followed by secondary disability, e.g. learners with a primary diagnosis of SLD may also have ADHD as a secondary diagnosis. According to the school's CEMIS[1] database, learners categorised according to primary diagnosis with SLD, currently make up 46 per cent of the total school population. Learners with a primary diagnosis of ADHD make up 16 per cent, learners with cerebral palsy 14 per cent, learners with autistic spectrum disorder (ASD) 12 per cent, learners with physical disabilities 8 per cent, learners with a primary diagnosis of epilepsy 2 per cent, learners who are primarily hearing-impaired 1 per cent, learners with mild intellectual disability and learners with behavioural disorders as primary disability making up the remaining 1 per cent of the total number. It is unclear why there is no mention of DCD on the CEMIS database.

In general, all learners take part in regular basic physical education that adheres to the Curriculum and Assessment Policy Statement (CAPS) as part of the National Curriculum Statement (NCS). According to CAPS, two hours of physical education should be included per week in Grades R –3. In Grade 4, time allocated for physical education changes to one hour per week (Department of Basic Education, 2012).

[1] Centralised Educational Management Information System (CEMIS). According to the WCED policy for the Management of Admission and Registration of Learners, WCED developed CEMIS for the compulsory registration of learners. This system is aimed at enabling the admission of learners in a timely and efficient way, as well as the tracking of all learners who enter the school system. All learner data is available on this data base, including age, gender, race and disability. Primary and secondary disability is recorded. The following disabilities are listed on CEMIS: deaf, hard of hearing, blind, partially sighted, CP, SLD, behavioural disorder, mild/moderate intellectual disability, severely intellectually disabled, physically disabled, autistic spectrum disorder (ASD), epilepsy, attention deficit disorder with/without hyperactivity.

At this school, learners with SLD/ADHD, both with or without DCD, receive class-group-based Occupational Therapy (OT). OT focuses on fine motor, visual perceptual, cognitive skills and processing deficits. Many of the learners with SLD/ADHD with DCD are identified as requiring OT, based on an OT assessment. These learners may receive group therapy or are placed on the waiting list for individual OT.

Learners with SLD /DCD at this school were not receiving any physiotherapy intervention thus making the need for such a programme necessary. Motor performance difficulties of children with DCD are often viewed as minor, thus not warranting attention, compared with the needs of children with more severe impairments such as cerebral palsy (Blank et al., 2012). Currently, no learners with SLD/ADHD with DCD are receiving physiotherapy intervention. Due to staff constraints, only learners with physical disabilities such as cerebral palsy, spina bifida or spinal cord injury (SCI) receive physiotherapy. Therefore, the usual care for this group can be described as no-physiotherapy intervention.

1.6. Aims and objectives

The main aim of this study was to determine the efficacy of a task-oriented, group-based programme (NTT) on motor performance, behavioural profile and health-related quality of life of children aged 6–10 identified with SLD and co-morbid DCD, attending a public school for Learners with Special Education Needs (LSEN) in Cape Town.

In the identified group of learners with SLD/DCD, the specific objectives of the study were:

1. to describe participants' motor performance (using the MABC-2 test) and functional motor problems (using the MABC checklist), and behavioural profile (using the SDQ) and health-related quality of life (EQ-5D-Y) as well as to describe the anthropometric (BMI) and demographic variables (gender, age, diagnoses, medication use).

2. to determine whether the intervention group showed an improvement in the following areas:
    a) Motor performance as determined by MABC-2
    b) Behaviour as determined by the Strengths and Difficulties Questionnaire (SDQ), completed by the parent and teacher
    c) HRQOL as measured by self-report European Quality of Life Five Dimensions for Youth (EQ-5D-Y).

3. to determine whether the intervention group improved more than those receiving usual care in the same aforementioned areas.

1.7. Significance of the study

NTT emphasises principles used to guide practice, and the importance of providing feedback to enhance learning. For learners with SLD, providing clear instructions, feedback and constant motivation may be beneficial to support learning in this setting. In NTT, the therapist guides the learner in the process of learning motor skills, while motivating and giving feedback to the learner. NTT looks at all the factors that limit a child's ability to perform a task. NTT provides a framework to help implement intervention tasks that are increasingly loaded to increase task demands and promote learning, within the constraints and limitations of the individual (Schoemaker et al., 2003; Niemeijer et al., 2007). It has been shown that group-based NTT can be used effectively to treat children with DCD in different settings: in areas of resource constraints, such as low-income schools (including South Africa) (Ferguson et al., 2013) as well as in other settings (Caçola, Romero, Ibana, & Chuang, 2016).

It has been found that group-based training produces similar improvements in motor performance compared to individual-based training and group-based training may be the preferred treatment option due to the associated cost savings (Hung & Pang, 2010). In their guidelines, The European Academy for Childhood Disability (EACD) (Blank et al., 2012) suggests that task-oriented approaches are recommended intervention strategies for learners with DCD and currently have the best cost-benefit. This study aims to contribute information on resource-efficient treatment methods for an overstrained education system struggling to provide the necessary care to children with developmental disabilities such as SLD and DCD. Should the group-based intervention in special needs schools be shown to be effective, it may offer physiotherapists an additional option for effective interventions in children with SLD and who also present with DCD.

The study also aims to assist therapists to individualise treatment and implement programmes based on a better understanding of how the application of NTT principles may affect motor performance, participation and function. It has been shown that physical activity has a positive effect on behaviour and therefore it would be expected that NTT will also show a positive change in behaviour. In a recent study (Bowling et al, 2017) conducted with children with behavioural problems, learners participated in a seven week programme of classroom based cycling. They experienced 32 to 51 per cent lower odds of poor self-regulation and less time out of class due to disciplinary reasons, as a result of better behaviour. A recent systematic review and meta-analysis by Yu, Burnett, and Sit

(2018) found that motor skill interventions (including task orientated approaches like NTT) are effective in improving motor performance as well as cognitive, emotional, and other psychological factors (including behaviour and participation) in children with DCD. The intervention duration ranged from four to 24 weeks. Therefore, it is feasible to expect change in these domains, including behaviour, within a nine week intervention period, as the NTT programme is made up of various tasks that require learners to be physically active.

This study aims to raise awareness regarding the impact of DCD on daily function. It is anticipated that the information gained can be used by educators and therapists to better understand learners with SLD/DCD and the functional motor problems and difficulties they face within the school environment.

2. Literature Review: Motor coordination difficulties in children with SLD and co-morbid DCD – presentation and interventions

2.1. Introduction

The aim of this literature review was firstly to describe motor impairments in children with SLD and secondly, to describe and review the interventions that could be used to treat these children. We considered models of intervention primarily used for children with motor impairments such as DCD to determine whether these interventions may be feasible for use in children with SLD. Specifically, we review the efficacy of using task-oriented, group-based intervention programmes. The findings of this review will illustrate how interventions can be set up for children with co-morbid DCD.

The databases PubMed, Cinahl, Ebscohost, Google Scholar and Cochrane were searched. Broad searches were conducted using the terms 'specific learning disability', 'specific learning disorder', 'developmental coordination disorder', 'motor dysfunction', 'motor coordination problems', 'group intervention', 'physiotherapy' and 'special schools' to identify studies relevant to this review. Then specific terms such as 'neuromotor task training', 'NTT', 'task-oriented training', 'developmental coordination disorder', 'intervention', 'motor coordination', 'movement assessment battery for children 2nd edition', 'MABC-2' and 'physiotherapy' were also used.

2.2. Specific Learning Disorder (SLD)

Specific learning disorder (SLD) combines the previously used terms of 'learning disorders' (LD) and 'academic skills disorders' and includes impairments in the domains of reading, written expression, and mathematics. SLD is defined as having persistent difficulties in reading, writing, arithmetic, or mathematical reasoning skills during formal years of schooling, according to the DSM-5 (American Psychiatric Association, 2013). Symptoms may include inaccurate, slow and effortful reading, poor written expression that lacks clarity, difficulties remembering number facts, or inaccurate mathematical reasoning. The individual's difficulties must not be better explained by developmental, neurological, sensory (vision or hearing), or motor disorders and must significantly interfere with academic achievement, occupational performance, or activities of daily living (American Psychiatric Association, 2013). According to the American Psychiatric Association (2013) the diagnosis of SLD is made through a clinical review of the individual's developmental, medical, educational, and family history, test scores and teacher observations, and response to academic interventions. The diagnosis of SLD also involves various assessments performed by an educational psychologist. In the South

African school context, the role of the school psychologist (educational psychologist) may include assessment of learners, development and implementation of intervention programmes, consultation with teachers, parents and other relevant professionals, programme development, and research, as well as the assessment of learners identified for experiencing barriers to their learning (Moolla & Lazarus, 2014). Learning disorders affect about 2–10 per cent of the school-age population worldwide (Al-Mamari et al., 2015; Margari et al., 2013). Statistics on learning disabilities in South Africa are limited and unclear, but the most recent data (taken from three sources: the 2001 Census, the 2007 Community Survey, and the 2009 Annual General Household Survey), estimates that approximately 10–30 per cent of children in South Africa present with learning difficulties (Nel, & Grosser, 2016).

Familial genetic studies indicate that approximately 30–60 per cent of infants born into families with language-based learning disorder (LLDs) are at risk of developing similar problems (Zare, Rezvani, & Benasich, 2016). Previous studies also indicate that LLDs are associated with detectable differences in brain structure that may begin ante-nattaly, and these anatomical differences are thought to be a contributing factor to LLD given the genetic predisposition identified in many of these disorders (Zare et al., 2016).

According to Bax (1999), SLD can be classified as a neurodevelopmental disorder due to the occurrence of problems to the developing brain. Learners who present with SLD are considered a heterogeneous group who present with signs and symptoms (e.g. difficulty with reading and/or writing, difficulty with math skills, difficulty with memory and attention) and also often present with co-occurring disorders or conditions (e.g. ADHD, DCD, ASD) and other (American Psychiatric Association, 2013; Fliers et al., 2008; Gray & Climie, 2016). In a recent study by Moll (2014), Reading Disorder (RD) and Mathematics Disorder (MD), which form part of SLD (American Psychiatric Association, 2013), were investigated. Processing speed, temporal processing, and working memory were investigated as cognitive risk factors, which were all found to all be associated with poor attention.

The role of special schools in South Africa is to support learners with high-level needs as well as to act as resource centres to mainstream schools. Learners with SLD are often referred to and enrolled in LSEN schools in the Western Cape when they cannot be accommodated in mainstream schools due to their high needs. LSEN schools offer learners the necessary support of a team of professionals in the fields including physiotherapy, speech and language therapy, occupational therapy and

psychology.

2.2.1. Motor coordination problems in learners with SLD

It is well known that learners with SLD present with problems with academic learning. It is interesting to note that they also present with motor difficulties. These motor difficulties have a significant impact on their daily life, presenting them with extra challenges. These learners are not only faced with academic problems, but also experience problems performing activities of daily living that require motor coordination. Furthermore, poor motor skills affect participation in sports and playground games. Ultimately these learners may present with behavioural, emotional and social problems, all of which will affect their quality of life.

Motor coordination problems can be defined as difficulties with gross or fine motor tasks that significantly impact activities of daily living and academic or school productivity, pre-vocational and vocational activities, leisure and play including e.g. running, jumping, untidy handwriting, as well as daily activities such as difficulty eating with a knife and fork, falling or tripping over objects, tying shoe laces, going down stairs etc. (American Psychiatric Association, 2013; Lingam et al., 2010)

2.2.2. Evidence of motor coordination difficulties in SLD

A defining feature of many neurodevelopmental disorders and conditions is its frequent association with motor coordination problems. One study, looking at Grades 2–6 learners in Brazil, reported that at least 50 per cent of students with learning difficulties have a co-morbid motor coordination development disorder (Fortes et al., 2016). In a review by Angold, Costello, and Erkanli (1999) concerning the prevalence, causes and effects of diagnostic co-morbidities among the most common groups of neurodevelopmental disorders, it was found that co-morbidity or co-existing disorders is the rule rather than the exception (Angold et al., 1999; Kaplan et al., 2001). For example, there is strong evidence that DCD is associated with SLD (Lingam et al., 2010); with ADHD (Kadesjo & Gillberg, 2001; Kaplan et al., 2001); with specific language impairment (SLI), autistic spectrum disorder (ASD) and developmental dyslexia or reading disability (Blank et al., 2012). The co-occurrence of learning disorders and ADHD ranges from 31–45 per cent which indicates a high rate of co-morbidity. (DuPaul, Gormley, & Laracy, 2013). The co-morbidity between DCD and ADHD has been reported to be approximately 50 per cent (Jongmans et al., 2003; Kadesjo & Gillberg, 2001) and it is also estimated that the co-morbidity between DCD and SLD is of a similar magnitude (Dewey et al., 2002; Jongmans et al., 2003; Kaplan et al., 2001). Very little is known about learners who present with SLD/DCD in this special school setting. In a study by Jongmans et al. (2003) conducted in the

Netherlands and Germany, learners without DCD and without SLD, learners without DCD but with SLD, learners with DCD but without SLD, and learners with both DCD and SLD were compared. It was found that learners with DCD and SLD were more likely to perform poorly in perceptual-motor tasks which form part of various daily motor activities, as well as tasks which require distinct patterns of perceptual-motor function. Problems in the latter area presented as difficulty with fast, goal-directed movements and maintaining balance while moving around.

2.3. Co-morbidities linked to SLD

Co-morbidity of neurodevelopmental disorders, specifically SLD, DCD and ADHD, is well documented and it has been suggested that co-morbidity is the rule rather than the exception (Angold et al., 1999; Kadesjo & Gillberg, 1999; Kaplan et al., 2001). Motor difficulties have also been identified in other neurodevelopmental disorders, including autism spectrum disorder (ASD) (Leonard, 2016). The most common co-morbidities found with SLD are described below.

2.3.1. Developmental Coordination Disorder (DCD)

The co-morbidity of DCD and learning disabilities is well documented (Dewey et al., 2002; Jongmans et al., 2003; Kaplan et al., 2001). DCD is defined as a disorder affecting motor skills and is often co-morbid with other neurodevelopmental conditions; where the primary feature is delayed motor skill acquisition, accompanied by motor execution that is substantially below the expected level when taking into account the individual's chronological age and opportunity for skill learning and use. This deficit in motor skills significantly and persistently interferes with activities of daily living, and impacts on academic productivity, pre-vocational and vocational activities, leisure, and play. The onset of symptoms is in the early developmental period and the motor skills deficit is not due to congenital or neurological conditions or intellectual disability (American Psychiatric Association, 2013). DCD is diagnosed based on meeting diagnostic criteria listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM- 5) (Table 1).

Table 1: DSM- 5 criteria for diagnosing DCD (Diagnostic and Statistical Manual of Mental Disorders)

A. The acquisition and execution of coordinated motor skills is substantially below that expected given the individual's chronological age and opportunity for skill learning and use. Difficulties manifest as clumsiness (e.g. dropping or bumping into objects) as well as slowness and inaccuracy of performance of motor skills (e.g. catching an object, using scissors or cutlery, handwriting, riding a bike, or participating in sports).
B. The motor skills deficit in Criterion A significantly and persistently interferes with activities of daily living appropriate to chronological age (e.g. self-care and self-maintenance) and impacts academic/school productivity, prevocational and vocational activities, leisure and play.
C. Onset of symptoms is in the early developmental period.
D. The motor skills deficit is not better explained by intellectual disability (intellectual developmental disorder) or visual impairment and are not attributable to a neurological condition affecting movement (e.g., cerebral palsy, muscular dystrophy, degenerative disorder).

According to Gibbs, Appleton, and Appleton (2007), children with DCD often present with difficulty with dressing, poor ball skills, immature art work and difficulty making friends. In school they often present with immature and laborious handwriting. The deficits in the acquisition and automation of motor procedures have negative impacts on a child's life, including lower levels of academic attainment, reduced participation in social and leisure activities, and increased risk of further health problems (both physical and mental) (Preston et al., 2016). Forty per cent of the children diagnosed with delayed motor development before starting school, continue to have this problem ten years later which may indicate that DCD is not a condition that only exists in early childhood (Blank et al., 2012; Smits-Engelsman et al., 2013).

Current prevalence estimates range from five to 20 per cent with five to six per cent being the most frequently quoted in the literature (Blank et al., 2012). According to the American Psychiatric Association (2013) five to six per cent of school-aged children aged five to 11 years have movement difficulties. Studies to determine prevalence have been performed in the UK (Lingam et al., 2009), Sweden (Kadesjo & Gillberg, 1999) Greece and Canada (Tsiotra, 2006). Valentini (2015) found that Brazilian children from disadvantaged areas presented with high prevalence of DCD; in this particular study 17.8 per cent presented with probable DCD and a further 15 per cent as at risk for DCD. There

have been few studies done in South Africa to determine the prevalence of DCD. A small study with 30 children (aged four to 12) from low-income farm communities found 20 per cent of these children presented with DCD and another 10 per cent were at risk of developing DCD. This study also raised questions about poor nutrition level and socio-economic and cultural factors (Prinsloo, 2003).

Some studies have been done in South Africa to investigate the incidence and prevalence of DCD. Peens, Pienaar, and Nienaber (2008) estimated the incidence of DCD in the North West Province to be as high as 35 to 66 per cent. According to a study by Pienaar (2004), the prevalence of DCD was significantly high (61.2 per cent) in the North West Province. In Bloemfontein, Free State province, the results of a study indicated that 15 per cent of children aged 6–8 have moderate to severe motor difficulties (De Milander, 2016). This indicates that South African children appear to have more motor difficulties than children in other parts of the world. However, small sample sizes preclude extrapolation of their findings to estimate prevalence of DCD nationally. It is known that the prevalence of DCD is higher in low socio-economic systems (Lingam et al., 2010), thus we can assume that the numbers of children with DCD living in other low-income areas in South Africa may be high (Wehby & McCarthy, 2013). Several possible explanations are given in the literature for the increased prevalence of DCD in low socio-economic systems, including the economic and social position of parents in relation to others, and the lack of motor experience of children due to environmental factors (Ferguson et al., 2013; Lingam et al., 2009). A higher prevalence of DCD in disadvantaged communities can also be related to educational, social and family constraints, most likely resulting in a lack of motor experiences for children living in disadvantaged communities (Valentini, 2015). The same can be said for South Africa: many classrooms are crowded and schools have limited space. Many children live in homes with restricted indoor and outdoor space or are not able to play outside due to community safety risks (Ferguson, Naidoo, & Smits-Engelsman, 2015). Learners from low-income areas in the Western Cape of South Africa often present with poor health which may also be related to motor coordination difficulties (De Villiers et al., 2012; Draper et al., 2010).

2.3.2. Attention Deficit Hyperactivity Disorder (ADHD)

It is often found that SLD and ADHD co-exist with ADHD being found to be the most common co-morbid condition in SLD (Bandla, Mandadi, & Bhogaraju, 2017; Karande et al., 2007). ADHD is a neurodevelopmental disorder with childhood onset and characterised by developmentally inappropriate levels of inattention, hyperactivity, and/or impulsivity and pervasive, significant functional impairment. ADHD is one of the most commonly diagnosed neurodevelopmental

disorders in childhood, affecting approximately five per cent of school-aged children worldwide (Polanczyk et al., 2007). In a systematic review, Polanczyk et al. (2007) identified original studies of ADHD prevalence conducted on all continents with the purpose of this study being to determine the possible causes of the varied worldwide estimates of the disorder and to compute its worldwide-pooled prevalence. Despite the higher number of studies conducted in North America and Europe, the study showed that ADHD is a well-studied disorder and that its prevalence rate has been estimated in several different cultures.

ADHD is characterised by a pattern of behaviour present in multiple settings (e.g. school and home that can result in performance issues in a social, educational, or work setting. Symptoms are divided into two categories: inattention, and hyperactivity and impulsivity. Symptoms include behaviours like failure to pay close attention to details, difficulty in organising tasks and activities, excessive talking, fidgeting, or an inability to remain seated in appropriate situations (American Psychiatric Association, 2013). Due to the developmentally inappropriate levels of inattention and impulsivity, children with ADHD often struggle to sit still and stay focused on a task, behaviour which is specifically challenging in a classroom environment where a lack of focus and attention may result in poor academic outcomes (Gray & Climie, 2016).

A study by Klassen et al. (2004) found that children with ADHD presented with clinically important deficits in HRQOL in all psychosocial domains. This included more parent-reported problems in terms of emotional behavioural role function, behaviour, mental health, and self-esteem when compared to a normative paediatric sample. In this study, ADHD was diagnosed in 131 children of whom fifty-one children (39 per cent) also presented with a comorbid learning disorder.

According to Barkley (1997), the neurophysiological model of executive functioning in children with ADHD comprises a deficit in behavioural inhibition. Children with ADHD lack proficiency in four areas of executive functioning skills: working memory; self-regulation or affect-motivation-arousal; internalisation of speech; reconstitution (behavioural analysis and synthesis). Deficits in behavioural inhibition, working memory, regulation of motivation, and motor control is mostly found to be affected in children with ADHD (Barkley, 1997).

A commonly used chemical supplement for ADHD is methylphenidate. In a systematic review by Smits-Engelsman et al. (2013), which looked at the efficacy of interventions to improve motor performance in children with DCD and co-morbid ADHD, three studies investigating

methylphenidate as intervention were included in the review . The use of methylphenidate in ADHD is well researched and has been proven to have a positive effect on both behavioural ADHD symptoms and fine-motor performance (i.e. handwriting) in children with combined DCD and ADHD (Smits-Engelsman et al., 2013). There has been some research into use of medication in other Neurodevelopmental disorders (NDDs) like ASD. In a systematic review by Jobski, Höfer, Hoffmann, and Bachmann (2017) it was found that there are not many pharmacological treatment options for ASD core symptoms. This systematic review also found that in ASD the non-core ASD symptoms (e.g. ADHD) and psychiatric comorbidities are often treated with medication. A recent systematic review by Agostoni et al. (2017) looked at the role of Omega-3 Polyunsaturated Fatty Acids (PUFAs) in Developmental Psychopathologies, including ASD and ADHD. The findings on the use of Omega-3 in ASD reported a small but not significant benefit in children with ASD. They also concluded that data in this field is limited as well as the sample size of studies also often being too small. The effect of Omega-3 supplementation in ADHD has been widely studied in this disorder through RCTs. A recent systematic review and meta-analysis by Chang, Su, Mondelli, and Pariante (2017) found that there is evidence that Omega- 3 supplementation improves clinical symptoms and cognitive performances in children with ADHD. Their finding was that most RCTs found Omega-3 supplementation to have a beneficial effect on ADHD symptoms.

ADHD has been found to be the most frequent co-morbid disorder to DCD. According to the European Academy for Childhood Disability (EACD), several clinical studies suggest a rate of higher than 50 per cent of co-morbidity (Blank et al., 2012). Rasmussen and Gillberg (2000) found in a 22-year longitudinal, community-based follow-up, that individuals suffering from ADHD with DCD had a much worse outcome in psychosocial functioning than individuals with ADHD without DCD.

Evidence from neuroimaging research suggests that children with ADHD and DCD exhibit disruptions in motor circuitry, which could account for the high rate of co-occurrence (McLeod, Langevin, Dewey, & Goodyear, 2016; McLeod, Langevin, Goodyear, & Dewey, 2014). In a Canadian study done by McLeod et al. (2014) the primary objective was to investigate the functional connections of the motor network in children with DCD and/or ADHD compared to typically developing controls, with the aim of identifying common neurophysiological substrates. Resting-state functional MRI was performed on seven children with DCD, 21 with ADHD, 18 with DCD + ADHD and 23 controls. When compared with the controls, children with DCD and/or ADHD exhibited similar reductions in functional connectivity between the primary motor cortex and the bilateral inferior frontal gyri, right supramarginal gyrus, angular gyri, insular cortices, amygdala, putamen, and pallidum. This

demonstrated that children with DCD and ADHD present with altered brain region communication, particularly within the motor network, also suggesting that children with DCD and/or ADHD exhibit disruptions in motor circuitry, which may contribute to problems with motor functioning and attention. The findings of this study support the existence of common neurophysiological substrates underlying both motor and attention problems. In a more recent study by McLeod et al. (2016) it was hypothesised that functional deficits observed in children with DCD and ADHD can be associated with neurodevelopmental alterations in within- and between-hemisphere motor network functional connection strength that disrupt this hemispheric dominance. In this study, functional MRI scans were used to examine functional connections of the left and right primary and sensory motor cortices in children with DCD, ADHD and DCD + ADHD, relative to typically developing children. The study showed that children with DCD, ADHD and DCD + ADHD exhibit atypical within- and between-hemisphere functional connection strength between sensory motor cortices, regions of the basal ganglia and cerebellum. This study further supports the theory that the development of atypical motor network connections represents common and distinct neural mechanisms underlying DCD and ADHD.

2.4. Impact of SLD with co-morbid DCD or ADHD

There are several studies investigating motor coordination problems in children with various neurodevelopmental disorders. This includes SLD, DCD, ADHD and ASD. Each of these neurodevelopmental disorders is unique in that it presents with different prevalence rates and symptoms. It is important to note that all these neurodevelopmental disorders have motor coordination problems and motor difficulties in common.

Learners with SLD often present with challenging behaviour (Cromby et al., 1994). A recent study by Crane et al. (2017) investigated the patterns and profiles of emotional and behavioural problems in children with and without DCD, using the Strengths and Difficulties Questionnaire (SDQ). Parent and teacher reports were investigated and compared. Teacher reports showed that children with DCD displayed higher rates of emotional and behavioural problems relative to their typically developing peers. The same was found in a study by Crane et al. (2017) also found that parents, more than teachers, reported hyperactivity to be more problematic in the DCD group. Parents also rated pro-social behaviours as less problematic than teachers in the DCD group. Research studies using the SDQ in DCD populations found high rates of difficulties overall, as well as on individual subscales (Crane et al., 2017; Green et al., 2006; Van den Heuvel, Jansen, Reijneveld, Flapper, & Smits-Engelsman, 2016). Emotional and behavioural problems can be viewed as primary, thus co-existing,

or secondary and possibly consequential (Green et al., 2006). Based on this research, it can be said that learners with DCD may experience difficulties in various behavioural domains.

Based on the above findings, it is clear that the different disorders intersect. It is clear, therefore, that the resulting impact of co-morbid disorders is vast. The impact of having multiple disorders (i.e. SLD with co-morbid DCD) can be evaluated using an International Classification of Functioning (ICF) framework. The International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY), is a classification system of health and health-related domains designed to record the characteristics of the developing child and the influence of its surrounding environment (WHO, 2015). As the functioning and disability of an individual occurs in a context, the ICF also includes a list of environmental factors.

The ICF model is useful in determining the impact of neurodevelopmental disorders on the lives of children. It provides a model for understanding the relationship between the impairments of children with neurodevelopmental disorders including the special population of SLD/DCD, and the activity limitations and participation restrictions experienced by these children.

A systematic review of limitations of activity and participation by Magalhães et al. (2011) found the following commonly identified themes: limitations in performance of classroom tasks; play and/or sports; activities of daily living; social skills. The most frequently cited issues were regarding play-related activities, including difficulties riding a bicycle or tricycle, rollerblading, using playground equipment, jumping rope and participating in free play. Participation in organised sport was limited by difficulty with running, jumping, and swimming. Classroom tasks were the second major issue, with poor handwriting and limitations in using hands to perform classroom tasks such as crafts being the limiting factors. Difficulty with self-care was also noted, specifically in dressing, and feeding using cutlery. Other factors limiting a child's participation included language and speech, poor social skills, a tendency towards loneliness and exclusion by peers, and feelings of inadequacy and/or poor quality of life related to motor awkwardness.

Secondary difficulties such as a lack of fitness and strength manifesting in a vicious cycle of motor activity avoidance, depression and social isolation, and decreased participation in physical activity are well documented (Rasmussen & Gillberg, 2000). Children with DCD have been shown to be less physically fit when compared to their typically developing peers (Farhat et al., 2015). It has also been found that children with DCD are less likely to participate in physical activities and subsequently it has been hypothesised that this condition may lead to children being overweight as well as at risk for obesity (Cairney, Hay, Veldhuizen, & Faught, 2010).

According to the EACD (Blank et al., 2012) a very important indication for the need for treatment is personal factors which include quality of life (well-being, satisfaction) and coping. A study by Karande (2012) investigating the self-perceived health-related quality of life of Indian children with specific learning disability, included 150 children diagnosed with SLD. Their HRQOL was documented using the DISABKIDS chronic generic module self-report version instrument. The finding was that children with newly diagnosed SLD perceived their psychosocial, physical, and overall HRQOL to be significantly compromised. In a subsequent study by Karande (2013) 136 children, newly diagnosed with SLD with co-occurring ADHD, were assessed using the DISABKIDS chronic generic module self-report version instrument. The study aimed to investigate the impact of untreated co-occurring ADHD on HRQOL. The finding was that, although the difference was not statistically significant, learners with SLD/ADHD scored better than learners with only SLD in independence, emotion, social inclusion and social exclusion facets, and in total score. In a pilot study, Flapper (2008) investigated the impact of the combined diagnoses of DCD and ADHD on HRQOL, and the effectiveness of methylphenidate on HRQOL. Learners included in this study reported lower general well-being at the start of the study across various domains. There was a significant improvement in HRQOL scores among learners receiving methylphenidate. Flapper (2013) investigated the co-morbidity of DCD in children with SLI and the impact of DCD on HRQOL in 65 learners. They found that HRQOL in learners with SLI and DCD HRQOL domain scores were significantly lower than in learners with SLI without DCD. Although there is limited evidence on HRQOL in learners with DCD, evidence suggests that multiple QOL domains may be affected (Zwicker et al., 2013). Based on this literature it can be concluded that learners with SLD and co-morbidities like ADHD and DCD present with lower HRQOL.

2.5. Assessment of motor and functional problems

DCD is diagnosed based on meeting diagnostic criteria listed in the DSM-5. In order to diagnose a child with DCD, both criteria A (motor skills) and B (functional problems) have to be met (American Psychiatric Association, 2013).

Motor questionnaires can be used to investigate the impact of motor problems on activities of daily life at home or school. Several questionnaires have been developed to gather information about functional motor performance including Developmental Disorder Coordination Questionnaire (DCD-Q), Children Activity Scales for Parents, Teacher Estimation of Activity Form, Motor Observation Questionnaire for Teachers, Children Activity Scales for Teachers and the Movement Assessment Battery for Children Checklist (Schoemaker et al, 2012). Some of the questionnaires are focused on the parent perspective, others on the teacher. The MABC Checklist can be completed by the parent or the teacher (Henderson, Sugden, & Barnett, 2007) and is most often completed by the teacher.

The Developmental Coordination Disorder Questionnaire (DCD-Q) was developed in Canada to identify children with movement difficulties. It is a parental questionnaire that aims to provide a qualitatively good and accurate assessment of the child's motor skills in daily life (Wilson et al., 2009).

Wilson et al. (2009) investigated the psychometric properties of the DCD-Q. The results provided evidence that the revised DCD-Q is a valid clinical screening tool for DCD. In a study by Schoemaker et al. (2012) the validity and reliability of the MABC-2 Checklist was investigated. It was found that it meets the standard for validity and reliability. The MABC-2 Checklist and the DCD-Q were also compared and the MABC-2 Checklist was better able to predict motor impairment.

The most widely used tests for the assessment of motor problems found in literature is the M-ABC (M-ABC, MABC-2) and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP, BOTMP2) (Blank et al., 2012).

The BOTMP is a norm-referenced test of motor function, mainly used in the USA and Canada and is a standardised, norm-referenced measure used by physical therapists and occupational therapists in clinic and school practice settings. The BOTMP provides a general motor ability factor and is divided into eight subsections which include running, general agility abilities, balance and coordination of bilateral movements, strength, coordination, speed and dexterity of upper limbs, speed of response, and visual motor control. The test has been revised and published as the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition. The instrument has separate norms for each gender (Blank et al., 2012; Deitz, Kartin, & Kopp, 2007).

The most widely used assessment of motor skills in the UK is the Movement Assessment Battery for Children (MABC) (Henderson et al., 2007). Over the last few decades, the standardised performance test has become one of the most widely used instruments for the detection of mild to moderate movement difficulties in children (Gueze, Jongmans, Schoemaker, & Smits-Engelsman, 2001). The MABC–2 Test is a standardised assessment tool that requires a child to perform a series of motor tasks in a strictly specific way to measure motor impairment objectively. The MABC-2 is a revision of the Movement Assessment Battery for Children (MABC), originally named the Test of Motor Impairment (TOMI) (Henderson et al., 2007).

Studies using the MABC show good to excellent inter-rater reliability, good to excellent test-retest reliability, and fair to good validity, as well as good specificity, and fair to good sensitivity when

compared to the BOTM. The latter depends on the chosen cut-off, with good sensitivity using the 15th percentile as cut-off (Blank et al., 2012).

The MABC-2 contains eight tasks in each of three age ranges i.e. 3–6, 7–10, and 11–16 years. Tasks relate to three specific areas: manual dexterity, ball skills, and balance (static and dynamic). A profile of a child's performance over the different test sections can be established. Total standard scores are calculated and converted into percentiles to determine how a child's motor coordination compares to typically developing children of the same age. The MABC-2 consists of eight physical subtests used to assess motor coordination in children aged three to 16 years. Raw scores for each item are converted into standard scores. The Total Test Score (TTS) is a sum of the individual standard scores and gives an impression of the overall motor proficiency. Component Standard Scores are a reflection of abilities in the three major performance areas: manual dexterity, aiming and catching, balance. Scores may be expressed in percentiles, with scores above the 16th percentile regarded as normal motor performance, scores between the 9th and 16th percentile suggesting motor difficulty, and scores at or below the 5th percentile considered as definitive for motor coordination problems (Henderson et al., 2007). The test scores provide information about how the child's motor performance compares to his or her peers and can provide an indication of the severity of the motor difficulties. There are no norms for the South African population, but Dutch norms have been used in research involving a South African population (Ferguson et al., 2013).

2.6. Interventions for motor problems

The major treatment approaches that have been used for children with motor coordination problems like DCD are process-oriented approaches and task-oriented approaches (Smits-Engelsman et al., 2013). The aim is to review the current available interventions for motor coordination problems and to establish whether or not these interventions are suitable for use in the SLD/DCD population.

A review of the most effective interventions for treating DCD suggests that task-based approaches have a more positive effect in improving functional outcomes compared to process-oriented approaches (Smits-Engelsman et al., 2013). A higher rate of transfer of skills can be expected when skills practised during treatment resemble skills required in daily life (Schoemaker et al., 2003). A systematic literature review by Offor, Williamson, and Caçola (2016) grouped interventions for children with DCD in three categories: traditional physical therapy; contemporary physical therapy (including active virtual gaming, hippotherapy and aquatic therapy;) ; task-oriented training.

Examples of task-based approaches include neuromotor task training (NTT) (Ferguson et al., 2013; Niemeijer et al., 2007; Smits-Engelsman et al., 2013), the cognitive orientation to daily occupational performance (CO-OP) approach (Mandich et al., 2001), virtual reality training (VRT) (Ferguson et al., 2013; Smits-Engelsman, Jelsma, Ferguson, & Geuze, 2015), and motor imagery (MI) training (Adams, Steenbergen, Lust & Smits-Engelsman, 2016; Wilson et al., 2016; Wilson, Thomas & Maruff, 2002).

Task-oriented interventions are characterised by the fact that the approach is client-oriented and therefore meaningful to the client as well as being goal-oriented, and aimed at activities and participation as described by the ICF-CY. It is also task- and context-specific, promoting the active role of the client, aiming at functionality not normality. It also places emphasis on the active involvement of parents or caretakers to enable transfer (Miyahara, Hillier, Pridham, & Nakagawa, 2014).

2.6.1. Neuromotor Task Training (NTT)

NTT is based upon a cognitive neuroscience approach to motor control, which implies that several cognitive and motor control processes can be distinguished during the preparation and execution of functional motor tasks, such as the processing of motor-task-related information, action planning, and initiation (Niemeijer et al., 2007). It is based on task analysis of the needs of the child. NTT focuses directly on teaching the skills that a child needs to master to perform functional activities, and to transfer acquired skills to daily life performance (Niemeijer et al., 2007; Schoemaker et al., 2003; Schoemaker et al., 2005). These cognitive and motor control processes can be linked to

executive functioning (Houwen et al., 2017). Therefore, NTT will be suited for children with executive function problems. In NTT, Newell's theory of task constraints is used as the basis for the analysis of task performance. Newell's model outlines three different domains that affect motor movements and how they are displayed by an organism: individual structural and functional, environmental, task. Each domain involves constraints that will encourage some movements but restrict others (Newell, 1989). NTT is a task-oriented approach to intervention and is mainly activity-oriented but also facilitates participation.

In NTT the problem is identified, goal setting takes place, followed by in-depth task performance analysis and hypothesis generation. The task is then adapted, which will then serve as therapy. For example, a child experiences difficulty with ball skills and in the initial assessment, catching a ball is identified as a task the child really wants to improve. The therapist observes the task performance in several environmental conditions followed by the therapist identifying the level of task performance and environmental condition in which the child can perform the task successfully, most of the time. The therapist will then assess the possible constraints experienced by the child when trying to catch a ball. The child is observed catching the ball in various environmental conditions (e.g. change in speed, distance, velocity). Therapy will include a lot of practice of tasks while difficulty is increased, e.g. ball size, repetitions to improve endurance, distance, relative position of ball thrower, moving around when catching and inclusion of more people in the game to start simulating a real ball game. The tasks should be challenging, but the child is still able to be successful on most attempts.

2.6.2. Cognitive Orientation to Daily Occupational Performance (CO-OP)

CO-OP is a top-down, task-oriented, client-centered approach that uses an iterative process of dynamic performance analysis and guided discovery to enable individuals to identify cognitive strategies that will improve performance (Mandich et al., 2001). According to Polataijko & Mandich (2004) there are five main objectives of CO-OP: skill acquisition, strategy use, generalisation of learned skills, strategies to real-world situations, transfer of learned skills, and strategies to novel tasks. CO-OP focuses predominantly on the use of cognitive strategies to facilitate skill acquisition, and uses a collaborative, problem-solving approach adapted from cognitive behavioural therapy. In a recent review by Anderson et al. (2017) the findings suggest that the CO-OP approach, when administered in group format, has the potential to benefit children living with motor coordination difficulties in both physical and psychosocial domains.

The CO-OP approach focuses on skill acquisition, development of cognitive strategies, generalization of skills and strategies to everyday life and transferring of learning to new skills and contexts. For example, a child struggles to catch a tennis ball when thrown against a wall. The therapist will ask the child to throw the ball against the wall and through a process of guided discovery the therapist will enable the identification of the specific strategies that will support performance success, e.g. "What do you think will happen if you throw the ball harder/higher/softer/etc.?". In CO-OP individuals learn how to talk themselves through performance problems. This enables the child to develop cognitive strategies through guiding and prompting, which will enable them to catch the ball successfully. Once they have mastered this they can apply the newly acquired skill to other contexts.

2.6.3. Motor Imagery (MI)

MI training involves the imagination of moving specific body parts without the actual movement of those parts. During MI, the participant is asked to imagine making a certain movement, which is expected to facilitate the participant in predicting the consequences of actions in the absence of the overt movement. In combination with continued actual practice, participants use the knowledge of the relation between vision and kinesthesis to make accurate predictions of the consequences of self-produced movements, which may reduce the errors in feedforward planning (Adams, Steenbergen, Lust & Smits-Engelsman, 2016; Wilson et al., 2016; Wilson, Thomas & Maruff, 2002). In Motor Imagery (MI) imagining moving specific body parts without the actual movement of those parts is utilised to teach motor skills. For example, the participant is asked to imagine performing a certain movement, e.g. throwing a ball. This is done by mental rehearsal of this skill, in combination with continued actual practice of the skill. Participants use the knowledge of the relation between vision and kinesthesis to make accurate predictions of the consequences of self-produced movements, which may reduce the errors in feedforward planning.

In a review by Smits-Engelsman et al. (2013) it was found that it is too early to state with confidence that MI training is effective for treating DCD and more high-quality research is needed to clarify the conditions under which motor imagery training is best implemented for children with DCD. A randomised controlled trial by Wilson et al. (2016) was a replication and extension of an earlier study (Wilson, Thomas, & Maruff, 2002*).* This new study included a group of children with DCD, while the earlier study had children of below-average motor skill. Both studies compared MI training, perceptual-motor training (PMT) and a third wait-listed control group. Results showed that the two intervention groups (on average) achieved significantly higher change scores than controls. Results showed that MI was equally effective as PMT in improving motor skill acquisition, with the two intervention groups improving their motor performance significantly. The researchers

concluded that MI training is a useful modality for children with DCD, with most showing significant improvements in movement skill (Wilson et al., 2016).

2.6.4. Use of virtual reality and virtual gaming

Studies making use of virtual reality games incorporate a technological component as the therapy element. Virtual gaming has been shown to improve balance in children with DCD effectively as well as other aspects of gross motor skill development, and is being used by physical therapists as a treatment option to improve balance as well as muscle strength (Gonsalves, Campbell, Jensen, & Straker, 2015). Visual Reality of Visual Gaming comprises of treatment through virtual reality training, with a commonly used modality being the Wii Fit. The Nintendo Wii Fit incorporates aspects of biofeedback and virtual reality, using motion sensor technology to engage the player in a virtual video game scenario, e.g. Slalom skiing on the balance board. This is done to achieve implicit learning.

Studies using the Nintendo Wii Fit as treatment modality - which incorporates aspects of biofeedback and virtual reality using motion sensor technology to engage the player in a virtual video game scenario - provided evidence to support the use of Wii training for children with DCD (Ferguson et al., 2013; Smits-Engelsman et al., 2015). However, in comparison to Wii training, the NTT approach resulted in greater improvement in motor proficiency, cardiorespiratory fitness and functional strength (Ferguson et al., 2013).

2.7. Factors influencing intervention success

Active participation, engagement and motivation to adhere to therapy for long enough to bring about changes in motor proficiency are integral components to intervention planning (Jelsma, Ferguson, Smits-Engelsman, & Geuze, 2015). Furthermore, it is important that interventions are suited to the context in which they are delivered and suited to the unique child variables. It is important that intervention programmes for children with DCD promote active participation and engagement, as opposed to inactive treatments, exercise classes or gross motor groups where children are not actively involved and engaged in problem solving and skills acquisition. For children to remain motivated for the full duration of the intervention, participants need to enjoy the intervention. It is also important for intervention programmes to be financially justifiable in terms of use of resources (e.g. group vs. individual, equipment, time). Interventions in this special population need to be suited to the characteristics of the participants. Due to the fact that learners present with SLD, it is therefore important to consider the need for adapted teaching strategies and possibly a

less cognitive approach. As learners may present with hyperactivity and inattentiveness due to ADHD, treating learners in smaller groups may help manage behaviour and as a result may produce better treatment outcomes.

2.8. Identifying an appropriate intervention approach for SLD

In some of the other intervention approaches, like CO-OP, VRT and MI training, the level of pure cognitive and verbal strategies used may be less suited for children with SLD/DCD. In contrast to these cognitive approaches, NTT promotes active participation and engagement. NTT is proven to be effective in children with DCD and recipients report that they enjoy this form of therapy (Smits-Engelsman et al., 2015). NTT is recommended for children of all ages as well as children with lower intellectual competence (Niemeijer et al., 2007). NTT can be used in areas of resource constraints such as low-income schools as there is no need for expensive equipment. It has been widely used to treat children with DCD in different settings, including South Africa (Ferguson et al., 2013).

Studies have shown that NTT can be offered in an individual, one-on-one format (Schoemaker et al., 2003) or in small-group format (Ferguson et al., 2013). A meta-analysis by Pless, Carlsson, Sundelin, and Persson (2000) showed that specific and individualised group-based therapy is effective in improving motor skills in children with DCD. In a recent updated systematic review and meta-analysis Smits-Engelsman et al. (2018) found that group- and individual-based intervention both produced large effects on motor performance. Group-based intervention produced a strong effect and may be a cost-effective option. The systematic review also found that groups of between four and six children are manageable and effective with one therapist and optional assistant (Smits-Engelsman et al., 2018). A recent systematic review of high-quality randomised controlled trials investigating motor skill programmes for children with DCD, found that there is strong evidence supporting a task-oriented NTT approach, individual and group-based (Preston et al., 2016).

According to a study by Ferguson et al. (2013), NTT can be used in mainstream schools for children that have DCD with less frequent co-morbidities. In this context task training yields positive change on measures of gross motor and fine motor skills (Niemeijer et al., 2007; Smits-Engelsman et al., 2013). Ferguson et al. (2013) found an improvement in motor performance in learners in a South African mainstream school through use of NTT in small groups. In this study, children aged 6–10 years, who had a Total Test Score (TSS) at or below the 16th percentile on the MABC-2 and who were identified by their teacher as presenting with a functional motor problem, were allocated to either NTT (n = 37) or Wii training (n = 19) groups. The NTT program was implemented for nine weeks, with two sessions per week each lasting between 45 and 60 minutes. The NTT approach produced greater

results across measures of motor proficiency, cardiorespiratory fitness and functional strength, with the NTT group showing a significant improvement over the intervention period.

A systematic review of high quality randomised controlled trials by Preston et al. (2016) reviewed nine randomised controlled trials investigating motor skills programmes in children with DCD of which programme duration ranged from five to twelve weeks, one to five times per week with each session lasting between 30 and 60 minutes. They concluded that NTT and task-oriented approaches were the most effective interventions for improving motor skills in children with DCD. A meta-analysis by Lucas et al. (2016) investigated the effect of interventions to improve gross motor performance in children with neurodevelopmental disorders, which included DCD, reviewed nine trials. In these nine trials interventions were performed over four to twelve weeks, at a frequency of one to three times per week with sessions lasting 10 to 60 minutes. They concluded that interventions with a task-orientated framework may improve gross motor outcomes in children with DCD. The findings were limited by the very low quality of the available evidence, where on the other hand the Preston et al. (2016) study included nine high quality RCTs investigating 15 interventions to improve motor skills specifically in DCD. Further research is recommended as findings were limited by the low quality of available evidence.

In a recent systematic review and meta-analysis (Yu et al., 2018) it was found that motor skill interventions (including task orientated approaches like NTT) are effective in improving motor performance and cognitive, emotional, and other psychological factors (including behaviour and participation) in children with DCD. A total of 50 studies (76 per cent) involved participants with pure DCD, 14 (21 per cent) studies included participants with DCD and comorbidities (e.g. ADHD), and 2 studies (three per cent) did not report information about comorbidities. Eighteen studies looked at the immediate effect of motor skill interventions on motor skill performance, comparing the intervention and control groups. The pooled effect size was positive and significant ($p < 0.001$). Yu et al. (2018) also found that studies using usual care as a control condition yielded larger effect sizes than those using other training programs. It was also found that studies conducted at schools, using a task-oriented approach and involving treatment lasting for nine weeks, yielded a large effect size.

In the abovementioned systematic review and meta-analysis (Yu et al., 2018), seven studies looked at improving cognitive, emotional and other psychological factors through motor skill interventions as primary or secondary outcome. The overall pooled findings for the outcome category of cognitive, emotional, and other psychological factors was significant ($p = 0.001$). The intervention durations ranged from four to 24 weeks.

A systematic review and meta-analysis investigating the efficacy of interventions to improve motor performance in children with DCD, reviewed task-oriented approaches to improve handwriting in regular and special schools (Smits-Engelsman et al., 2013). Smits-Engelsman et al. (2013) reports that a task- oriented self-instruction approach, based on NTT, had a positive effect on handwriting. Self-instruction, specifically used in handwriting, is designed to enhance an individual's self-control through verbal statements that prompt, guide, and maintain non-verbal actions (Jongmans et al., 2003). However, this approach and the effect on motor skills and performance have not yet been examined in LSEN schools where learners may present with more co-morbidities.

When considering children with DCD, NTT has been shown to be an effective treatment method, as it is tailored to meet the individual needs and constraints of each child while allowing for group-based intervention (Lucas et al., 2016; Preston et al., 2016; Yu et al., 2018). Interventions presented in groups were found to improve learners' ability to deal with peer problems, reduce performance anxiety, encourage task engagement and improve adherence (Cacola, Romero, Ibana, & Chuang, 2016; Smits-Engelsman et al., 2018). Hung and Pang (2010) found that learners who received group-based exercise experienced a stronger sense of competence, improve participation in the intervention as well as in other physical activities affecting their overall motor competence Therefore, this research study aims to investigate whether NTT is also an effective treatment method for learners with DCD and co-morbidities. According to the literature, it is evident that NTT improves motor outcomes when measured by the MABC-2 (Ferguson et al., 2013; Niemeijer et al., 2007; Schoemaker et al., 2003). Ferguson et al. (2013) also showed that NTT improves fitness parameters, but it is unknown if NTT can change behavioural profile and quality of life by improving the motor skills and performance of children with DCD. Previous studies have not shown whether NTT may have a consequential effect on children's emotional and behavioural characteristics, and ability to concentrate, which is often an area of difficulty for learners with DCD (Dewey et al., 2002; Missiuna, Rivard, & Pollock, 2011).

Currently, literature provides strong evidence of improvements in the functional ability of children with DCD through the use of NTT (Lucas et al., 2016; Preston et al., 2016; Smits-Engelsman et al., 2013). Information regarding the most effective treatment to achieve specific outcomes in learners with SLD with/without ADHD with co-morbid DCD, who attend special schools, is scarce. With the increasingly limited resources in the public education and health sectors, group-based intervention programmes may be an appealing approach if it can be proven that group intervention produces similar, if not better, outcomes than individual intervention. It is also not known what the effect such

a programme may have on children's environmental and personal factors, and activity, in terms of the ICF-CY. NTT through group intervention may also be proven to have a positive impact on the child's behavior as experienced by the parent and teacher.

The goal of intervention is to reduce activity limitations and improve participation. Participation has been found to be vital for children's social and academic development as well as for their sense of competence and self-identity (Cairney, Hay, et al., 2010). Often when activity limitations and consequently participation restrictions are reduced, the child flourishes. As a result of intervention, not only can social changes be identified, but also personal changes (Mandich, Polatajko, & Rodger, 2003).

2.9. Conclusion from the literature

The aim of this literature review was firstly to describe motor impairments in children with SLD and secondly, to describe and review the interventions that could be used to treat these children. Based on this literature review, it can be concluded that learners with SLD/DCD are a unique group, presenting with motor coordination difficulties, behavioural difficulties and lower HRQOL. Information regarding the response to task-oriented interventions to achieve specific outcomes in learners with SLD/DCD with/without ADHD, who attend special schools, is scarce. Therefore this study aims to show the effect NTT has on motor coordination, behavioural profile and HRQOL in learners with SLD/DCD.

3. Methodology

3.1. Research design

A cross-sectional descriptive design was used to illustrate the prevalence of co-morbidities in the SLD population including ADHD and DCD, and document the medical history, birth history and use of medication in the study sample.

A quasi-experimental design, with pre- and post-tests, was used for the intervention study. The study involved two groups of learners identified with SLD/DCD or motor coordination problems. One group was allocated to the intervention group (group-based NTT) for nine weeks and the other group was allocated to a waiting list and received usual care.

3.2. Participants

A sample of convenience, consisting of children aged 6–10 attending this LSEN school was used to select children who met the inclusion criteria.

3.2.1. Inclusion Criteria

All children aged 6–10 years, and between Grades 1–4, who presented with a primary diagnosis of SLD with/without ADHD (according to CEMIS database), whose parents consented to participation were included.

These learners were then assessed for DCD, using the four DSM- 5 criteria (American Psychiatric Association, 2013):

1. Learners presented with motor skills below the expected norm for their age, scoring ≤ 16th percentile for their age on the MABC-2, indicating motor coordination problems.
2. Learners presented with functional problem like dropping or bumping into objects, difficulty with catching an object, using scissors or cutlery, handwriting, riding a bike, or participating in sports, as assessed by teachers and parents using the MABC Checklist and functional problem.
3. According to the parent questionnaire, it was determined if the onset of symptoms was in the early developmental period.
4. For learners included in the study it was determined by the use of CEMIS that the motor skills deficit was not due to intellectual disability (intellectual developmental disorder) or visual impairment and are not attributable to a neurological condition affecting movement (e.g., cerebral palsy, muscular dystrophy, degenerative disorder).

DCD was defined as having a functional motor problem according to the MABC Checklist and a MABC TSS ≤ 16th percentile (Henderson et al., 2007). All children with SLD with/without ADHD with co-morbid DCD were eligible for inclusion into the intervention study.

3.2.2. Exclusion criteria

Learners with the following conditions as primary or secondary diagnosis - intellectual disability (Intellectual Developmental Disorder), severe visual impairment, cerebral palsy, muscular dystrophy, degenerative disorders, spina bifida, spinal cord injury (SCI), any syndromes, illness on the day of testing, acute fractures - were not included in the study.

3.2.3. Sample-size calculation

No previous studies have been conducted among children with SLD/DCD. Therefore, the sample-size calculations were based on a previous South African study in which the efficacy of NTT treatment determined by the change in MABC scores was investigated (Ferguson et al., 2013). The total sample-size required in each arm of the intervention phase was calculated using the web-based statistical calculator[2]. Accordingly, it was established that 36 participants were required to enter this two-treatment parallel-design study (18 participants per group) in order to detect a treatment change of two standard scores (SD = 2.5) on the MABC-2 at a 0.05 per cent significance level with 90 per cent probability. A two-sided alpha was used. See table with means below. It is hypothesised that the effect size (ES) in SLD population is expected to be lower.

[2] http://www.statisticalsolutions.net/pss_calc.phpsoftware package

Table 1: Sample-size calculation for intervention

	Sample-size calculation two means, t-Test, ind. samples H0: Mu1 = Mu2
	Value
Population Mean Mu1	4.26
Population Mean Mu2	6.26
Population S.D. (Sigma)	1.76
Standardized Effect (Es)	-1.13
Type I Error Rate (Alpha)	0.05
Critical Value of t	2.03
Power Goal	0.90
Actual Power for Required N	0.91
Required N (per group)	18

3.3. Measurement instruments

3.3.1. Parent questionnaire

A parent questionnaire was used to obtain demographic and medical information on each child.

The questionnaire consisted of several closed and open-ended questions pertaining to the birth history, health status, motor coordination skills and attention of the child (See *Appendix E*). The questionnaire had been used in this context in previous studies and was validated by experts (Ferguson et al, 2014).

3.3.2. Movement Assessment Battery for Children (MABC) Checklist and Movement Assessment Battery for Children-2nd Edition (MABC-2)

The MABC Checklist and the MABC-2 performance test were used to identify co-morbid DCD. The MABC-2 was also used as a primary outcome measure to evaluate the efficacy of the intervention.

The MABC-2 and Checklist (see *Appendix N & O*) are both standardised assessment tests designed to detect functional motor performance and motor skill impairment challenges in children. The MABC Checklist investigates the effects of motor difficulties on activities of daily living. It can be used to assess learners in groups in a classroom setting and is therefore a useful screening tool. The Checklist is divided into three sections: movement in a static or predictable environment; movement in a dynamic or unpredictable environment; non-motor factors (behaviour). The final score comprises the first two sections (A and B). Section A consists of questions regarding movement in a static and/or predictable environment. Section B consists of questions regarding movement in a dynamic and/or unpredictable environment. A higher score indicates poorer motor competence. For each age group, red, orange and green zones are identified. A maximum score of 90 can be obtained for the Checklist. More experienced functional motor problems will result in a higher score. The ranges are age-specific.

The behaviour section considers the extent to which a learner's attitudes and feelings about motor tasks are situation-specific or more generalised (Henderson et al., 2007). In this study, Dutch norms were used. Learners who scored in the orange and red zones for their age - indicating a functional motor problem - were included in the study.

The MABC Checklist is useful in assessing functional problems in DCD, as a comprehensive range of functional activities can be assessed. The sensitivity of the Checklist has been found to be low, the specificity acceptable and the Checklist met the standards for validity and reliability (Schoemaker et al., 2012).

The MABC-2 performance test comprises eight subtests measuring different aspects of motor performance for each of the three age bands (3–6 years, 7–10 years, and 11–16 years). It includes manual dexterity, aiming and catching, and balance. Scores may be expressed in percentiles, with scores above the 16th percentile regarded as normal motor performance, scores between the 9th and 16th percentile suggesting motor difficulty, and scores at or below the 5th percentile considered as definitive for motor coordination problems (Henderson et al., 2007). Total standard scores and percentiles are provided as part of the test, indicating the extent to which a child falls below the level of his or her age peers. In cases where children are unable to complete an item of a particular test, the lowest standard score for that test item, as reported in the manual, was substituted.

Although there are no norms for the MABC-2 in South Africa, it has been used in South African studies with the focus on motor development and developmental coordination disorder (DCD) (Ferguson et al., 2013). In this study Dutch norms were used.

A TSS MABC score ≤ 16th percentile suggests that the child is at risk of having a movement difficulty (Henderson et al., 2007). To be identified as DCD, these learners met the criteria according to the DSM-5.

3.3.3. Strengths and Difficulties Questionnaire (SDQ)

The parent and teacher versions (Goodman, 1997) of the Strengths and Difficulties Questionnaire (SDQ) was used to identify behavioural problems in the sample, and was used pre- and post-intervention to evaluate change in behavioural and emotional problems.

The SDQ (*see Appendix P & Q*) was completed in English by teachers and parents/guardians. The SDQ consists of twenty-five items that are divided into five sections: a) emotional symptoms (5 items); b) conduct problems (5 items); c) hyperactivity/attention deficit (5 items); d) peer relationship problems (5 items); e) pro-social behaviour (5 items). The SDQ also includes an impact score completed by the teacher and parent.

The SDQ has several advantages, including a compact format, a focus on strengths and difficulties, and improved reporting of inattention, peer relationships, and pro-social behaviour. The questionnaire consists of a single form suitable for both parents and teachers, a feature which may lead to improved parent-teacher correlations (Goodman, 1997). The parent and teacher SDQ consists of five domains (emotional problems, conduct problems, hyperactivity, and peer relations) as well as the pro-social domain. The Total Difficulties Score is generated by adding up scores from all the domains except the pro-social domain. The resultant score ranges from 0–40. A lower score indicates a lower risk for behaviour problems and a higher score indicates a higher risk for behavioural problems. The pro-social score is the opposite, with a low score indicating a high risk and a high score indicating a lower risk. The impact supplement, which is an additional short questionnaire, consists of items related to overall distress and impairment, and can be summed to generate an impact score that ranges from 0–10 for parent report, and from 0–6 for teacher report. A higher score on the impact score indicates a more significant impact on various areas, including home life, classroom learning, peer relations, friendship and leisure activities.

The psychometric properties of the SDQ parent and teacher questionnaires have been investigated and internal consistency, test-retest reliability, and inter-rater agreement were found to be satisfactory. As regards the parent and teacher versions, the teacher version seemed more reliable compared to the parent version at subscale level (Stone, Otten, Engels, Vermulst, & Janssens, 2010).

The SDQ is known to be a quick and cost-effective screening tool to administer. In a recent study by Hoosen, Davids, de Vries, and Shung-King (2018) the SDQ was found to be a very useful tool in an African setting. In this study, most of the participants were from South Africa.

3.3.4. European Quality of Life 5-Dimensions Questionnaire for Youth (EQ-5D-Y)

The European Quality of Life 5-Dimensions Questionnaire for Youth (EQ-5D-Y) was used to determine Health-Related Quality of Life (HRQOL) in children according to their own experience at baseline. It will also be used to evaluate the impact of the intervention on quality of life.

The EQ-5D-Y (*see appendix R*) is a self-completed youth version questionnaire, designed for children and adolescents aged 8–12 years. It has been validated in Cape Town (Ravens-Sieberer et al., 2010). For children aged 4–7 who are not able to complete the questionnaire themselves, a proxy version can be used. It is designed to evaluate the health-related quality of life of the youth and consists of five dimensions (mobility; looking after myself; doing usual activities; having pain or discomfort; feeling worried, sad, unhappy). Each of these can have one of three responses (The EuroQol Group, 1990). The EQ-5D also has a VAS (Visual Analogue Scale) to measure daily health (The EuroQol Group, 1990). The self-report versions (completed by the child) were used. All parents were asked to complete the proxy form to be used in cases where learners were not able to complete the questionnaire themselves.

Ravens-Sieberer et al. (2010) tested the feasibility, reliability, and validity of the EQ-5D-Y in a multinational study, of which South Africa formed part. In a study by Scott, Ferguson, and Jelsma (2017) in a South African population, the EQ-5D-Y dimensions were found to be reliable on test-retest, except for the usual activities dimension. The Visual Analogue Scale (VAS) was also found to be reliable. Scott et al. (2017) found that the EQ-5D-Y could be used with confidence as an outcome measure for acutely ill children. It however demonstrated poorer psychometric properties in children with no health condition or chronic conditions. It was recommended that the EQ-5D-Y should be used as part of the routine assessment of children and that it is a feasible and useful assessment.

3.4. The research team

The research team comprised: the researcher; trained physiotherapy students who assessed learners in order to identify participants; a trained therapist blinded to allocation, to intervention or

control group who assessed learners pre- and post-intervention; a trained physiotherapist who administered the group-based therapy; a research assistant.

The NTT-based programme was developed by the researcher in consultation with experts in the field of NTT. The programme was discussed with the trained physiotherapist who administered treatment. The treating therapist received training prior to starting the study. This included eight hours of face-to-face training in the principles of NTT as well as more than twelve hours of self-study, which included reading articles on NTT and similar approaches. The physiotherapist was experienced in working in the field of paediatrics and was trained by the research supervisor.

After the completion of reassessment of all participants on all outcome measures, the researcher completed all data collection and commenced data analysis.

3.5. Procedure

3.5.1. Ethical approval and permission

Ethical approval was obtained from the University Of Cape Town, Faculty of Health Sciences Human Research Ethics Committee (UCT HREC Ref 426/2016) *(Appendix A).*

Permission to access CEMIS and conduct the study in the school was obtained from the Western Cape Education Department (WCED), the school principal and School Governing Body (a body representing the interests of children and parents at the school) *(Appendix B &C).*

3.5.2. Informed consent and assent

Letters were sent to parents of all identified children informing them of the study *(Appendix D)* and seeking their consent to assess their child. If parents chose not to have their child included in the study, they could inform the researcher at this stage. Parents who informed the researcher that their child cannot be part of this study were excluded.

Parents of learners eligible for the intervention study received an information letter *(Appendix E)* and were invited through their children to attend an information meeting. If they agreed to take part in the intervention study, they were asked to complete informed consent forms *(Appendix F).*

All learners were asked to complete informed assent forms *(Appendix J).* The study was explained to the children in an age-appropriate manner. They were given time to decide whether they wanted to participate (if they elected not to, they were not enrolled, even if their parents had consented) *(Appendix G).*

Teachers were given written information on the study *(Appendix K)* and were requested to complete consent forms *(Appendix L).*

3.5.3. Funding

Funding was obtained from the South African Physiotherapy Society (SASP). This funding was used to pay for the assistants who performed the baseline, pre- and post-intervention assessments, as well as the research assistant. Funding was obtained from the UCT Department of Health and Rehabilitation Science and the Faculty of Health Science Research Committee in order to pay for the physiotherapist who administered the nine weeks of treatment.

3.5.4. Recruitment

The researcher identified the sample by accessing the CEMIS database and identifying children aged 6–10 years and in Grades 1–4, who attend the school and who present with SLD with/without ADHD. After identification of the sample, parents/guardians of identified learners were sent an information letter with details of the study *(Appendix D*). Parents/guardians could contact the researcher with questions regarding the study.

3.6. Data collection

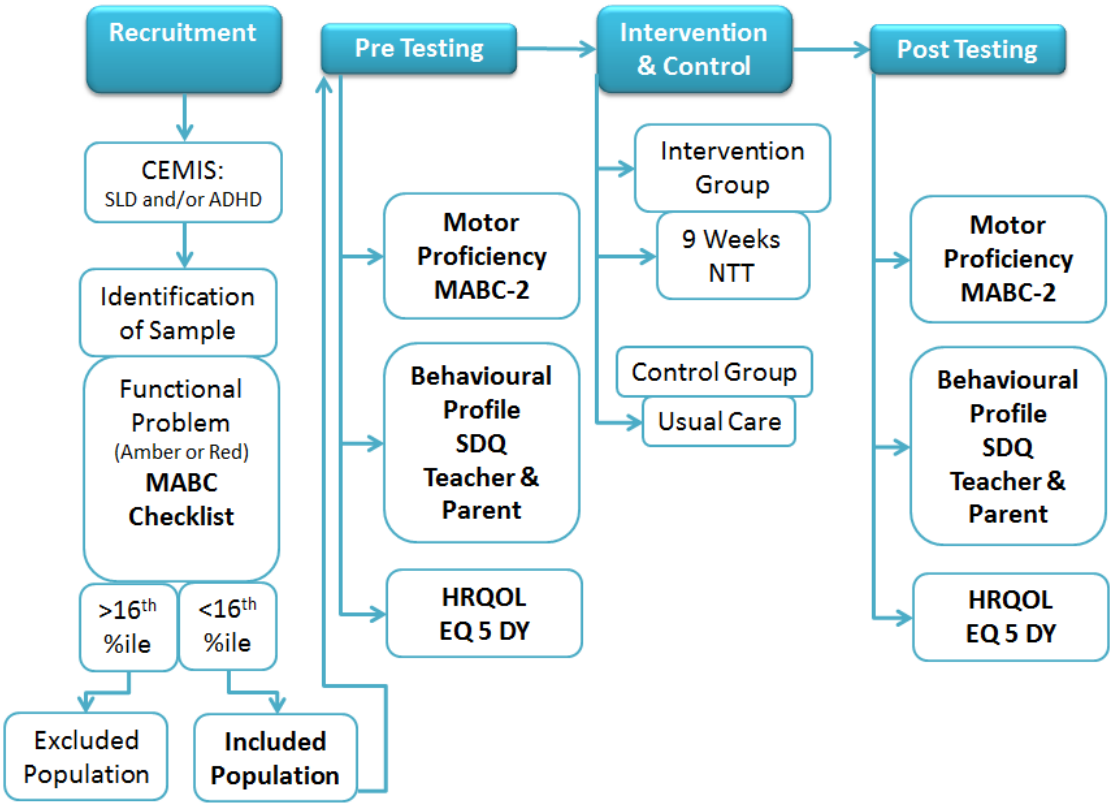

Figure 3: Study Overview

3.6.1. Sample identification

Data collection for identification of the sample took place during school time over the period August 2016 to March 2017. Testers (physiotherapy students and trained physiotherapists) received training on the administration of the MABC-2 prior to commencement of the study.

The parents/guardians were asked to sign the consent forms *(Appendix F)* to participate in baseline testing and to complete a parent questionnaire. The questionnaire covered questions relating to general health, birth history, motor coordination skills and attention.

MABC Checklists were completed for each child by their class teachers. The MABC Checklist was explained to teachers by the researcher. A teacher, who had come to know the learner through the current school year and was the learner's current class teacher, was asked to complete an MABC Checklist per child, to determine if they presented with a functional motor problem (red or orange score). If a teacher declined to participate, the parent was asked to complete the checklist.

Parents were asked to complete a questionnaire to obtain information on birth history, health status, motor coordination skills, and attention *(Appendix E).*

Learners who met the eligibility criteria (age and diagnosis) were assessed on a one-to-one basis using the MABC-2 by a group of trained testers in the school's physiotherapy gym area. Learners who scored ≤16th percentile (TSS) on the MABC-2 and presented with a functional motor problem on MABC Checklist (scoring within the orange or red zones for their age) were eligible for inclusion into the study. These learners were then allocated to the intervention (n=18) or control (n=18) group. Parents of these learners were informed of test results through a written report and were invited to meet with the researcher in person. If the learner met the eligibility criteria for the intervention, additional consent forms were required to participate in the intervention study, either as part of the intervention or the control group.

3.6.2. Pre-intervention testing

In 2017, a trained research assistant (physiotherapist) re-assessed all the children in the intervention and control group (n=36) in the week preceding the intervention. All learners included in the study were assessed on all three outcome measures pre-intervention (MABC-2, SDQ Teacher and SDQ Parent, EQ-5D-Y).

The SDQ was explained to the teachers and parents by the researcher. The SDQ Parent (SDQ-P) was sent home to be completed by the parents and the SDQ-Teacher (SDQ-T) version was completed by teachers at school. The EQ-5D-Y was explained to learners by the trained tester and administered on an individual basis. The EQ-5D-Y was completed by parents to serve as a proxy where learners were not able to complete the questionnaire, which was not the case as all leaners (n=36) were able to complete the EQ-5D-Y.

3.6.3. Allocation to intervention and control group

Allocation to the intervention or control group was planned to be randomised by method of stratified randomisation. Unfortunately, due to organisational difficulties and the academic requirements of the school, this was not possible. All possible options were considered, but it was felt that ensuring that the nine-week programme is presented at school during school times made it fair and accessible to all learners.

Allocation to the intervention or control group was thus performed by the teachers. If teachers observed motor coordination problems which they felt were severe, they allocated learners to the intervention group. The remaining learners were then allocated to the control group. Although all

learners in the intervention and control group presented with motor coordination problems according to the MABC – 2 test scores, only learners whose teachers perceived their motor coordination difficulties as being more severe (teachers' opinion) were allocated to the intervention group. The control group was a wait-listed control group, meaning that these learners were allocated to a waiting list and would receive the intervention after the active treatment group. During the study, as part of the control group and while on the waiting list, they would receive usual care.

3.7. Intervention

The intervention commenced the week following the pre-assessments. The therapist received training in the principles of NTT and the intervention programme prior to the start of the nine weeks. The treating therapist was blinded to the pre-intervention scores of learners.

The NTT-based program was implemented for nine weeks, with two sessions per week, each session lasting between 45 and 60 minutes. Children were allocated to groups based on their school timetable. The groups did not exceed the ratio of 2:1 (children to adult supervisor). One therapist (trained physiotherapist) presented each intervention group along with a trained assistant (not a therapist) to assist and supervise each group, consequently each activity involving two children was supervised and facilitated by one adult.

The NTT-based programme (Ferguson et al., 2013; Niemeijer et al., 2007; Schoemaker et al., 2003) incorporated principles of guided discovery to facilitate implicit learning of task components, with positive feedback to support learning. The programme content was developed based on learners' areas of difficulty, as identified by the MABC-2, i.e. manual dexterity, ball skills and balance. Activities included components of soccer, netball and basketball, variations of tagging games, skipping with a rope, and other popular games organised as workstations. Children participated under the guidance of the therapists who manipulated aspects of the environment and tasks as needed.

NTT is a task-oriented training programme for children with DCD originally developed to be used by physiotherapists. The principles of NTT are based on task analysis, thus breaking a task down into component parts. This is the basis on which skills are taught in the task-oriented approach and enables the focus to fall on the main problem areas in the task. Task analysis, being a key principle of NTT, incorporates planning, execution and evaluation in order to be able to adapt the task to make it achievable for the child and therefore facilitating learning. Furthermore, skills are learned progressively through task loading, changing spatial and temporal constraints of the task, and by combining tasks. This is dependent on the learning stage a child has reached for a specific skill.

Based on these principles, task or environmental constraints are adapted by the therapist in order to make a task easier or more difficult. This makes NTT suitable for younger children or children who are verbally less competent (Niemeijer et al., 2007). Knowledge from studies on motor-learning strategies with regards to the most effective method to instruct, practise and provide feedback are implemented in the treatment sessions, taking into account the level of proficiency of the child. Examples may be given in order for the child to master the task. Once the child has mastered the basic task, variations are given. This may include changing materials, the environment, and the rules of the task. Time to practise the task is provided, creating the opportunity to spend time on the task. The therapist needs to provide clear instructions about which task to perform, how to perform it, and what to attain, as a sense of achievement is critical for motor learning; therefore, NTT therapists should provide instructions that are useful. Information should be given in such a way that the child recognises his/her errors. Feedback about how a task was performed is essential for skill learning. In NTT, the provision of adequate feedback on performance is encouraged because it may enhance motor learning, especially in children with motor problems. Both the motivational and the informational functions of feedback are emphasized in NTT (Blank et al., 2012; Niemeijer et al., 2007; Smits-Engelsman et al., 2013). Currently there is no evidence about what frequency and duration of intervention is necessary for long-term success (Blank et al., 2012).

The NTT programme took place over nine weeks, with two sessions per week each lasting between 45 and 60 minutes. This is similar to other studies performed in a South African school context (Ferguson et al., 2013). The frequency of the intervention was based on previous studies where task-oriented approaches where used and significant change in motor function was found in learners with DCD (Ferguson et al., 2013, Schoemaker et al., 2003, Niemeijer et al., 2007). In the study by Ferguson et al. (2013), learners in the intervention group received nine weeks of group-based NTT, two sessions of 45- 60 minutes per week. In the study by Niemeijer et al. (2007), learners in the intervention group received NTT in pairs for 30 minutes per week for nine weeks. In the study by Schoemaker et al. (2003), learners received 30 minutes of individual NTT per week for 18 weeks.

Participation in the programme was monitored and managed through attendance registers. In the case where a participant missed a session or was not able to attend for reasons e.g. class outing, absenteeism, assessment in class, school activity, an additional group session was scheduled, as far as possible.

The first five minutes of each session was used to play a game that served as a warm-up or ice-breaker, e.g. ‘Simon Says’. The rest of the session consisted of four activities, set up as workstations. The group started together at the first station, followed by two separate stations where the group

was split up. This made up 30 minutes of the session. The last activity or station consisted of a game that the whole group could play together for another 10 minutes. The last 5–10 minutes of the session was used as reflection time. The therapist asked the learners questions e.g. “What went well? What did you like? What would you like to do differently next time? Which games would you like to play? Are there any of these activities you will try at home or on the playground?”.

The intervention programme was structured in such a way that each week had a specific theme. Each week consisted of two sessions. Each activity was structured as a game.

Table 2: NTT Programme[3]

Week 1	Session 1 & 2	Running games
Week 2	Session 3 & 4	Balance games
Week 3	Session 5 & 6	Jumping horizontal (e.g. hop scotch games, rope-jump games, jump to put ball in basket, jump over fence etc.).
Week 4	Session 7 & 8	Jumping vertical (progress towards rope jumping, jumping over an object etc.)
Week 5	Session 9 & 10	Jumping vertical and horizontal (components of skipping rope or jumping over objects)
Week 6	Session 11 & 12	Bimanual: throwing
Week 7	Session 13 & 14	Aiming: kicking
Week 8	Session 15 & 16	Aiming: throwing and catching
Week 9	Session 17 & 18	Complex activities: skipping with a rope, dancing

3.8. Control group: usual care

Learners allocated to the control group continued to receive usual care for the nine-week intervention period. This included continued OT and physical education. At the research setting, only learners with physical disabilities (cerebral palsy, spina bifida) received physiotherapy. Usual care can therefore be described as no-physiotherapy intervention.

Usual care includes basic physical education presented by class teachers. Basic physical education should consist of two hours of physical education per week in Grade R–Grade 3. In Grade 4, time allocated for physical education changes to one hour per week. (Department of Basic Education, 2012) Based on discussions with teachers and observations in the research setting, it was found that this policy was generally adhered to. The NTT group also continued with physical education with their class group, as no learner was excluded from classroom activities based on their participation in the study.

[3] See *Appendix S* for further details

While it appears that the lack of physiotherapy falls short of best practice, children with DCD also receive OT as part of their usual care. The aim of physiotherapy (PT) and OT for children with DCD are similar. However, different approaches are used by each discipline. These different approaches may yield different outcomes in terms of outcomes assessed. Best practice would therefore be a combination of OT and PT for DCD. However, this is currently not possible within the financial constraints of the institution. At this school OT makes up various programmes including sensory motor groups, fine motor groups, visual perception groups and class groups. Some of the older learners also receive typing lessons. Some learners also receive individual OT sessions. Sensory motor groups focus on balance, coordination, tactile and sensory integration, as well as postural control. Fine motor groups focus on cutting with scissors, folding, sticking, and general craft activities to improve fine motor function. Visual perception groups focus on two-dimensional worksheets and all areas of visual perception e.g. visual discrimination, form constancy (form discrimination), figure ground (foreground-background differentiation), spatial relations, visual closure, visual sequencing and visual memory. All grade 1 and 2 learners participate in class groups. This consists of handwriting tasks, pencil grasp, and position in space. Individual OT sessions would focus on learners' specific needs and would include a combination of the above-mentioned interventions.

It is known that there are similarities and differences between OT and PT. In this study, usual care was described as not receiving PT but continuing with physical education and OT, where learners were already receiving OT at the start of the nine weeks. Leaners did not commence OT in the nine weeks if they had not been receiving it prior to the study. OT was not withheld from any learner in the study and learners in the NTT group also continued with OT if they were already receiving OT.

In the NTT and usual care group, 31 leaners received OT throughout the duration of the study (Table 3). Learners also received different forms of OT interventions (Table 4). During the nine-week study, all learners continued with OT programmes which they were already receiving prior to the start of the study. Both the NTT and usual care group continued with OT for the duration of the study as OT was not withheld or stopped for the duration of this study, irrespective of whether the learner was allocated to the intervention or control group. It is important to note that OT included sensory motor, fine motor, visual perception and class groups as well as typing. Some learners received individual therapy which can be a combination of the above-mentioned areas; some learners received more than one form of OT.

Table 3: Learners receiving OT

Group	Number of Learners receiving OT
Usual Care	**17**
NTT	**14**

Table 4: Number of Learners receiving different OT interventions

Group	Class group	Fine Motor	Individual Therapy	Sensory Motor	Visual Perceptual	Typing
Usual care (n=18)	8	7	11	4	4	2
NTT (n=18)	6	5	7	2	3	0
Total	**14**	**12**	**18**	**6**	**7**	**2**

3.9. Post- Intervention Testing

The week following the nine-week intervention, a trained research assistant (physiotherapist) re-assessed all the children in the intervention and control group (n=36). All learners included in the study were assessed on all three outcome measures post-intervention (MABC-2, SDQ Teacher and SDQ Parent, EQ-5D-Y). The trained research assistant was blinded to allocation of learners to intervention or control group.

3.10. Data management

All consent forms, assessment forms and the records of treatment for each child were kept in individual folders. Folders will be numbered to maintain anonymity and kept in a locked cupboard in the researcher's office. The data was entered into password-protected Excel spreadsheets weekly.

3.11. Data analysis

All data was analysed using the SPSS 23-software programme. Descriptive statistics were used to analyse and present variables related to the population including mean, standard deviation and range.

The Shapiro Wilk test and the Levene's Test for Equality of Variances for normality were used to determine whether assumptions were met for parametric analysis. Comparisons between groups

(e.g. gender, conditions, age) were assessed using independent tests for normally distributed data or Wilcoxon for non-parametric data.

Differences in demographic and anthropometric characteristics between groups were calculated at baseline using Pearson's Chi-Squared test (gender) or independent t-tests (age, BMI, waist circumference). Histograms were used to describe the classification distribution of motor skills across the two groups.

To test the effects of the intervention, the General Linear Model was used for MABC-2, SDQ and EQ-5D-Y-health-outcome measures. Time of assessment (i.e. pre- and post-intervention) was used as the within-subjects factor and group (treatment – control) as the between-subjects factor.

Paired sample t-tests for post-intervention effect within the groups were also done for motor proficiency, behavioural profile and HRQOL. Independent t-tests were used to determine how both groups with normally distributed numerical data (MABC-2, SDQ and EQ-5D-Y-health) differed between the post-intervention assessments. Effect sizes (d) were calculated to determine the practical significance of these differences, where d-values greater than 0.5 were taken to indicate a moderate effect and values greater than 0.8 were taken to indicate a large practical significance (Fern & Monroe, 1996).

The Wilcoxon test was used to examine differences in non-normally-distributed ordinal data with categorical variables (EQ-5D-Y) within each group and the Mann-Whitney U test was used to compare differences between the two groups post-intervention.

3.12. Ethical considerations

Ethical considerations were adhered to according to the research ethics guidelines of the declaration of Helsinki (WHO, 2013). Participation in the study was voluntary. Participants were allowed to withdraw from the study at any time and it was made clear that there would be no negative consequences. Participation in the study did not affect - and will not in future - the treatment learners will receive at school.

Reports for all children who were assessed were sent to parents to show their child's performance in the tests used in the study. Children identified with DCD were given written feedback which served as an assessment report for parents.

The study aimed to interrupt classroom and teaching time minimally. The research aimed to affect learners' class and teaching time minimally. Research assistants performed testing during approved periods in school hours (i.e. physical education lessons, break times) and thus enabled the researcher to fulfill the role of therapist during school hours.

To minimise the risk of minor injury, all activities took place under adult supervision at all times. A first-aid kit was available at all times. The participants were allowed adequate rest periods and water was available to them at all times. In the unlikely event of more serious emergencies, the protocol was to contact parents/guardians immediately and, if necessary, the relevant emergency services.

There was no discrimination on the grounds of gender, race, ethnicity or social backgrounds. The study was fair to all participants and the opportunity to take part in the study was offered to all qualifying learners. Intervention sessions were scheduled before school buses or group transport departed, in order to allow all learners who qualified the opportunity to participate. The learners allocated to the usual care group were not disadvantaged in any way.

Information provided by parents through completed questionnaires and testing score sheets was securely stored. All information and data, in hardcopy or electronic form, was coded and stored securely with controlled access. Electronic data was password-protected. Only the researcher and research supervisors had access to the information. No names of participants were mentioned throughout the study, as learners were assigned individual codes. All teachers, assistants and assessors were required to complete a confidentiality agreement *(Appendix L).*

3.13. Conflict of interest

The researcher is employed by the Department of Education as a school-based therapist, but there was a clear distinction between the role of physiotherapist and researcher. No treatment was withheld from learners not taking part in the study, nor did any non-participating learners suffer any negative impact because of the research project. The study minimally interrupted classroom time. For the duration of the study, the researcher was employed by the Western Cape Department of Education (WCED) and based at the mentioned school, making it possible for the researcher to implement an intervention programme at the school. The researcher also has a good relationship with the management and staff of the school as well as other therapists, which should make it possible to share findings of this research project with similar schools. This will be beneficial to the mentioned school as well as the broader community of schools with learners with SLD and co-morbid DCD.

4. Results

4.1. Description of the sample

Consent forms were distributed to all learners who met the inclusion criteria (N=85) as determined by CEMIS (i.e. presenting with primary or secondary diagnosis of SLD, aged 6–10 years, and in Grades 1–4 attending the LSEN school). Fifty-eight parents agreed to participate in the study and each child provided consent. The remaining 27 parents either did not return consent forms (n=26) or indicated that they were not interested in participating in the study (n=1).

According to CEMIS, of the 58 learners who agreed to participate, 46 had a primary diagnosis of SLD, 10 had a primary diagnosis of ASD (secondary SLD) and two had a primary diagnosis of ADHD (secondary SLD).

Table 5: Primary and secondary diagnosis according to CEMIS

Primary and Secondary Diagnosis	N
Number of learners with 1° diagnosis of SLD	*46*
SLD only, no 2° diagnosis	40
SLD + ADHD	1
SLD + Behavioural disorder	5
number of learners with 2° diagnosis of SLD	*12*
ASD +SLD	10
ADHD +SLD	2
Total (*1° or 2° diagnosis of SLD)*	58

4.2. Medical, demographic and birth history

All parents completed the parent questionnaire *(Appendix D)*, consisting of several closed and open-ended questions pertaining to birth history, health status, motor coordination skills and attention of the child. Out of the 58 parents, 16 parents (27.6 per cent) indicated that their child was born preterm and 34 learners (58.6 per cent) were reported to have an additional medical condition (unspecified or allergies). Of the 22 learners taking medication, 20 stated their children were taking methylphenidate and two atomoxetine.

BMI was calculated (kg/m^2) for each child and categorised according to BMI percentiles for age (WHO, 2017). Of the 58 learners, nine were not assessed due to them not meeting the inclusion age range when assessment commenced. Of the remaining 49 learners, 30 learners had a normal healthy BMI for their age, seven were overweight and 10 were obese. Two learners were underweight for their age.

4.3. Functional motor problems

Using the parent questionnaire, 52 parents (89.6 per cent) reported that their child experiences motor problems at home. Motor problems in the questionnaire referred to general motor problems, untidy or slow handwriting, difficulty manipulating small objects, difficulty tying shoelaces, difficulty running/walking without falling, difficulty running without getting tired, difficulty making food without messing and difficulty catching/throwing accurately. The remaining parents (10.4 per cent) reported no problems at home.

Of the 58 learners, the MABC Checklist was completed for 44 learners by their class teacher. The remaining 14 were not returned by the teacher involved. According to the checklist scores, 32 learners were classified in the red zone and 7 in the orange zone; thus 39 learners (88.6 per cent) assessed by teachers on the MABC Checklist presented with a functional motor problem.

Of the 14 learners for whom no Checklist was received from their teacher, the parents of only three indicated that they exhibited no functional motor problems at home. The parents of the other 11 indicated that they experienced some functional problems at home.

Three of the learners whose parents indicated that they do not have motor functional problems at home, according to the parent questionnaire, were identified as experiencing a functional problem at school according to the MABC Checklist completed by their teachers.

Therefore 55 of the 58 (95 per cent) learners were identified to have a functional problem by either parent or teacher.

4.4. Motor performance scores

The MABC-2 was completed for 49 learners. Nine learners were not assessed due to the fact that they fell outside the age and grade range at the time the assessments were performed. Based on the MABC-2, 40 learners scored in the orange and red zones (Figure 4). The MABC-2 mean score per category (Figure 5) shows that learners in the red and orange categories scored lower in almost all areas than those learners in the green category. It is interesting to note that learners in the green category scored slightly lower in the manual dexterity category compared to learners in the orange category. Categories are determined by the Total Test Score (TSS) ≤16th percentile per age group.

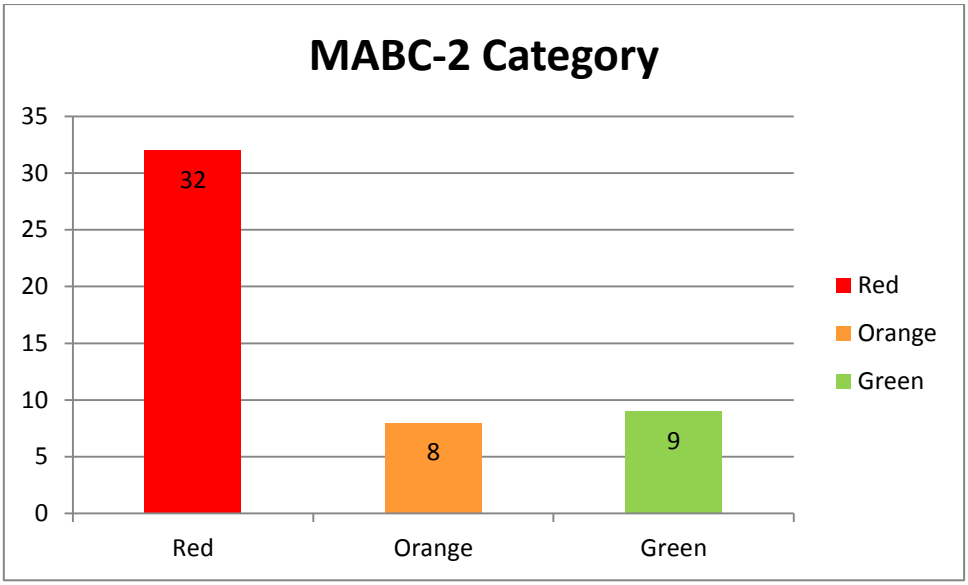

Figure 4: Number of learners per MABC-2 Category

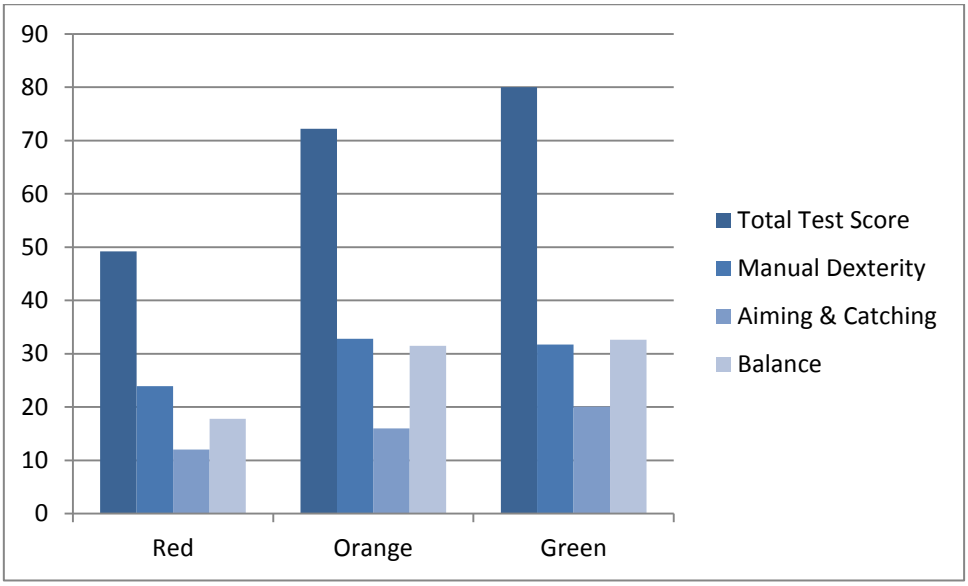

Figure 5: MABC-2 Mean Scores per MABC-2 category

4.5. Enrolment into the intervention study

To be enrolled in the intervention study, learners had to be aged 6-10 years for the duration of the study and in Grades 1–4. Due to unforeseen delays with regards to starting the intervention on time, by the time the baseline assessments were performed, nine learners were outside the age (6–10 years) or grade (Grades 1–4) range set by the inclusion criteria; three learners were in Grade 5 and six learners were older than 11 years by the time the intervention commenced. To be included in the intervention, learners had to score ≤ 16th percentile (TSS) on the MABC-2 and present with a

functional motor problem as determined by the MABC Checklist or parent questionnaire, therefore, have a concurrent diagnosis of DCD as per the DSM-5 criteria. Based on this criteria, thirty-six (n=36) learners were included in the next phase of the study.

4.6. Baseline characteristics intervention (NTT) and control (Usual Care) group

The intervention group (NTT) consisted of 18 children (14 boys and four girls), mean age 9.14 years (SD= 1.25) and the control group (Usual Care) consisted of 18 children (13 boys and five girls), mean age 9.51 years (SD= 1.12). No significant difference was found between the groups in terms of mean age at pre-test (t=0.91, df = 34, *p*= 0.37) or gender distribution (Chi^2 = 0.148, df = 1, *p* = 0.7).

The BMI of the NTT intervention group (M = 17.92 $kg/m^{2,}$, SD = 4.96) was comparable (t= 0.86, df = 34, *p* = 0.4) to that of the usual care control group (M = 19.18 kg/m^2, SD = 3.59) and no significant differences were found in terms of waist circumference between the intervention group (M = 62.44 cm, SD =9.52) and the control group (M = 67.03 cm, SD = 10.77), with t= 1.3, df= 34 and *p* = 0.45.

Functional problems were identified for the intervention group and the control group at baseline by the teacher and the parent (Table 6). All learners in the intervention and control group presented with a functional problem (orange or red) on the MABC Checklist (Table 7). No significant difference was found in terms of MABC-2 TSS scores between the intervention group (M=3.22, SD =2.05) and the control group (M =2.83, SD =2.07), with t= -0.57, df= 34 and p = 0.57 at pre-test.

Table 6: Number of learners with functional problems (n = 36)

Functional Motor Problem according to Teacher (MABC Checklist)	Functional Problem according to Parent (Parent Questionnaire)
n = 36	n = 33

Table 7: Functional problem MABC - Checklist category (n = 36)

Functional problem according to teacher	MABC Checklist category
n = 30	Red
n = 6	Orange

Table 8: MABC-2 scores and number of learners scoring within each percentile

MABC- 2 Score (percentile)	Number of learners (n =36)
16th	6
5th	10
2nd	3
1st	1
0.5th	9
0.1st	7

Behavioural problems were identified by teachers and parents, using the SDQ as screening tool. The total difficulties score indicates the severity and the content of the psychosocial problems (Goodman, 1997). When considering the total difficulties scores as assessed by the SDQ, the scores can be categorised as being close to average, slightly raised, high and very high. Based on responses received from teachers, the total difficulties scores showed that in the group of learners included in the study (n= 36), 63 per cent can be categorised as close to average, 13 per cent as slightly raised, one per cent as high and 13 per cent as very high. When looking at the total difficulties scores pre-intervention according to the parent SDQ in the group of learners included in the study (n= 36), 53 per cent can be categorised as close to average, 19 per cent as slightly raised, 11 per cent as high and 17 per cent as very high.

Health-related quality of life, as assessed by the EQ-5D-Y, was assessed for all participants pre-intervention (n=36) through self-report questionnaires. When looking at the scores in the five domains (mobility, looking after myself, participation in activities, pain or discomfort and emotional experiences) 87 per cent of participants indicated that they have no problems across the five domains, 10 per cent indicated that they have some problems, mostly in the domain of “pain and discomfort”, with some learners experiencing some problems in the domains of “participation in activities” and “emotional experience”. Only three per cent of learners indicated that they experienced a lot of problems in one of the five domains, with most of these learners indicating the domain of “looking after myself” being where they experience a lot of problems.. Health scores were also assessed through VAS overall scores, with 69 per cent of learners reporting their health to be the best health imaginable (100), 24 per cent rating their overall health between 80 and 95. Seven per cent of participant scored their overall health below 70.

4.7. Intervention effect on motor performance

All thirty-six participants recruited completed the study. Complete assessments were available for all children pre- and post-intervention. In cases where children were unable to complete an item of a particular subsection in the MABC-2, the lowest standard score for that item (as reported in the manual) was allocated.

The analysis of the overall motor performance (Table 9), as reflected by the mean Total Standard Score (TSS) of the MABC-2 for the total group, revealed a significant difference in motor performance between repeated measures (*time)* (*p= 0.003*). There was also a significant difference between groups over time (*time* x *group*) (*p= 0.046*). The analysis of balance scores also indicated a significant difference between repeated measure (*time)* (*p=0.021*) but not when considering the difference between groups over time (*time x group)* (p= 0.84). Due to significant changes between repeated measures (*time)* and between groups over time (*time x group),* further analysis of changes within each group (Table 10, Table 11) and between groups (Table 12) were performed to compare the efficacy of NTT with usual care.

Table 9: Effect of NTT and usual care on motor performance (TSS) and component scores (MD, AC and balance)

MABC-2	F [1,34]	Partial η 2	P	F [1,34]	Partial η 2	P
		Time			**Interaction Time x Group**	
TSS	9.98	0.23	***0.003***	4.28	0.11	***0.046***
MD	1.28	0.04	0.27	2.50	0.07	0.12
A&C	0.02	0.001	0.88	0.22	0.01	0.64
Balance	5.88	0.15	***0.021***	0.04	0.001	0.84

The result of a paired sample t-test (Table 10) indicated the mean TSS of the NTT group improved significantly over the intervention period (mean difference 1.33 ± 1.37; $p < 0.001$) yielding a large effect size (d= 0.95). The balance component score in the NTT group also showed a significant improvement (mean difference 1.06 ± 1.80; $p= 0.02$), though yielding a rather small effect size (d = 0.10).

The control group did not show any significant changes over the intervention period while receiving usual care (Table 11).

An independent t-test for post-intervention effect between the groups (Table 12) showed a significant difference in Total Standard Score (TSS) for NTT (M= 4.56, SD= 2.15) and the usual care group (M= 3.11, SD= 2.08) with t = -2.05 and $p=0.048$. No other significant differences were noted between groups.

Table 10: Mean (SD) post intervention scores on MABC-2 for intervention (NTT) group (n=18)

	MABC-2			NTT	
	Pre	**Post**	**t**	**p**	**d**
TSS	3.22 (SD=2.05)	4.56 (SD=2.15)	4.12	***<0.001***	0.95
MD	3.78 (SD=2.41)	4.78 (SD=2.86)	1.82	0.09	0.43
A&C	5.39 (SD=2.68)	5.72 (SD=2.67)	0.43	0.67	0.50
Balance	5.67 (SD=2.35)	6.72 (SD=2.85)	2.49	***0.02***	0.10

Table 11: Mean (SD) scores post intervention on MABC-2 for control (UC) group (n=18)

	MABC-2			Usual Care	
	Pre	**Post**	**T**	**p**	**d**
TSS	2.83 (SD=2.07)	3.11 (SD=2.08)	0.70	0.49	0.17
MD	3.56 (SD=2.12)	3.39 (SD=2.38)	0.34	0.74	-0.10
A&C	4.39 (SD=2.52)	4.22 (SD=3.18)	-0.23	0.82	0.18
Balance	4.89 (SD=2.89)	5.78 (SD=2.67)	1.31	0.21	-0.16

Table 12: MABC-2 independent t-test effect between groups

MABC-2		M	SD	t	P
TSS	NTT	4.56	2.15	-2.05	***0.048***
	Usual care	3.11	2.08		
MD	NTT	4.78	2.86	-1.58	0.12
	Usual care	3.39	2.38		
A&C	NTT	5.72	2.67	-1.53	0.13
	Usual care	4.22	3.17		
Balance	NTT	6.72	2.85	-1.03	0.31
	Usual care	5.78	2.67		

4.8. Individual response to intervention

Mean attendance for the 18 participants that were allocated to the NTT group was 15 sessions out of a maximum of 18 sessions (SD = ±1.28).

Post-intervention tests indicated that 14 of 18 participants in the NTT (intervention) group improved their TSS on the MABC-2. The TSS for one participant remained the same and there was a decrease of one standard score for three participants.

In the usual care (control) group, seven learners showed an improvement in scores. Six learners showed a decrease in TSS scores, of whom two learners decreased with two or more standard scores and five learners showed no change.

Using the smallest detectable difference (SDD 95 per cent) of two standard scores as the cut-off on the MABC-2 (Henderson, Sugden, Barnett, & Smits Engelsman, 2010) it was determined that nine of the 18 children who received NTT improved their TSS. It is interesting to note that although the usual care group did not show a significant improvement in their TSS, five of the 18 learners improved their TSS with two or more standard scores.

Concerning the balance component scores, 12 of the 18 participants in the NTT group improved their balance standard score on the MABC-2. The balance score remained unchanged for three

participants and three participants showed a decrease in their score. Using the SDD, seven participants improved their balance standard score.

In the control group, five children improved, of whom only two learners improved more than the SDD. It was also noted that five learners' scores did not change and six had lower scores.

4.9. Behavioural Profile

4.9.1. Teacher perspective

The analysis of the effect of NTT and usual care on behavioural profile (SDQ) completed by the teachers (Table 13), revealed a significant change in the emotional ($p = 0.002$), behaviour/conduct ($p = 0.006$) and overall stress ($p < 0.05$) domains over *time.* There was a significant change in the pro-social domain ($p = 0.02$) over time. No significant difference was found between groups over time in any domain. Due to significant differences between repeated measures (*time*), further analyses of changes within each group (Table 14) were performed.

Table 13: Effect of NTT and usual care on behaviour profile (SDQ) completed by teacher

SDQ Teacher	F [1,34]	Partial η 2	P	F [1,34]	Partial η 2	P
	Time			Interaction Time x Group		
Emotional	12.22	0.32	***0.002***	0.32	0.01	0.58
Behaviour/ Conduct	8.88	0.25	***0.006***	3.54	0.12	0.07
Hyperactivity	0.54	0.02	0.47	0.005	0.002	0.94
Getting along with others /peer	1.49	0.05	0.23	0.03	0.001	0.87
Helpful/ pro-social	6.52	0.20	***0.02***	0.86	0.03	0.36
Overall stress/ TOTAL	4.36	0.14	***<0.05***	0.80	0.03	0.38
Impact	1.90	0.08	0.18	0.06	0.002	0.80

The results of a paired sample t-test (Table 14) indicated the within-group effects in SDQ teacher scores was significant in the emotional domain score in the usual care group as the mean SDQ score improved significantly over the intervention period (mean difference 2.31 ± 2.63; $p = 0.01$) yielding a large effect size (d= -0.88) as well as showing a significant improvement in the behaviour/conduct domain (mean difference 1.77 ± 2.52; $p= 0.03$), yielding a moderate effect size (d = -0.70). The usual care group also showed a significant improvement in the impact score (mean difference 1.09 ± 1.51, $p = 0.04$) with a moderate effect size (d = -0.72).

The results indicate that the intervention group did not show any significant changes over the intervention period while receiving NTT, although changes in mean scores were noted.

Table 14 Comparison of mean (SD) pre- and post-intervention scores on SDQ as completed by the teacher for the Intervention (NTT) and control (usual care) groups

SDQ Teacher	NTT					Usual Care				
	Pre	Post	t	P	d	Pre	Post	t	p	d
Emotional	3.53	1.87	1.96	0.07	-0.51	5.46	3.15	3.17	***0.01***	-0.88
	SD= 3.62	SD=2.42				SD =3.28	SD =2.51			
Behaviour/ Conduct	1.73	1.33	1.31	0.21	-0.34	3.00	1.23	2.53	***0.03***	-0.70
	SD= 1.75	SD =1.72				SD =2.52	SD =1.83			
Hyperactivity	4.33	4.80	-0.54	0.60	0.14	3.92	4.31	-0.51	0.62	0.21
	SD =3.42	SD =3.23				SD =3.59	SD =2.06			
Getting along with others /peer	2.53	1.93	0.99	0.34	-0.25	3.92	3.46	0.75	0.47	-0.21
	SD =2.10	SD =1.49				SD =2.33	SD =2.18			
Helpful/ pro-social	6.27	7.20	-1.71	0.11	0.44	3.92	5.92	-1.60	0.14	0.44
	SD=3.41	SD=2.70				SD= 3.75	SD = 2.78			
Overall stress/ TOTAL	11.20	9.93	0.95	0.36	-0.24	15.31	12.15	1.89	0.08	-0.52
	SD =5.83	SD =6.13				SD =7.81	SD =6.59			
Impact	1.33	1.13	1.00	0.33	-0.26	2.36	1.27	2.39	***0.04***	-0.72
	SD = 1.29	SD = 1.51				SD = 2.25	SD = 1.79			

4.9.2. Parent perspective

The analysis of the effect of NTT and usual care on the behavioural profile (SDQ) completed by the parents (Table 15), revealed a significant change in the emotional ($p < 0.05$) and behaviour/conduct ($p = 0.04$) domains as well as in the overall stress domain ($p = 0.04$) when looking at the difference between groups over time. No significant changes were noted between repeated measures for the total group (*time).* Due to significant change between groups over time (*time x group)*, further analysis of changes within each group (Table 16) were performed.

Table 15: Effect of NTT and usual care on behaviour profile (SDQ) completed by parents

SDQ Parent	F [1,34]	Partial η 2	P	F [1,34]	Partial η 2	P
	Time			Interaction Time x Group		
Emotional	0.54	0.02	0.47	4.22	0.12	***<0.05***
Behaviour/ Conduct	3.34	0.10	0.08	4.67	0.14	***0.04***
Hyperactivity	1.80	0.06	0.19	0.59	0.19	0.45
Getting along with others /peer	0.76	0.03	0.39	1.19	0.04	0.28
Helpful/ pro-social	2.20	0.07	0.15	0.00	0.00	1.00
Overall stress/ TOTAL	0.07	0.002	0.80	4.78	0.14	***0.04***
Impact	0.57	0.02	0.46	0.94	0.03	0.32

When comparing SDQ parent differences within groups (Table 16), the mean SDQ score in the behaviour/conduct domain of the NTT group improved significantly over the intervention period (mean difference 0.75 ± 1.00 ; $p = 0.01$) but yielded a small effect size (d= -0.31). The UC group did not show any significant changes.

Table 16: Comparison of mean (SD) pre- and post-intervention scores on SDQ as completed by the parents for intervention (NTT) and control (usual care) groups

SDQ Parent	NTT					Usual Care				
	Pre	**Post**	**t**	**p**	**d**	**Pre**	**Post**	**t**	**p**	**d**
Emotional	3.94	3.38	0.96	0.35	0.12	3.31	4.50	-1.91	0.08	0.48
	SD =1.98	SD =2.42				SD =1.99	SD =1.90			
Behaviour/ Conduct	2.50	1.75	3.00	***0.01***	-0.31	1.69	1.75	-0.22	0.83	0.06
	SD =1.67	SD =1.73				SD =1.66	SD =1.18			
Hyperactivity	6.00	5.31	1.58	0.14	-0.24	6.19	6.00	0.39	0.70	-0.10
	SD =2.76	SD =2.75				SD =2.10	SD =2.10			
Getting along with others /peer	2.25	2.19	0.15	0.88	0.15	2.56	3.13	-1.41	0.18	0.35
	SD =1.15	SD =1.97				SD =1.79	SD =1.96			
Helpful/ pro-social	7.81	8.19	-1.25	0.23	0.31	8.00	8.38	-0.92	0.37	0.23
	SD =2.54	SD =2.34				SD =1.97	SD =1.78			
Overall stress/ TOTAL	14.69	12.63	1.78	0.10	-0.04	13.75	15.38	-1.33	0.20	0.33
	SD =4.99	SD =6.22				SD =5.20	SD =5.25			
Impact	1.63	1.56	0.20	0.84	-0.05	1.81	2.31	-1.02	0.33	0.25
	SD =1.20	SD =1.82				SD =2.43	SD =2.87			

4.10. Health-related quality of life (HRQOL)

The analysis of the effect of NTT and usual care on HRQOL through the analysis of the EQ-5D-Y completed by the learners (n=36) (Table 17), revealed a significant difference in the health status (VAS Score) (*p = 0.02*) between repeated measures (*time).* There was no significant difference between groups over time.

Table 17: Effect of NTT and usual care on HRQOL

EQ5DY	F [1,34]	Partial η 2	p	F [1,34]	Partial η 2	p
		Time			Interaction Time x Group	
Health	6.61	0.20	***0.02***	0.205	0.008	0.65

The health score is determined by the use of a VAS, with a score of 100 indicating the best possible health the participant can imagine and 0 the worst possible health. It is noted that both the NTT (mean difference 14.29 ± 32.72) and usual care group (20.40 ± 39.34) showed a decrease in mean scores from pre- to post-intervention. Although both groups showed a decrease in mean scores, both the NTT (p = 0.13) and usual care (p = 0.06) score changes were not significant (Table 18).

Table 18: Comparison of mean (SD) pre- and post-intervention scores on EQ-5D-Y (Health) for intervention (NTT) and control (usual care) groups

EQ5DY Self-report	NTT					Usual care				
	Pre	Post	t	P	d	Pre	Post	T	P	d
Health	93.714	79.43	1.63	0.13	0.44	94.67	74.27	2.01	0.06	-0.52
	SD = 10.079	SD=35.04				SD = 13.16	SD = 34.26			

When analysing the ordinal data of the EQ-5D-Y domains (Table 19), no significant changes were noted. EQ-5D-Y domain scores were analysed as ordinal data considering the mean rank difference between paired samples. When looking at the number of learners experiencing problems in each

domain post-intervention for the intervention and control group (Table 20), the NTT group did not perform better overall compared to the usual care group (UC).

Table 19: EQ-5D-Y domains' mean rank difference between paired samples

EQ5DY	Z	P
Mobility	-1.00	0.32
Looking after myself	-0.38	0.71
Participation in activities	-1.41	0.16
Pain or discomfort	0.00	1.00
Emotional experience	0.00	1.00

Table 20: Number of learners (n=36) experiencing problems in EQ-5D-Y domains (post-intervention)

EQ 5 DY Domains	No problems		Some problems		A lot of problems	
	NTT	UC	NTT	UC	NTT	UC
Mobility	12	16	6	2	0	0
Looking after myself	14	14	4	4	0	0
Doing usual activities	16	17	2	0	0	1
Having pain or discomfort	11	13	6	5	1	0
Feeling worried, sad or unhappy	16	16	1	1	1	1

5. Discussion

This study compared the efficacy of a nine-week, NTT-based intervention and usual care in improving motor performance, behaviour and quality of life in children 6–10 years with SLD and co-morbid DCD. This chapter discusses the findings of the study as well as some of its limitations. Recommendations are given for future research in this field, as well as the implications for physiotherapy practice in special schools and special populations.

5.1. Main findings

The results of the study show that the intervention can improve motor performance in general, and has a positive effect on balance specifically in children with SLD/DCD. The intervention also proved to have a positive effect on the behavioural profile of the children, although the change was only significant in one domain (behaviour/conduct), according to the parents. No improvements were observed in the behavioural profile in the intervention group by the teachers. The current intervention was unable to demonstrate any effect on health-related quality of life within this sample.

5.2. Motor performance

Learners were included in the study if they presented with DCD co-morbid with SLD. In addition, children in the group also presented with secondary diagnoses such as hyperactivity, ADHD and behavioural problems.

Previous literature suggests that at least 50 per cent of children with learning difficulties have a co-morbid motor coordination development disorder (Fortes et al., 2016). In this study, 81.6 per cent of SLD learners assessed on the MABC-2 presented with motor performance problems. This is significantly higher than the suggested percentage of learners with learning difficulties who present with motor coordination problems or DCD. In the group of learners included in the study (n= 36), 83.3 per cent scored below the 5th percentile on the MABC-2. Furthermore, 44.4 per cent of the learners in the study, scored below the 0.5th percentile on the MABC-2, indicating a significant movement difficulty and severe motor coordination problems (Henderson et al., 2010).

5.3. General effect of the intervention

NTT-based interventions have previously shown positive effects in populations of children with DCD (Ferguson et al., 2013; Niemeijer et al., 2007; Schoemaker et al., 2003). However, this is the first study looking at the intervention in a special population of learners with SLD and co-morbid DCD. We hypothesised that the NTT-based programme will have a positive effect on motor performance in learners with SLD/DCD because it has shown positive effects in a similar population group.

The study found that there was a significant difference in motor performance between groups (Table 12). The NTT group showed a larger, significant improvement in overall motor performance (TSS) as measured by the MABC-2, and specifically improved balance scores after the nine-week intervention (Table 10). The improvement may be attributed to the principles underpinning NTT-based interventions. This includes guided discovery to facilitate implicit learning of task components with positive feedback to support learning, as well as focusing on planning, execution and evaluation in order to be able to adapt the task to make it achievable for the child and therefore facilitate learning. NTT also has broad advantages in the SLD co-morbid population as these learners often present with a low attention span, difficulty in learning new concepts, and difficulty following instructions (American Psychiatric Association, 2013). The NTT approach acknowledges that learning and skill acquisition is strongest when the learner understands the meaning of the exercise and finds the task to be useful or relevant to his or her life, and is thus valid in the child's environment with the support of parents and teachers (Miyahara et al., 2014; Sugden, 2007). In this study, the exercises chosen were useful, relevant and valid. Learners practised activities that they would perform in daily life, on the playground or at home, and in which they wanted to improve. This approach enables the child to interact with the environment resulting in acquiring new or improved motor function (Niemeijer et al., 2007). For example, learners' practised components of soccer which is a popular game often played at school and in communities. In an NTT-based approach, learners participate in activities that are familiar tasks, but adapted to their motor level by the therapist. Task-oriented approaches like NTT are regarded as active approaches to motor learning with a lower cognitive demand, compared to other approaches like CO-OP, therefore making it more suitable for this population (Ferguson et al., 2013). According to teaching principles, low cognitive-demand tasks involve stating facts, following known procedures, and solving routine problems (Van De Walle 2012). Children with DCD have been reported to have difficulties with learning new motor skills (Wilson, Ruddock, Smits-Engelsman, Polataijko & Blank, 2013) making NTT a more suitable approach in this SLD/DCD population.

Although a significant improvement in overall motor performance was observed for learners who received NTT intervention, the effect size was small (Table 10). This could possibly be attributed to the fact that learners with SLD have general difficulties in areas of learning due to obstacles acquiring the underlying academic skills needed (American Psychiatric Association, 2013). According to the DSM-5 (American Psychiatric Association, 2013), SLD is considered to be a type of neurodevelopmental disorder that impedes the learner's ability to learn or use specific academic skills (e.g. reading, writing, or mathematics), which are the foundation for academic learning

(American Psychiatric Association, 2013). Thus, the limited ability of the learners may also have affected the rate of motor skill acquisition.

5.4. Effect of the intervention: specific areas

The NTT group in this study did not show significant improvements in aiming and catching (A&C) (Table 10). It was expected that the NTT group would show an improvement in A&C, as the treatment programme included a variety of ball games and activities. The learners in the NTT group enjoyed the ball games and since many of the learners wanted to improve in ball games like soccer and basketball, pre- and post-intervention scores were expected to show improvement in this domain. It is suggested that the complex motor processes, such as attention, anticipation and parameterisation which are required in the aiming and catching tests of the MABC-2, were not sufficiently addressed by the intervention programme. It is possible that learners with SLD and DCD need more specific and intense training to improve their performance in A&C.

The NTT group did not show a significant improvement in manual dexterity (MD) component scores (Table 10). This was not surprising as the focus of the intervention programme was not MD and few MD activities and skills were included.

Improvement in balance in the NTT group was significant, although a small effect size was demonstrated (Table 10). The improvement in the NTT group may be attributed to activities used during the nine-week programme such as hopping, jumping, stepping on various unstable surfaces and running through obstacle courses where dynamic balance is required. Many of the activities were performed outside on grass, which may also lead to changes in dynamic balance due to the need to adapt to uneven terrain.

5.5. Usual care

The UC group did not show any significant change in any area (TSS, Balance, A&C, MD) over the nine-week period (Table 11). These results may be interpreted to indicate a need for further research to determine whether UC in this population has any effect on motor performance.

In summary, the NTT intervention resulted in statistically significant and clinically important improvements in motor performance (TSS and Balance) from pre- to post-intervention test. In contrast, the usual care group showed no statistically significant change. Furthermore, in the NTT group, TSS and balance improvements showed a large effect size with clinical importance. The usual care group did not show any significant change in any area and effect size in the usual care group was small and found to be clinically not important. This finding concurs with findings of a review of

interventions for learners with DCD where larger effect sizes for task-oriented approaches were reported compared to other interventions (Smits-Engelsman et al., 2013).

5.6. Behavioural profile

In the school environment, learners with DCD face difficulties with organisational skills, attention and behaviour, which is typically compounded by low self-esteem and social problems. Studies have shown other forms of treatment e.g. fatty acids supplementation and the use of methylphenidate may have a positive effect on the behaviour of learners with DCD (Smits-Engelsman et al., 2013). Very little is known about the effect of intervention programmes such as NTT on the behavioural profile of learners with DCD.

When looking at the total group effect, there was no significant difference between groups according to the teachers (Table 13). According to the teachers who completed the behavioural profile for the learners, the learners in the intervention group did not show any significant changes over the intervention period while receiving NTT (Table 14). When looking at the total group effect, there was a significant difference between groups according to the parents (Table 15). Further analysis showed that the learners in the NTT group improved significantly in the behaviour/conduct domain (Table 16).

5.7. Behavioural profile: teacher perspective

The analysis of the behavioural profile of learners from the perspective of the teacher produced some interesting findings. In the usual care group, the SDQ score in the emotional and behaviour/conduct domains as well as impact scores showed a significant improvement (Table 14).

There was a change (decrease) in the mean scores of the emotional, behaviour/conduct, peer relations, impact on classroom activities, and overall stress domains as well as a change (increase) in mean scores in the pro-social domain, but these changes in mean scores were found to be non-significant over the intervention period while receiving NTT (Table 14).

The usual care group improved significantly in the emotional domain, yielding a large effect size (Table 14). The emotional domain considers concepts such as complaints of headaches, worries, feelings of unhappiness, feelings of sadness, and nervousness or clinginess in new situations. Although it is known that the acquisition of proficient fine and gross motor skills may consequently have an impact on the development of other aspects of functioning such as social and emotional development(Crane et al., 2017), the reason why the usual care group would show a significant improvement is not clear. It is possible that the usual care group showed a significant improvement as a result of non-random allocation of learners to groups, as the mean value in this domain at pre-

test was higher for the usual care group than the NTT group. It could possibly also be attributed to the fact that the intervention programme was presented by an unfamiliar therapist and the intervention group had to establish a new relationship during the nine weeks. In contrast, the learners of the usual care group continued with therapists and teachers with whom they were already familiar and had established a relationship. This could have impacted the behaviour of the learners.

The behaviour/conduct domain score in the usual care group also showed a significant improvement yielding a moderate effect size (Table 14). The behaviour/conduct domain considers questions such as, 'does the child often display temper tantrums or a fiery temper/ are they generally obedient/ do they fight with other children/do they lie or cheat/ do they steal from home, school or elsewhere?' Again, the reason why the usual care group would show a large significant improvement is unknown. It is possible that this effect is the result of non-random allocation of learners, as noted previously.

In the usual care group, the change in the impact score also improved significantly (Table 14). The impact score can indicate if the person completing the SDQ (teacher or parent) thinks the learner has a problem affecting them in the school or home environment. If the teacher or parent feels the learner is experiencing problems at school or home, the impact supplement enquires further about chronicity, distress, social impairment, and burden to others, with a higher score indicating a bigger impact. Therefore, based on the SDQ scores, the teachers felt that the behaviour of leaners in the usual care group had a lesser impact on the school environment after the nine weeks than before. This cannot be explained by any specific treatment or intervention. Teachers allocated learners to groups based on a learner's need for therapy intervention in the area of motor difficulties. It has been suggested that teachers are not adequately able to identify children with motor difficulties in their class (Gritzman, 2012). Teachers may have allocated learners based on their interpretation of which learners would benefit from receiving nine weeks of NTT, e.g. those currently not receiving as much intervention as other learners, those presenting with motor problems that impact on functional activities, or those presenting with behavioural difficulties like hyperactivity in class. Therefore it is possible that more learners with behaviour problems were allocated to the intervention (NTT) group, as the overall stress domain mean score was higher pre-test than that of the usual care group.

5.8. Behavioural profile: parent perspective

When looking at the results from the SDQ completed by the parent, the results differed from that of the teacher SDQ results. In the NTT group, a significant improvement was found in the

behaviour/conduct domain (Table 16), where the teacher SDQ showed no significant change in the NTT group.

The behaviour/conduct domain considers questions such as, ‘ does the child often display temper tantrums or hot tempers/ is he/she generally obedient or prone to fighting with other children, are there incidences of lying, cheating or stealing at home, school or elsewhere?’. Although the improvement was significant, the effect size was very small. Further research into this finding is recommended as the NTT group had a significantly higher mean score at pre-test compared to the usual care group, showing that the NTT group presented with more behavioural and conduct problems pre-test, compared to the usual care group.

Although found to be non-significant, it is interesting to note that the NTT group showed a change in the mean total difficulties score (overall stress) (Table 16). However, additional research is needed to investigate if NTT has a positive impact on general behaviour and therefore a secondary impact on mental health as the total difficulty score of the SDQ is a fully dimensional measure, with each one-point increase in the total difficulty score corresponding to an increase in the risk of mental health disorder. Further research is also needed to understand the relationship between motor difficulties and emotional and behavioural symptoms. It is recommended that interventions for children with DCD should support mental health and behavioural problems, as well as motor development (Green et al., 2006). Evidently, the NTT based-programme is aligned with this recommendation as NTT focuses directly on teaching the skills required to master in order to perform functional activities, as well as transferring these acquired skills to activities of daily life (Niemeijer et al., 2007; Schoemaker et al., 2003; Schoemaker et al., 2005). Improved function can influence the child’s confidence, participation and improve quality of life, therefore supporting mental health and behaviour (Eime, Young, Harvey, Charity, & Payne, 2013; Klassen et al., 2004).

Parents often notice children presenting with a low frustration tolerance, decreased self-esteem, and a lack of motivation due to difficulties coping with activities that are required in all aspects of life (Missiuna et al., 2011). Therefore the perspective of the parent is very important. The parent’s observation, in combination with that of the teacher, provides a holistic picture of the behavioural profile of the learner, and also the learner’s mental health state.

5.9. Comparison between teacher and parent SDQ findings (post-intervention)

In a recent study by Crane et al. (2017) it was found that parents reported their child with DCD’s hyperactivity to be more problematic than teachers did. The same phenomenon was observed in this study, as parents scored hyperactivity higher than teachers in both the NTT and usual care

groups. Crane et al. (2017) also found that parents rated the pro-social behaviour of their children with DCD more highly (i.e. less problematic) than teachers. This was also found to be true in this study, as parents in both NTT and usual care groups rated pro-social behaviour less problematic (i.e. higher score) than teachers. In the study by Crane et al. (2017), the finding was that there was a non-significant trend towards parents rating their child with DCD's behaviour and conduct problems as more severe than teachers did. This was not the case in this study. Parents of learners in the NTT group scored behaviour to be more problematic than teachers did, and also indicated a significant improvement in the behaviour/conduct domain post-intervention. In the usual care group, teachers rated behaviour/conduct more problematic than parents pre-intervention, but lower than parents' scores post-intervention, also showing a significant improvement in scores as rated by the teachers.

Crane et al. (2017) found that there was general consensus between the ratings given by parent and that of teachers. This was not the general finding in this study. The difference could possibly be attributed to the fact that learners in this study present with other co-morbidities and not only DCD as in the study by Crane et al. (2017). Learners in this study present with SLD and resulting behavioural and emotional problems, of which ADHD is the most common, as well as co-occurring problems and conditions adding to SLD learners experiencing academic difficulties (Sahoo et al., 2015). Another reason for possible differences between teacher and parent SDQ scores may be attributed to the fact that learners behave differently at school as opposed to at home, or it could also be due to the fact that teachers have a broader benchmark against which to compare learners with DCD (Crane et al., 2017; Gritzman, 2012). Further research is needed to determine if teachers are able to form a more accurate impression of the learner with regards to motor skills and how it relates to behaviour. In the clinical setting it is very important that professionals obtain reports from both teachers and parents when using the SDQ with children with DCD, in order to form a more holistic view of learners' behaviour and how it is impacted by poor motor skills.

5.10. Health-related quality of life (HRQOL)

HRQOL was assessed by using the EQ-5D-Y. Both in the NTT and UC health status (VAS) mean score changes were not significant (Table 18). When analysing the ordinal data of the EQ-5D-Y domains, no significant changes were noted (Table 19). It is interesting to note that more learners in the NTT group indicated that they experience "some problems" across all domains compared to learners in the UC group. The same amount of learners in the NTT and UC group reported "a lot of problems" across all domains post-intervention (Table 20).

HRQOL has been advocated as a measure of the level of interference in day-to-day functioning. It is a multidimensional construct, defined as the impact of health status (including disease and

treatment) on physical, psychological (adjustment and self-esteem), and social functioning (family and peer relationships) (Eiser, 2004). In this study, no significant improvements in HRQOL were found in the NTT or usual care group. When analysing the EQ-5D-Y domains, no significant changes were noted. In a previous study, the findings in the DCD/ADHD population was that HRQOL was found to be significantly lower in children with DCD/ADHD in most domains, and in total scores, compared to that of the control group (Flapper, 2008). The HRQOL results in this study were not compared to non-DCD/ADHD controls, but the NTT and UC groups scored their health and quality of life poorly in the total health category.

Flapper (2008) investigated the effect of methylphenidate in the DCD/ADHD population on HRQOL using the Dutch-Child-AZLTNO-Quality-of-Life (DUX-25) and the TNO-AZL-Child Quality-of-Life (TACQOL) questionnaires. Their findings were that the DCD/ADHD group reported significant improvements in HRQOL total scores. In this study a different intervention (NTT) and outcome measure (EQ-5D-Y) was used and the findings were that learners in both groups reported lower scores after nine weeks. The decrease in health and other domain score in both the NTT and usual care groups cannot be explained by any specific intervention. Possible explanations could be that learners at this school present with other co-morbidities in addition to SLD with co-morbid DCD, including ADHD, ASD and behavioural disorders, which may have an impact on HRQOL which is unrelated to intervention. In a study by Hubert-Dibon, Bru, Gras Le Guen, Launay, and Roy (2016), children with SLI who attended specialised schooling programmes showed reduced HRQOL scores in the school environment. This may be explained by the fact that children receiving such specific schooling programmes are likely to be children with more severe language and social difficulties.

In a recent South African study investigating the use of the EQ-5D-Y to assess the HRQOL of children with different health states, it was found that the EQ-5D-Y could be used effectively with acutely ill children, but recorded poorer psychometric properties in children with no health or chronic condition (Scott et al., 2017).

As the impact of DCD on daily life at home and at school is an important consideration when treating learners with DCD, the evaluation of quality of life is very important. Further research is needed to investigate the HRQOL and the impact of NTT in this particular population.

5.11. Recommendations for future research and clinical practice

The NTT programme was designed based on literature and consultation with experts in the field of task-oriented intervention. The effect size was found to be smaller in this study than other studies investigating task-oriented approaches (Smits-Engelsman et al., 2013). This could be due to the fact that learners in this study presented with SLD and co-morbid DCD. It could also possibly be linked to

the heterogeneity of the group. Learners with SLD have general difficulties in areas of learning due to challenges with acquiring the underlying academic skills needed which in turn impacted on motor skills development. Further research is needed to show if the results would be different and specifically if effect size would be bigger if the intervention was longer than nine weeks. Although nine weeks of NTT showed a significant improvement in overall motor performance, taking into account that learners also presented with SLD, a longer period could possibly have yielded better results as learners with SLD take longer to master and acquire new skills. In a recent systematic review and meta-analysis by Yu et al. (2018), it was found that motor skill interventions (including task orientated approaches like NTT) are effective in improving motor performance. In this study, intervention periods ranged from four to 24 weeks, with most studies (76 per cent) involving participants with pure DCD (no co-morbidities). It is possible that learners with co-morbid DCD would require a longer intervention period.

The optimal frequency of training for coordination purposes in learners with DCD has not been established. The frequency of the intervention was based on previous studies using task-oriented approaches and significant change in motor function was found in learners with DCD (Ferguson et al., 2013; Niemeijer et al., 2007; Schoemaker et al., 2003). In the study by Ferguson et al. (2013), learners in the intervention group received nine weeks of NTT, two sessions of 45- 60 minutes per week. In the study by Niemeijer et al. (2007), learners in the intervention group received 30 minutes of NTT per week for nine weeks. In the study by Schoemaker et al. (2003), learners received 30 minutes of NTT per week for 18 weeks. Further research is needed to determine if learners with co-morbid DCD would benefit from higher frequency intervention.

The results from this study also showed an improvement in motor performance in learners in the NTT group where the intervention was presented in small groups. It has been found that group settings offered more opportunity for social interaction, motivated children to compete with each other, and contributed to a stronger sense of ability as a result of successful performance in front of other learners in the group (Peters & Wright, 1999). Further research is needed to determine if learners with co-morbid DCD will show greater improvement when treated in pairs or individually.

In this study, the NTT approach was investigated in an SLD with co-morbid DCD population, making this study different from previous studies investigating NTT in learners with DCD. This study is also unique as it aimed to investigate the effect of NTT not only on motor performance but also on behavioural profile and HRQOL. Although the study aimed to look at the learners in terms of the ICF model and across a spectrum of ICF dimensions, this study did not specifically look at participation, and body structure and function, of learners. It is however noted that the study aimed to investigate

the effect of the improvement in activity (motor performance) in the home and school environment in terms of behavioural profiles as well as quality of life, therefore looking at the personal and environmental domains of the ICF. Further research is needed to investigate the effect of a task-oriented approach, like NTT, on all domains of the ICF, including participation, and body structure and function, in this SLD co-morbid DCD population.

For clinical practice, a nine-week NTT-based approach is recommended for leaners with co-morbid DCD. Benefits of the study also included that physiotherapy practice will be better informed, and the findings and results should be used by the therapists to assess the efficacy of their interventions. Furthermore, as the intervention was found to be effective, more learners may benefit in future as group programmes can be implemented in the school setting. Although time management in a school context where learners are following a mainstream curriculum can be challenging, participation in this programme yielded positive results. It is also recommended that interdisciplinary team work should be improved, as multidisciplinary approaches may be more beneficial and may result in improvement in more areas. Learners in this study received OT and physical education during the nine-week intervention period. This may have contributed to the improvement observed. Improved collaboration and interdisciplinary consultation is recommended in order to develop programmes that are effective and result in significant improvements. A multi-disciplinary approach is suggested for future studies to investigate the need for physiotherapy driven NTT within LSEN schools. Based on this research, it is recommended that teachers should be better equipped to identify motor problems in learners, as well as have an improved knowledge about DCD. Further research is also recommended to better understand the teacher's role in the management of learners with co-morbid DCD.

5.12. Limitations

The study presents with several limitations discussed below.

5.12.1. ICF Framework

All domains of the ICF framework were not assessed and results were only measured in two areas, namely activity (motor performance) and personal factors (HRQOL and behavioural profile). Participation, environment, and body structure and function are important domains of the ICF which provide information on the holistic picture of the learners as well as a holistic view on their function.

5.12.2. Allocation to groups

A quasi-experimental design was chosen for the circumstances since conducting a randomised controlled trial was not possible. Allocation to intervention (NTT) and control (usual care) groups was

not randomised. Learners were allocated to groups by class teachers based on if the learners presented with motor coordination problems but was also possibly influenced by various factors including how much therapy the learner was currently receiving at school, the need for therapy, in addition to the presentation of motor problems. Due to this method of allocation, selection bias could have occurred. Randomisation of learners would have led to better quality research.

Although participants were not randomised, it is important to note that the two groups were similar at pre-test with regards to most outcome measures, with no statistically significant differences in most areas. Areas where it is possible that non-randomised allocation may have had an impact on study results include the behavioural profile (SDQ Teacher), emotional and pro-social domains, where there was a significant difference in mean scores pre-intervention between groups.

5.12.3. Usual care

Although not statistically significant, it was noted that the post-intervention mean scores in the usual care group showed an improvement in motor performance. The reason for this is most likely that learners in both groups participated in life orientation (LO) including physical education, as per the CAPS curriculum. The school also offers extra-curricular activities to learners after school, which includes swimming, mini cricket, soccer and ball skills programmes. The learners attending aftercare at school and making use of bus transport mostly attended these groups, including some of the learners in the usual care and NTT groups. Although sport or extra-murals are not compulsory, the physical education lessons form part of LO and are mandatory.

OT was not withheld from any learners. Learners in both the NTT and usual care group attended OT for the duration of the study. This included sensory motor groups, class groups, fine motor groups, visual perceptual groups, and typing groups as well as individual OT. Some learners received more than one form of OT. Of the 18 learners in the usual care group, all but one learner received some form of OT. In the NTT group, 4 of the 18 received no form of OT. The effect of OT could not be excluded in this study, although slightly more learners in the usual care group received OT than the NTT group.

Although this may not seem ideal for the purposes of this study, allowing learners to participate in LO is in keeping with the mainstream curriculum. It is also seen as best for the learner. The continuation of OT was considered to be ethical and aligned with best practice.

5.12.4. Retention of effect

Due to time constraints, only immediate post-intervention effects were investigated in this study. However, evidence of retention of skills or continual improvement is important to motivate the

introduction of similar programmes in the future. A three-month follow-up study could have demonstrated whether learners in the NTT group continued to improve and if skills learned and improvements recorded were retained. Further research is needed to determine the retention of skills in this special population.

5.12.5. Behaviour and HRQOL

Limited research has been done in the areas of behaviour and the self-perceived quality of life in learners with SLD/DCD. Future research investigating behaviour and HRQOL in this population is needed to further determine how interventions can be adapted as well as what the impact of task orientated interventions are on these domains. Collaboration with experts in the field of behaviour and psychology should be consulted in future studies, specifically in the assessment of behaviour and HRQOL.

6. Conclusion

Learners with SLD and co-morbid DCD present with motor problems, behavioural problems and HRQOL problems. It has been found that this special population benefitted from a task-oriented NTT intervention programme.

The results of this study showed that a task-oriented programme (NTT) has a positive effect on motor performance in learners with co-morbid DCD. The learners who received NTT showed a significant improvement in motor skills compared to learners who received UC. The finding of this study that the NTT group showed a significant improvement in motor function (TSS) supports the hypothesis that usual care (OT and Physical education) was not enough to show a significant improvement in nine weeks. The NTT and the UC groups showed some improvement in behavioural profile after the nine-week period, but neither significant overall. The programme also did not show a positive effect on quality of life after the nine-week period. Further research is required to investigate the effect of NTT intervention on behaviour and quality of life in this special population. Further research should also address the limitations in this study including randomised allocation to NTT and UC groups, as a randomised controlled trial would result in better quality research.

Learners with co-morbid DCD are currently not receiving physiotherapy intervention in this LSEN school. This study provides evidence for effective intervention that can be implemented in the school to improve motor performance in learners with co-morbid DCD. Although the intervention did not show an overall significant improvement in behaviour profile, the intervention programme did have a significant positive effect on the behaviour/conduct domain, according to parents. The study also demonstrated that NTT, presented in a small-group format, results in significant improvements in motor performance. This makes this approach a cost-and-time-effective approach in an under- resourced setting where there is a serious need for intervention in the DCD population.

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8. Appendices

A. HREC Approval

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.arieffdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

01 August 2016

HREC REF: 426/2016

Dr G Ferguson
Physiotherapy
F-45
Health & Rehab Sciences
FHS

Dear Dr Ferguson

PROJECT TITLE: THE EFFICACY OF A TASK-ORIENTATED GROUP INTERVENTION PROGRAMME FOR CHILDREN WITH DEVELOPMENTAL COORDINATION DISORDER WITH CO-MORBIDITIES (MSc Candidate - R Crafford)

Thank you for your response letter dated 17 July 2016, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 August 2017.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF in all your correspondence.

We acknowledge that the student, Roche Crafford will also be involved in this study.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.

HREC 426/2016

B. Permission letter to principal and SGB

4 Bell Rd

Claremont

7708

Dear Principal and School Governing Body

Request to perform a research study at the school

As you are aware, I am a qualified physiotherapist employed at the school by WCED. I am currently registered for a Master's degree with the University of Cape Town. The title of my thesis is *The efficacy of a task-oriented group-intervention programme for children with Specific Learning Disorder with co-morbid Developmental Coordination Disorder.* In order to commence my study, I need to identify learners aged 6–10 years in Grades 1– 4 who attend The School and who present with motor activity difficulties.

Particulars of the Researcher

Title: Ms

Surname: Crafford

First Names: Roché

Tel: 082 2274617

E-mail: rochecrafford@gmail.com

Procedure of the study

A timetable of the proposed dates that the study will take place will be sent to you after ethical clearance has been obtained from the University of Cape Town.

With permission received from yourself and WCED, I will use the CEMIS database to identify learners who qualify for the study. These learners should currently attend the school. They must be 6–10 years old and in Grades 1–4. Boys and girls will be included. Learners classified as SLD with/without ADHD according to CEMIS, will be included. Teachers of identified learners will be asked to identify any functional problems these learners might have. For learners to qualify for participation in the study, they need to have a functional problem identified by the teacher.

Prior to further participation, all teachers and parents of the participants will receive an information leaflet explaining the aims of this study. In order to participate they will have to sign a letter of consent. Teachers will be requested to sign a confidentiality agreement as well as a letter of consent to participate in the study. The study will be explained to the children in an age-appropriate manner and they will be given the opportunity to sign assent or to decline participation.

Testing will only commence with the consent of the learner's parents/guardian as well as consent from the identified learner's teacher. These learners will be identified as 'indication of possible DCD' or 'suspect for DCD'. Trained testers will administer motor activity measurements on this group during school time if this can be arranged with school management. To guarantee objectivity of the test results, the researcher (R. Crafford) will not be involved in performing these tests during school time.

Learners whose scores are ≤16th percentile on the motor activity measurement will be included in the study. These learners will be included in the study. Learners identified as 'indication of possible DCD' or 'suspect for DCD' but who do not meet the motor activity measurement criteria, will not be included in the study. Parents of these learners will be informed of test results and it will be explained that if this intervention programme proves to be effective, it may lead to the implementation of a group-intervention programme for all learners with motor difficulties, 'indication of possible DCD' or 'suspect for DCD'. Therefore, their children may benefit in future. Learners identified as 'indication of possible DCD' or 'suspect for DCD', but who do not meet inclusion criteria, will continue to receive usual care at the school.

The intervention will consist of a nine-week intervention programme, presented at school, for learners with motor difficulties. Children whose scores are ≤16th percentile on the motor activity measurement will be included in the study, either in the intervention or control group.

Who will know the outcome of the tests?

As all participants will be allocated a specific number, no information will be linked in any way to any participant. Only the researcher will have access to participants' personal information. No participant will suffer because of discrimination or be harmed in any way, as none of the participants will be identifiable in the study. The school itself will be identified and mentioned in the research.

Only the parents will receive the individual test results of their child. It is their decision and discretion to share the results with the child's teacher. The research study will only publish aggregate data for entire groups of participants.

Potential risks

This includes the potential distress caused by reports that the participant is not performing within the normal range. It might be distressing for parents/guardians to learn that their child is performing below the norm. Therefore, the researcher will be available to discuss any concerns they may have. Because not all learners attending The School will be included in this research, the matter will be handled with great sensitivity to limit any possible stigma.

The direct risks involved to participants involved in this study will be minimal; all activities are part of children's normal daily activities. In the unlikely event of minor injuries, e.g. if any child should fall or bump his knee, first aid will be available. If any serious injury were to occur, parents/guardians and the emergency services will be contacted immediately. If counselling or other support services are required, the learner will be referred to the school psychologist.

No-fault clause by the University of Cape Town: what if something goes wrong?

"The University of Cape Town (UCT) undertakes that in the event of a child suffering any significant deterioration in health or well-being, or from any unexpected sensitivity or toxicity, that is caused by their participation in the study, it will provide immediate medical care. UCT has appropriate insurance cover to provide prompt payment of compensation for any trial-related injury according to the guidelines outlined by the Association of the British Pharmaceutical Industry, ABPI 1991. Broadly speaking, the ABPI guidelines recommend that the insured company (UCT), without legal commitment, should compensate the child's parents without them having to prove that UCT is at fault. An injury is considered trial-related if, and to the extent that, it is caused by study activities. Parents must notify the researcher immediately if any injuries occur during this research, whether it is research-related or other related complications.

UCT reserves the right not to provide compensation if, and to the extent that, the child's injury came about because he/she chose not to follow the instructions that they were given while they were taking part in the study. The parents' right in law to claim compensation for injury where they prove negligence is not affected. Copies of these guidelines are available on request".

Potential benefits

The data obtained will be used to create awareness regarding the impact DCD has on the quality of life of learners as well as their motor activity limitations. The results obtained from this research will assist in implementing future interventions in schools and improving education models. The research will also aim to better equip teachers to include similar programmes as part of the school curriculum. Implementation of interventions sooner rather than later, will ensure better long-term outcomes for these learners.

If you have any concerns or questions regarding participant rights or their welfare, you can contact me or my supervisor, Dr Gillian Ferguson, as well as the Human Research Ethics Committee (HREC) of the University of Cape Town (Prof. Marc Blockman).

Your assistance in this matter will be greatly appreciated.

Kind regards

_____ _____

Roché Crafford
Researcher
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Prof. Marc Blockman
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_____

Dr Gillian Ferguson
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C. Permission to access CEMIS and assess children at the school, Department of Education, Western Cape

4 Bell Rd

Claremont

7708

Dear Sir/Madam

Request to perform a research study at the school

I am a qualified physiotherapist employed by WCED at the school. I am currently registered for a Master's degree with the University of Cape Town. The title of my thesis is *The efficacy of a task-oriented group-intervention programme for children with Specific Learning Disorder with co-morbid Developmental Coordination Disorder."*

In order to commence my study, I need to identify learners aged 6–10 years in Grades 1– 4 who attend the school and who present with motor activity difficulties.

Particulars of the Researcher

Title:	Ms
Surname:	Crafford
First Names:	Roché
Tel:	082 2274617
E-mail:	rochecrafford@gmail.com

Place of study

I am applying for permission to conduct the study at The School.

My request

I hereby specifically request permission to

1) access the CEMIS database and
2) to conduct the research study at The School

I have requested permission from the following people:

1) The SGB
2) The principal

Informed consent

I will obtain informed consent from all parents involved in the study and assent from each learner.

Procedure of the study

After ethical clearance is obtained, the researcher (R. Crafford) will contact the identified study population to request permission to participate in the study. If they are willing, they will undergo testing at the school. If they meet the inclusion criteria, they will be included in an intervention programme that is to be run at the school. A trained tester will perform all tests and the researcher (R. Crafford) will not be performing any tests during school hours to avoid research bias or a conflict of interest.

After ethical clearance has been obtained, a timetable of the proposed dates of the study will be sent to the principal of The School to assure that it suits all participating parties.

I will use the CEMIS database to identify learners that qualify for the study. These learners should be attending the school currently. They must be aged 6–10 years and in Grades 1–4. Boys and girls will be included. Learners classified as SLD with/without ADHD according to CEMIS, will be included. Teachers of identified learners will be asked to identify any functional problems these learners may have. For learners to qualify for participation in the study, they need to have a functional problem identified by the teacher.

Prior to further participation, all teachers and parents of the participants will receive an information leaflet explaining the aims of this study. In order to participate they will have to sign a letter of consent. Teachers will be requested to sign a confidentiality agreement as well as a letter of consent to participate in the study. The study will be explained to the children in an age-appropriate manner and they will be given the opportunity to sign assent or to decline participation.

Testing will only commence with the consent of learner's parent/guardian as well as consent from the identified learner's teacher. These learners will be identified as 'indication of possible DCD' or

'suspect for DCD'. Trained testers will administer motor activity measurements on this group during school time if this can be arranged with school management. To guarantee objectivity of the test results, the researcher (R. Crafford) will not be involved in performing these tests during school time.

Learners whose scores are ≤16th percentile on the motor activity measurement will be included in the study. These learners will be included in the research study. Learners identified as 'indication of possible DCD' or 'suspect for DCD' but who do not meet the motor activity measurement criteria will not be included in the study. Parents of these learners will be informed of test results and it will be explained that if this intervention programme proves to be effective, it may lead to the implementation of a group intervention programme for all learners with motor difficulties, 'indication of possible DCD' or 'suspect for DCD'. Therefore, their children may benefit in future. Learners identified as 'indication of possible DCD' or 'suspect for DCD', but who do not meet inclusion criteria, will continue to receive usual care at the school.

The research study will consist of a nine-week intervention programme, presented at school, for learners with motor difficulties. Children whose scores are ≤16th percentile on the motor activity measurement will be included, either in the intervention or control group.

Who will know the outcome of the tests?

As all participants will be allocated a specific number, no information will be linked in any way to any participant. Only the researcher will have access to participants' personal information.

No participant will suffer because of discrimination or be harmed in any way, as none of the participants will be identifiable in the study. The school itself will not be identified and mentioned in the research.

Only the parents will receive the individual test results of their child. It is their decision and discretion to share the results with the child's teacher. The research study will only publish aggregate data for entire groups of participants.

Potential risks

This includes the potential distress caused by reports that the participant is not performing within the normal range. It might be distressing for parents/guardians to learn that their child is performing below the norm. Therefore, the researcher will be available to discuss any concerns they may have. Because not all learners attending The School will be included in this research, the matter will be handled with great sensitivity to limit any possible stigma.

The direct risks involved to participants involved in this study will be minimal; all activities are part of children's normal daily activities. In the unlikely event of minor injuries, e.g. if any child should fall or bump his knee, first aid will be available. If any serious injury were to occur, parents/guardians and the emergency services will be contacted immediately. If counselling or other support services are required, the learner will be referred to the school psychologist.

No-fault clause by the University of Cape Town: what if something goes wrong?

"The University of Cape Town (UCT) undertakes that in the event of you suffering any significant deterioration in health or well-being, or from any unexpected sensitivity or toxicity, which is caused by your participation in the study, it will provide immediate medical care. UCT has appropriate insurance cover to provide prompt payment of compensation for any trial-related injury according to the guidelines outlined by the Association of the British Pharmaceutical Industry, ABPI 1991. Broadly speaking, the ABPI guidelines recommend that the insured company (UCT), without legal commitment, should compensate you without you having to prove that UCT is at fault. An injury is considered trial-related if, and to the extent that, it is caused by study activities. You must notify the researcher, the study leader, immediately of any injuries during this research occur, whether it is research-related or other related complications.

UCT reserves the right not to provide compensation if, and to the extent that, your injury came about because you chose not to follow the instructions that you were given while you were taking part in the study. Your right in law to claim compensation for injury where you prove negligence is not affected. Copies of these guidelines are available on request".

Potential benefits

Children identified as DCD will benefit as their performance in daily activities may improve because of the intervention programme. Furthermore, if the intervention is found to be effective, more learners may benefit in future, as group programmes can be implemented in the school setting.

The data obtained will be used to create awareness regarding the impact DCD has on the quality of life of learners as well as their motor activity limitations. The results obtained from this research will assist in implementing future interventions in schools and improving education models. The research will also aim to better equip teachers to include similar programmes as part of the school curriculum. Implementation of interventions sooner rather than later, will ensure better long-term outcomes for these learners.

If you have any concerns or questions regarding participant rights or their welfare, you can contact me, my supervisor, Dr Gillian Ferguson, as well as the Human Research Ethics Committee (HREC) of the University of Cape Town (Prof. Marc Blockman).

Your assistance in this matter will be greatly appreciated.

Kind regards

_____

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Researcher
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Dr Gillian Ferguson
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D. Recruitment flyer/information letter

4 Bell Rd

Claremont

7708

Dear Parent/Guardian

I am a qualified physiotherapist employed by WCED at The school. I am registered for a Master's degree with the University of Cape Town. The title of my thesis is *The efficacy of a task-oriented group-intervention programme for children with Specific Learning Disorder with co-morbid Developmental Coordination Disorder.* In order to start my study, I need to identify learners who have motor activity difficulties. Learners must be 6–10 years old and in Grades 1 – 4 at the school.

I will obtain permission from the Department of Education and the principal and school governing body (SGB). I will identify learners with Specific Learning Disorder (SLD) with/without Attention Deficit Hyperactivity Disorder (ADHD) from the school database (CEMIS). All information will be treated confidentially.

With help from teachers, I will determine if these learners present with a functional motor problem. A functional motor problem can be: difficulty with hopping, skipping, climbing on the jungle gym, struggling with dressing especially doing buttons and laces, struggling to sit still and upright at a desk, tiring quickly, and displaying untidy handwriting.

Once learners have been identified, you will receive further information. You will also have another opportunity to decide whether your child should take part in the research. If you agree to the study, further information, including consent forms, will be communicated to you.

If you do not want your child to be part of this initial screening process - where your child's records are accessed and a questionnaire completed by the teacher - please inform me, the researcher, by contacting me on the number/e-mail below.

If you have any concerns or questions regarding participant rights, please feel free to contact me.
Your assistance in this matter will be greatly appreciated.

Kind regards

_____

Roché Crafford

Researcher

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_____

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Supervisor

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E. Information letter to parents/guardian of learners identified as 'possible DCD' or 'indication of DCD' to participate in assessment

4 Bell Rd

Claremont

7708

Dear Parent/Guardian

Request to allow your child to participate in a research study

I am a qualified physiotherapist employed by the Western Cape Education Department (WCED) at the school. I am currently registered for a Master's degree with the University of Cape Town. The title of my thesis is *The efficacy of a task-oriented group-intervention programme for children with Specific Learning Disorder with co-morbid Developmental Coordination Disorder.*

I have identified learners aged 6–10 years in Grades 1–4 at the school with Specific Learning Disorder (SLD) with/without Attention Deficit Hyperactivity Disorder (ADHD) With help from teachers, I have further determined which of these learners present with a functional motor problem (e.g. difficulty with hopping, skipping, climbing on the jungle gym, struggling with dressing, especially doing buttons and laces, struggling to sit still and upright at a desk, displaying untidy handwriting etc.). This was based on the MABC Checklist, which assesses age-appropriate class activities and behaviour in the class setting.

I am writing to you because your child meets these criteria. I would like your consent to include him/her as a participant in the research study.

The aim of my study is to test the effect a group-intervention programme has on the motor abilities of children with motor activity difficulties. The study also aims to help understand the effect that these motor difficulties have on their participation in other activities in their daily lives.

The study will look at motor performance, function, and the learner's perception of his/her quality of life and participation levels. I would like to compare the results of those who take part in the group programme to those who do not.

The results from this study will be used to create awareness about motor difficulties in children. The results from this research could also help to start similar programmes in schools in the future. The study aims to better understand learners with motor difficulties in schools.

If you decide to participate in this study, I will ask you to sign an informed consent form where you voluntarily choose for your child to participate in the study. Your child will sign an assent form to confirm his/her participation.

With your permission, your child will be tested on the *Movement Assessment Battery for Children (MABC).* This test consists of 8 items. We will ask your child to do some of the following: stand on one leg, hop on squares, catch and throw beanbags, etc. This tests age-appropriate functional skills, balance and ball skills. The tests will be done by trained assessors and will take 20–40 minutes to complete. To impact minimally on learning time, the times your child will be out of the class will be arranged with the principal and teacher. Your child will be asked to complete a range of questionnaires (*The European Quality of Life 5-Dimensions Questionnaire for Youth* (*EQ-5D-Y)* questionnaire). These questionnaires respectively determine the child's view on their participation and health-related quality of life. Your child's weight, height, waist circumference and body mass index (BMI) will also be measured. You will be asked to complete the *Strengths and Difficulties Questionnaire for parents*. This questionnaire will be sent home with your child to be completed and returned to school. This questionnaire helps to detect behavioural and emotional challenges in children aged 3–16 years. The questionnaire covers problems that you may be experiencing with your child at home such as emotional, conduct, peer relation problems, hyperactivity/attention deficit, and pro-social behaviour. You will also be asked to complete a general health and medical history questionnaire about your child.

Who will be doing the tests and intervention?

Trained testers will perform the assessments.

Where will these tests take place?

All assessments will take place at the school. Each child will do the different activities individually with the tester in the gym area**.**

When will these tests take place?

I will request permission for tests to take place in school hours in the gym area of the school and will attempt to keep disruption of normal school activities to a minimum.

Who will know the outcome of the tests?

Only the parents will receive the individual test results of their child. It is your decision to share the results with your child's teacher. The research study will only publish combined data for entire groups of participants.

What are the risks involved in this study?

This includes the potential distress caused by reports that the participant is not performing within the normal range. It might be distressing for parents/guardians to learn that their child is performing below the norm. Therefore, the researcher will be available to discuss any concerns they may have. Because not all learners attending The School will be included in this research, the matter will be handled with great sensitivity to limit any possible stigma.

The direct risks involved to participants involved in this study will be minimal; all activities are part of children's normal daily activities. In the unlikely event of minor injuries, e.g. if any child should fall or bump his knee, first aid will be available. If any serious injury were to occur, parents/guardians and the emergency services will be contacted immediately. If counselling or other support services are required, the learner will be referred to the school psychologist.

Can I refuse to take part in this study?

Participation is voluntary. Refusal to participate will not result in any penalty or loss to you or your child, nor will it influence your future relations with the researcher or any other institutions involved. You are free to withdraw your consent at any time or to discontinue participation without any prejudice. No reimbursement will be given to you or your child. The study or withdrawal there from, will have no financial implication for the participant.

What about privacy?

All the information I will obtain about you and your child will be confidential. All information you provide, and your child's results from all the tests, will be stored securely under password-controlled access. No names will be mentioned when I report the results of my research study. A report on your child will be given to you at the end of the study. Only you as the parents/guardians will receive the

results of your child's assessments. It is your decision to share the results with your child's teacher. Any suspicion of possible or suspected negligence with regard to the confidentiality of information can be reported to the researcher, Roché Crafford, or her supervisor, Dr Gillian Ferguson. The matter will be investigated further and any necessary steps will be taken.

Potential benefits

This study offers an opportunity for motor performance to be assessed. Parents/guardians will receive written reports of their child's performance. If your child is found to have motor co-ordination difficulties, they will be invited to be part of the intervention group. The group programme will take place in the next school year. If your child is not part of the intervention group, they will not be disadvantaged in any way. They will benefit from the study in future, as they will be placed on a waiting list to receive the intervention. The study aims to provide information on how to start group programmes to address motor difficulties in schools. The study also aims to raise awareness in schools around learners with motor difficulties.

No-fault clause by the University of Cape Town: what if something goes wrong?

'The University of Cape Town (UCT) undertakes that in the event of you suffering any significant deterioration in health or well-being, or from any unexpected sensitivity or toxicity that is caused by your participation in the study it will provide immediate medical care. UCT has appropriate insurance cover to provide prompt payment of compensation for any trial-related injury according to the guidelines outlined by the Association of the British Pharmaceutical Industry, ABPI 1991. Broadly speaking, the ABPI guidelines recommend that the insured company (UCT), without legal commitment, should compensate you without you having to prove that UCT is at fault. An injury is considered trial-related if, and to the extent that, it is caused by study activities. You must notify the researcher, the study leader, the school principal immediately if any injuries occur during this research, whether it is research-related or other related complications.

UCT reserves the right not to provide compensation if, and to the extent that, your injury came about because you chose not to follow the instructions that you were given while you were taking part in the study. Your right in law to claim compensation for injury where you prove negligence is not affected. Copies of these guidelines are available on request.

If you have any concerns or questions regarding participant rights or the welfare of your child, you can contact me, Roché Crafford, or my supervisor (Dr Gillian Ferguson, 021-4066045), as well as the

Human Research Ethics Committee (HREC) of the University of Cape Town (Prof. Marc Blockman, 021-4066496)'.

Your assistance in this matter will be greatly appreciated.

Kind regards

_____ _____

Roché Crafford
Researcher
082 227 4617
rochecrafford@gmail.com

Prof. Marc Blockman
Chairperson of HREC
021-4066496
Marc.Blockman@uct.ac.za

_____

Dr Gillian Ferguson
Supervisor
021-4066045
gillian.ferguson@uct.ac.za

Parent questionnaire (given as part of Appendix E)

Please answer all questions. All information given in this questionnaire will be kept confidential.

Child's full name	
Child's date of birth	
Child's grade	
Where do you live	
Telephone numbers	
E-mail address	

Section B: Your child's birth history and health

Were there any complications during the mother's pregnancy?	**Yes**	**No**
If yes, please explain		
Were there any complications at the birth of your child?	**Yes**	**No**
If yes, please explain		
Was your child born underweight?	**Yes**	**No**

If yes, please explain		
Was your child premature at birth (born early)?	**Yes**	**No**
If yes, please explain		
Has your child ever been seriously ill or hospitalised?	**Yes**	**No**
If yes, please explain		
Does your child suffer from any medical conditions or take any medication?	**Yes**	**No**
If yes, please explain?		
Does your child have any problems with eyesight/ vision	**Yes**	**No**
If yes, please explain?		
Does your child suffer any problems with ears/ hearing	**Yes**	**No**
If yes, please explain?		

Section B: Your child's motor coordination skills

Does your child struggle with motor activities at home?	**Yes**	**No**

Please tick the boxes (✓) if your child has difficulties with any of the following:	Yes	No
1. Writing neatly and fast enough with a pen/pencil		
2. Manipulating small objects (e.g. threading beads on a string, building Lego blocks,) or cutting with scissors		
3. Tying shoelaces ,buckles, zips and buttons		
4. Running and walking with without falling or tripping or bumping into things		
5. Taking part in chasing and catching games without getting tired		
6. Able to make own food (e.g. make a sandwich or pour own juice) without spilling/messing		
7. Catching and throwing or kicking a ball accurately		
8. Taking part in team sports		
9. Learning a new activity or /game (e.g. how to ride a bicycle, skip rope or tie shoelaces)		
10. Skipping with a rope or hopping games		
11. Can you think of any other activities you child finds difficult?		

Section C: Attention and cognitive

Does your child struggle to pay attention (easily distracted) at home?	Yes	No
If yes, please explain		
Has your child ever failed a grade a school?	**Yes**	**No**
If yes, please explain		

Section D: Joints and flexibility

Does your child ever complain of joint or muscle pain?	**Yes**	**No**
If yes please explain		
Did your child ever sprain any of his/her joints? (E.g. twisted ankle, knee, shoulder, hips)?	**Yes**	**No**
If yes, please explain		

Results of M-ABC: Notification to parents

Dear Parent/Guardian

With your permission, your child was tested on the *Movement Assessment Battery for Children (MABC).* The test included the following: stand on one leg, hop on squares, catch and throw beanbags, etc. This tests age-appropriate functional skills, balance and ball skills. Your child's score on this test is included.

Trained assessors performed the tests. It was arranged with the principal and teacher when your child would be out of class to impact on learning time minimally**.**

Your child *meets/does not meet* the requirements to be included in the study, therefore he/she scored *equal to or below/higher* than the 16th percentile on the MABC test. This means that your child *presents with/does not present with* movement difficulties and what is called Developmental Coordination Disorder (DCD).

If you have any questions please feel free to contact me. If you would like to discuss these results with me in person, please feel free to contact me and arrange a meeting. Alternatively, feel free to contact me telephonically.

Your assistance in this matter will be greatly appreciated.

Kind regards

_____

Roché Crafford

Researcher

082 227 4617

rochecrafford@gmail.com

_____

Prof. Marc Blockman

Chairperson of HREC

021-4066496

Marc.Blockman@uct.ac.za

_____

Dr Gillian Ferguson

Supervisor

021-4066045

gillian.ferguson@uct.ac.za

F. Consent form for parents/guardians of children with 'possible DCD' or 'indication of DCD' to continue with testing

I, Roché Crafford (researcher), have fully explained to _____ (parent/guardian) the purpose of this study. The purpose of this study is to test the effect that a group-intervention programme has on the motor abilities of children. It also looks at the effects motor difficulties have on their participation and function in daily life. I have tried to answer all possible questions that parents/guardians may have. I have explained and clarified all procedures, risks and benefits involved in this study. I have answered and will answer all questions to the best of my ability. I will inform the parents/guardians of any changes in the procedure or the risks and benefits, should any occur during the course of the study or after. I have also informed them of the time schedule during which the tests will be performed.

_____

Roché Crafford
Researcher
082 227 4617
rochecrafford@gmail.com

I _____ (parent/guardian) have been adequately informed about the purpose of this study as well as the procedure, risks and benefits. I hereby give permission for my child's participation in this study. I know that Roché Crafford and her associates will be available to answer any questions I may have. I understand that participation is voluntary and I am free to withdraw this consent and discontinue participation in this project at any time. This will not affect my child's care. I was informed that there would be no financial or other remuneration if I participate in this study. The purpose of the assessments that will be performed was clearly explained to me and I understand the importance of my child's participation.
I have been offered a copy of this form.

_____ _____

Parent/Guardian Witness

G. Assent form for children identified as 'possible DCD' or 'indication of DCD' to participate in further testing (to be read out to participants by tester)

The study will be explained to the children in an age-appropriate manner and they will be given the opportunity to sign assent or to refuse participation. Assent will be obtained at the school after the parents have been informed what the research entails.

Request to participate in a research study

My name is Roché Crafford. I am a physiotherapist working at the school. I am studying how to help children who find certain activities, for example, running, throwing and catching a ball or writing neatly a bit difficult. Your parents gave me permission to ask you if you want to take part in a few activities and answer some questions about your life.

Why do I want you to take part in this study?

I want to know if children who find some physical activities difficult are happy with different things in their life such as moving around, taking care of themselves and their feelings.

Therefore, we have to see how easy you find these activities and watch how you do different things.

If you have any questions about what it means to have movement difficulties, please let me know.

What do you have to do?

We will ask you to do some physical activities from a game (the *Movement ABC-2*). The activities will be familiar to you, it will include placing pegs, threading lace, drawing on a line, catching, throwing a beanbag, standing on one leg, hopping in squares, and walking with your feet behind each other.

We will ask you to complete *the EQ-5D-Y* questionnaire about how you see your current health. You do not have to worry about reading the questions - -+0 an adult will help you and explain each question and activity to you. No one else will be able to see how you scored in the activities.

We will also measure your weight, height, and waist circumference, and your body mass index (BMI) will be calculated.

What do your parents/guardians have to do?

They will also be asked to fill in the *Strengths and Difficulties questionnaire for parents*. This questionnaire will tell us more about your feelings and emotions (if you are happy, sad or angry).We will ask you to take this form to them and to bring the completed copy back to the school.

When will these tests take place?

All of this will happen during school time. It will not make you miss important class time or any other activities that you might have.

How long will it take?

The physical activities will take about 20 – 40 minutes of your time.

What happens after the tests?

If we see that there are things that you find a bit difficult, we will tell your parents/guardians. We may also ask you to take part in a group at school to work on the things you find difficult. This group will take place next year.

Who will know the outcome of the tests?

Only your parents will receive the results of your tests. They can decide if they want to tell your teacher how you did in the tests.

Can you say no to take part in this study?

You are free to say no, even if you parents have already said yes**.** Even if you start, you can still stop at any time you want to; your teachers and I will not hold it against you. You may also ask any questions about this study.

What about privacy?

If you decide to take part in this study, I am not allowed to tell anyone except your parents how you did in your physical test. I am not allowed to tell anyone what you said or wrote on your paper. Even if your parents, teachers or friends ask me what you wrote, I will not tell them. To take part in this study is completely your own choice; no one can force you to take part. Only your parents/caregivers will receive your results. They can decide if they want to share the results with your teacher. You will not receive any money or gifts for taking part in this study.

What are the risks involved in this study?

It may be difficult for you and your parents/guardians to learn that you are struggling with some activities. I will be available to talk about any problems or worries that you or your parents may have.

This study will not harm you in any way. It will take place at your school. If I see that you find some of the activities a bit difficult, I will tell your mom or dad to help you work on it. If you get hurt in any way, or feel ill, please tell me immediately so that I can ask your parents/guardians to take you to the doctor.

Making a cross in the box or writing your name means that you understand what I have told you and that you want to take part in my study.

<u>If you want to take part, sign this section</u>

Child's printed name:

Signature of child or X _____ ☐

Signature of tester: _____

Date: _____

<u>If you do not want to take part, sign this section</u>

Child's printed name:

Signature of child or X _____

Signature of tester: _____ ☐

Date: _____

H. Permission letter to parents/guardian of learners who meet inclusion criteria

4 Bell Rd

Claremont

7708

Dear Parent/Guardian

Request to allow your child to participate in a research study

I am a qualified physiotherapist employed by WCED at The school. I am registered for a Master's degree with the University of Cape Town. The title of my thesis is *The efficacy of a task-oriented group-intervention programme for children with Specific Learning Disorder with co-morbid Developmental Coordination Disorder.* For me to complete my study, I need to identify learners who present with motor activity difficulties also known as DCD. Learners must be 6–10 years in age and in Grades 1–4 at the school.

The aim of my study is to test the effect a group-intervention programme has on the motor abilities of children with motor activity difficulties. I also aim to better understand the effect that these motor difficulties have on their participation in other activities in their daily lives.
With your consent, your child was assessed and meets all the inclusion criteria to be part of the intervention group. (MABC scores between the 9th and 16th percentile suggesting motor difficulty, functional difficulty and presenting with SLD with/without ADHD)

What do I have to do?
You are invited to attend an information meeting to discuss this research study, which includes the intervention programme. If you decide to take part in the study, you will be asked to sign an informed consent. By signing this, you allow your child to take part in the study. Your child will also have to sign an assent form to confirm his/her willingness to participate.

The test and questionnaires that were done previously (MABC-2, M-ABC Checklist, EQ-5DY, SDQ, weight, height and BMI) will be repeated.

About the intervention programme

Your child will be allocated to either the intervention group or the control group. The group programme will take place two days per week for 30-45 minutes over a period of nine weeks. The learners allocated to the control group, which will receive usual care, will not be disadvantaged in any way. This group will be placed on a waiting list to receive group therapy after the study, consequently benefitting.

Who will conduct the tests and present the programme?

Trained testers will perform tests and oversee questionnaires. The researcher, with help from trained assistants, will run the programme.

Where will this programme take place?

The programme will take place at the school. The learners will be divided into groups in which they will participate in the programme. The programme will be run during school hours in the physiotherapy gym area of the school at a time that will arranged with class teachers to impact teaching time minimally.

What do I - the parent- have to do?

You will be asked to complete the *Strengths and Difficulties Questionnaire for parents*. This questionnaire will be sent home with your child to be completed and returned to school. This questionnaire helps to detect behavioural and emotional challenges in children aged 3–16 years. The questionnaire covers problems that you might experience with your child at home such as emotional, conduct, peer relation problems, hyperactivity/attention deficit, and pro-social behaviour.

Who will help me complete the questionnaire?

You will complete the written questionnaire on your own. If you need help, you are welcome to contact the researcher.

What do the teachers have to do?

Your child's teacher will be asked to complete the *Strengths and Difficulties Questionnaire for teachers.* This questionnaire requires the teacher to provide his/her perspective on your child in a classroom setting.

What if I can't read/understand the questionnaires?

All questionnaires will be provided in English, but if you cannot read and/or understand the questionnaires, translation can be arranged. A reliable translator (a teacher at the school) will be asked to assist us in translating and explaining the instructions, but every question is straightforward and should require no further explanation. If you need help, please contact me on the numbers listed in this letter.

Who will know the outcome of the tests?

Only you, the parents, will receive the results of your child. It is your decision and discretion should you wish to share the results with the child's teacher.

What are the risks involved in this study?

The risks include the distress caused by reports that the participant is not performing within the normal range. It might be distressing for you as parents/guardians to learn that your child is performing below the norm; therefore, the researcher will be available to discuss any concerns you may have.

Because not all learners attending The School will be included in this research, the whole matter will be handled with utmost discretion to limit any possible stigma.

The direct risks involved to participants involved in this study will be minimal. All activities are part of children's normal daily activities. In the unlikely event of minor injuries, e.g. if any child should fall or bump his knee, a first aid kit will be available at all times. Though it is highly unlikely, necessary preparations will be made in case of serious injury. In such an event, parents/guardians and the emergency services will be contacted immediately. If counselling or other support services are required, the learner will be referred to the school psychologist.

Can I refuse to take part in this study?

Participation is voluntary. Refusal to participate will not result in any penalty or loss to you or your child, nor will it prejudice your future relations with the researcher or any other institutions involved. You are free to withdraw your consent at any time or to discontinue participation without any prejudice. No reimbursements will be given to you or your child, and the study, or withdrawal there from, will have no financial implication to the participant.

What about privacy?

All the information I will gather about you and your child will be confidential. All information you provide and your child's results from all the tests will be stored securely under password-controlled access. No names will be mentioned when I report the results of the research study. A report on your child will be given to you at the end of the study. Only you as the parents/guardians will receive the results of your child's assessments. It is your decision and discretion if you want to share the results with your child's teacher. Any suspicion of possible or suspected negligence with regard to the confidentiality of information can be reported to the researcher, Roché Crafford, or her supervisor, Dr Gillian Ferguson. The matter will be investigated further and any necessary steps will be taken.

Potential benefits

This study offers an opportunity for motor performance to be assessed and most likely be improved. If your child is found to have motor co-ordination difficulties, and they are included in the intervention group, he/she will benefit in that they will be invited to participate in the group programme to be offered at school. If your child is not part of the intervention group, they will not be disadvantaged in any way. Usual care will continue at school. This means nothing will change in your child's programme at school. They will benefit from the study in future, as they will be placed on a waiting list to receive the intervention. The study aims to provide information on how to implement group programmes in schools to address motor difficulties. The study also aims to raise awareness in schools around learners with motor difficulties.

***No fault clause by the University of Cape Town*: What if something goes wrong?**

The University of Cape Town (UCT) undertakes that in the event of you suffering any significant deterioration in health or well-being, or from any unexpected sensitivity or toxicity that is caused by your participation in the study it will provide immediate medical care. UCT has appropriate insurance cover to provide prompt payment of compensation for any trial-related injury according to the guidelines outlined by the Association of the British Pharmaceutical Industry, ABPI 1991. Broadly speaking, the ABPI guidelines recommend that the insured company (UCT), without legal commitment, should compensate you without you having to prove that UCT is at fault. An injury is considered trial-related if, and to the extent that, it is caused by study activities. You must notify the researcher, the study leader, the school principal immediately if any injuries occur during this research, whether it is research-related or other related complications**.**

UCT reserves the right not to provide compensation if, and to the extent that, your injury came about because you chose not to follow the instructions that you were given while you were taking part in the study. Your right in law to claim compensation for injury where you prove negligence is not affected. Copies of these guidelines are available on request.

Before you complete and sign the consent form, if you have any concerns or questions regarding participant rights or their welfare, you can contact me or my supervisor, Dr Gillian Ferguson, 021-4066045, as well as the Human Research Ethics Committee (HREC) of the University of Cape Town (Prof. Marc Blockman, 021-4066496).

The information meeting will take place on (date) at (time). The meeting will be held at the school. Your assistance in this matter will be greatly appreciated.

Kind regards

_____

Roché Crafford

Researcher

082 227 4617

rochecrafford@gmail.com

_____

Prof. Marc Blockman

Chairperson of HREC

021-4066496

Marc.Blockman@uct.ac.za

_____

Dr Gillian Ferguson

Supervisor

021-4066045

gillian.ferguson@uct.ac.za

I. Consent form for parents/guardians of children with possible DCD or indication of DCD who meet inclusion criteria (MABC ≤16th percentile) to be included in intervention programme

I, Roché Crafford (researcher) have fully explained to _____ (parent/guardian) the purpose of this study, which is to test the effect a group-intervention programme has on the motor abilities of children, as well as understanding the effects these motor difficulties have on their participation and function in daily life. I have tried to answer all possible questions that may concern the parents/guardians and to explain and clarify all procedures, risks and benefits involved in this study. I have answered and will answer all questions to the best of my ability. I will inform the parents/guardians of any changes in the procedure, or the risks and benefits should any occur during the course of the study or after. I also informed them about the time schedule for further testing through the completion of questionnaires by parents and by children, to determine a baseline as well as to reassess after nine weeks. I have also explained the procedure of how the group programme will work, i.e. how learners will be allocated to an intervention or a control group.

_____

Roché Crafford

Researcher

082 227 4617

rochecrafford@gmail.com

I _____ (parent/guardian) have been satisfactorily informed about the purpose of this study as well as the procedure, risks and benefits. I hereby give permission for my child's participation in this study. I know that Roché Crafford and her associates will be available to answer any questions I may have. I understand that participation is voluntary and that I am free to withdraw this consent and discontinue participation in this project at any time, and that withdrawal will not affect my child's care. I was informed that there would be no financial or other remuneration if my child participates in this study. The purpose of further assessment through completion of questionnaires as well as the purpose of the intervention was clearly explained to me, and I understand the importance of my child's participation.

I am also aware that my child will be allocated to an intervention or a control group. I have been offered a copy of this form.

_____ _____

Parent/Guardian Witness

J. Assent form for children identified as 'possible DCD' or 'indication of DCD' to participate in the intervention/control group including further testing

To be read out to participants by tester

The study will be explained to the children in an age-appropriate manner and they will be given the opportunity to sign assent or to refuse participation. Assent will be obtained at the school after the parents have been informed what the research entails.

Request to participate in a research study

My name is Roché Crafford. I am a physiotherapist working at The School. I am writing a paper about children who have problems with the way they do certain things that includes movement of their bodies. Your parents gave me permission to ask you if you want to take part in a few activities and answer some questions about your life.

Why do I want you to take part in this study?

We want to know if children who find some physical activities and movements difficult are happy with different things in their life such as moving around, taking care of themselves, and their feelings. We want to see how easy you find these activities and to watch how you do different things.

If you have any questions about what it means to have movement difficulties, please let me know.

What do you have to do?

We have asked you to do some physical activities from a game (the *Movement ABC-2*). We have also asked you to answer some questions. We are going to ask you to do the physical activities (MABC-2) and the questions again (EQ-5D-Y). We are also going to ask you to do the running test (20mSRT) again. We also want to take your height, weight and calculate your BMI.

What do your parents/guardians have to do?

They will be asked to fill in the *Strengths and Difficulties Questionnaire (SDQ) for parents*. The questions will tell us more about your feelings and emotions (if you are happy, sad, or angry). We will ask you to take this form to them and to bring the completed copy back to the school.

What do your teachers have to do?

Your teacher will be asked to complete the *Movement Assessment Battery for Children's Checklist* (MABC-Checklist). This questionnaire will tell us about your functional classroom and playground movement (how you move around in class and outside). They will also be asked to complete the *Strengths and Difficulties Questionnaire* (SDQ) about their experience of your behaviour and emotional difficulties in the classroom.

When will these tests take place?

The tests will happen during school time. It will not make you miss important class time or any other activities that you might need to take part in. The tests will take place in school time, and the group programme will take place at school.

What happens after the tests?

After the test, we will ask you if you want to be part of a group where you do exercises and play games. This group will do activities at school to work on the things they find difficult. This group will take place at school two times a week for an hour. There will also be another group, called the control group. This is the group that will not take part in group activities but continue as usual.

Who will know the outcome of the tests?

Only your parents will receive the results of your tests. They can decide if they want to tell your teacher how you did in the tests.

Can you refuse to take part in this study?

You are free to say no, even if your parents have already agreed**.** Even if you start, you can still stop at any time you want - your teachers and I will not hold it against you. You may also ask any questions about this study.

What about privacy?

If you decide to take part in this study, I am not allowed to tell anyone except your parents how you did in your physical test. I am not allowed to tell anyone what you said or wrote on your paper. Even if your parents, teachers or friends ask me what you wrote, I will not tell them. To take part in this study is completely your own choice; no one can force you to take part. Only your parents/caregivers will receive your results. They can decide if they want to share the results with your teacher. You will not receive any money or gifts for taking part in this study.

What are the risks involved in this study?

It may be difficult for you and your parents/guardians to learn that you are struggling with some activities. I will be available to talk about any problems or worries that you or your parents may have.

This study will not harm you in any way. It will take place at your school. If I see that you find some of the activities a bit difficult, then I will tell your mom or dad to help you work on it. If you get hurt in any way, or feel ill, please tell me immediately so that I can ask your parents/guardians to take you to the doctor.

What are the benefits of taking part?

What we find out from this study will help us to understand how we can help children with movement difficulties. It will also help the school to plan classes and help the teachers.

Making a cross in the box or writing your name means that you understand what I have told you and that you want to take part in my study.

<u>If you want to take part, sign this section</u>

Child's printed name:

Child's signature or X _____ ☐

Signature of tester: _____

Date: _____

<u>If you do not want to take part, sign this section</u>

Child's printed name:

Child's signature or X_____ ☐

Signature of tester: _____

Date: _____

K. Information leaflet for teachers

As you are aware, I am a qualified physiotherapist employed by the WCED at the school. I am registered for a Master's degree with the University of Cape Town. The title of my thesis is *The efficacy of a task-oriented group-intervention programme for children with Specific Learning Disorder with co-morbid Developmental Coordination Disorder (DCD).* In order to complete my study, I need to identify learners aged 6–10 in Grades 1–4 at the school. These learners must present with motor activity difficulties.

I have identified certain children in your class (with permission from the principal and School Governing Body) from the school database (CEMIS) with Specific Learning Disorder (SLD). With/without Attention Deficit Hyperactivity Disorder (ADHD) With your help, I would like to determine if these learners present with a functional motor problem (e.g. difficulty with hopping, skipping, climbing on the jungle gym, struggling with dressing, especially doing buttons and laces, struggling to sit still and upright at a desk, tiring quickly, and displaying untidy handwriting.

You are hereby invited to participate in this research study.

What is the purpose of this study?

The aim of my study is to test the effect that a group-intervention programme has on the motor abilities of children with motor activity difficulties and to improve the understanding of the effect these motor difficulties have on children's participation in other activities in their daily life.

Specifically, I would like to compare motor performance, learners' perception of their quality of life, and participation levels, among children with motor difficulties that participate in a group programme, with their peers who do not participate in the programme.

The data obtained from this study will be used to create awareness regarding motor difficulties in children. The results obtained from this research could assist in implementing future interventions in schools. The results will also improve understanding of learners with motor difficulties in schools.

What do I, the teacher, have to do?

As teacher you play a big part in this study, since you are in contact with these children for a substantial part of the day and might experience them differently from their parents/guardians. You will be asked to complete the *Movement Assessment Battery for children's checklist* (MABC-checklist). This questionnaire will test a child's functional classroom and playground movement, thus

what your view is of a child's age-appropriate class activities, movement, and behaviour during the day. You will also be asked to complete the *Strengths and Difficulties Questionnaire (SDQ)* regarding your experience of some of your learners in terms of behaviour and emotional difficulties. The questionnaire covers problems that you might experience in your class such as emotional conduct, peer relation problems, hyperactivity/attention deficit, and pro-social behaviour. The researcher will be available to answer any questions you might have relating to the questionnaires. You will be informed well in advance when the questionnaires will be distributed and you are requested to return the completed copies as soon as possible.

How long will it take?

All the questionnaires will not take up more than an hour of your time in total, and it is only for that specific day. All questionnaires are straightforward and relate to everyday circumstances and activities.

What do the parents/guardians have to do?

The parents/guardians of learners who meet the inclusion criteria for the study (identified as having SLD with/without ADHD, identified by the class teacher as having a functional problem and scoring ≤16th percentile on the MABC test) will be asked to complete the *Strengths and Difficulties Questionnaire (SDQ) for parents*. This questionnaire helps to detect behavioural and emotional challenges in children 3–16 years.

What do the children have to do?

All learners with SLD ~~with~~/without ADHD and identified by you the teacher as having a functional problem will be tested on the *Movement Assessment Battery for Children.* This test consists of eight items. We will ask each child to stand on one leg, hop on squares, catch and throw beanbags, etc. The test determines age-appropriate functional skills of children including balance and ball skills. This test will take 20-40 minutes and will be conducted at times that will impact minimally on learning time**.**

With the parents' consent, the learners will be asked to complete a range of questionnaires. *The EQ-5D-Y* questionnaire shows the child's view on his/her participation, and health-related quality of life. Each leaner's fitness will be assessed through the 20m shuttle run test. The test consists of a 20m course marked on opposite ends by lines of tape. Subjects are required to run between the two lines until a beep goes off. The time between the beeps is decreased for consequent shuttles. The

subject's score is determined according to the level and number of shuttles completed until the subject is unable to continue further. The learner's weight, height and BMI will also be measured.

If a child meets the requirements to be included in the study, he/she will be allocated to either the intervention group or the control group. All learners in the intervention and control groups will be reassessed on all outcome measures before they start a nine-week programme. They will also be reassessed after the nine weeks.

What if I cannot read/understand the questionnaires?

All questionnaires will be in English, but if you do not understand the English questionnaires, we will translate the questionnaire into the language of your choice. A reliable translator (a teacher at the school) will be asked to assist us in translating and explaining the instructions, but every question is straightforward.

Who will know the outcome of the tests?

Only parents/guardians will receive the results of their child. It is their decision and discretion should they wish to share the results with you as teacher.

What are the risks involved in this study*?*

For the teacher

There are no risks for you as teacher. You will be required to fill in all questionnaires as honestly as possible. You do not have to be scared that parents/caregivers will find out if you gave their child a lower score in certain sections, or that you will be threatened or victimised. All information pertaining to all participants will be kept confidential and cannot be traced back to you.

For the child

The risks include the distress caused by reports that a child is not performing within the normal range. It may be distressing for the child and his/her parents/guardians to learn that he/she is performing below the norm. Therefore, the researcher will be available to discuss any concerns or questions parents may have. Because not all learners in the school will take part in this study, the matter will be handled with utmost discretion to limit any possible stigma.

The direct risks involved to participants involved in this study will be minimal. All activities are part of children's normal daily activities. In the unlikely event of minor injuries, e.g. if any child should fall or

bump his knee, a first aid kit will be available. Though it is highly unlikely, necessary preparations will be made in case of serious injury occurring. In such an event parents/guardians and the emergency services will be contacted immediately. If counselling or other support services are required, the learner will be referred to the school psychologist.

Can I refuse to take part in this study?

Participation in this study is voluntary and will not incur any cost to you. You will not receive any financial incentive to participate. Your decision whether or not to participate will not prejudice your future relations with the participating parties nor any other institutions involved. If you decide to participate, you are free to withdraw your consent at any time and to discontinue participation at any time without prejudice. You will not suffer any discrimination if you decide not to take part.

What about privacy?

All participants will be allocated a specific number; no information will be linked in any way to you. Only the researcher will have access to participants' personal information. No names will be mentioned when I report the results of my research study. Therefore, privacy and confidentiality will be maintained at all times. You will be asked to sign a confidentiality agreement if you decide to participate. Only the parents/caregivers will receive their child's results. It is their decision and discretion should they wish to share the results with you the teacher.

Potential Benefits

The data obtained will be used to create awareness regarding the impact that DCD has on the quality of life of learners, as well as their motor activity limitations. The results obtained from this research will assist in implementing future interventions in schools, and improving education models. The research will also aim to better equip teachers to include similar programmes as part of the school curriculum. Implementation of interventions sooner rather than later, will ensure better long-term-outcomes for these learners.

No-fault clause by the University of Cape Town: What if something goes wrong?

"The University of Cape Town (UCT) undertakes that in the event of you suffering any significant deterioration in health or well-being, or from any unexpected sensitivity or toxicity, which is caused by your participation in the study, it will provide immediate medical care. UCT has appropriate insurance cover to provide prompt payment of compensation for any trial-related injury according to the guidelines outlined by the Association of the British Pharmaceutical Industry, ABPI 1991. Broadly speaking, the ABPI guidelines recommend that the insured company (UCT), without legal commitment, should compensate you without you having to prove that UCT is at fault. An injury is considered trial-related if, and to the extent that, it is caused by study activities. You must notify the researcher, the study leader, immediately of any injuries during this research occur, whether it is research-related or other related complications. UCT reserves the right not to provide compensation if, and to the extent that, your injury came about because you chose not to follow the instructions that you were given while you were taking part in the study. Your right in law to claim compensation for injury where you prove negligence is not affected. Copies of these guidelines are available on request".

If you have any concerns or questions regarding participant rights or their welfare, you can contact me or my supervisor (Dr Gillian Ferguson, 021-4066045), as well as the Human Research Ethics Committee (HREC) of the University of Cape Town (Prof. Marc Blockman, 021-4066496).

Your assistance in this matter will be greatly appreciated.

Kind regards

_____ _____

Roché Crafford
Researcher
082 227 4617
rochecrafford@gmail.com

Prof. Marc Blockman
Chairperson of HREC
021-4066496
Marc.Blockman@uct.ac.za

_____

Dr Gillian Ferguson
Supervisor
021-4066045
gillian.ferguson@uct.ac.za

L. Consent form for teachers

I, Roché Crafford (researcher), have fully explained to _____ (teacher) the purpose of this study, which is to test the effect that a group-intervention programme has on the motor abilities of children, as well as understanding the effects these motor difficulties have on their participation and function in daily life. I have tried to answer all possible questions that may concern the teachers. I have explained and clarified all procedures, risks and benefits involved in this study. I have answered and will answer all questions to the best of my ability. I will inform all teachers involved of any changes in the procedure, or the risks and benefits, should any occur, during the course of the study or after. I have also informed him/her about the time schedule for each questionnaire and procedure.

_____

Roché Crafford
Researcher
082 227 4617
rochecrafford@gmail.com

I _____ (teacher) have been satisfactorily informed of the procedure set out above, with its possible risks and benefits. I hereby agree to participate in this study through the completion of questionnaires regarding some of the children in my class. I will complete every questionnaire honestly and to the best of my knowledge, to help with the accuracy of the results. I know that Roché Crafford and her associates will be available to answer any questions I may have. I understand that participation is voluntary and I am free to withdraw this consent and discontinue participation in this project at any time, and that it will not affect my career or relationship with colleagues and parents. I was informed that there would be no financial or other remuneration if I participate in this study. I am aware that this study will not take more than an hour of my time. I have been offered a copy of this form.

_____ _____

Teacher Witness

M. Confidentiality agreement

Research title: *The efficacy of a task-oriented group-intervention programme for children with Specific Learning Disorder with co-morbid Developmental Coordination Disorder.*

This confidentiality agreement is entered into by…… (***teacher/assistant/tester***) and R. Crafford (researcher) for the purpose of preventing the unauthorized disclosure of confidential information as defined below. The researcher must take every precaution possible to protect the identity of the research participants and preserve the confidentiality of information obtained during this research. I ……. ***(teacher/assistant/tester)*** agree to the following aspects of this research:

- I understand that all the material I will be asked to record is confidential.
- I understand that the contents of the consent forms, questionnaires and MABC-2 can only be discussed with the researcher.
- I will not keep any copies of the information nor allow third parties to access them.
- I will only disclose the confidential information if required to do so by law.

The parties acknowledge that they have read and understand this agreement and voluntarily accept the duties and obligations set forth herein.

Research tester/assistant/teacher's name: _____

Research tester/assistant/teacher's signature: _____

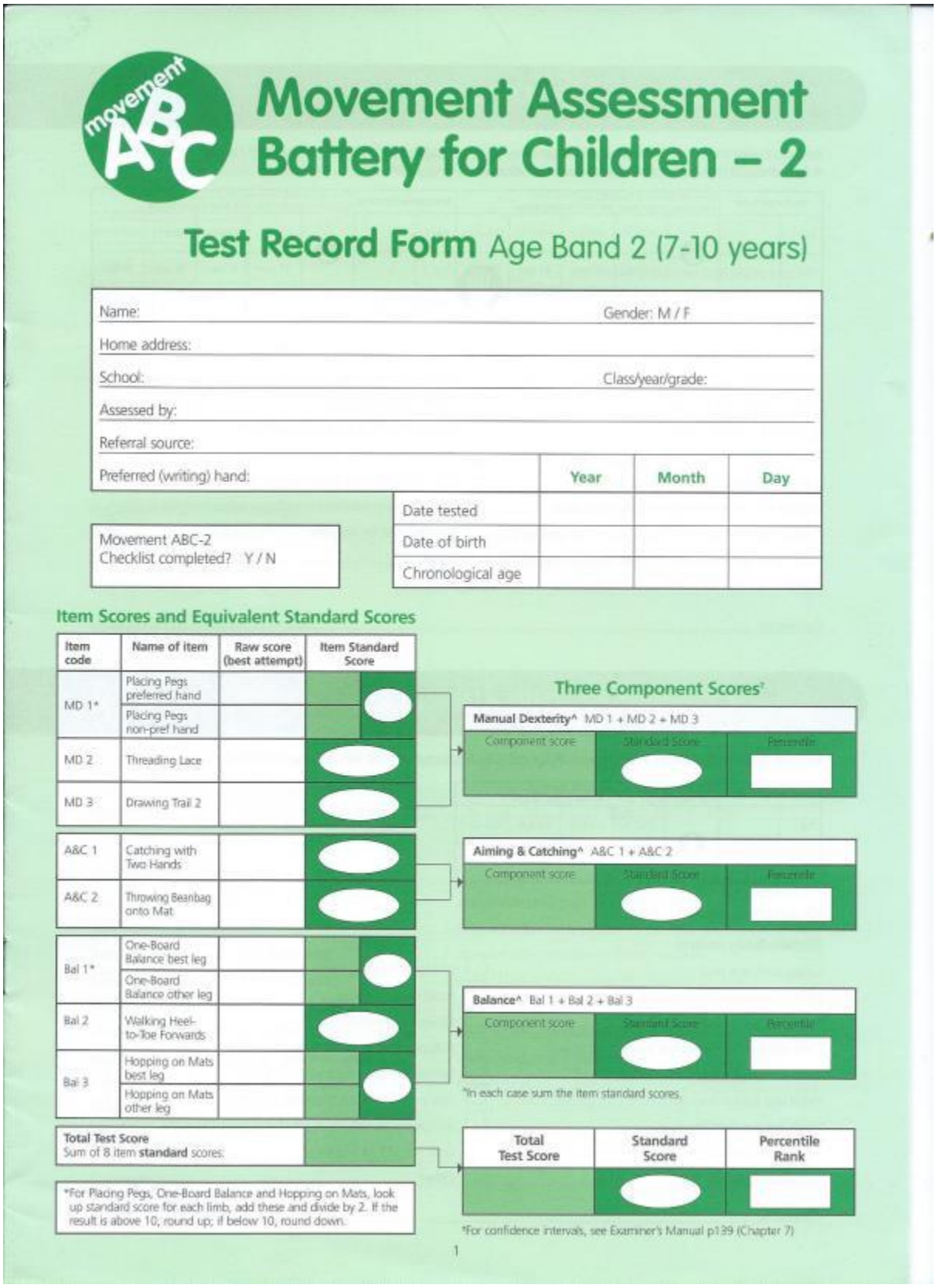
Date: _____

Researcher's name: _____

Researcher's signature: _____

Note: The research assistant/teacher will be given a copy of this form to retain for her/his record

N. Movement Assessment Battery for Children 2nd Edition (MABC-2)



Movement Assessment Battery for Children – 2

Test Record Form Age Band 2 (7-10 years)

Name: Gender: M / F

Home address:

School: Class/year/grade:

Assessed by:

Referral source:

Preferred (writing) hand:

Movement ABC-2 Checklist completed? Y / N

	Year	Month	Day
Date tested			
Date of birth			
Chronological age			

Item Scores and Equivalent Standard Scores

Item code	Name of item	Raw score (best attempt)	Item Standard Score
MD 1*	Placing Pegs preferred hand		
	Placing Pegs non-pref hand		
MD 2	Threading Lace		
MD 3	Drawing Trail 2		
A&C 1	Catching with Two Hands		
A&C 2	Throwing Beanbag onto Mat		
Bal 1*	One-Board Balance best leg		
	One-Board Balance other leg		
Bal 2	Walking Heel-to-Toe Forwards		
Bal 3	Hopping on Mats best leg		
	Hopping on Mats other leg		
Total Test Score Sum of 8 item **standard** scores:			

*For Placing Pegs, One-Board Balance and Hopping on Mats, look up standard score for each limb, add these and divide by 2. If the result is above 10, round up; if below 10, round down.

Three Component Scores*

Manual Dexterity^ MD 1 + MD 2 + MD 3

Component score	Standard Score	Percentile

Aiming & Catching^ A&C 1 + A&C 2

Component score	Standard Score	Percentile

Balance^ Bal 1 + Bal 2 + Bal 3

Component score	Standard Score	Percentile

*In each case sum the item standard scores.

Total Test Score	Standard Score	Percentile Rank

*For confidence intervals, see Examiner's Manual p139 (Chapter 7)

1

Manual Dexterity 1: PLACING PEGS

Record: Preferred hand: R / L (should be same as for Drawing Trail); Time taken (secs); **F** for failure; **R** for refusal; **I** if inappropriate (note reasons below)

Preferred hand		Only administer a second trial if the first trial takes longer than the time stated below:					Non-preferred hand		Only administer a second trial if the first trial takes longer than the time stated below:				
Trial 1			7:0-7:11	8:0-8:11	9:0-9:11	10:0-10:11	Trial 1			7:0-7:11	8:0-8:11	9:0-9:11	10:0-10:11
Trial 2			37 secs	33 secs	32 secs	29 secs	Trial 2			47 secs	41 secs	36 secs	34 secs

Qualitative observations

Posture/body control

- ☐ Sitting posture is poor
- ☐ Holds head too close to task
- ☐ Holds head at an odd angle
- ☐ Does not look at board while inserting pegs
- ☐ Does not use pincer grip to pick up pegs
- ☐ Exaggerates finger movements in releasing pegs
- ☐ Does not use the supporting hand to hold board steady
- ☐ Does extremely poorly with one hand (asymmetry striking)
- ☐ Changes hands or uses both hands during a trial
- ☐ Hand movements are jerky
- ☐ Moves constantly/fidgets

Adjustment to task requirements

- ☐ Misaligns pegs with respect to holes
- ☐ Uses excessive force when inserting pegs
- ☐ Is exceptionally slow/does not change speed from trial to trial
- ☐ Goes too fast for accuracy
- **Other** _____

Comments: _____

Manual Dexterity 2: THREADING LACE

Record: Time taken (secs); **F** for failure; **R** for refusal; **I** if inappropriate (note reasons below)

No. of seconds		Only administer a second trial if the first trial takes longer than the time stated below:				
Trial 1			7:0-7:11	8:0-8:11	9:0-9:11	10:0-10:11
Trial 2			37 secs	34 secs	29 secs	27 secs

Qualitative observations

Posture/body control

- ☐ Sitting posture is poor
- ☐ Holds materials too close to face
- ☐ Holds head at an odd angle
- ☐ Does not look at board while inserting tip of lace
- ☐ Does not use pincer grip to hold lace
- ☐ Holds lace too far from tip
- ☐ Holds lace too near tip
- ☐ Finds it difficult to push tip with one hand and pull it through with the other
- ☐ Changes threading hands during a trial
- ☐ Hand movements are jerky
- ☐ Moves constantly/fidgets

Adjustment to task requirements

- ☐ Sometimes misses hole with tip of lace
- ☐ Gets muddled in the threading sequence
- ☐ Is exceptionally slow/does not change speed from trial to trial
- ☐ Goes too fast for accuracy
- **Other** _____

Comments: _____

Manual Dexterity 3: DRAWING TRAIL 2

Note: BIC Atlantis pen to be used

Record: Hand used: R/L/Both; No. of errors; **F** for failure; **R** for refusal; **I** if inappropriate (note reasons below)
Number of errors should be counted after testing using scoring criteria provided in Appendix A of the Manual.

	No. of errors
Trial 1	
Trial 2	

Do not administer a second trial if the child completes the first trial perfectly (i.e. no errors).

Qualitative observations

Posture/body control

- Sitting posture is poor ☐
- Holds head too near paper ☐
- Holds head at an odd angle ☐
- Does not look at trail ☐
- Holds pen with an odd/immature grip ☐
- Holds pen too far from point ☐
- Holds pen too close to point ☐
- Does not hold paper still ☐
- Changes hands during a trial ☐
- Moves constantly/fidgets ☐

Adjustment to task requirements

- Progresses in short jerky movements ☐
- Uses excessive force, presses very hard on paper ☐
- Is exceptionally slow ☐
- Goes too fast for accuracy ☐
- **Other** _____

Comments: _____

Aiming & Catching 1: CATCHING WITH TWO HANDS

Note: With a bounce at 7 and 8; without a bounce at 9 and 10

Record: Number of correctly executed catches; **R** for refusal; **I** if inappropriate (note reasons below)

Practice: ☐☐☐☐☐ 10 Trials: ☐☐☐☐☐☐☐☐☐☐ Total: _____

Qualitative observations

Posture/body control

- Standing posture is poor ☐
- Does not follow trajectory of ball with eyes ☐
- Turns away or closes eyes as ball approaches ☐
- Arms are not raised symmetrically for catching ☐
- Holds hands out flat with fingers stiff as the ball approaches ☐
- Hands and arms held wide apart, fingers extended ☐
- Arms and hands do not 'give' to meet impact of ball ☐
- Fingers close too early or too late ☐
- Movements lack fluency ☐

Adjustment to task requirements

- Does not adjust body position for catching ☐
- Does not adjust position of feet as necessary ☐
- Judges force of throw poorly (too much or too little) ☐
- Does not adjust to height of rebound ☐
- Does not adjust to direction of rebound ☐
- Does not adjust to force of rebound ☐
- **Other** _____

Comments: _____

Aiming & Catching 2: THROWING BEANBAG ONTO MAT

Note: Target is the orange circle, not the whole mat

Record: Hand used: R / L / Both; Number of successful hits; **R** for refusal; **I** if inappropriate (note reasons below)

Practice: ☐☐☐☐☐ 10 Trials: ☐☐☐☐☐☐☐☐☐☐ Total:_____

Qualitative observations

Posture/body control

- Balance while throwing is poor ☐
- Does not keep eyes on target ☐
- Does not use a pendular swing of the arm ☐
- Does not follow through with the throwing arm ☐
- Releases beanbag too early or too late ☐
- Changes hands from trial to trial ☐
- Movements lack fluency ☐

Adjustment to task requirements

- Errors are consistently to one side of target (asymmetry striking) ☐
- Control of direction variable ☐
- Judges force of throw poorly (too much or too little) ☐
- Control of force is variable ☐
- **Other** _____

Comments: _____

Balance 1: ONE-BOARD BALANCE

Record: Time balanced (secs); **R** for refusal; **I** if inappropriate (note reasons below)

		No. of seconds			No. of seconds
Right Leg	Trial 1		Left Leg	Trial 1	
	Trial 2			Trial 2	

Do not administer a second trial if the child maintains balance for 30 seconds

Qualitative observations

Posture/body control

- Body appears rigid/tense ☐
- Body appears limp/floppy ☐
- Sways wildly to try to maintain balance ☐
- Does not hold head and eyes steady ☐
- Makes no or few compensatory arm movements to help maintain balance ☐
- Exaggerated movements of arms and trunk disrupt balance ☐
- Does extremely poorly on one leg (asymmetry striking) ☐
- **Other** _____

Comments: _____

Balance 2: WALKING HEEL-TO-TOE FORWARDS

Record: Number of correct consecutive steps from the beginning of the line; Whether entire line was walked successfully; **R** for refusal; **I** if inappropriate (note reasons below)

	No. of steps	Entire line?
Trial 1		YES / NO
Trial 2		YES / NO

Do not administer a second trial if the child completes 15 steps OR completes the whole line in fewer than 15 correctly executed steps.

Qualitative observations

Posture/body control

- Body appears rigid/tense ☐
- Body appears limp/floppy ☐
- Sways wildly to try to maintain balance ☐
- Does not keep head steady ☐
- Does not compensate with arms to maintain balance ☐
- Exaggerated arm movements disrupt balance ☐
- Is very wobbly when placing feet on line ☐

Adjustment to task requirements

- Goes too fast for accuracy ☐
- Individual movements lack smoothness and fluency ☐
- Sequencing of steps is not smooth/pauses frequently ☐
- **Other** _____

Comments: _____

Balance 3: HOPPING ON MATS

Record: Number of correct consecutive hops (maximum of 5); **R** for refusal; **I** if inappropriate (note reasons below)

		No. of hops			No. of hops
Right Leg	Trial 1		Left Leg	Trial 1	
	Trial 2			Trial 2	

Do not administer a second trial if the child completes 5 perfect hops on the first trial

Qualitative observations

Posture/body control

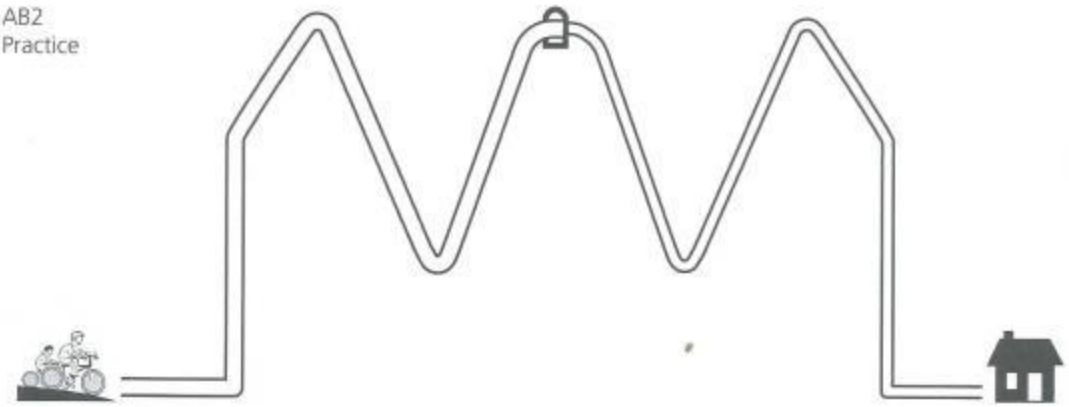
- Body appears rigid/tense ☐
- Body appears limp/floppy ☐
- Non-supporting leg held up in front of body ☐
- Hops with stiff legs/on flat feet ☐
- Lacks springiness/no push-off from feet ☐
- Arm movements are exaggerated ☐
- Arms swing out of phase with legs ☐
- Does not use arms to assist hop ☐
- Stumbles on landing ☐
- Does extremely poorly with one leg (asymmetry striking) ☐

Adjustments to task requirements

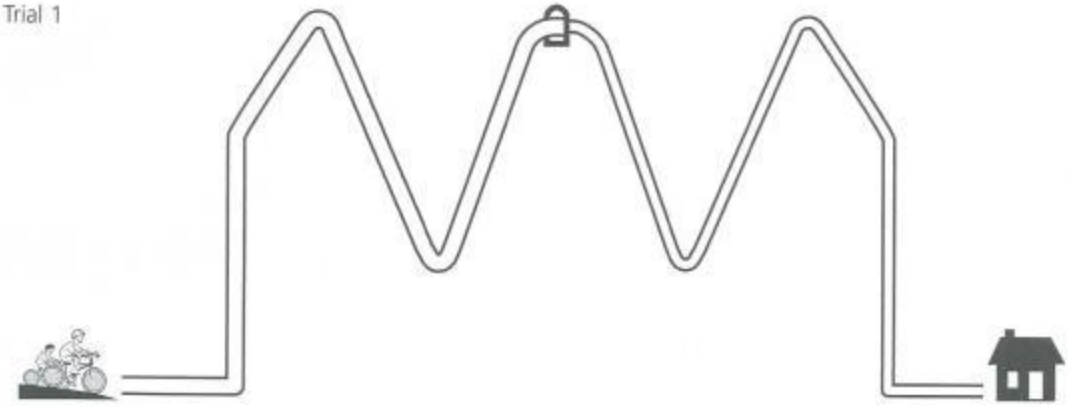
- Goes too fast for accuracy ☐
- Does not combine upward and forward movements effectively ☐
- Uses too much effort ☐
- Movements are jerky ☐
- **Other** _____

Comments: _____

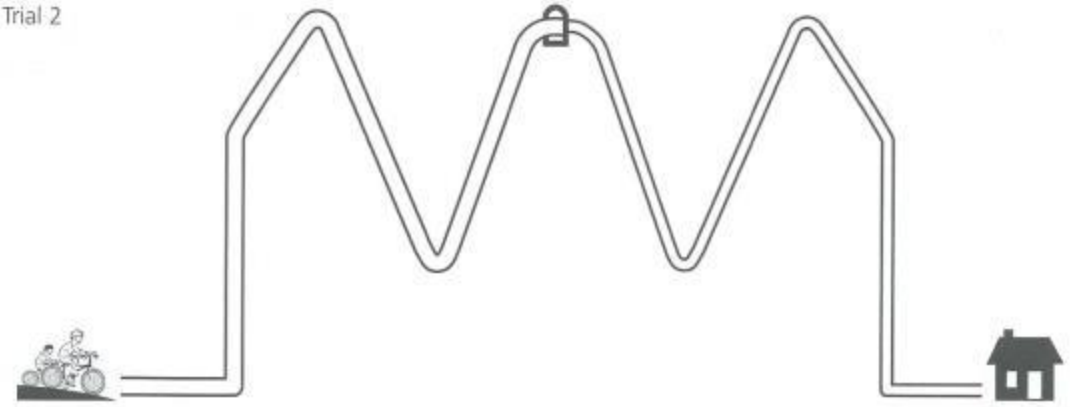
AB2
Practice



Trial 1



Trial 2



O. Movement Assessment Battery for Children (MABC) Checklist

Movement Assessment Battery for Children – 2

Checklist

Name of Child: Gender: M / F

Age: Class/Grade:

School:

Address:

Name of Respondent:

Profession: Teacher Therapist Parent Other

Date of Assessment:

Red Zone	≥ 42	≥ 25	≥ 17	≥ 13	≥ 10	≥ 7	≥ 3	≥ 2
Amber Zone	41 40 39 38 37 36 35 34	24 23 22 21 20	16 15 14 13 12	12 11 10 9	9 8 7 6	6 5 4	2 1	1
Green Zone	33 or less	19 or less	11 or less	8 or less	5 or less	3 or less	0	0
Age	5	6	7	8	9	10	11	12

Motor Competence: Section A ☐ Section B ☐ Total Motor Score: A + B = ☐

Find the child's Total Motor Score in the column appropriate for his/her age and determine whether it falls in the Red ☐ Amber ☐ or Green ☐ zone (tick one)

Non-motor factors that might affect movement

(a) Do you think the characteristics noted in Section C prevent the child from demonstrating his/her true movement capability? (circle one): **not at all / a little / a great deal**.

(b) How important will it be to consider these factors when planning an intervention programme? (circle one): **not at all / somewhat / very**.

Complete Section A and B before completing the global ratings on page 3.

Section A: Movement in a Static and/or Predictable Environment

0 = Very Well 1 = Just OK 2 = Almost 3 = Not Close NO = Not Observed		
A.1	**Self-Care Skills**	
A.1.1	Maintains balance while standing to pull on articles of clothing (e.g. trousers, skirt).	
A.1.2	Puts on articles of clothing over the head (e.g. T-shirt, sweater).	
A.1.3	Fastens buttons (e.g. on shirt, coat).	
A.1.4	Washes and dries hands.	
A.1.5	Pours liquid from one container to another (e.g. from a jug to a beaker).	
A.2	**Classroom Skills**	
A.2.1	Manipulates small objects (e.g. blocks, beads, sheets of paper).	
A.2.2	Forms letters using a pencil or pen.	
A.2.3	Uses scissors to cut paper.	
A.2.4	Walks around the classroom avoiding fixed/stationary objects and persons.	
A.2.5	Transports objects (e.g. books, pots of pens) around the room without dropping them.	
A.3	**PE/Recreational Skills**	
A.3.1	Jumps keeping two feet together on take off and landing.	
A.3.2	Hops on either foot.	
A.3.3	Throws a beanbag or ball so that another stationary child can catch it.	
A.3.4	Uses stationary gym/playground equipment (e.g. climbing frame, slide).	
A.3.5	Crosses the gym/playground avoiding collision with stationary objects/persons.	
	SECTION A TOTAL	

Additional information (optional)

Please indicate whether the child is known to have a generalised learning difficulty ☐ and/or a difficulty in: attention ☐ speech/language ☐ literacy ☐ social adjustment ☐ emotional control ☐

Section B: Movement in a Dynamic and/or Unpredictable Environment

	0 = Very Well 1 = Just OK 2 = Almost 3 = Not Close NO = Not Observed	
B.1	**Self-Care/Classroom Skills**	
B.1.1	Maintains balance when frequent adjustments are required (e.g. sitting on a bench then relocating as other children sit down; standing in a line among moving children).	
B.1.2	Moves around a busy classroom collecting in/giving out objects (e.g. books, pens).	
B.1.3	Carries a tray/drink around a room avoiding moving persons (e.g. in the dining hall).	
B.1.4	Keeps time to a musical beat by clapping hands or tapping feet.	
B.1.5	Moves body in time with music or other people (e.g. marches in line, dances in a group).	
B.2	**Ball Skills**	
B.2.1	Catches a ball using a two-handed catch.	
B.2.2	Hits/strikes a moving ball using a bat or racquet.	
B.2.3	Throws a ball while on the move so that another child can catch it.	
B.2.4	Continually bounces and keeps control of a large playground ball.	
B.2.5	Participates in a team game using skills of throwing, catching, kicking or striking.	
B.3	**PE/Recreational Skills**	
B.3.1	Rides a bicycle without stabilisers.	
B.3.2	Participates in dodging and chasing games.	
B.3.3	Maintains balance in water among other children (e.g. standing in the swimming pool).	
B.3.4	Uses non stationary gym/playground equipment (e.g. swings, scooters).	
B.3.5	Crosses the gym/playground avoiding collision with moving objects/persons.	
	SECTION B TOTAL	

Global Ratings

Overall, do you think this child has a movement difficulty? **YES / NO**

If yes, do these difficulties adversely affect the child's: (please circle)

Classroom learning	not at all	a little	a great deal
PE/recreational activities	not at all	a little	a great deal
Self esteem	not at all	a little	a great deal
Social interaction	not at all	a little	a great deal

Section C: Non-motor Factors that Might Affect Movement

	Yes	No
C.1 **Disorganised** (e.g. scattered clothes slows up dressing after PE; puts on shoes before socks).		
C.2 **Hesitant/forgetful** (e.g. slow to start complex actions; forgets what to do in the middle of an action sequence).		
C.3 **Passive** (e.g. hard to interest; requires much encouragement to participate).		
C.4 **Timid** (e.g. fearful of activities such as jumping/climbing; constantly asks for assistance).		
C.5 **Anxious** (e.g. trembles; becomes flustered in a stressful situation).		
C.6 **Impulsive** (e.g. starts before instructions are complete; impatient of detail).		
C.7 **Distractible** (e.g. looks around; responds to irrelevant noises).		
C.8 **Overactive** (e.g. squirms and fidgets; moves constantly when listening to instructions, fiddles with clothes).		
C.9 **Overestimates own ability** (e.g. tries to make tasks more difficult; tries to do things too fast).		
C.10 **Underestimates own ability** (e.g. complains of task difficulty; anticipates failure before starting).		
C.11 **Lacks persistence** (e.g. gives up quickly; is easily frustrated).		
C.12 **Upset by failure** (e.g. looks tearful; refuses to try task again).		
C.13 **Unable to get pleasure from success** (e.g. fails to respond to praise).		
Other (please specify).		

Thank you for completing this Checklist. Please return it to:

Name: _____

Address: _____

_____ Postcode: _____

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P. Strengths and Difficulties Questionnaire (SDQ Parent)

Strengths and Difficulties Questionnaire

P 4-16

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of the child's behaviour over the last six months.

Child's Name ..... Male/Female

Date of Birth.....

	Not True	Somewhat True	Certainly True
Considerate of other people's feelings	☐	☐	☐
Restless, overactive, cannot stay still for long	☐	☐	☐
Often complains of headaches, stomach-aches or sickness	☐	☐	☐
Shares readily with other children (treats, toys, pencils etc.)	☐	☐	☐
Often has temper tantrums or hot tempers	☐	☐	☐
Rather solitary, tends to play alone	☐	☐	☐
Generally obedient, usually does what adults request	☐	☐	☐
Many worries, often seems worried	☐	☐	☐
Helpful if someone is hurt, upset or feeling ill	☐	☐	☐
Constantly fidgeting or squirming	☐	☐	☐
Has at least one good friend	☐	☐	☐
Often fights with other children or bullies them	☐	☐	☐
Often unhappy, down-hearted or tearful	☐	☐	☐
Generally liked by other children	☐	☐	☐
Easily distracted, concentration wanders	☐	☐	☐
Nervous or clingy in new situations, easily loses confidence	☐	☐	☐
Kind to younger children	☐	☐	☐
Often lies or cheats	☐	☐	☐
Picked on or bullied by other children	☐	☐	☐
Often volunteers to help others (parents, teachers, other children)	☐	☐	☐
Thinks things out before acting	☐	☐	☐
Steals from home, school or elsewhere	☐	☐	☐
Gets on better with adults than with other children	☐	☐	☐
Many fears, easily scared	☐	☐	☐
Sees tasks through to the end, good attention span	☐	☐	☐

Do you have any other comments or concerns?

Please turn over - there are a few more questions on the other side

Overall, do you think that your child has difficulties in one or more of the following areas: emotions, concentration, behaviour or being able to get on with other people?

No	Yes- minor difficulties	Yes- definite difficulties	Yes- severe difficulties
☐	☐	☐	☐

If you have answered "Yes", please answer the following questions about these difficulties:

- How long have these difficulties been present?

Less than a month	1-5 months	6-12 months	Over a year
☐	☐	☐	☐

- Do the difficulties upset or distress your child?

Not at all	Only a little	Quite a lot	A great deal
☐	☐	☐	☐

- Do the difficulties interfere with your child's everyday life in the following areas?

	Not at all	Only a little	Quite a lot	A great deal
HOME LIFE	☐	☐	☐	☐
FRIENDSHIPS	☐	☐	☐	☐
CLASSROOM LEARNING	☐	☐	☐	☐
LEISURE ACTIVITIES	☐	☐	☐	☐

- Do the difficulties put a burden on you or the family as a whole?

Not at all	Only a little	Quite a lot	A great deal
☐	☐	☐	☐

Signature ..... Date .....

Mother/Father/Other (please specify:)

Thank you very much for your help

Q. Strengths and Difficulties Questionnaire (SDQ Teacher)

Strengths and Difficulties Questionnaire

T 4-17
FOLLOW-UP

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of the child's behaviour **over the last month**.

Child's Name ..... Male/Female

Date of Birth.....

	Not True	Somewhat True	Certainly True
Considerate of other people's feelings	☐	☐	☐
Restless, overactive, cannot stay still for long	☐	☐	☐
Often complains of headaches, stomach-aches or sickness	☐	☐	☐
Shares readily with other children (treats, toys, pencils etc.)	☐	☐	☐
Often has temper tantrums or hot tempers	☐	☐	☐
Rather solitary, tends to play alone	☐	☐	☐
Generally obedient, usually does what adults request	☐	☐	☐
Many worries, often seems worried	☐	☐	☐
Helpful if someone is hurt, upset or feeling ill	☐	☐	☐
Constantly fidgeting or squirming	☐	☐	☐
Has at least one good friend	☐	☐	☐
Often fights with other children or bullies them	☐	☐	☐
Often unhappy, down-hearted or tearful	☐	☐	☐
Generally liked by other children	☐	☐	☐
Easily distracted, concentration wanders	☐	☐	☐
Nervous or clingy in new situations, easily loses confidence	☐	☐	☐
Kind to younger children	☐	☐	☐
Often lies or cheats	☐	☐	☐
Picked on or bullied by other children	☐	☐	☐
Often volunteers to help others (parents, teachers, other children)	☐	☐	☐
Thinks things out before acting	☐	☐	☐
Steals from home, school or elsewhere	☐	☐	☐
Gets on better with adults than with other children	☐	☐	☐
Many fears, easily scared	☐	☐	☐
Sees tasks through to the end, good attention span	☐	☐	☐

Do you have any other comments or concerns?

Please turn over - there are a few more questions on the other side

Since coming to the clinic, are the child's problems:

Much worse	A bit worse	About the same	A bit better	Much better
☐	☐	☐	☐	☐

Has coming to the clinic been helpful in other ways, e.g. providing information or making the problems more bearable?

Not at all	Only a little	Quite a lot	A great deal
☐	☐	☐	☐

Over the last month, has the child had difficulties in one or more of the following areas: emotions, concentration, behaviour or being able to get on with other people?

No	Yes-minor difficulties	Yes-definite difficulties	Yes-severe difficulties
☐	☐	☐	☐

If you have answered "Yes", please answer the following questions about these difficulties:

• Do the difficulties upset or distress the child?

Not at all	Only a little	Quite a lot	A great deal
☐	☐	☐	☐

• Do the difficulties interfere with the child's everyday life in the following areas?

	Not at all	Only a little	Quite a lot	A great deal
PEER RELATIONSHIPS	☐	☐	☐	☐
CLASSROOM LEARNING	☐	☐	☐	☐

• Do the difficulties put a burden on you or the class as a whole?

Not at all	Only a little	Quite a lot	A great deal
☐	☐	☐	☐

Signature ..... Date .....

Class Teacher/Form Tutor/Head of Year/Other (please specify):

Thank you very much for your help

R. European Quality of Life Five Dimensions for Youth (EQ 5D-Y)

EQ-5D-Y

Describing your health TODAY

Under each heading, please tick the ONE box that best describes your health TODAY

Mobility *(walking about)*

I have no problems walking about ❑
I have some problems walking about ❑
I have a lot of problems walking about ❑

Looking after myself

I have no problems washing or dressing myself ❑
I have some problems washing or dressing myself ❑
I have a lot of problems washing or dressing myself ❑

Doing usual activities *(for example, going to school, hobbies, sports, playing, doing things with family or friends)*

I have no problems doing my usual activities ❑
I have some problems doing my usual activities ❑
I have a lot of problems doing my usual activities ❑

Having pain or discomfort

I have no pain or discomfort ❑
I have some pain or discomfort ❑
I have a lot of pain or discomfort ❑

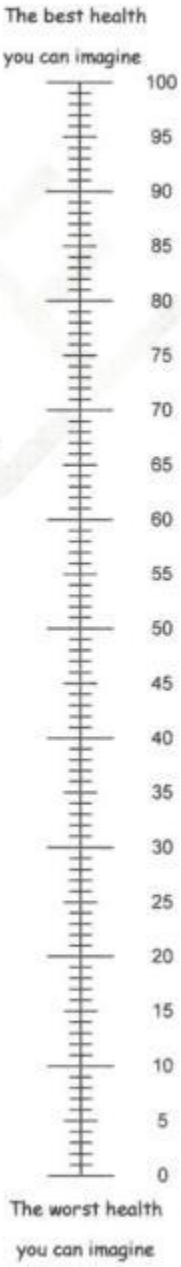
Feeling worried, sad or unhappy

I am not worried, sad or unhappy ❑
I am a bit worried, sad or unhappy ❑
I am very worried, sad or unhappy ❑

2

How good is your health TODAY

- We would like to know how good or bad your health is TODAY.
- This line is numbered from 0 to 100.
- 100 means the best health you can imagine.
  0 means the worst health you can imagine.
- Please mark an X on the line that shows how good or bad your health is TODAY.



S. Intervention programme (nine-week NTT-based programme)

Each session will include the following:

Start of session (5 minutes)

Choose one of the following goals that will be a warm-up/ice-breaker for the session:

- Running
  Run on the spot, in circles, accelerate, jump, change direction (clockwise/anti-clockwise), overtake each other etc.
- Star jumps and/or scissor jumps
- "Simon Says…"
- Wall squats/pretend to sit on a chair/count how long you can hold the position

Activities (40-50minutes)

Week 1:

Session 1 & 2

- **Running games**

Week 2:

Session 3 & 4

- **Balance Games**

Week 3:

Session 5 & 6

- **Horizontal jumping games**

  Horizontal jumping e.g. hop scotch games, rope jump games, jump to put ball in basket, jump over fence etc.

Week 4:

Session 7 & 8

- **Vertical jumping games**

  Vertical jumping, progress towards rope jumping, jumping over an object etc.

Week 5:

Session 9 & 10

- **Jumping: horizontal and vertical**

Vertical and horizontal jumping – components of skipping rope or jumping over objects

Week 6:

Session 11 & 12

- **Bimanual: throwing**

Week 7:

Session 13 & 14

- **Aiming: feet**
- **Aiming: hands**
- **Throwing and catching**

Week 8:

Session 15 & 16

- **Skipping**

Week 9:

Session 17 & 18

- **Dancing**
- **Other additional activities:**
- **Fine motor tasks (Making food and crafts)**

End of session (Reflection) (5 min)

Standing in a circle, throw a ball. When you catch the ball the instructor asks you a question about the session.

Sitting in a circle, pass a beanbag; when the beanbag is passed to you, the instructor asks you a question about the session.

- What went well?
- What did you like?
- What would you like to do differently next time?
- Which games would you like to play?
- Are there any of these activities you will try at home or on the playground?

Activities

Running games

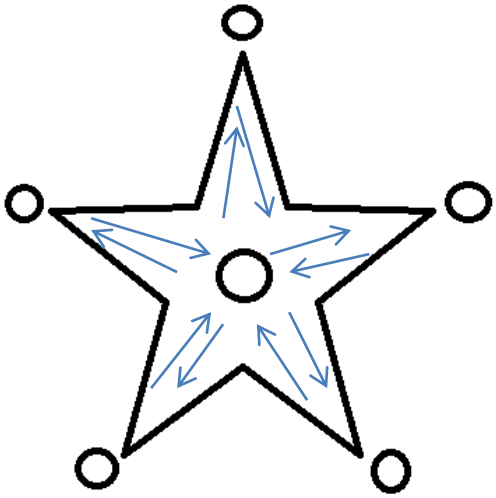
Running: agility/stopping-starting

a) Structured running - "Card Game runs"

Goal	Endurance
Description	Learners run between two cones, placed 2m apart. Run in a specific sequence. All learners run between cones. Pick a course where an adult can be stationed at both ends, each having several decks of playing cards. When the runners get to one end or the other they are dealt a card. They keep this card and run back to the other end to get a second card. Continue running back and forth, getting a card each time. When they have five cards, they can keep new cards by trading in one from their hand. The goal is to have the hand with the highest point total when the run ends. Aces are worth 11 points and face cards are worth 10 points.
Duration	5 min
Repetitions	10 shuttle runs between cones
Speed	Comfortable speed
Rest	After 10 shuttle runs, rest 30 seconds
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task), progress to next exercise or variation
Group size	4 learners
Variation	Increase distance between cones from 2m to 4m etc.

b) Unstructured running - "Star run"

Goal	Endurance
Description	Learners run between two cones, placed 2m apart, but there can only be one learner at a cone at a time. The cones are placed 2m apart from a central point. Explain what a star shape is. Learners

	must run from the middle cone to each cone to form a star. Only one learner at a time at a cone, when another learner arrives, the learner at the cone must run back to the central point and to the next cone.
Duration	5 min
Repetitions	As many shuttles in time allowed
Speed	As fast as they can, if two learners are at the cone at the same time they must immediately run to the other cone
Rest	After 10 shuttle runs, rest 30 seconds
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task), progress
Group size	2 learners
Variation	Increase distance between cones from 2m to 4m etc.

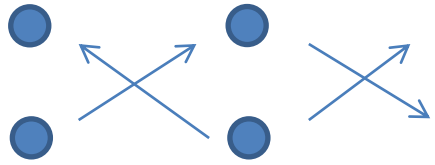
c) Variation of (a) and (b) – "Cheetah Runs"

Goal	Endurance and Speed
Description	Learners try to run to the cone to get there before the other learners. Running between cones, increase distance between cones from 2m between cones to 4m etc. Cones can be placed in a straight line
Duration	5 min
Repetitions	10 shuttle runs or as many as learners can achieve in 5 min
Speed	Learner can decide speed – encourage faster

	speed
Rest	After 10 shuttle runs, rest 30 seconds
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task before they are too tired), progress
Group size	2 learners

d) Running and changing direction – "Shadow Run"

One learner is the runner and one is the shadow. The runner must decide if he/she is running at angles/left to right/running around the cone/touching the cone and the shadow runner must follow and do exactly what the runner does.

Goal	Agility
Description 	Running between cones, changing direction • Run at angles (criss-cross with cones in two lines) • Change direction (run from left to right then from right to left) • Run to the cone/run around the cone/touch the cone
Duration	5 min
Repetitions	10 shuttle runs
Speed	Learner can decide speed
Rest	After 10 shuttle runs, rest 30 seconds
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task before they are too tired), progress
Group size	2 leaners

e) Running speed - "Frozen Statues".

Instructor blows a whistle and the learners must "freeze" on the spot. Learners must reach the cone before the whistle blows

Goal	Speed
Description	Instructor blows a whistle and the learners must "freeze" on the spot. Learners must reach the cone before the whistle blows.

Duration	5 min
Repetitions	Reaction time – learners running from cone to cone, blow whistle. Long reaction time to shorter reaction time. 10 repetitions, vary reaction time
Speed	Increase speed, start with comfortable speed, and increase to faster speed
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task before they are too tired), progress
Group size	4 learners
Variation	One type of speed (walking) progress to walk-run-walk and variation in speed

f) Running speed, agility and endurance – "Tag"

Goal	Connecting principles: Speed, Endurance, Agility
Description	Playing "Tag" - One learner at a time gets to be the catcher. Chases other kids until touches them, swop roles.
Duration	5 min
Repetitions	Allow all learners to have a chance to be the catcher
Speed	-
Rest	As needed
Criterion to go on with next exercise	-
Group size	4 learners

g) Running speed, agility and endurance - "Froggie Tag"

Goal	Connecting principles: Speed, endurance, agility
Description	Frog tagging (playing tag) One learner is standing with a ribbon in the back of their pants. Try to get to the ribbon

	of the person in front of you by jumping frog jumps may be while keeping your feet together. Vary in ribbon length/progress to string
Duration	5 min
Repetitions	Allow all learners to have a chance to be the catcher
Speed	-
Rest	As needed
Criterion to go on with next exercise	-
Group size	4 learners

Equipment needed:

- Cones
- Whistle
- Pieces of ribbon and string

Balance Games

Walking / running in balance situations

a) Walking on a line -"Tightrope walking in the circus"

Goal	Balance , dynamic
Description	Learner walks on a line on the ground, masking tape Example of game: Two lines close to each other, one learner walking on each line. One start end one beginning 1) Passing each other 2) Turning when they meet 3) Handing over something
Duration	10 min
Repetitions	10 repetitions
Speed	Walking speed
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task without stepping off line), progress If learners can complete task with variation – progress to combined task
Group size	4 learners, taking turns
Variation	Increase distance (longer line) Increase speed walking →running
Connecting Tasks: (combining two tasks)	Vary walking on line – walk heel to toe, walk on toes, and walk on heels

b) Walking while holding objects- "Balancing act"
Staying with the circus theme, pretend to balance objects on head etc*.*

Goal	Balance , dynamic balance

Description	Start with: Balance the bean bag on head, on shoulder, etc. Walk around without dropping bean bag "Market Place": Play a game of selling items at the market. Place a towel ring on your head with basket/bucket manoeuvre in between stationary objects and moving kids/"cars".
Duration	10 min
Repetitions	As many times as possible
Speed	Walking speed
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task without dropping bean bags), progress If learners can complete task with variation – progress to combined task.
Group size	4 learners, all participating at the same time
Variation	Therapist says light turns green/orange/red/ traffic, etc. Example: Two learners want to get fast to the same customer and they see who can get there first, etc. This game includes: 1. Change direction 2. Add obstacles like cones to walk around 3. Increase distance learners have to walk 4. Change underground – progress to more unstable surface/mat/carpet/grass 5. Add obstacles like cones to walk → run around (increase speed)
Connecting Tasks: (combining two tasks)	Walk/step over objects while balancing bean bag

	Walk across objects in circuitry

Equipment needed:

- Cones
- Beanbags
- Towels
- Mats
- Masking tape to make a line

Horizontal Jumping

E.g. hop scotch games, rope jump games, jump to put ball in basket, jump over fence etc.

a) Jumping forward - "Long jump"

Tell the learners a story about the Olympics and long jump. Tell the learners about winning medals at the Olympics etc.

Goal	Improve Jumping in horizontal direction
Description	Jump with two feet from starting point to next cone Cones placed in a row
Duration	10 min for exercise in total, 30 sec of jumping in series of 10 repetitions, resting as needed between sets. Repeating as many as possible.
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed after each set of 10
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping from cone to cone), progress If learners can complete task with variation – progress to combined task
Group size	4 learners, all participating at the same time
Variation	Move cone further or see how far learners can jump Small jumps make jumps bigger Vary in distance (further) Jump from cone to cone in a straight line Jump from cone to cone zig zag Jump forward/backwards/to the left/right

Connecting Tasks: (combining two tasks)	Run-up before jumping with two feet

b) Horizontal jumping – "Kangaroo jumping"

Talk about animals that can jump. Ask learners if they know what a kangaroo looks like and where they live.

Goal	Improve Jumping in horizontal direction
Description	"Kangaroo Jumping" : Jump with two feet from starting point to next cone Cones placed in a row
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping from object to object), also complete precision activity If learners can complete task with variation – progress to combined task
Group size	2 learners, taking turns
Variation	Start with jumping without a cone → cones→ big hoops → smaller hoops
Connecting Tasks: (combining two tasks)	Run-up before jumping with two feet

c) Horizontal jumping – "Giant Kangaroo jumps"

Goal	Improve Jumping in horizontal direction
Description	Jump with two feet from starting point to next cone Cones placed in a row

Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping from object to object), and have completed jumping task If learners can complete task with variation – progress to combined task
Group size	2 learners
Variation	Jump to the left or the right/inside/outside hoop (Precision)

d) Jumping forward – "Hop-scotch"

Combine jumping forward in a horizontal direction with jumping to a target.

Description	Learners try to jump with two feet from starting-point (hoop) to next hoop. Connecting principles of jumping in a horizontal direction with precision and direction change. Jump two feet together, hop on one leg, etc.
Duration	10 min
Repetitions	10 repetitions, then progress
Group size	4 learners

Equipment needed:

- Cones
- Whistle
- Rope
- Hoops

Vertical jumping

Learners progress towards jumping over a rope, jumping over an object etc**.**

a) Vertical jumping - "Hop Don't Stop"

Learners must pretend that they have springs under their feet and must jump as high as possible.

Goal	Improve jumping in vertical plane
Description	Jump with two feet; see how high you can jump
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping from object to object), and has completed jumping task If learners can complete task with variation – progress to combined task
Group size	4 learners
Variation	Small jumps make jumps bigger Vary in height (measure) "Who can jump the highest?"

b) Vertical jumping – "Jolly jumper"

Goal	Improve jumping in vertical plane
Description	Jump with two feet; see how high you can jump
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed

Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping over object), and has completed jumping task If learners can complete task with variation – progress to combined task
Group size	2 learners
Variation	Jump over a line → rope → stick Jump over a rope forward/backward/sideways Jump over a stick forward/backward/sideways

c) Vertical jumping – "Lily pads" or "Leap frog"

Goal	Improve jumping in vertical plane
Description	Jump with two feet over an object held by therapist/assistant
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping over object), and has completed jumping task If learners can complete task with variation – progress to combined task
Group size	2 learners
Variation	Start with jumping over a rope on the ground → at shin level → at knee level → higher? Jump to the left or the right/inside/outside hoop (Precision) Jump over rope no movement → movement

	Move side to side → swing overhead

d) Connecting principles of jumping up and over – "Leap frog"

Goal	Jumping in vertical plane
Description	Jump over objects in various ways
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping over object), and have completed jumping task If learners can complete task with variation – progress to combined task
Group size	2 learners
Variation	Combine up and over Run-up before jumping with two feet over a cone/rope/block Step over a stick at ankle/shin/knee level Jump over a stick at ankle/shin/knee level

e) Connecting principles /Complex task - "Skipping rope"

Goal	Combined skills: vertical jumping + timing = skipping rope
Description	Each learner receives a skipping rope, attempts skipping with rope
Group size	4 learners
Duration	10 min
Repetitions	As many as needed, allow learner to experiment

Equipment needed:

- Cones
- Rope
- Stick
- Hoops
- Skipping ropes

Jump vertical and horizontal – components of skipping rope or jumping over objects

a) Jumping in vertical and horizontal planes – "Kangaroo hopping"

Goal	Jumping in vertical and horizontal plane
Description	Learner tries to jump with two feet from starting point (first cone) to the next cone. See how many jumps the learner can achieve in a row, hopping like a kangaroo. Important to bend the knees, hands in front of body.
Duration	15 min
Repetitions	>10 repetitions, jumping from cone top cone, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping cone to cone), and have completed jumping task If learners can complete task with variation – progress to combined task
Group size	4 learners, two groups of 2
Variation	Hoops/cones close together, increase distance Jump next to cones, progress to jump in hoops Jump forward/backward/sideways Jump to the left or the right/inside/outside hoop (Precision)

b) Connecting principles /Complex task

Goal	Jumping in vertical and horizontal plane with timing
Description	Learner tries to jump with two feet from starting point (first cone) to the next cone.
Duration	15 min
Repetitions	>10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping cone to cone), and have completed jumping task If learners can complete task with variation – progress to combined task
Group size	4 learners
Variation	Increase/decrease amount of times learners jumps in one turn "Kangaroo race/kangaroo chase" (Increase speed - time) Jump with two feet together Standing on one leg – change it to flamingo hops

Equipment needed:

- Cones
- Hoops

Bimanual – throwing

a) Throwing - "Flying Objects"

Goal	Throwing
Description	Pretend that the ball is a flying object and by throwing it you are making it fly. Standing in a circle, one learner stands in the middle of the circle. Aiming with balls: arm-hand overhead throwing two hands/one hand. Learner in the middle throws to learners in the circle. Take turns to throw.
Duration	15 min
Repetitions	10 repetitions, per learner, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by throwing 7/10 accurately) If learners can complete task with variation – progress to combined task
Group size	4 learners
Variation	Vary in distance (make the circle smaller →bigger) Vary in one/two handed throw Vary in light/heavy ball Vary in throwing to learner across/next to/etc. Vary in throwing with a bow/straight/bounce Vary ball size (tennis ball/soccer ball/bigger ball) Throw to a friend (aim is throwing not catching) Throw to a bucket/into a hoop/net

	Vary in dribble before throwing (bounce the ball x amount of times)

b) Connecting principles throwing while moving - "Moving flying objects"

Goal	Throwing
Description	Standing in a circle, one learner stands in the middle of the circle. Aiming with balls: arm-hand overhead throwing two hands/ one hand. Learner in the middle throws to learners in the circle. Take turns to throw, learners moves, thrower stays
Duration	15 min
Repetitions	>10 repetitions, then change thrower
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by throwing 7/10 accurately) If learners can complete task with variation – progress to combined task
Group size	4 learners
Variation	Clockwise/counter-clockwise. Taking turns to throw

c) Connection principles /complex task – "Basketball"

Goal	Throwing – bimanual use of the hands
Description	Playing basketball
Duration	15 min
Repetitions	Taking turns, playing
Speed	-

Rest	If needed
Criterion to go on with next exercise	
Group size	4 learners

Equipment needed:

- Tennis balls
- Soccer ball
- Bigger ball
- Basketball hoop

Aiming: feet

a) Aiming with feet – "Dribbling the ball"

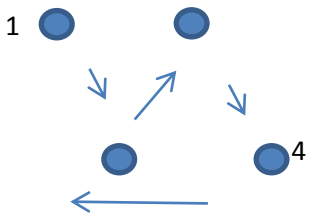
Goal	Aiming with feet, accuracy
Description	Dribbling the ball with feet
Duration	10 min
Repetitions	10 repetitions, then progress to variation
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by aiming accurately 7/10 times) If learners can complete task with variation – progress to combined task
Group size	4 learners, each with a ball
Variation	Increase distance between cones Vary in light/heavy ball Decrease ball size (big ball/soccer ball/tennis ball) Walk from one cone to the opposite side whilst dribbling the ball with feet Dribble around the cones/through and around

b) Connecting principles accuracy and aiming - "Laduma! Kick for goal"

Goal	Aiming with feet
Description	Kick ball towards ten pins to knock it over
Duration	15 min
Repetitions	>10 repetitions, then progress
Speed	-

Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by accurately aiming at objects) If learners can complete task with variation – progress to combined task
Group size	4 learners, each with ball
Variation	Use right and left foot alternating Variation balls size (tennis ball/soccer ball/bigger ball) Distance between learners and target increases Increase speed Start walking, progress to running Learner moves, receives ball at certain spot

c) Aiming and kicking the ball - "Aim is the name of the game!"

Goal	Kicking/aiming with feet
Description  	Ball is kicked back and forth, between the 2 rows from one end of the line to the opposite end and then back to the start (1-2-3-4-1…etc.)
Duration	10 min
Repetitions	16 repetitions, then progress
Speed	Start by kicking slowly Ask learners to kick faster
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by kicking accurately most

	kicks) If learners can complete task with variation – progress to combined task
Group size	4 learners
Variation	Increase distance between learners

d) Connecting principles - "Listen to the whistle"

Goal	Kicking/aim with feet
Description	Reaction time – use a whistle to indicate when to kick Kick with left/right foot Kick between two cones Kick to a learner Kick to the learner across/next to
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by kicking accurately 7/10) If learners can complete task with variation – progress to combined task
Group size	4 learners, two groups
Variation	Use right and left foot alternating Make the goals smaller Increase distance between learners, when kicking to each other

e) Connection principles /Complex task – "Soccer"

Playing Soccer – learners play soccer in two teams

10-15 minutes

Equipment/material:

- Cones
- Whistle
- Soccer ball
- Bigger ball
- Tennis ball

Aiming and throwing: hands

a) Aiming and Throwing - "Tennis"

Goal	Aiming and Throwing
Description	Bean bag "tennis" Throw a bean bag to the child standing opposite him/her Catch the bean bag on the bat without dropping it Start with adult throwing the bean bag/ball to learners
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by catching at least 7/10 times) If learners can complete task with variation – progress to combined task
Group size	4 learners in two groups
Variation	Increase distance between learners Bean bag → soft ball →tennis ball Progress to learner throwing to another learner Start with tennis bat, progress to a smaller bat (table tennis bat)

b) Connecting principles – "Bean bag bats"

Goal	Aiming and throwing
Description	Throw a bean bag to the child standing opposite him/her (learner to learner) Catch the bean bag on the bat without dropping it Reaction time – use a whistle to indicate when to throw See if the learner can pretend the bean bag is a pancake and the bat is a pan – "Flipping Pancakes"
Duration	15 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by catching at least 7/10) If learners can complete task with variation – progress to combined task
Group size	2 learners
Variation	Use two hands to hold the bat/throw Use one hand to hold the bat/throw

c) Connection principles /complex task – "Bean bag tennis"

Goal	Aiming and throwing
Description	Progress to "tennis" between two learners
Duration	15 min
Repetitions	As many as needed / game
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e.

	complete the task by accurately aiming 7/10)
Group size	4 learners in groups of 2
Variation	

Equipment needed:

- Cones
- Whistle
- Bean bag/soft ball/tennis ball
- Tennis bat/wooden bat/table tennis bat

Catching an object

a) Catching games - "Cold potato, hot potato"

Learner catches the ball when it is a "cold potato" and then throws it back to the therapist because it is a "hot potato". Repeat the words or create a song using "Hot potato, cold potato".

Goal	Catching an object
Description	Try to catch a middle-to-large size, easy-to-catch ball. Therapist/assistant throws the ball to learners.
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by catching at least 7/10 times) If learners can complete task with variation – progress to combined task
Group size	4 learners, 2 adults
Variation	Increase distance between learner and thrower Vary in power Vary in ball size Vary in bounce/straight/bow Learner has to turn 180° before catching

b) Connecting principles - "Catching the flying fish in a bucket"

Goal	Catching an object
Description	Start with adult throwing the bean bag to learner holding the bucket, learners catches

	beanbag in bucket
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by catching at least 7/10 times) If learners can complete task with variation – progress to combined task
Group size	2 learners
Variation	Increase distance between learner and thrower Vary in power Vary in ball size Vary in bounce/straight/bow Learner has to turn 180° before catching

c) Connection principles /Complex task: - "Listen to the whistle"

Goal	Catching an object
Description	Reaction time – throw the object when learner hears the whistle.
Duration	15 min
Repetitions	10 repetitions, then progress
Speed	Increase/decrease time between whistles
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by catching at least 7/10 times) If learners can complete task with variation – progress to combined task

Group size	4 learners, two groups
Variation	Progress to learner throwing to another learner Progress to catching beanbag/ball in hands and putting it in the bucket

Equipment needed:

- Cones
- Whistle
- Beanbag/soft ball/tennis ball
- Buckets

Skipping

a) Jumping and coordination – "Five Little Monkeys"

Five little monkeys, Jumping on the bed. One fell off, And bumped his head
Mama called the doctor, And the doctor said: "No more monkeys jumping on the bed!"

Goal	Jumping and coordination
Description	Jump over objects in various ways – Jump with two feet; see how high you can jump Small jumps make jumps bigger Vary in height (measure) "Who can jump the highest?"
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping over object), and has completed jumping task If learners can complete task with variation – progress to combined task
Group size	2 learners
Variation	Jump over a line → rope → stick Jump over a rope forward/backward/sideways Jump over a stick forward/backward/sideways Start with jumping over a rope on the ground → at shin level → at knee level → higher?

b) Skipping over a moving rope – "England, Ireland, Scotland, Wales"

Description	Jumping over a rope that is moving to progress to skipping
Variation	Jump over rope no movement → movement Move side to side → swing overhead (Start with 2 learners holding a rope, swing from side to side) Start with skipping and running to improve rhythm → progress to rope
Group size	2 learners
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping over object), and has completed jumping task If learners can complete task with variation – progress to combined task

c) Skipping over a moving rope – "Banana, banana, banana split"

Goal	Jumping and coordination
Description	Jump over a moving rope
Duration	10 min
Repetitions	10 repetitions, then progress
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping over rope) If learners can complete task with variation – progress to combined task where learner has his/her own rope
Group size	4 learners
Variation	Progress to learner gets his/her own rope Start with heavy rope, progress to lighter rope

Equipment needed:

- Masking tape to make a line
- Stick
- Rope
- Skipping ropes

Chores/making food

a) Fine motor and manual dexterity task, baking biscuits (if possible use real dough)

Goal	Fine motor/manual dexterity
Description	Playing with play dough – baking biscuits Activity can take place sitting at a table
Duration	20 – 40 min
Repetitions	-
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by making biscuits)
Group size	4 learners
Variation	Rolling it out Rolling in different directions Holding the rolling pin with two hands Making balls and pressing it flat Big → Small balls of dough
Connecting principles	Cutting the play dough with a toy knife Using cookie cutters Packing the cut outs on a plate Using Marie Biscuits, mix icing sugar and water, put on biscuits, decorate with Smarties

Equipment needed:

- Play dough
- Real dough, if possible
- Rolling pin
- Cookie cutter
- Toy knife
- Plates
- Marie Biscuits, icing sugar, water, mixing bowl, spoon, knives, Smarties

Dancing

a) Coordination and motor planning – "Dance party"
Play music learners like to which they can dance

Goal	Coordination and motor planning
Description	Learners dance by doing various things, start with free moves → copy the therapist
Duration	20 min
Repetitions	Repeat until learners are able to perform a short routine by copying therapist
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task)
Group size	4 learners
Variation	Free moves → Copy the therapist Imitate/shadow dance Teach simple dance move (e.g. stepping/moving in different directions) Dance to music, music stops → "Freeze" Teach simple routine (only a few steps → progress to more complex sequence)

b) Connecting principles , coordination and motor planning – "Makarena"

Goal	Coordination and motor planning
Description	Learners copy the therapist by doing a simple dance like the "Makarena"
Duration	20 min

Repetitions	Repeat until learners are able to perform a short routine
Speed	-
Rest	If needed
Criterion to go on with next exercise	-
Group size	4 learners
Variation	Progress to more complex dance moves Memorise short routine

Equipment needed

- Music
- Radio/CD player

Cutting/gluing/crafts

a) Fine motor and manual dexterity - "Let's make a small present for teacher"

Goal	Fine motor skills/Manual dexterity
Description	Cutting, gluing, folding – making a card or an artwork
Duration	20 min
Repetitions	Complete one "gift"/"craft
Speed	-
Rest	If needed
Criterion to go on with next exercise	If learners are successful in this task (i.e. complete the task by jumping over object), and has completed jumping task If learners can complete task with variation – progress to combined task
Group size	4 learners, each working on individual project
Variation	Cutting an easy shape – circle More difficult shape – square, triangle, "ice cream" etc. Stick picture on page – glue bigger pieces, glue smaller pieces

b) Connecting principles, more complex task

Progress to cutting, gluing, coloring, folding, etc.

Goal	Fine motor skills/manual dexterity
Description	Activity performed sitting at the table
Duration	20 min
Repetitions	Complete one “gift”/”craft
Speed	-
Rest	If needed
Criterion to go on with next exercise	-
Group size	4 learners, each corking on their own project
Variation	Paper → cardboard Glue stick → more liquid glue Colouring crayons → pencils

Equipment needed:

- Scissors
- Paper
- Glue
- Glitter, stickers, etc.