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The Role of Executive Functioning in Early Literacy Performance at Selected Low and High performing Primary Schools in Zambia

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Abstract

In this study, Executive functioning skills at selected primary schools were examined to determine their influence on Zambian first graders' literacy performance. Kroesbergen *et al.* (2009) argues that executive function is an umbrella term for different higher order functions, such as planning, inhibition, and updating, and executive functions are necessary for the adequate execution of complex goal-directed activities. Learning is a complex process and is heavily dependent on a number of factors one of which is executive functioning. In view of the persistent low literacy levels among children, scholars in Zambia have taken keen interest in trying to offer empirical evidence on the literacy situation in trying to address this challenge among school-going children. In the current study, 100 grade 1 children (47 boys and 53 girls) from 10 selected primary schools (5 low performing and the other 5 high performing) were recruited and tested in early literacy skills. Age descriptives of participants were *total Mean = 108.9; (SD = 15.86)*, for low performing *Mean = 109.5; (SD = 17.66)* and for high performing *Mean = 107; (SD = 13.27)*. Class teachers of pupil-subjects answered to a questionnaire and the information provided was part of children's data. The study established that children were rated differently in their executive functioning skills. Low performing and high performing schools had different strengths and weaknesses in terms of their influence on children's performance in literacy. Clearly, high performing schools performed better on reading and writing. From both school-categories, phonemic awareness was the most problematic outcome which could not be predicted by any of the background variables.

Keywords: *Executive functioning, Low Performing Schools, High Performing Schools, pedagogical factors, literacy, cognitive abilities and developmentalist.*

1. Introduction

In this study, we examined executive functions as predictors of literacy skill-attainment because research has shown that executive functions are a set of cognitive abilities that control and regulate behavior that is required for learning. Executive functions in this regard include: working memory, inhibitory skills and attention (Diamond *et al.*, 2007) [6]. These skills cover basic cognitive processes that organize thought resources towards a desired condition and preschool and foundational years of schooling seem to be an important time for the development of executive functions. Executive functions are especially important in novel situations in which one cannot rely on routine and have in common the regulation of other cognitive skills. Learning behavior in its active form depends on psychological skills which include attention, inhibition and working memory. Kassin (2001:131) [10] states that, "attention is a state of awareness consisting of the sensation, thoughts, feelings that one is attending to something at a given moment." Executive function skills, therefore, are supposed to be stimulated in preschool and elementary grades as teachers are expected to teach activities which stimulate skills such as attention, working memory and inhibition skills (Diamond *et al.*, (2007) [6]. These skills are associated with school readiness, turn-taking and paying attention.

Individual differences among children predispose children to risky and beneficial experiences. Those children who most need improvement benefit the most from available learning experiences. Children with the weakest executive functions benefit the most from any executive function intervention or program (Flook *et al.*, 2010; Karbach & Kray, 2009; Lakes & Hoyt, 2004) [7, 9, 12]. Hence, early executive function training should be an excellent tool for leveling the playing field and reducing social disparities in executive functions, thus heading off social disparities in academic achievement (O'Shaughnessy *et al.*, 2003). Because executive functions predict school readiness (Blair & Razza, 2007) [4], later academic performance

(Raver *et al.*, 2011; Li-Grining, Raver, & Pess, 2011) ^[13, 17], and mental and physical health (Moffitt *et al.*, 2011) ^[15], if the early disparity in executive functions is narrowed, the disparity in school readiness and academic and health outcomes should be narrowed as well.

Children's executive functions should be challenged throughout training because executive function demands need to keep increasing as children's executive functions improve, or few gains will be seen (Bergman-Nutley *et al.*, 2011; Holmes *et al.*, 2009; Klingberg *et al.*, 2005) ^[3]. There may be two reasons for this. First, if people do not keep pushing themselves to do better, they stop improving. Second, if the difficulty of an activity does not increase, it becomes boring, and children lose interest. Clearly, Executive Functions can be improved in children, even in those as young as 4 or 5 years of age, without specialists and even without computers. To improve executive functioning, focusing narrowly on them may be less effective than also addressing emotional and social development.

Attention is a cognitive process of selectively concentrating on one aspect in the environment while ignoring other things. Attention has also been referred to as the allocation of processing resources. It is, therefore, a very important child-characteristic in as far as learning academic and other skills is concerned. This so because learning a concept is achieved by information being perceived, stored in the short term memory before being passed on in the long term memory where it is stored for a long time. To perceive any form of stimulus, the learner is supposed to pay particular attention to that. A stimulus does not present itself in isolation, but it exists mostly with other distracters. Santrock (2004) ^[19] argues that selective attention involves focusing one specific experience while ignoring others. Young learners are strongly influenced by the features of the task that stand out. Executive functions develop rapidly during childhood, with substantial changes occurring between 3 and 5 years (Müller, *et al.*, 2006) ^[16]. After the age of 6 or 7, children more efficiently attend to the relevant dimensions of the task or the problem. Developmentalists believe that this change reflects a shift to cognitive control to attention, so that children act less impulsively and reflect more. Examples of attention include listening carefully to what someone is saying while ignoring other conversations in a room.

Self-regulation positively affects a student's ability to learn by promoting social competence, academic achievement, goal-directed behaviors and emotional states (Buckner, Mezzacappa, & Beardslee, 2009) ^[5]. More specifically, it comprises "cognitive, evaluative, and behavioral processes that guide goal-directed action and emotional responsiveness" (Rudolph, *et al.*, 2001) ^[18]. In the classroom, self-regulated behaviors are critical to student learning because they enable self-sustained efforts toward achieving a teacher's instructional goals. Over time, a self-regulated learner has a greater chance of acquiring new academic skills as a result of shared learning goals that bring about purposeful actions before, during, and after instructional activities within a lesson.

Selective attention work hand-in-hand with short and long term memory. Memory consists of three places; registering, storing (based on repetition sometimes) and recalling (based on active repetition). For learning to be successful, all the three stages must be available. Registering information entails transforming or sensory stimuli into the kind of code that memory accepts and that memory accepts and that code is placed in memory. Registering information is also called

encoding which is a very important process in literacy development as the child learns to read. Storing means retaining information that has been encoded. Once information is stored, recalling or retrieving it involves recovering the stored information to the working memory. The working memory has been described as an active information processor responsible for storing and processing information for a short time (Baddeley, 1996) ^[11].

One of the potential factors that might negatively influence children's writing skill is student behaviors such as inattention and hyperactivity. Although correlated, inattention and hyperactivity are distinct constructs (e.g. Goodyear & Hynd, 1992) ^[8]. Inattention has been hypothesized to reflect problems in self-regulation of internal cognitive processes while hyperactivity may reflect problems in self-regulation of behavior (Barkley, 1996) ^[2]. Classrooms are complex learning environments where teacher and child characteristics interact and influence children's learning.

Child-related factors and pedagogical factors influence learning behaviour. The environments in which children are found present different contexts. Developmentally sensitive contexts include many everyday activities involving physical action, play, problem solving, and exploration of materials and events (Martin, 2000) ^[14]. Particularly sensitive are social contexts in which parents and others (e.g., older siblings, preschool teachers, etc.) employ modeling, instructions, questions, conversations, and narratives to mediate critical pre-developmental proficiencies, such as early literacy, numeracy, and language (Tharp & Gallimore, 1989) ^[20].

2. Material and methods

Data was captured through a pupils' self-report biographical data sheet, tests to assess reading and writing skills as well as a teacher-answered questionnaire (BRIEF). The following data collection instruments were used in the study:

- (a) Pupil-demographic data sheet
- (b) The Basic Skills Assessment Tool (Bemba version-revised)
- (c) Behaviour Rating Inventory for Executive Function (BRIEF).

2.1 Measures and reliability scales

To test internal reliability of each of the instruments, Cronbach alpha reliability tests were calculated for each of the instruments as stated below.

Pupil-demographic data sheet

Through a self-report questionnaire, children provided data on their: age, gender, care-givers' socioeconomic status, caregivers' education attainment, mostly spoken language at home, mostly spoken play language and mostly spoken classroom language and home possessions. ($\alpha = .82$).

The Behaviour Rating Inventory of Executive Functions (BRIEF) specifically measured each child's executive behaviour which included: inhibition, shift, emotional control, working memory including planning and organisation. These skills are important in regulating learning and performance of learners in academic skills such as reading, writing and mathematics. Children's class-teachers at their own time filled in the BRIEF questionnaire for every child who participated in this study ($\alpha = .95$).

The Basic Skills Assessment Tool (BASAT) was the literacy (reading and writing) assessment tool administered at a time when learners had been in school for almost a year. This instrument consisted of seven measures each focusing on a specific literacy skill. The measures included: alphabet

knowledge, phonemic awareness including reading and writing. The instrument was administered to children individually and on average took about 25 minutes per child. Alphabet knowledge was assessed through letter-naming and letter-identification including letter-sound and sound-letter association. For alphabet measures, children were presented with an A4 sheet with 26 letters of the English alphabet. These letters were typed in a random order to avoid memorization of the ‘alphabet song’ but to ensure that the children knew the letters ($\alpha = .96$). Phonemic awareness was tested through sound discrimination of familiar words ($\alpha = .96$). Reading was tested through presenting syllables, words and sentences ($\alpha = .97$). In terms of reading comprehension, children were required to associate four pictures each having three word or phrase-options from which a correct one was selected by the child who underlined it ($\alpha = .98$).

3. Results and Discussions

Results below show that between LPS and HPS were significant differences on the following variables: emotional control, working memory, planning and organisation as well as reading and writing. The result of the variables did not show any significant differences.

3.1 Descriptives between Low and High performing Schools

Table 1: Means, Standard Deviations and p-values

Variable	Sch. Quality	M	SD	p-value
Age in months	Low	109.5	(17.66)	1.000
	High	107	(13.27)	
Preschool	Low	.42	(.07)	1.000
	High	.46	(.07)	
Home possessions	Low	6.33	(2.92)	.570
	High	5.98	(3.00)	
Inhibition	Low	7.33	(5.08)	.882
	High	6.73	(3.92)	
Shift	Low	5.29	(4.83)	.532
	High	5.69	(3.12)	
Emotional control	Low	3.84	(2.76)	.042**
	High	5.07	(2.92)	
Working memory	Low	6.44	(5.93)	.044**
	High	9.22	(4.77)	
Plan. and organisation	Low	3.40	(3.27)	.016**
	High	4.87	(3.03)	
Reading and writing	Low	-.27	(.83)	.030**
	High	.27	(1.12)	
Alphabet knowledge	Low	.03	(.79)	.600
	High	-.08	(1.18)	
Phonemic awareness	Low	-.11	(1.07)	.604
	High	.09	(.97)	

p-value significant at $p < .05$

3.2 Discriminant Function analysis

Means for the five executive function skills between LPS and HPS were also compared through the discriminant function analysis. This was done on the basis of school quality as a grouping variable. Results show that children who went to LPS were rated to be better in the all the executive function skills.

Table 2: Means and Standard Deviations

Variable	LPS		HPS	
	M	(SD)	M	(SD)
Inhibition	6.66	(5.24)	7.06	(4.29)
Shift	4.76	(4.85)	7.70	(3.23)
Emotional control	3.48	(2.85)	5.22	(3.01)
Working memory	5.80	(5.95)	9.42	(4.84)
Planning and organ.	3.12	(3.22)	4.74	(3.03)

The bivariate correlations reveal that there were significant associations with school quality and shift, emotional control and working memory. Reading and writing was also positively and significantly associated with school quality. Age and working memory showed a negative association.

Table 3: Bivariate Correlations

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Quality of school	1	-.061	-.060	.042	.115	.287**	.319**	.253*	-.076	.062	.219*
2. Age in months		1	-.154	-.134	-.183	-.194	-.209*	-.138	-.022	-.111	-.057
3. Gender			1	-.007	-.113	-.070	-.065	-.171	.116	-.042	-.101
4. Inhibition				1	.664**	.791**	.754**	.559**	.060	.078	-.118
5. Shift					1	.714**	.736**	.661**	-.118	.034	-.055
6. Emotional control						1	.884**	.735**	-.101	.111	-.135
7. Working memory							1	.756**	-.105	.095	-.118
8. Plan. and organisation								1	-.196	.167	-.099
9. Alphabet knowledge									1	.000	.000
10. Phonemic awareness										1	.000
11. Reading and writing											1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

From the three analyses namely: bivariate correlations, t-tests and the discriminant function analysis conducted in the study, the role of executive functions and their association with literacy skills at low and high performing schools were examined. To start with, bivariate correlations was run to find out if there were any associations between executive functions, literacy skill-attainment.

For the sake of developing literacy skills, the study hypothesized that children needed to regulate their behaviour. Therefore, executive function skills are supposed to be stimulated in preschool and elementary grades as teachers are expected to teach activities which stimulate executive function skills such as attention, working memory and inhibition skills (Diamond *et al.*, 2007) [6]. Blair (2010) also notes that executive function skills are associated with school readiness, turn-taking and paying attention. It is not clear, however, if the Zambian teacher education curriculum contains executive functions as part of course content. If teachers are not aware of these skills and how they influence behaviour of children, they would include them in routine skills which children are subjected to almost on the daily basis.

Based on this argument, children’s performance in reading and writing cannot be detached from executive functioning. Executive function skills are key to learning achievement in that they guide a learner how to plan, control and monitor their own learning. As already alluded to, these skills can be taught to learners by care-givers at home and teachers in schools who on a daily basis interact with learners.

This study further hypothesized that children who went to high performing schools would be rated high on executive functions compared to those who went to low performing schools. However, findings of the study revealed on the contrary. Children who went to high performing schools were generally rated poor on emotional control, working memory and planning and organization. This may imply that teachers who taught at high performing schools were more strict with monitoring children’s behaviour in the classroom and any diversion from their instructions was described in terms of poor executive functioning. This strictness could also be linked to high expectations from children’s learning during reading and writing.

However, teachers who are very strict may sometimes misjudge children who are always willing to participate in class. Such children may be described to be naughty and would be rated with low inhibition. On the part of teachers, teaching in crowded Zambian public school classrooms can be a challenge as well. Certain executive functions such as planning and organization and emotional control seem to

work in favour of those outgoing children whose presence is always noticeable. Lack of planning and organization skills can lead to loss of concentration on given classroom tasks such drawing, copying and solving some sums. Because executive functions predict school readiness (Blair & Razza, 2007), later academic performance (Raver *et al.*, 2011; Li-Grining, Raver, & Pess, 2011) [13, 17], and mental and physical health (Moffitt *et al.*, 2011) [15], if the early disparity in executive functions is narrowed, the disparity in school readiness and academic and health outcomes should be narrowed as well.

The study also revealed that children who went to LPS came from homes with more siblings in other grades. Since most children who went to high performing schools had few other children in other grades in the home, the assumption is that lack of adequate peer interaction in the home predisposed such children to poorer emotional control when they got in a school environment with many other children. From this perspective, children who fail to regulate their behaviour are likely to perform poorer in literacy because learning usually demands concentration, recall, organization and making task linked adjustments which differs from predetermined remote instructions.

In Zambia, the school systems do not seem to emphasise executive functions as it appears to be one of the missing themes at primary teacher training level. For this reason children do not seem to receive the best executive functioning skills they need. Once children are oriented on how to regulate their own learning, it is likely that learning instructions would be easily applied by children in early and later grades.

From the present study, low and high performing schools showed significant differences between working memory and planning and organisation only. This is not different from the results of bivariate correlation results presented above were associations were noticed with the same executive function skills. Among the three executive function skills, working memory recorded the higher margin.

The results above also confirm that grade 1 children in Zambian primary schools lack executive function skills orientation. This lack of self-regulatory skills would certainly have a negative telling effect on pupils performance in academic skills. It was interesting to note that even after grouping the background variables in a discriminant function analysis, working memory, planning and organization, and emotional control were the only executive functions skills which were significant. All these results confirm that Grade 1 teachers do not seem to adequately understand and appreciate

the role of executive functions and their connection learning achievement.

In this study, results on working memory indicate that children who went to high performing schools were rated by their teachers to have poor working memory while those who went to low performing schools were rated to have better working memory. A similar result pattern was found for planning and organization indicating that children who went to high performing schools were not better at planning and organization compared to those who went to low performing schools. It is possible, therefore, that low rating on executive functions was also noticeable among other correlates of academic skill-performance because some cognitive skills facilitate the acquisition of certain academic skills. It is, therefore, expected that children who are rated high on executive functions can also be described as high achievers in literacy and numeracy.

4. Conclusion

The present study further acknowledges that the performance of learners at school cannot be viewed and addressed in isolation from either child characteristics and the school environment. The school is merely an environment where a child expresses his/her potential. Classroom teachers, therefore, need to play a facilitator-role and to do so, every teacher needs some knowledge, skills and competences to motivate and support learners to regulate their behaviour to benefit from learning. Although teachers teach learners in a group, learner-support is better rendered to suit individual needs, making teaching a demanding job.

Saez (2012), for example, established that effective individualized instruction was related to higher reading scores. For this reason, teachers of young children especially, need to be passionate about how they organize and conduct their teaching without which their presence in the classroom would not benefit young learners. This is important because young learners, for example those in the first grade are highly dependent on the teacher for guidance and support. Developing regulatory skills is just one of the ways on making children profit from learning literacy and other academic skills.

5. Recommendations

Based on the findings of the study:

- The Ministry of Education should orient teachers of young children on the important of executive functioning
- The Teacher Education Curriculum should include executive functioning as one the courses for teacher training
- Primary schools should initiate and utilize parental involvement in order to enhance self-regulation amongst young children
- Schools through Continuing Professional Development (CPD) need to emphasize the need for teacher monitor and guide children in self-regulation skills

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