

THE IMPORTANCE OF THE EXECUTIVE FUNCTION OF THE BRAIN IN EARLY LITERACY DEVELOPMENT

Ansie C Lessing & Marike W de Witt
University of South Africa

ABSTRACT

The emphasis in literature on the role of neuropsychology in successful reading acquisition triggered the researchers' interest in the nature of the executive function of the brain (EF), as well as the possible role thereof in the mastering of early literacy skills as the foundation of reading excellence. Research indicates that the development of early literacy skills involves the interaction of perceptual skills, established concepts and the EF. Preschool teachers seem to be uninformed about the importance of the EF at a preschool level. These findings led to the researchers' interest in the importance of the EF in early literacy activities. Eight relevant activities were selected and analysed to determine the importance of the EF to complete them. The research question was: Which aspects of the EF are important to complete the selected activities? An explorative investigation was done in a qualitative research approach, to test the researchers' analysis of the EF in these selected activities. The Delphi technique was used to present the findings to experts in the field of early child development (ECD) for their views. Although the participants mostly agreed with the researchers' analysis, suggestions were made to expand the role of the EF in some of the activities. The researchers concluded that the EF plays an important role in the understanding and completion of preschool activities for mastering early literacy skills. The researchers suggest a change in teachers' approach to enhance preschool children's early literacy giving special attention to the awareness of and development of the EF.

KEYWORDS

Anticipation, early literacy, executive function of the brain, form consistency, grouping, preschool child, relations, schema matching, sequence and pattern completion, sound consistency, thinking

INTRODUCTION

According to literature, adequate mastering of early literacy skills provides an advantage for school beginners which makes it easier for them to learn to read and serves as a significant predictor of reading success at a later stage (Castro & Barrera, 2019; Colé, Duncan & Blaye, 2014; Diamond & Ling, 2016; Osei, Liang, Mensah & Stephan, 2016). The ability to perceive objects and situations and apply meaning to the experience requires applicable perceptual skills as well as integrating and relating perceptions with existing concepts, to gain an understanding of an object or a situation (Polat, Kucukoglu & Sari, 2016; Priyadarshi, Goswami & Madhuban, 2012). This entire process depends on perception, established concepts in the memory and the application of the EF to attach meaning to what is perceived. Perceptual skills and concept

formation, as prerequisites for the understanding of text, are not only important and indispensable facets in mastering reading skills (Nicolopoulou, 2010; Education and Training, 2019) but are also closely connected to the processes of the EF as described in neuroscience (Lessing & De Witt, 2017). These aspects go hand in hand as perception and concept formation are necessary for the operation of the EF and the EF is essential for perception and the development of concepts. As such, the mastering of perceptual skills, sufficient concept formation and the application of the EF are essential aspects of early literacy development and enhance the child's readiness for the reading process. The researchers' continuous research of the EF over time led to realising the necessity of purposeful development thereof at a preschool level already. This triggered the researchers' interest in the occurrence and thus, the importance of the executive function in early literacy activities.

In their workshops on the EF, the researchers found that most teachers were well aware of the importance of perceptual skills and concept formation but were uninformed regarding the role and importance of the executive function of the brain in early literacy development (De Witt & Lessing, 2018). Furthermore, limited information on the development of the EF at a pre-primary level is found in literature. In this article, the authors attempt to contribute to applied theory by investigating the importance of the EF in several selected early literacy activities. Identifying the use of the EF in the activities can draw teachers' attention to this important aspect and help teachers to focus on the purposeful development of the EF to a greater extent.

The aim of the study was twofold. First, to select and analyse several activities aiming at early literacy development in terms of the importance of the EF. Secondly, to submit the researchers' analysis to experts in the ECD field for their views of the EF in these activities. These aims are embedded in the research questions: Which aspects of the EF are used to support the activities? Which aspects of the EF are important to complete the selected activities?

CONCEPTUAL FRAMEWORK

For the purpose of substantiating the empirical research, early literacy and the EF are briefly discussed before attending to the importance of the EF in early literacy development as background for the analysis of the suggested activities.

Early literacy

Early literacy refers to the knowledge of the relation between language, phonological and phonemic awareness, knowledge of the alphabet and an understanding of common print concepts related to reading and writing that a young child should obtain before starting with the formal reading process (Castro & Barrera, 2019). However, it is not only about the ability to identify letters, numbers and shapes but also implies a set of skills, knowledge and attitudes of which the main components include an awareness of language, listening, oral communication and writing skills (Shrier, 2013; De Witt & Lessing, 2016). Elements such as attention, vocabulary, phonological and phonemic awareness, knowledge of the alphabet, understanding of common print concepts, drawing skills and several perceptual competencies go hand in hand

with early literacy and can be seen as prerequisites for its development (Fielding-Barnsley & Hay, 2012).

Both auditory and visual perception as early literacy skills are important in the reading process as various sensory modalities are activated to enhance understanding (comprehension) when reading a passage. Auditory as well as visual perception underlie the early literacy skill of phonological awareness and enable children to understand that language is made up of individual sounds (phonemes) and letters to form the words we speak, write and read (Joubert, Bester, Meyer & Evans, 2019). Knowledge of concepts and the accommodation and assimilation of concepts with existing knowledge are essential aspects of gaining an understanding of the written word. There is an interaction between perception and concepts on the one hand and the EF on the other, since the first requires the operation of the EF to result in understanding and the EF needs perception and concepts to complete the action.

The child demonstrates their highest levels of ability through play and the activities included in this investigation were intended to enhance perception and concept formation via play (De Witt, 2021). These activities included different visual and auditory aspects and were aimed at the development and understanding of skills that enhance perception and concept formation and forms the foundation for early literacy acquisition. Phonemic awareness and knowledge of alphabet letters require various perceptual skills and concepts. For example to recognise the letter 'a' requires the ability to see the form and hear the sound. When the letter is in a word it also involves memory as well as the sequence of the letters.

Executive function of the brain

The research focuses on the importance of the EF in selected early literacy activities and is not an investigation into the nature of the EF. Below is a brief description of the EF as background to the investigation. The EF refers to a group of interrelated processes that enable one to plan, focus, remember, control behaviour, work purposefully and manage complex cognitive processes simultaneously (Huizinga, Baeyens & Burack, 2018). Attention control, cognitive flexibility, inhibition control, initiation, meta-cognition, organising, planning, reaction to feedback, self-regulation, switching and working memory are characterised processes of the executive function of the brain. (see Figure 1)

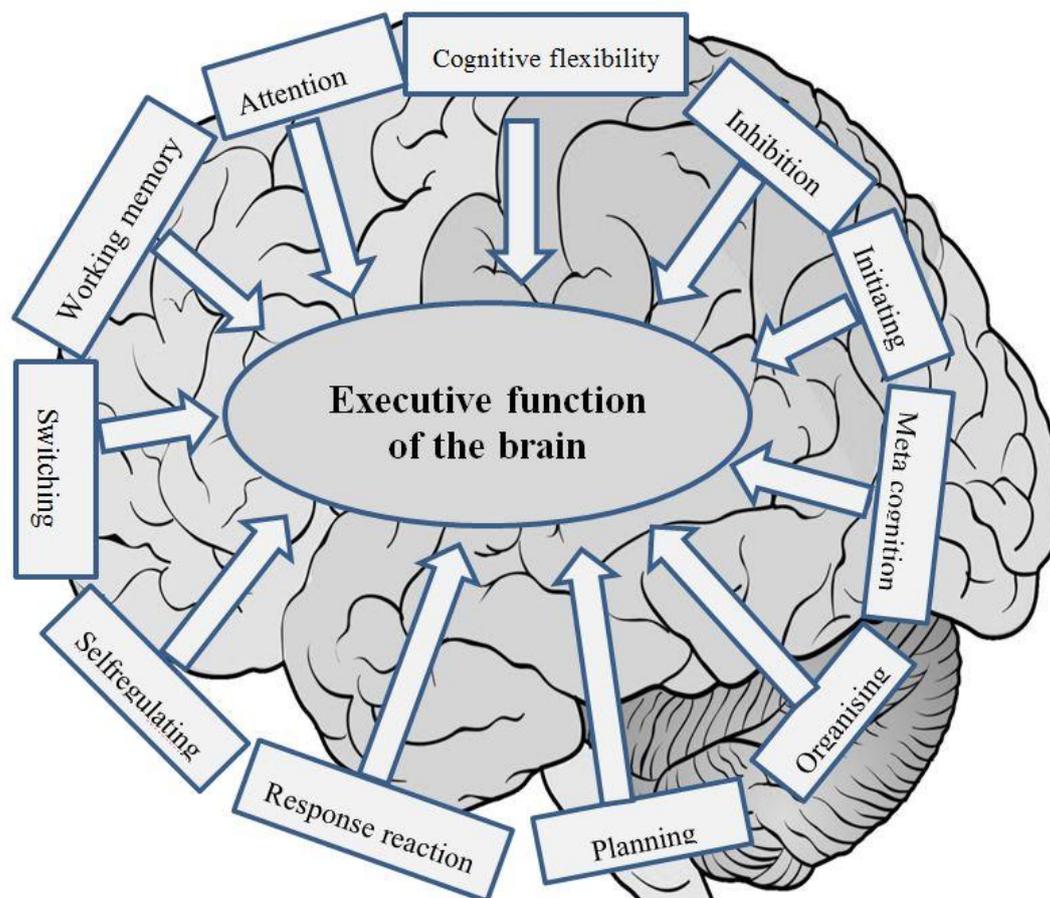


Figure 1 The executive functions of the brain

According to the Center on the Developing Child at Harvard University (2014), the EF helps one to ‘focus on multiple streams of information at the same time, monitor errors, make decisions in light of available information, revise plans as necessary, and resist the urge to let frustration lead to hasty actions’, which are important aspects in interpreting experiences and completing activities. The EF involves a long developmental process which starts in the perinatal period and sharply increases during the preschool stage (Rosas, Espinoza, Porflitt & Ceric, 2019; Shrier, 2013). As time passes, executive function changes from a developmental perspective to multiple creative cognitive skills (Akyurek, 2018).

Diamond and Ling (2016) consider the EF processes very important for reading. This emphasises the importance of looking into the development of these aspects in early childhood. Functions like controlling impulses, paying attention and retaining information actively in the memory during activities need to be practised since early childhood as these actions do not happen automatically (Center on the Developing Child at Harvard University, 2014).

The importance of EF processes in early literacy activities

The authors acknowledge that early literacy depends on a variety of skills, including auditory and visual perception and the development of various concepts but in this article, the focus is

to a greater extent on the importance of the EF in acquiring early literacy skills. Following is a discussion of the EF in terms of early literacy. To avoid unnecessary repetition, the role of the EF in the analysis of the selected activities should be read in conjunction with this discussion of the various aspects of the EF. (see Table 1).

Attention is a basic and supporting component of the executive system that guards learning and directs interaction with the environment (Akyurek, 2018). *Attention control* implies the ability to focus on a specific task despite attention distractors or fatigue (Leslie & Fox, 2019). To the preschool teacher, this implies that the young child's attention is focused on the activity or game with the purpose of establishing certain concepts. Concentration is an important aspect of the learning process and a variety of techniques may be used in supporting the young child to focus and concentrate. The ability to avoid conventional or habitual reactions, known as *inhibitory control*, is closely related to focus of attention (Rosas et al., 2019). Inhibitory control contains resistance to initial impulses and the tendency to act impulsively. The EF, inhibitory control prevents the child from yielding to external stimuli, internal impulses and habits (Center on the Developing Child at Harvard University, 2014; Diamond & Ling, 2016). Inhibition control on the part of the child results in focusing, pre-planning procedures and distinguishing the instruction from other impulses, and focusing specifically on accomplishing the task at hand.

Another important aspect to develop is *cognitive flexibility*, which refers to the ability to adapt to change and to be able to view a matter from different points of view (Diamond & Ling, 2016). Cognitive flexibility enables the child to simultaneously consider multiple streams of information and to move amongst these ideas (Center on the Developing Child at Harvard University, 2014; Leslie & Fox, 2019; Rosas et al., 2019). Activities regarding cognitive flexibility aim at the child's observation of similarities and differences, sequences and patterns, and enable the child, as an example, to arrange different colours of beads according to colour. Cognitive flexibility enables the preschool child to compare information and make decisions in cases where different options are possible. *Conversion* goes hand in hand with cognitive flexibility and refers to the ability to divert attention and focus from the original to a new idea (Cooper-Kahn & Dietzel, 2020). This skill develops when the child gains insight into their actions through self-regulation. *Self-regulation* implies control over emotions and behaviour in order to achieve objectives and is an important aspect of the total learning process. Clarity regarding the purpose of a task motivates the child to focus on the task. According to Charlesworth and Lind (2012), self-regulation enables a person to question the outcome of a series of events and to search for better solutions for an assignment or problem.

Cooper-Kahn and Dietzel (2020) emphasise the importance of *reaction to feedback*, which refers to the ability to react to feedback regarding a certain action and to change behaviour accordingly. The educator has an important function in establishing the child's reaction to this regarding a specific action. The preschool child can be supported in evaluating behaviour and specific actions. Encouragement and recognition will play an important role in this respect.

Due to a variety of reasons, children may hesitate to start an activity and may need support to get started. *Initiation of activity* enables the child to overcome inertia to commence a task

(Leslie & Fox, 2019; Lessing & De Witt, 2019), to generate ideas independently and with problem-solving strategies (Cooper-Kahn & Dietzel, 2020). Weak assertiveness, a lack of self-confidence and feelings of failure may lead to unwillingness on the part of the child to participate in an activity. The adult needs to be aware of this and should support children in developing self-confidence and being assertive.

Even at a young age, children can develop the ability to evaluate personal efforts and to note positive and negative aspects. *Meta-cognition* implies the ability to distance oneself and evaluate the effectiveness of thoughts, perspectives and mental processes (Leslie & Fox, 2019; Lessing & De Witt, 2019). Organising and planning are also aspects of the EF and play essential roles in activities. *Organising* is an important function in arranging objects (Cooper-Kahn & Dietzel, 2020) and entails the development of a system as a basis for logical thinking and understanding and provides the foundation for the management of information and objects (Leslie & Fox, 2019). Establishing structures enables the preschooler to master the concept of organising and should therefore purposely be encouraged.

Planning is the ability to determine tasks and to establish the most important ones necessary for the completion of a task (Cooper-Kahn & Dietzel, 2020). Mastering the concept of planning enables the child to complete tasks in a logical way (Center on the Developing Child at Harvard University, 2014). The pre-primary child can, for example, be taught to plan the completion of a puzzle by first searching for the corners and then the outlines of the puzzle and lastly for the details or an object inside the picture.

Working memory plays a role in many daily activities of the preschool child. Rosas et al. (2019) regard working memory as the ability to operate with mental representations and enables an individual to retain information in the memory until the task is accomplished and thus, serves as the basis for many executive functions (Akyurek, 2018). The function of the working memory entails storage while other cognitive processes such as the association of information with existing information take place (Diamond & Ling, 2016). Working memory plays an important role, especially with the preschooler who lacks broader experience and the educator should focus on its development (Cartwright, 2012; Colé et al., 2014; De Witt & Lessing, 2018; Diamond & Ling, 2016).

The problem in ECD activities is that the focus is not necessarily on these processes because educators do not recognise their link to EF and the development of pre-literacy competencies. A change in the focus of the activities implies that children's EF should be challenged. It would be important to gradually improve the difficulty of tasks and to ensure that children focus throughout. Children should be assisted in staying calm, being creative and flexible, not quitting, considering where to start with an activity, completing tasks and reflecting on their achievements (McIntoch & Leslie 2019). The development of these competencies should be the focus of the teacher and should form the basis of all activities.

THE IMPORTANCE OF THE EF IN THE SELECTED ACTIVITIES

Based on activities that De Witt and Lessing (2018) regard as important for the mastering of reading, the researchers selected such everyday activities used by preschool teachers to develop perceptual skills and concepts, aiming to determine which aspects of the EF are concurrently covered by these activities. The selected activities aim at the development of form and sound consistency, sequence and pattern completion, grouping, anticipation, schema matching, thinking and relations, as indicated by De Witt and Lessing (2018). The following activities lend themselves to the activation of the EF in early literacy.

Form consistency

Bara and Bonneton-Botté (2017) stress the importance of letter knowledge acquisition as a component of children's literacy development. The mastering of form consistency enables the child to recognise the shape of letters and words in the reading process. Form consistency relies on the cognitive ability to recognise and manipulate forms irrespective of size, form or direction and to visualise an outcome when using them (De Witt & Lessing, 2016; Kaiser & Hemmeter, 2014). To successfully complete an activity on form consistency requires relevant perceptual skills and concepts and depends on cognitive processes, which entail the EF.

Activity: Which piece (1, 2, 3 or 4) will complete the rectangle?



Figure 2 An activity on form consistency

The importance of the EF in this activity includes *initiation of activity* (willingness to do the activity) as well as *planning* and *inhibitory control* to prevent a trial-and-error approach. *Cognitive flexibility* enables the child to mentally compare the various options and *working memory* plays an important role in the selection of the suitable option. Through *self-regulation*, the child can keep the aim of the activity in mind and work towards it.

Sound consistency

Sound consistency relies on auditory perception and enhances sound knowledge, which enables the child to match sounds with specific letters (Bara & Bonneton-Botté, 2017). Awareness of the phonological units of speech, rhythm and alliteration (relying on sound consistency) and knowledge of the alphabet are the best predictors of the successful mastering of initial reading (Fielding-Barnsley & Hay, 2012; Johnston & Nahmad-Williams, 2009).

Activity: Listen to the rhythm and then repeat it by clapping your hands



Figure 3 An activity on sound consistency

The aspects of the EF involved are *initiation of activity* (showing willingness to do the activity) and *attention* to the rhythm of the series. The *working memory* plays a crucial role in remembering the sequence of and pauses between the various clapping sounds. *Cognitive flexibility* allows for various responses and *self-regulation* assists in determining the correctness of the response and *reaction* in the case of a mistake.

Sequence and pattern completion

Mastering the concept of sequence and pattern completion enable the child to perceive letters in a certain sequence, form a word and make meaning of what is read (Ackerman & Kloss, 2019). Gouldthorp, Katsipis and Mueller (2017) describe sequencing as the ability to identify and recall the temporal order of events and in their study with children between the ages of eight- and eleven-years-old, they found that the sequencing skill contributes to a better comprehension of reading text. Activities on sequence and pattern completion require the child to be able to compare items according to specific criteria or present them in a required sequence (Kaiser & Hemmeter, 2014), an important competency required for mastering reading (Priyadarshi et al., 2012).

Activity: Look at the pattern on the pegboard (different forms and colours) and repeat the pattern.

The aspects of the EF involved are *initiation of activity* to start with the activity by paying *attention*. Completion of the activity needs *planning* and *working memory* to keep the plan in mind. *Cognitive flexibility* plays a role in the choice and comparison of the attempt with the given example and enables the child to evaluate the outcome. *Self-regulation* may result in *reaction to feedback* by accepting the attempt or changing the sequence.

Grouping

Mastering the concept of grouping enables the child to encode sounds or letters to form a word in the reading process. Grouping refers to the ability to put similar objects together or collect objects according to the same characteristics or criteria (De Witt & Lessing, 2016; Priyadarshi et al., 2012). Sorting and grouping form the basis for future *classification* of objects or related events and go hand in hand with *one-to-one correspondence* (Charlesworth & Lind, 2012).

Example: Provide a variety of objects like marbles and beads of different forms, sizes and colours. Request the child to group the various objects according to form, size and colour and put it in different containers.

Regarding the EF involved, the child *initiates the activity* by attending to and identifying similar objects according to unique characteristics that require *working memory* and *cognitive flexibility*. Proceeding with the activity needs *planning* and *organising* of the objects into groups. After completing the activity, the child evaluates the attempt (*self-regulation*) and if necessary, makes changes (*reaction to feedback*).

Anticipation

Anticipation plays an important role in the reading process and refers to the ability to make reasonable guesses or estimations based on experience (Charlesworth & Lind, 2012). Mastering the concept enables the child to predict and correct anticipation of a word contributes to a higher reading speed.

Activity: Provide three glasses of different sizes and a jug containing 250 ml of water. The child must estimate (anticipate) to what height each glass will be filled with 250 ml of water.

Various cognitive processes are also involved. The child must *begin the activity* by attending to the instructions and estimating *various possibilities*, and *self-regulation* plays an important role in the child's attempt to estimate and *correct* the height of the fluid in the glass.

Schema matching

Schema matching enables the child to recognise words from previous reading experiences. When the child has no schema available for matching a word that is read, a new schema needs to be created (Diamond & Ling 2016). Piaget (cited in Johnston & Nahmad-Williams, 2009) describes a schema as a set of linked mental representations of the world (thinking structures) underlying cognition and contributing to high-order thinking skills in older children. Developing schemas depends on an experiential environment that contributes to the development of concepts. Schemas enable one to understand and respond to situations according to previous experience (Smith, 2006).

Activity: Lay the table and make sure that the number of plates equals the number of children.
(One-to-one correspondence)

After *initiating the activity* and *attending* to the assignment, the child uses *working memory* to select the number of plates according to the counted number of children. *Self-regulation* plays an important role when the child checks the number of plates to the number of children. A discrepancy allows for *cognitive flexibility* and a *reaction to feedback* allows for correcting the difference.

Thinking

The reading process depends on different modalities of thinking: prediction, estimation, perception of cause and effect and one-to-one relationships as well as the application of divergent and convergent thinking. Thinking allows the child to decode unfamiliar words in the reading process, combine words and sentences for meaning and evaluate and question the reading matter (De Witt & Lessing, 2018). Thinking forms the basis for problem-solving and involves the following four processes: reasoning, communication, connections and representation (Charlesworth & Leali, 2011). For example, after reading, the reader must be able to comprehend the text, connect different ideas to existing knowledge and reason about the facts.

Activity: Provide the child with several picture or story cards that, when placed in sequence tell a story, with the request to put the cards in a logical order to tell a story.

The activity depends on the understanding of various concepts and requires self-monitoring, semantic organising, interpreting and summarising of facts, mental representations, the use of existing knowledge and meta-cognition (Owen, 2008). The following aspects of the executive function of the brain play a role in this activity: *initiation of activity, attention control, cognitive flexibility, reaction to feedback, meta-cognition, working memory and self-regulation.*

Relations

The relation between letter sounds and letters enables the reader to recognise words in reading. Observing and thinking about underlying relationships that appear in a passage allows the reader to gain an understanding of what has been read. The perception and coherence of different relationships are enhanced by the actualisation of the various aspects of the executive function of the brain. Relations refer to how two or more people or objects are connected and are described by words like connection, relation, association, link, correlation, correspondence, interrelation and interconnection (Oxford Dictionary, 2015). Interrelationships and concepts including spatial relationships, cause and effect, ordering and sequence provide the skills to understand relatedness.

Activity: Provide the child with rods of different lengths with the assignment to arrange them from short to long.

The child visually perceives the rods as different in length but to be able to complete the task needs to remember the request and understand spatial conditions. The following aspects of the executive function of the brain play a role in this activity: *initiation of activity, attention control, cognitive flexibility, reaction to feedback, working memory, self-regulation, planning and organising.*

An overview of the EF in the selected activities

In Table 1, the different EF processes are mapped onto the activities explained in the previous section. In this table, the importance of the EF is underlined by providing a summary of the EF processes in the selected activities.

Table 1 The importance of the EF in preschool activities

Activity	Executive Function										
	Attention control	Cognitive flexibility	Inhibition control	Initiation of activity	Meta-cognition	Organising	Planning	Reaction to feedback	Self-regulation	Conversion	Working memory
Form consistency	√	√	√	√				√	√		√
Sound consistency	√	√		√				√	√		√
Sequence and pattern completion	√	√		√			√	√	√		√
Grouping	√	√		√		√	√	√	√		√
Anticipation	√	√		√				√	√		√
Schema matching	√	√		√				√	√		√
Thinking	√	√		√	√			√	√		√
Relations	√	√		√		√	√	√	√		√

According to Table 1, initiation for activity, attention control, cognitive flexibility, reaction to feedback and self-regulation play a role in all the selected activities. The researchers wanted to validate their classification by presenting Table 1 to the participants in the empirical research part of this study.

RESEARCH DESIGN AND METHOD OF THE PILOT STUDY

Research method and data collection

The Delphi technique (Salkind, 2012 as a qualitative method was used in an explorative investigation to answer the research question: Which EF processes are important to complete

the selected activities? Using the EF in the activities will stress the importance of the EF in early literacy development to a large extent.

Delphi research was suitable for this research as the expertise of only a few participants was necessary to confirm the findings. In using the Delphi technique, a panel of experts was requested to evaluate a suggested idea or method. Each participant had the opportunity to comment on the various aspects, based on their personal opinion, experience or previous research. The feedback from the experts was then processed and after the facilitator (researchers, in this instance) grouped the comments and combined the responses, the document was returned to the participants for further comments. Various rounds may take place and the process may entail multiple rounds of participation, aiming to reach the correct responses to the questions through consensus (Mulder, 2017; Salkind, 2012; Twin, 2020). The anonymous summary of the feedback allows participants to revise their earlier answers in light of the feedback from other participants.

The authors prepared a working document (Delphi commentary list) which consists of two sections, namely background information and the authors' views of the role of the EF in the activities. The background information informs participants about the research, defining the concepts and providing information on the aim and selection of the activities. The second part provided a suggested activity for each of the different aspects important for the mastering of reading as well as a table reflecting our view of the EF involved in the completion of the suggested activity. The Delphi commentary list was sent to some experts (Mulder, 2017) with the request to comment on the presented view and provide their fine-tuning of the role of the EF in the suggested activities.

Participants

The authors used purposive and convenience selection of the participants. Ten participants were selected because they were regarded as experts due to their involvement in pre-primary education as well as applicable qualifications, knowledge and experience in the field. Eight persons showed a willingness to participate and present their views. The participants selected were two university lecturers in the ECD field with more than 15 years of experience (A and B), a preschool principal with more than 15 years of experience (C) and five preschool teachers with more than five years of experience (D–H).

Ethical aspects

This article is the culmination of an in-depth theoretical study and empirical research on early literacy development, initial reading and the executive function of the brain which was done over the past two decades in various schools and preschools in Limpopo. The onset of this research took place in collaboration with the Limpopo Departments of Education, Social Development and Health, all of which carefully attended to the ethical aspects of the research and intervention. Furthermore, all the parents and caregivers of children included in the research were contacted and agreed to participate.

The American Psychological Association (APA) ethical standards were followed in conducting the study (Cherry, 2020). As far as professional ethics are concerned, the researchers validated the following as important for this investigation: anonymity, objectivity and integrity; the way the data was recorded; the ethical principles governing the publication of the findings and participants’ awareness of the purpose of the findings. The respondents were given adequate information regarding the aims of the research, the procedures that would be followed, possible advantages and disadvantages to them, the credibility of the researchers and how the results would be used. Participants were thus able to make an informed decision about their involvement in the research. The researchers ensured that they were competent to undertake the research project which implied thorough preparation.

DATA ANALYSIS

The researchers coordinated the Delphi method and facilitated the responses of the selected panel of experts. All comments and suggestions given by the participants were considered and analysed to identify common and conflicting viewpoints. If consensus was not reached, the new viewpoints were added to the Delphi commentary list, after which the list was sent out to the experts in the second round of evaluation.

Findings from the Delphi commentary list

The following discussion of the findings focuses on the executive function of the brain as presented in Table 2.

Table 2 Findings: Delphi commentary list

Activity	Executive function of the brain	First round								Second round
		A	B	C	D	E	F	G	H	A-H
Form consistency	Initiation of activity	√	√	√	√	√	√	√	√	√
	Attention control	√	√	√	√	√	√	√	√	√
	Cognitive flexibility	√	√	√	√	√	√	√	√	√
	Self-regulation	√	√	√	√	√	√	√	√	√
	Reaction on feedback	√	√	√	√	√	√	√	√	√
	Added:									
	Working memory		√	√						√
	Organising	√	√	√						√
	Planning	√	√	√						√
Sound consistency	Initiation of activity	√		√	√	√	√	√	√	√
	Attention control	√		√	√	√	√	√	√	√
	Cognitive flexibility	√		√	√	√	√	√	√	√
	Working memory	√		√	√	√	√	√	√	√
	Self-regulation	√		√	√	√	√	√	√	√
	Reaction on feedback	√		√	√	√	√	√	√	√

	Added: Organising	√								√
	Planning	√								√
Sequence and pattern completion	Initiation of activity	√	√	√	√	√	√	√	√	√
	Attention control	√	√	√	√	√	√	√	√	√
	Planning	√	√	√	√	√	√	√	√	√
	Cognitive flexibility	√	√	√	√	√	√	√	√	√
	Reaction to feedback	√	√	√	√	√	√	√	√	√
	Working memory	√	√	√	√	√	√	√	√	√
	Self-regulation	√	√	√	√	√	√	√	√	√
	Added: Inhibition			√						√
	Organising	√				√				√
Grouping	Initiation of activity	√	√	√	√	√	√	√	√	√
	Attention control	√	√	√	√	√	√	√	√	√
	Planning	√	√	√	√	√	√	√	√	√
	Cognitive flexibility	√	√	√	√	√	√	√	√	√
	Reaction to feedback	√	√	√	√	√	√	√	√	√
	Working memory	√	√	√	√	√	√	√	√	√
	Self-regulation	√	√	√	√	√	√	√	√	√
	Organising	√	√	√	√	√	√	√	√	√
Anticipating	Initiation of activity	√	√	√	√	√	√	√	√	√
	Attention control	√	√	√	√	√	√	√	√	√
	Cognitive flexibility	√	√	√	√	√	√	√	√	√
	Reaction to feedback	√	√	√	√	√	√	√	√	√
	Working memory	√	√	√	√	√	√	√	√	√
	Self-regulation	√	√	√	√	√	√	√	√	√
	Added: Organising	√								√
	Planning	√								√
Schema matching	Initiation of activity	√	√	√	√	√	√	√	√	√
	Attention control	√	√	√	√	√	√	√	√	√
	Cognitive flexibility	√	√	√	√	√	√	√	√	√
	Reaction to feedback	√	√	√	√	√	√	√	√	√
	Working memory	√	√	√	√	√	√	√	√	√
	Self-regulation	√	√	√	√	√	√	√	√	√
	Added: Organising	√		√						√
	Planning	√								√
Thinking	Initiation of activity	√	√	√	√	√	√	√	√	√
	Attention control	√	√	√	√	√	√	√	√	√
	Cognitive flexibility	√	√	√	√	√	√	√	√	√
	Reaction to feedback	√	√	√	√	√	√	√	√	√
	Working memory	√	√	√	√	√	√	√	√	√
	Self-regulation	√	√	√	√	√	√	√	√	√

	Added:									
	Organising	√								√
	Planning	√								√
Relations	Initiation of activity	√	√	√	√	√	√	√		√
	Attention control	√	√	√	√	√	√	√		√
	Cognitive flexibility	√	√	√	√	√	√	√		√
	Reaction to feedback	√	√	√	√	√	√	√		√
	Working memory	√	√	√	√	√	√	√		√
	Self-regulation	√	√	√	√	√	√	√		√
	Organising	√	√	√	√	√	√	√		√
	Planning	√	√	√	√	√	√	√		√

Table 2 reflects the participants' agreement with the authors' views regarding the role of the EF in the suggested activities. Two of the participants added working memory, planning and organising to the authors' view of some of the selected activities. Both indicated that working memory plays an important role in activities regarding form consistency. One of them justified the addition by saying: '... because the child uses previous experience (knowledge) to complete the task'. It is also indicated that inhibition needs strengthening and is important in activities on sequence and pattern completion. The justification for the inclusion was: 'The kids' normal reaction will be one of starting thread and build to hearts content, though, the child needs to wait, look, listen to specific instructions and follow instructions'.

The executive function of the brain with regard to schema matching was also expanded with 'organising' by one of the participants and was justified as follows: 'The pre-schooler organises objects according to specified criteria'. The participant, who is a lecturer and has more than 15 years of experience in the ECD field, felt that 'organising' and 'planning' should be included for all activities.

The Delphi commentary list was expanded with the following suggestions: 1) 'working memory' was added to activities for the strengthening of 'form consistency', 2) 'inhibition' was added for activities regarding 'sequence and patterning' and 3) 'organising' and 'planning' as aspects of the executive function were included in all the activities. These fine-tunings were mainly made by the more experienced participants.

The adapted Delphi commentary list was returned to the participants. Consensus was reached on the different aspects of the executive function of the brain as applicable to the activities suggested by the researchers in the second round of evaluation.

CONCLUSION AND RECOMMENDATIONS

Research indicates the importance of early literacy development as well as EF for reading success. Much attention is given to the development of perceptual skills and concepts in preschools and preschool teachers seem to be uninformed of the possible importance of the EF in these activities. The researchers selected eight early literacy activities to determine the

importance of the EF for the completion thereof and the expert participants, who reviewed the findings, confirmed them and even expanded the use of the EF in some of the activities.

The researchers are convinced that inadequate mastering of reading skills can be ascribed to insufficient stimulation regarding the development of concepts and the different aspects of the executive function of the brain, among other things. To support such conviction would require a longitudinal study where the reading achievements of children who had been subjected to such a purposeful program at a pre-primary level is compared to a control group.

Considering that particular everyday activities support the development of the EF for reading, pre-primary teachers should be encouraged to put greater emphasis on such activities. The value of this investigation for preschool education is that teachers may take note of it and concentrate to a greater extent on the development of the various aspects of the EF and not only on perceptual skills and concept development. A change in the focus of support with explicit and purposeful development of the EF may in the long run lead to better reading achievement by South African children.

Although the investigation, as an explorative study, was largely theoretical in nature and limited to a few participants, the data generated by the Delphi commentary list confirmed that the suggested activities could enhance the EF. The outcome of this study stresses the importance of the EF and will hopefully encourage the critical exchange of ideas in the early childhood field.

Based on this confirmation the authors recommend the following:

- The curriculum for training teachers should include knowledge and application of the role of the EF in concept development.
- Teachers must be made aware that cognitive development does not only take place due to growth but also needs purposeful stimulation and enhancement.

This research is the culmination of a research journey on early literacy and the EF which took place over several years and ended with the researchers' beliefs in the importance of the EF, not only in reading acquisition but also in early literacy. The researchers hope that the inclusion of the EF in teachers' training will contribute to greater success in reading for South African learners.

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BIOGRAPHICAL NOTES

Ansie C Lessing is a Research Fellow in the Department of Psychology of Education at Unisa. Her teaching experience includes involvement in the teaching of Hons BEd (School Guidance and Counselling), MEd (Guidance) and the supervision of postgraduate students. She was a member of the team responsible for the training of educational psychologists. Her research focus and interests are postgraduate supervision and examination, discipline, initial reading, the executive function of the brain and support to learners with learning impairment and emotional problems. She was involved in education for the last 45 years.

Marika W de Witt is a research fellow in the Department of Psychology of Education at the University of South Africa. She has teaching/ lecturing experience of more than 35 years. She was involved in teacher training programmes, including the training of preschool student teachers as well as postgraduate students. She also acts as promoter for Masters and Doctoral students. Professor de Witt has published numerous research articles in nationally and internationally accredited journals in the field of education. Her research interests focus on, inter alia, executive function of the brain, early literacy and early numeracy.