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School-Based Teacher Motor Interventions for Pupils with Cerebral Palsy in Ghana

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ABSTRACT

This paper presents the findings of a study that utilized three focus groups in unearthing school-based teacher motor skill interventions for pupils with cerebral palsy and related challenges in Ghana. Overall, 23 teachers (12 males; 11 females) selected through maximum variation sampling constituted the different focus groups. Whereas teachers implemented a number of motor skill activities for pupils with cerebral palsy on a daily basis, majority emphasized fine motor skill activities, utilized task-specific motor training strategies and applied explicit motor skill instructions. Teachers generally did not utilize the concept of stages of motor learning in their respective motor skill interventions. Furthermore, some teachers found implementing developmentally appropriate motor skill interventions challenging. It is recommended that teachers endeavour to incorporate more gross motor skill activities as they have the potential to boost fine motor skills. Again, teachers should incorporate implicit motor skill instructions in teaching motor skill activities to pupils with cerebral palsy as these pupils may have limited capacity for explicit motor skill instructions.

Keywords: Fine Motor Skills, Gross Motor Skills, Pupils with Cerebral Palsy, School-Based

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I. Introduction

Cerebral palsy (CP) is most characterized by motor disabilities and defined as "a group of disorders of the development of movement and posture, causing activity limitations that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain" (Rosenbaum *et al*., 2007, p. 8). Despite being described as a non-progressive condition, the motor disabilities in CP tend to be more prominent as the infant/child ages (MacLennan *et al*., 2015). For the typically developing infant, the development of motor skills spans the first year of life to adulthood and comprise of basic motor skills and recreational motor skills (Haywood & Getchell, 2014). Basic motor skills are sub-divided into gross and fine motor skills. Whereas gross motor skills are those required for whole body movement such as walking, climbing and standing, fine motor skills pertain to skills required for manipulating objects and typically involve movements of the fingers, wrist and hand. Writing, turning pages, and buttoning clothing are prime examples of fine motor skills. Whereas gross and fine motor skills are obviously distinguishable, the bulk of motor skills activities require concurrent use of both gross and fine motor skills (Krebs, 2000).

Motor skills are essential indicators of school readiness and critical for academic performance of pupils (Sandler *et al*., 1992; Sortor & Kulp, 2003). Gross motor skills enable pupils to navigate and explore the school environment, assume and maintain appropriate postures as well as provide the endurance necessary for a full day at school. Furthermore, gross motor skills are essential in honing fine motor skills (Brook *et al*., 2017). As an example, a pupil's ability to support his/her upper body on a seat is linked to writing ability (Kid Sense Child Development, 2017). By contrast, quality and speedy accomplishment of classroom related tasks are contingent on fine motor skills. Furthermore, recent research have affirmed that development of fine motor skills are linked to improvement in math and reading abilities of pupils (Pagani *et al*., 2010; Grissmer *et al*., 2010).

Whereas motor skills of most typically developing children may be developed age 5 years (Ulrich, 2000), children with CP usually have delayed motor skills beyond the aforementioned age (Van Rooijen *et al*., 2012). On the specifics of foundational elements of motor skills such as strength, agility, balance, flexibility, co-ordination, proprioception and reaction time, children with CP have consistently scored lower compared to their typically developing peers (Barela *et al*., 2011; Saavedra *et al*., 2009; Berg-Emons *et al*., 1996).

II. Review of Related Studies

This study is underpinned by the dynamic system theory and reinvestment theory. The dynamic system theory, first proposed and developed by Thelen (1989) asserts that movement arises from the interaction of multiple sub-systems that emanates from three constraints; the individual, the task and the environment. None of the aforementioned constraints is ranked higher than the other in terms of producing efficient movement but rather, work in spontaneous pattern formation to produce efficient movement. Specific to this study, dynamic system theory holds that classroom motor skills of pupils with CP could be positively influenced through task modification and provision of an optimal environment and often without explicit instructions from teachers.

The reinvestment theory, also known as Masters' conscious processing hypothesis proposed by Masters (1992) and further developed by Masters *et al*. (1993) postulates that relatively automated motor processes could be disrupted if consciously accessed task relevant declarative knowledge are used to control the mechanics of one's movement. The theory holds that motor learning progresses from a verbal knowledge stage in which motor performance is consciously controlled and requires attention for successful execution to a procedural stage in which little to no attention is required (Maxwell *et al*., 2003). More importantly, the theory postulates that motor skills acquired without large amount of task-relevant declarative knowledge, also known as implicit motor learning tends to significantly reduce the propensity for reinvestment and allows for better motor performance.

Whereas some studies (Dalvand *et al*., 2012; Van Rooijen *et al*., 2012; Barela *et al*., 2011) have focused on the potential negative consequences of poor motor skills in pupils with cerebral palsy, there is paucity of studies proffering school-based motor skills interventions for pupils with cerebral palsy. Furthermore, the diverse and varied nature of motor disabilities among pupils with cerebral palsy makes challenges associated with teaching motor skills inevitable. Indeed, some teachers attested to experiencing challenges with motor skills interventions during the researcher's preliminary interaction with them in Ghana.

A number of motor skill interventions aimed at improving the motor skills of pupils with cerebral palsy may be applied by teachers. These school-based motor interventions are usually not executed in isolation but integrated as part and parcel of classroom activities and targets the developmental level of pupils rather than their chronological age. Most of these interventions tend to be functional based and are either task-specific or process-specific (Blank *et al*., 2012). Task-specific motor training is context-specific in which the training is solely focused on skills required to accomplish specific task or tasks. The training focuses on improving motor performance through goal directed practise and repetition. Thus, there is similarity between the motor intervention by the teacher and the very goal of that same intervention. Additionally, pupils undergoing task-specific training typically receive feedback from the teacher (Hubbard *et al*., 2009). Process-specific motor training on the other hand aims to improve motor skills by enhancing body functions such as sensory integration, perception and muscle strength. Thus, process-specific motor training is geared towards remediating impairment. However, the bulk of motor skill interventions, including school-based motor interventions may be task-specific as it is much easier to implement and has generally proven to be more effective than the process-oriented approach (Yu *et al*., 2018).

Beyond the type of school-based motor skill intervention that may be utilized by teachers, different authors have expressed varied opinions on the desirable duration and frequency required for these interventions to be most effective. Indeed Gordon *et al*. (2011) makes the argument the frequency of motor intervention may be more important in improving the motor skills of pupils with cerebral palsy than the type of intervention. The author asserted different motor interventions that were implemented at the same duration and frequency tended to yield similar outcomes for pupils with cerebral palsy. Johnston (2009) asserts greater duration and frequency of motor interventions is required to achieve improved motor skills outcomes in pupils with cerebral palsy. Martin (2006) by contrast named specific motor interventions that may be applied by teachers and their respective optimal duration and frequencies. The author asserted stretching for pupils with cerebral palsy should be done daily and last between 5 and 15 minutes whereas balance training should be done as frequently as possible. By contrast, gross motor activities aimed at strengthening should be done three to four times a week for best results.

Arpino *et al*. (2009) on the contrary deduced greater duration and frequency (defined as greater than three sessions per week) yielded an overall small effect compared to motor interventions that were less intense for pupils with cerebral palsy. The authors further deduced that beyond the frequency and duration per session, motor skill interventions for pupils with cerebral palsy need to be executed over an extended period of time to be most effective.

In spite of the fact that most gross motor skills training for pupils may be done outdoors, some gross motor interventions are applicable in the classroom. Most gross motor skill intervention in the classroom are executed during short breaks between lessons or incorporated as part of teachers' lesson (Stewart *et al*., 2004). Gross motor activities that may be executed during lesson breaks may include stretching, jumping, running on the spot and other physical activities that involve whole body movement. By contrast, gross motor skills that are incorporated in lessons may be used to demonstrate solutions to problems in academic areas such as math, geography and geometry. As an example, in math, pupils may demonstrate any fraction by moving and placing themselves in particular sections of the class demarcated by the teacher until that fraction is illustrated by the number of students within specific demarcations. Alternatively, geographical locations may be taught in the classroom by making pupils move to specific areas of the classroom marked as north, south and other similar geographical designations. Geometric figures may be demonstrated by making pupils move and form shapes such as triangles, circles and other similar geometrical figures (Donnelly *et al*., 2009).

On the specific activities geared towards improving fine motor skills, Rule and Stewart (2002) established the nature of the activity rather than the amount of activity, is most crucial to improving fine motor skills. Strevig (2009) advocates teachers should utilize three main activities within the classroom: cutting, writing, drawing, and manipulation of small objects. However, these activities should begin with a freehand approach before pupils attempt to refine them. Pupils attempting cutting for example should start with freehand cutting before progressing to cutting out specific shapes. Similarly, writing, drawing should begin with open ended activities before gradually evolving to more specific activities including tracing and copying using different writing instruments. Cantu (2004) advocates the making of crafts within the classroom could go a long way to boost the fine skills of pupils as craft making involves multiple fine motor activities. Poole *et al.* (2005) emphasized that selected fine motor activities by teachers should not be physically exhausting or frustrating for pupils. The author further asserted that providing appropriate materials for different skill levels would reduce exhaustion and frustration among pupils practicing fine motor activities.

Martin (2006) listed other factors that are crucial for effective teaching of motor skills. These factors include motivation of the pupil with cerebral palsy, encouraging active exploration by the pupil with cerebral palsy, demonstration of motor skill by teachers, variability in teaching motor skills, and intermittent feedback to the pupil with cerebral palsy.

Generally, teaching motor skills takes one of two approaches; explicit motor learning or implicit motor learning. Explicit motor learning is the more traditional approach of motor learning in which it is anticipated learning progresses from verbal-cognitive stage to a final autonomous stage in which the movement is automatized by the learner (Maxwell *et al.*, 2003). Kleynen *et al.* (2014, p. 5) defined explicit motor learning as "learning which generates verbal knowledge of movement performance such as facts and rules, involves cognitive stages within the learning process and is dependent on working memory involvement". It often involves the accrual of declarative knowledge related to motor skills and is dependent on conscious processes.

Implicit motor learning on the other hand bypasses the initial accrual of declarative knowledge characteristic of explicit motor learning. Rather, motor skill learning involves the direct accumulation of procedural knowledge of the motor task. Thus, implicit motor learning is not dependent on conscious processes as well as working memory. Typically, learners are unable to describe the technicalities related to performing the motor skill (Kal *et al*., 2013). Compared to explicit motor learning, implicit motor learning is characterized by a greater level of automaticity and minimal conscious control. The greater automaticity of motor skills acquired implicitly insulates learners from resorting to declarative knowledge during motor performance (reinvestment), especially when under pressure of fatigue or during dual task (Kal *et al*., 2018). Implicit motor learning may be achieved through errorless practice, use of familiar analogies, and simplification of motor task (Tse *et al*., 2001). Errorless practice involves guiding the performer in the motor skill such that errors are reduced to the barest minimum. This is assumed to reduce the need for task relevant declarative knowledge and encourage implicit motor learning (Poolton *et al.*, 2005). Using familiar analogies to teach a motor skill involves relating the movement to a fundamentally similar concept. This is believed to encourage implicit motor learning and indeed Liao and Masters proved novice tennis players who applied analogical learning in hitting the ball generally performed better under psychological pressure compared to those subjected to explicit motor skill instruction.

For the novice, motor skill acquisition, like several other skills, goes through different stages. In the first stage of motor skills learning, the learner attempts to acquire explicit knowledge related to the basics of the particular motor skill. Typically, the learner applies cognitive and verbal processes at this stage. It is generally agreed that motor skill acquisition goes through three stages: cognitive, associative, and autonomous stages (Fitts & Posner, 1967).

The cognitive stage of motor skills acquisition, also known as the verbal-motor stage, primary involves the conveyance and assimilation of new knowledge related to the specific motor skill. It is characterized by huge gains in performance; the performance however is typically inconsistent. It is during this stage that instructions, guidance, and augmented feedback are most critical to improving motor skills (Schmidt & Lee, 2005).

The associative stage is less verbal, more conscious, with relatively minor gains in motor skills. By this stage, the learner has discovered the best way to execute the motor skill and consciously makes subtle adjustments to achieve the best execution. The movement is generally more fluent and efficient as the learner attempts to convert declarative knowledge into a procedural one. Typically, the associative stage tends to last longer (Schmidt & Lee, 2005).

The autonomous stage is the final stage of motor skills. At this stage, motor skills are largely automatized, with minimal conscious processing. Further, the learner has the luxury of processing other information not linked to the primary motor skill. Whereas the autonomous stage requires less cognitive and attentional engagements, the learner may experience certain disadvantages. First, it may create ample opportunity for irrelevant and distracting thoughts in the mind of the learner. Second, the autonomous stage may reinforce the execution of incorrect motor skills as a certain level of comfort and confidence would have been achieved by this stage. The autonomous stage may take several months or years to achieve (Huber, 2020).

Implementing motor skills interventions have often been challenging for most teachers. Knowledge related to stages of motor learning, motor learning approaches and developmentally appropriate motor skill interventions are critical for effective teaching of motor skills. However, Graham (2013) emphasized "inadequate knowledge and training on developmentally appropriate motor skill interventions" (p. 6) on the part of teachers as the most prominent barrier that militates against the teaching of motor skills in the classroom. The author further asserts that in the few instances that teachers had a clear idea of developmentally appropriate motor skill interventions, they were uncertain of the frequency, intensity and duration

essential to implementing these interventions. Similarly, Donica and Lust (2015) in their study of the challenges experienced by teachers in teaching motor skills in the classroom asserted the vast majority of these teachers lacked the technical knowledge and experience to implement appropriate motor skill interventions. The authors further make the argument teachers' lack of knowledge and training on motor skills interventions represents a significant barrier towards improving the motor skills of these pupils as compared to clinicians, teachers have the most contact hours with affected pupils. Specific to cerebral palsy, Saavedra, Joshi, Woollacott and van Donkelaar (2009) asserted inadequate knowledge and training in motor skill interventions on the part of teachers is further compounded by the heterogeneous nature of CP in which different pupils with cerebral palsy may require unique or modified motor skill interventions.

Inadequate materials and assistive devices that enhance motor skills training in the classroom have the potential to hamper teachers' motor skill interventions. Within school settings, Brown (2014) based on a study that assessed how teachers prioritized motor skills training makes the argument that whereas materials and assistive devices for gross motor training may be obvious to teachers, they may not be privy to those required for fine motor training. This argument is reaffirmed by Cameron *et al*. (2012) who found more than half of teachers were not familiar with assistive devices related to fine motor training in a study that focused on school-based fine motor activities of pupils with cerebral palsy. Graham *et al*. (2007) asserted that the absence of these materials and devices on some occasions makes it impossible for teachers to administer any effective fine motor intervention as some pupils with cerebral palsy are absolutely dependent these materials and devices. Furthermore, Berry (2009) asserted that some pupils with cerebral palsy may overexert themselves in their efforts to practice fine motor activities without the requisite assistive devices. This often results in fatigue on the part of pupils with cerebral palsy and further strains the effort of teachers in teaching fine motor skills.

Teaching motor skills to pupils with cerebral palsy is a painstaking effort that requires allocating significant amount of time in the classroom. As an example, Donnica and Lust (2015) observed nearly half of all pupils with cerebral palsy required some level of assistance from their teachers in practicing writing, further underscoring the significant amount of time required to teach motor skills. The enormous amount of time required to teach motor skills in the classroom tend to deter some teachers from implementing motor skills activities (Graham, 2013), especially for teachers without teaching assistants. Furthermore, Brown (2010) revealed nearly half of all teachers believed motor skill interventions were so time consuming they disrupted other equally relevant lessons. The author further revealed the majority of teachers found it difficult calming pupils with cerebral palsy down, especially after gross motor activities, negatively impacting classroom management.

Individuals with CP, including pupils with cerebral palsy are particularly prone to fatigue and this tends to limit their participation in motor skills activities. In these individuals, the fatigue may be manifested in difficulties with concentration, behaviour problems, sleepiness, irritability, slowness of movement and the onset of tremors (Hirsh *et al*., 2010). Brunton and Rice (2012) further state that pupils with cerebral palsy may require greater energy to execute the same amount of motor activity as their peers without CP, further limiting their ability to partake in motor activities over extended periods. Hirsh *et al*. (2010) pupils with bilateral CP are most prone to fatigue during motor skills activities. The authors further asserted that the easy fatigability on the part of pupils with cerebral palsy means teachers need more time to take these pupils through motor skills activities in school settings.

Ensuring the safety of pupils with cerebral palsy occasionally tends to limit the extent to which some teachers implement motor skills interventions in the classroom. Relative to gross motor training, loss of balance and potential falls among pupils with cerebral palsy is a challenge teachers must manage with caution, especially when space is limited. Fine motor activities in the classroom usually involve the use of sharp and pointed tools including scissors, paintbrushes, pens and pencils. For pupils with cerebral palsy with deficits in fine motor skills, the threat of injuries from these tools is increased several folds (Cameron, 2012). However, Donnica and Lust (2011) make the point that injuries rarely occurred when pupils with cerebral palsy were consistently supervised during fine motor.

III. Methodology

A. Study Sample

Maximum variation sampling was applied in selecting 23 participants who formed the three focus groups. Focus Group 1 (FG 1) was made up of 7 teachers from Yumba Special School, 8 teachers from Garden City Special School constituted Focus Group 2 (FG 2). Finally, 8 teachers from Twin City Special School formed Focus Group 3 (FG 3). Teachers ought to have thought for a minimum of two years to be included in the study.

B. Data Collection

Data collection in this current study was preceded by the signing of informed consent form between researcher and participants. Focus group discussions were carried out in three of the special schools involved in this study in the following order: Yumba Special School, Garden City Special School and Twin City Special School and followed a similar protocol. The discussions were typically scheduled in the evening (3-5pm) when teachers were done with their respective lessons and were held on the respective school premises. Participants sat around a table with the researcher. At the start of each discussion, the researcher explained the purpose, procedures, and rules of the discussions and informed participants of their rights as well. In order to encourage equal participation, participants were encouraged to respect each other's opinions, privacy and confidentiality. Participants were further encouraged to express their honest opinions and were free to pass comments on other participants' responses. All participants were given the opportunity to respond to every question posed during the discussion. The focus group guide was organized around

the research questions underpinning this study. The researcher led the focus group discussions. The entire session was audio-taped whereas the researcher made hand-written notes as well. Each focus group discussion lasted approximately 70 minutes.

C. Data Analysis

Focus group discussion data were summarized using thematic analysis. In this study, thematic analysis of data was executed sequentially in the following phases: transcription, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Transcription involved transcribing the recorded audio data into a written one. As a general rule, 5 minutes of dialogue was followed by 15 minutes of transcription.

The next phase involved generating initial codes based on repeating patterns in the data set. In this current study, colour coding was applied. The coding process was a cyclical one involving back and forth between the data set to settle on the final themes. The themes generated from the coding were then linked to the research questions to gain better perspective. The initial themes generated were then applied to form broader patterns within the data set by combining it with coded data. Additionally, the potential relationships between different themes were examined.

The themes generated were then reviewed by searching for data that support the proposed themes. This was crucial for revising, expanding, and condensing some themes. Additionally, themes were scrutinized for their coherent patterns. Next, the entire thematic map was analyzed for consistency with the data set. The next stage involved re-naming all themes and making a write-up of their significance as related to the data set.

Producing the report was the final stage of the thematic analysis and focused on a straightforward, clear and concise presentation of the story as depicted by the data set. The final themes were linked to the research questions to produce a coherent report. Generally, the report supported the research questions. Additionally, extracts were included to support specific themes and points raised in the narrative.

IV. Results

Table I presents the demographic characteristics of participants involved in the three focus groups. Overall, 23 teachers (12 males; 11 females) participated in the three different focus groups. The mean age of participants involved in the focus group discussion was 39.1 years (sd=6.6). The majority of participants were special teachers. Over half of teachers had attained a bachelor's degree. Participants' teaching experience ranged from 2 to over 10 years with all participants having encountered a pupil with cerebral palsy in the classroom.

TABLE I: Demographic Characteristics of Focus Group Participants

Demographic	Male f (%)	Female f (%)	Total n (%)
Age (years)			
20-29	3 (25)	2 (18.2)	5 (21.7)
30-39	5 (41.7)	4 (36.4)	9 (39.1)
40-49	4 (33.3)	5 (45.5)	9 (39.1)
Teachers' Background			
Special Teacher	11 (91.7)	10 (90.9)	21 (91.3)
Regular Teacher	1 (8.3)	1 (9.1)	2 (8.7)
Level of education			
Diploma	2 (16.7)	3 (27.3)	5 (21.7)
Bachelor's Degree	7 (58.3)	7 (63.6)	14 (60.9)
Post-graduate	3 (25.0)	1 (9.1)	4 (17.4)
Years of Experience			
2	2 (16.7)	2 (18.2)	4 (17.4)
3-5	4 (33.3)	5 (45.5)	9 (39.1)
6-10	4 (33.3)	2 (18.2)	6 (26.1)
Over 10	2 (16.7)	2 (18.2)	4 (17.4)
Experience with PWCP			
Yes	12 (100)	11 (100)	23 (100)
No	0 (0)	0 (0)	0 (0)

Note. PWCP = Pupils with Cerebral Palsy, f = frequency, n = number of units

The themes from the three groups are summarized under the major topics that were presented to them for discussion: specific activities employed in teaching motor skills to pupils with cerebral palsy, mode of instructing pupils with cerebral palsy during motor skill activities, incorporation of stages of motor learning, frequency of motor skill instruction, and duration of motor skill instruction per session. Pseudonyms adopted by participants were applied in the narrative.

A. Specific Activities Employed in Teaching Motor Skills to Pupils with Cerebral Palsy

The following themes were dominant based on the focus group discussion: "writing", "drawing", "object manipulation", "short breaks for stretching" and "activities of daily living". Within each focus group, majority of teachers emphasized their respective motor skill interventions often targeted fine motor skills. For example, Kenneth (FG 2) emphasized the bulk of their motor skills interventions for pupils with cerebral palsy focused on honing fine motor skills.

> *Writing and handling smaller objects and materials is a major problem for the two pupils with cerebral palsy in my class. Due to this, I make a lot of time for them to practise them. They have little challenge with walking about but holding a writing instrument and other activities involving the use of the hands are quite difficult tasks for them*. (Verbatim expression of Kenneth)

Freda (FG 3) was among participants, though in the minority, who reported applying both gross and fine motor skill interventions for pupils with cerebral palsy. Freda stated:

> *I make my pupils with cerebral palsy do fine motor skills such as writing, drawing, and object manipulation. Later, once they have improved, I proceed with more complex writing and drawing. However, I often give my class stretching breaks … when a lesson goes beyond 30 minutes.* (Verbatim expression of Freda)

When probed further as to why they did not implement gross motor activities as much as fine motor activities, teachers explained pupils with cerebral palsy had numerous opportunities to practise gross motor skills beyond the classroom whereas certain fine motor skills could only be done in the classroom. Furthermore, in some instances, space for gross motor activities was at a premium. Karim (FG 1) said the following:

> *Pupils with cerebral palsy do a lot of gross motor activities on their own. They walk at home and walk in school and do the other gross motor activities as well. But when it comes to fine motor skills such as writing, the only opportunity they may have is the classroom*. (Verbatim expression of Karim)

It is instructive to note that majority of teachers employed task-specific motor training, which focuses on goal directed movement and task accomplishment.

B. Issuing Instructions to Pupils with Cerebral Palsy during Motor Skills Activities

Teachers generally asserted it was important to issue specific instructions to pupils with cerebral palsy during motor skills activities as they required some level of guidance. Per teachers' own account, both verbal and non-verbal instructions were applied during motor skill interventions in the classroom. However, majority of teachers had a preference for verbal instruction during motor skills activities. Ama (FG 3) gave thorough description of how she issued motor skill instructions to pupils with cerebral palsy.

> *I usually start by giving a brief verbal description of the process to the pupil. It serves to prepare them both psychologically and physically for the motor activity. I start by explaining the entire process of the motor activity to them.* (Verbatim expression of Ama)

Some teachers further conceded they did not often issue instructions for gross motor skills activities in the classroom as they believed executing gross motor skills did not involve numerous details compared to fine motor activities. Mary (FG 1) passed the following comment:

> *If you take stretching for instance, the pupil with cerebral palsy assumes a standing position and stretches the arm and trunk. It is actually instinctive; all us here stretch when we are tired of sitting or wake up in the morning. Compare that to a fine motor activity like tying shoelaces which involves a lot of manipulation from the fingers.* (Verbatim expression of Mary)

However, in both FG 2 and FG 3, some participants, though in the minority expressed views contrary to that of Mary and asserted it was necessary to issue instructions for gross motor skills in order to achieve optimal gross motor performance in the classroom. Freda (FG 3) stated the following:

> *For most pupils with cerebral palsy to perform decent fine motor skills, they need to have decent gross motor skills. For example, pupils with cerebral palsy can write better with the fingers if they can position the whole arm properly. Positioning of the arm to allow for fine motor skills is a gross motor activity and the pupil with cerebral palsy can benefit a lot if given good instruction on that.* (Verbatim expression of Freda)

It is informative to note that the vast majority of teachers' response on motor skill instructions focused on fine motor activities. Apparently, these teachers did not deem it necessary to issue instructions for gross motor skill activities in the classroom. Furthermore, it is obvious most teachers adopted an explicit motor learning approach. These findings have obvious implications for motor skill interventions in the classroom.

C. Incorporating the Specific Stages of Motor Learning in Teaching Motor Skills to Pupils with Cerebral Palsy

Whereas teachers generally admitted to not applying specific stages of motor learning in teaching motor skills to pupils with cerebral palsy, some adopted an incremental approach in teaching motor skills whereas others-based motor skills activities solely on the tolerance levels of pupils with cerebral palsy. Kojo (FG 1) said:

> *In my experience, children with cerebral palsy tend to get tired easily during motor activities. Therefore, I design the classroom motor skill activities to reduce the impact of tiredness on the part of pupils with cerebral palsy.* (Verbatim expression of Kojo, FG 1)

Though teachers may have developed their unique ways of introducing motor skill activities to pupils with cerebral palsy, the fact that they did not incorporate the stages of motor skill learning could impact the effectiveness of their respective motor skill interventions.

D. Incorporating Developmentally Appropriate Activities in Teaching Motor Skills to Pupils with Cerebral Palsy

On the implementation of developmentally appropriate motor skill activities, some teachers found it worthwhile whereas others thought it was not always feasible. The following comment by Freda (FG 3) and Francis (FG 2) are representative of the different perspectives on developmentally appropriate motor skill activities.

> *Naturally pupils with cerebral palsy are at different motor skill levels. Due to these differences, I make moderate changes to the motor skill activities for individual pupils with cerebral palsy even if the entire class is participating in that particular activity*. (Verbatim expression of Freda)
>
> *On one occasion, all pupils in my class were doing gross motor skills in the form of sit to stand stretches. There was this pupil with cerebral palsy who had challenges with trunk control. Due to his poor trunk control, I often focus on appropriate sitting whereas the others engage in sit to stand stretches. However, because the vast majority of the pupils were engaged in the sit to stand and probably because he found that activity fascinating as well, he was always eager to join the sit to stand activities which is quite risky for him as he tends to suffer falls due to the poor trunk control.* (Verbatim expression of Francis)

E. Incorporating Progressive Motor Skill Activities in Teaching Motor Skills to Pupils with Cerebral Palsy

Whereas some teachers generally employed a progressive approach in teaching motor skills to pupils with cerebral palsy, others viewed different motor skill activities as

independent of each other and did not generally apply a progressive approach. Comments from Eric (FG 1) and Yaw (FG 3) were generally representative of the different perspectives.

> *The pupil with cerebral palsy typically will learn the motor skill faster if the progressive approach is used. In my class the progressive approach is applied to both gross motor skills and fine motor skills. When it comes to gross motor skills for example, I do engage my pupils with appropriate sitting and standing posture before making them walk in the classroom*. (Verbatim expression of Eric)
>
> *I believe the situation is quite different in pupils with cerebral palsy. The condition may affect one part of the body whereas leaving the other side completely unaffected; therefore you may be surprised that they may find a relatively difficult motor task easier if let's say the activity involves only one side of the body. On the other hand they may struggle with activities that involve the use of both hands*. (Verbatim expression of Yaw)

F. Frequency of Teaching Motor Skills to Pupils with Cerebral Palsy

Teachers generally asserted they taught motor skill activities on a daily basis as the different lessons of the day typically involved some motor activities.

> *In my class there is no day that we don't do motor skill activities. These activities are fundamental to what I teach … and I always ensure it is done daily. My school is acutely aware of the importance of motor skill activities for pupils with cerebral palsy. It is part of my lessons and there is literally no subject that does not involve motor skills*. (Verbatim expression of Mary, FG 1)

G. Duration of Motor Skills Activities on Average

On the average duration of motor skill activities for pupils with cerebral palsy in their respective classrooms, some teachers estimated the typical session lasted 15 minutes whereas others emphasized duration was dependent on how long pupils with cerebral palsy tolerated a particular motor skill activity.

> *I believe the nature of the activity, how well they are enjoying it and sometimes whether other pupils are engaged in that same activity determines how long that particular motor activity lasts. What I have observed is that, pupils with cerebral palsy who have mild intellectual disability are able to do motor skill activities for far longer periods compared to those with severe and profound disabilities*. (Verbatim expression of Adwoa, FG 2)
>
> *On average I will put it at 15 minutes. In my experience this is the period within which pupils with cerebral palsy are most engaged with the motor activity. It is also the time period within which they are able to follow instructions better and are most efficient.* (Verbatim expression of Ernestina, FG 1)

V. Discussion

The focus group discussions revealed the majority of teachers emphasized fine motor skill activities in the classroom whereas few teachers consistently applied both gross and fine motor activities. Gross motor skills applied by some teachers included stretching breaks, walking breaks, appropriate sitting, and trunk control. These gross motor activities are largely consistent with those suggested by Stewart *et al*. (2004) as well as Donnelly *et al*. (2009). Fine motor skills applied by teachers included writing, painting, drawing and object manipulation. Whereas these fine motor activities are consistent with those recommended by Strevig (2009) as well as Cantu (2004), the finding suggests that majority of teachers find fine motor skills more critical to classroom activities compared to gross motor skills. Indeed, some teachers admitted to the aforementioned assertion.

These contentions by some teachers could hamper the development of crucial gross motor skills required for classroom and school activities in general. Though pupils with cerebral palsy may have opportunities to practise gross motor skills activities outside of school, school-based gross motor activities present unique opportunities to practice the gross motor skills most relevant to school activities. Furthermore, Brook *et al*. (2017) asserted gross motor skills are crucial in developing fine motor skills. Thus, the fact that some teachers did not focus on gross motor skills could derail any fine motor activity they implement. In the same vein the few teachers who implemented both gross and fine motor activities are likely to complement the development of the two-skill set in pupils with cerebral palsy.

It is obvious teachers employed task-specific motor interventions in teaching motor skills to pupils with cerebral palsy. Hubbard *et al*. (2009) stressed task-specific motor training is geared towards skills relevant for achieving specific tasks. Yu *et al*. (2018) further stated that compared to process-specific motor training, task-specific motor training is much easier to implement and potentially more effective. Thus, chances are high that pupils with cerebral palsy being exposed to these task-specific motor activities would improve. More importantly, the task-based approach applied by teachers is consistent with the dynamic systems theory underpinning this study. The aforementioned theory asserts task-specific motor intervention is one of three ways of teaching and potentially improving motor skills.

The focus group discussions established teachers largely adopted the explicit motor learning approach which has a number of implications for their respective motor skill interventions per the reinvestment theory applied in this study. First, it generates relatively larger amount of verbal knowledge, also known as declarative knowledge and is dependent on conscious processes as well as working memory of pupils with cerebral palsy (Maxwell *et al*., 2003; Kleynen *et al*., 2014). Second, applying the explicit motor learning approach means pupils with cerebral palsy are likely to resort to declarative knowledge especially when experiencing psychological pressure or fatigue (Maxwell *et al*., 2003; Mullen *et al*., 2007). Considering the fact that pupils with cerebral palsy have underlying brain injury and may have limited working memory as well, learning motor skills via the explicit motor learning approach may represent

an arduous task for these pupils. More importantly, Poolton *et al*. (2004) asserted the greater the amount of declarative knowledge a learner accumulates, the higher the chances of reinvestment, especially when under pressure or experiencing fatigue. In reinvestment, relatively automated motor skills are disrupted as an individual makes the effort to recollect declarative knowledge related to those motor skills. This would naturally lead to a drop in the motor skill performance of pupils with cerebral palsy.

It is informative to note that reinvestment is largely associated with the left half of the brain (Crews & Landers, 1993; Steenbergen & van der Kamp, 2008). Thus, pupils with cerebral palsy with right hemiplegia may be insulated to some extent from experiencing reinvestment during motor skills activities due to disruption in working memory responsible for verbal storage. However, this should not be construed as an advantage per se when it comes to motor learning, as Maxwell *et al*. (2003) asserted some level of declarative knowledge may be required at the first stage of motor learning.

It is revealing that the bulk of explicit motor instructions by teachers applied to fine motor skills. Teachers generally perceived gross motor skills too simplistic to warrant instructions. This finding has the potential to negatively impact gross motor development of pupils with cerebral palsy, especially those required for school-based activities. Gross motor skills, like any other motor skill can be learned and improved upon. Furthermore, as stated earlier, improvement in gross motor skills could positively influence the development of fine motor skills as most motor activities require concurrent use of both set of motor skills.

Linked to the issue of motor skill instructions by teachers is the application of stages of motor leaning during motor activities by pupils with cerebral palsy. Teachers generally acknowledged they did not implement stages of motor learning in teaching motor skills to pupils with cerebral palsy, but rather adopted an incremental approach whereas others based motor interventions solely on the tolerance levels of pupils with cerebral palsy. Though an incremental or tolerance level approach may be useful in teaching motor skills, applying the stages of motor learning would ensure teachers are better positioned to anticipate the progress pupils with cerebral palsy make and guide them accordingly.

Fitts and Posner (1967) suggested some amount of declarative knowledge may be useful in the first stage of motor learning (verbal-cognitive stage) as learners tend to apply both verbal and cognitive processes in the early stages of learning a novel motor skill. It is a stage characterized by huge gains in performance; however, the performance is typically inconsistent. Instructions, guidance and augmented feedback by teachers on the motor performance of pupils with cerebral palsy may be most useful at this stage (Schmidt & Lee, 2005). In the second stage, also known as associative stage, the learner attempts to convert declarative knowledge to procedural knowledge. At this stage teachers ought not to issue verbal instructions as pupils with cerebral attempt to discover more efficient ways of executing a particular motor skill. In the final stage, also known as autonomous stage, the motor skill is largely automatized and teachers may then focus on newer motor skill.

It should be noted that whereas some teachers adopted an incremental or progressive approach in teaching motor skills to pupils with cerebral palsy, other teachers were not conversant with the progressive approach or simply thought it was unnecessary. These teachers not adopting a progressive approach to teaching motor skills may potentially overwhelm pupils with cerebral palsy as a result of which these pupils may not show the anticipated improvement in motor skills. For example, Strevig (2009) advocated fine motor activities such as cutting, writing, drawing, and manipulation of objects by pupils with cerebral palsy should start with a free hand approach before pupils attempt to refine the aforementioned tasks.

The fact that some teachers did not implement developmentally appropriate motor skill interventions in the classroom has the potential to undermine their efforts towards improving the motor skills of pupils with cerebral palsy. Indeed Graham (2013) stressed inadequate knowledge on developmentally appropriate motor interventions as a huge challenge for teachers. As stated by Van Rooijen *et al*. (2012) as well as Woollacott and Burtner (1996), motor skills of pupils with cerebral palsy may not be dependent on their respective chronological ages; their motor skills may be dependent on the underlying motor impairment and related factors. Thus, some teachers not applying developmentally appropriate interventions implies some pupils may be engaged in motor activities above or below their developmental levels. Pupils with cerebral palsy engaging in motor skill activities above their respective developmental levels may find the task arduous, lose interest or not show much improvement after several sessions. Conversely, pupils with cerebral palsy engaging in motor skill activities below their respective developmental levels suggests these pupils may not be getting the opportunity to practise the more complex motor skills required of their respective developmental levels.

The findings revealed teachers generally engaged pupils with cerebral palsy in motor skill activities on a daily basis. Although some teachers emphasized focusing on the quality of movement rather than task accomplishment was most important, the finding is important in several ways. Gordon *et al*. (2011) emphasized the frequency of motor activity may be more crucial in improving motor skills than the type of intervention based on a study that applied the same frequency and duration to different motor skill interventions. Johnston (2009) also makes the point that greater frequency of motor skill activities tend to improve motor skills of persons with cerebral palsy.

Optimal duration of gross and fine motor skills has always been a contentious issue. In this current study, some teachers targeted an average of 15 minutes per session for fine motor activities whereas others based duration of motor skill activities (both gross and fine motor skills) purely on the tolerance levels of pupils with cerebral palsy. Similar to this finding, different authors have proposed different durations for motor skill activities. Martin (2006) believes different motor activities require different durations. The aforementioned author believes gross motor activity such as stretching should be done 5-10 minutes whereas balance training should be done as much as possible. Arpino *et al*. (2009) by contrast advocates greater duration of gross and

fine motor skills may not necessarily be effective. The fact some teachers based duration of motor activities on tolerance levels of pupils with cerebral palsy is reasonable. Indeed, the focus group revealed pupils with cerebral palsy were prone to fatigue and limited mental concentration during motor skill activities. Hirsh *et al*. (2010), as an example asserted pupils with cerebral palsy may be prone to fatigue during motor skills activities which may truncate those activities. The author further stated this fatigue may be manifested in the form of difficulties with concentration, behaviour problems, sleepiness, irritability, slowness of movement and the onset of tremors.

VI. Recommendations

In light of the finding that teachers tended to emphasize fine motor skill activities, teachers need to incorporate more gross motor skill activities in the classroom on a consistent basis. As articulated in the discussion section, gross and fine motor skills are intrinsically linked and emphasis on one set of skill may serve to derail acquisition of both vital skill sets. Whereas teachers may conceive gross motor skill activities as requiring a lot of classroom space, there are a number of creative ways to undertake these activities. Sit to stand activity as an example, represent simple but effective gross motor activity that fits the classroom setting. For this activity to fit meaningful gross motor activity, it has to be repeated a number of times during a session. As an example, ten repetitions of sit to stand activity should be meaningful gross motor skill activity for pupils with cerebral palsy. During the aforementioned activity, teachers should observe how pupils execute the activity whereas giving minimal verbal instructions. Again, teachers may incorporate gross motor skills into the different lessons of the day. As an example, Donnelly *et al.* (2009) recommends pupils may demonstrate any fraction by walking and placing themselves in particular sections of the class demarcated by the teacher until that fraction is illustrated by the number of students within specific demarcations. Similarly, teachers can encourage pupils with cerebral palsy to walk about forming geometric figures. It is important for teachers emphasizing gross motor skills to pupils with cerebral palsy through activities of daily living to continue doing so; however they should focus on the quality of movement in order to encourage more efficient gross motor skills.

On the finding that teachers favoured explicit motor skill instruction, it is recommended teachers endeavour to incorporate more implicit motor learning strategies in teaching motor skills to pupils with cerebral palsy. Though it may be useful to apply some level of verbal motor skill instruction at the beginning of teaching a novel motor skill activity, applying a largely implicit motor learning approach would ensure pupils with cerebral palsy avoid reinvestment under pressure or when fatigued. Teaching motor skills through analogies is a practical way for teachers to reinforce implicit motor learning in pupils with cerebral palsy. When applying analogies in teaching motor skills, teachers should endeavour to use very familiar analogies in the Ghanaian culture. With the passage of time, teachers could have a repertoire of analogies that would apply to the different motor skills they strive to teach. Guiding pupils with cerebral palsy through motor skills activities and simplification of task would further promote implicit motor learning whereas saving teachers precious time. Similarly, incorporating the cognitive, associative, and autonomous stages of motor learning would further consolidate motor skill interventions by teachers.

The study further revealed some teachers struggled with developmentally appropriate motor skill interventions as well as applying motor learning theories. It is recommended that the Ministry of Education, through the Ghana Education Service institute formal school-based rehabilitation services including physiotherapy and occupational therapy services. These services could be rendered once every month and should be done in collaboration with teachers and should target the educational needs of pupils with cerebral palsy. Whereas special educators may have some knowledge on motor skills interventions, the field of motor skills and motor learning is rapidly evolving and there is the need for different experts to collaborate on the best interventions for pupils with cerebral palsy. This collaboration would further provide opportunities for teachers to learn more about school-based motor interventions which they can implement consistently in their respective classrooms.

Furthermore, core stakeholders including the Ghana Education Service, teachers, Parent-Teacher Associations and rehabilitation experts should as much as possible, collaborate to provide the necessary assistive technology, devices and adaptive equipment that enhance the gross and fine motor skills of pupils with cerebral palsy. Appropriate Paper-based Technology provides a unique, affordable and readily available opportunity for stakeholders to acquire some of these devices and equipment. Walking frames, hand braces, calipers, canes, special tables and chairs are critical assistive devices that would promote the development of gross and fine motor skills of pupils with cerebral palsy whereas making it easier for teachers to teach these vital skill sets. Fortunately, a number of teachers and rehabilitation experts in Ghana have had extensive training in Appropriate Paper-based Technology through the Jacob's Well Foundation. Core stakeholders need to collaborate with these experts and ensure they have the necessary resources to build these devices. Core stakeholders should collaborate on purchasing other assistive devices and technology that would not be produced by Appropriate Paper-based Technology.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

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