

Towards a Theory-driven Integration of Environmental Education: The Application of Piaget and Vygotsky in Grade R

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ABSTRACT

Jean Piaget and Lev Vygotsky's respective theories on human development have made meaningful contributions to numerous fields, including education. Hence, various authors have spelled out the applicability of these theories, jointly or individually, in areas such as mathematics, language, assessment and so forth, mainly; in senior classes within the field of education. However, there seems to be a dearth of scholarly work that brings to light the applicability of these theories in the integration of Environmental Education (EE) in the realm of Early Childhood Education (ECE). The author contends that this paucity could be attributed to the general 'neglect' of ECE. Thus, through this article, the author tries to demonstrate how the two theories can be applied in the integration of EE in Grade R. He uses a theme drawn from the mathematics National Curriculum Statement (NCS) pursued in the South African public school system to make his point.

KEYWORDS

Piaget, Vygotsky, Assimilation, Environmental Education, Early Childhood Education, Grade R, Scaffolding, Internalization

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Introduction

Piaget and Vygotsky's respective theories of cognitive development have contributed immeasurably to the field of education. One quintessential example worth citing, among many others, is the contribution towards the conceptualization of the interminably burgeoning tenet universally known as *constructivism*. Constructivism posits that in the process of learning, learners do not simply acquire new knowledge but they use various tools that include their personal experiences and skills, to assign meaning to 'new' information and, thereby, construct their own knowledge (White, 2011; Blake & Pope, 2008). Hence, White (2011) argues that "constructivism puts the individual at the centre of learning, forming meaning through experience" (p. 90), and that it

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(constructivism) is based on the “belief that people can only understand what they have themselves constructed” (ibid). Constructivism continues to shed light and is, thus, invaluable in enabling scholars, teachers and a myriad of practitioners from various fields to make sense of how learning takes place.

Furthermore, numerous authors have sought to elucidate the applicability of the theories by the two reputable thinkers, both collectively and individually, in the teaching and learning of various subjects. For example, scholars have written about the utilization of these theories in mathematics pedagogy across different levels of education (e.g. Denhere, Chinyoka & Mambue, 2013; Ojose, 2008; Phillips, 1995). Others have reflected on how these paradigms facilitate instructional management and assessment (e.g. Simatwa, 2010; Lutz & Huitt, 2004). Likewise, some scholars have highlighted the role of Piaget and Vygotsky’s theories in play-based learning and cognitive development in Early Childhood Education (e.g. Bodrova, Germeroth & Leong, 2013; Gordon & Browne, 2011; Nicolopoulou, 1993). Indeed, owing to the monumental scholarship of these great minds, any attempt to exhaust Piaget and Vygotsky’s influences in the field of education would be futile.

Notwithstanding the immense contribution by the two theorists to the field of education, it seems very little (if anything) has been written about the applicability of Piaget and Vygotsky in the integration of Environmental Education (EE) in Early Childhood Education (ECE). In my considered view this could be, partly, attributed to the general ‘neglect’ of the field of ECE. In her paper entitled, *revealing the Research ‘hole’ of Early Childhood Education for Sustainability: a Preliminary Survey of the Literature*, Davis (2009) does not only highlight the dearth of research that focuses on EE in ECE but she also laments the universal abandonment of ECE. Accordingly, Davis (2009) writes that: “the early years are those that traditionally have received the least attention from the education world” (p. 241). Furthermore, she asserts that, “this pattern of neglect extends to the field of environmental education/education for sustainability” (ibid.). Apart from Davis (2009), there are other authors who also underscore the ‘neglect’ of ECE (e.g. Adegami & Adewole, 2013; Kamerman, 2006; Calman & Tarr-Whelan, 2005). Thus, to some extent, the need to contribute towards addressing this ‘neglect’ prompted the penning of this paper.

Therefore, this paper seeks to demonstrate how Jean Piaget’s theory on the Stages of Cognitive Development and Lev Vygotsky’s Sociocultural Perspective could be applied in the integration of Environmental Education in Grade R – Grade R refers to the South African equivalent of the class known as the Preschool or Kindergarten class in other parts of the world. In this discussion, I commence by briefly presenting some basic assumptions of each of the two theories. Thereafter, I provide an illustration on how the two theories could be used, simultaneously, in the integration of EE in Grade R. By way of illustration, I use the mathematics theme: “numbers, operations and relations” (Department of Basic Education, 2011, pp. 19 – 22) prescribed in the Grade R National Curriculum Statement (NCS), also referred to as the Curriculum and Assessment Policy Statement (CAPS), implemented in South African public schools. However, in view of the fact that, a typical Grade R learner falls within the age-group of 4 – 6 years, my discussion of Piaget’s stages of cognitive development is confined to the first two stages, namely; the sensori-motor and

the pre-operational stages. Therefore, any reference to the other two stages by Piaget will be cursory. The following is, thus, a reflection on Piaget's theory of cognitive development.

Jean Piaget's Theory of Cognitive Development

Piaget posits that learning and intellectual development occur due to continuous interaction between a child and the environment (Gordon & Browne, 2011). Central to learning and development is cognition. Muthivhi & Broom (2009) define cognition as; "the internal structuration of thought driven by subject's own activity in the world of experience" (p. 14) in a perpetual quest to acclimatize to the surroundings. Through cognition, information about the world is acquired, transformed, stored and regularly retrieved by the cognizing subject in order to interact with the environment (Brandimonte, Bruno & Collina, 2006; Greeno, Collins & Resnick, 1996). Inherent in cognition are cognitive structures and several dynamic and interdependent processes that include assimilation, accommodation and organization, all of which assist a developing child to adapt to the environment (Simatwa, 2010; Muthivhi & Broom, 2009; Blake & Pope, 2008).

Although cognition is, from childhood through adulthood, an intrinsic element of learning, intellectual development and other human actions; humans are not born cognizing. This point is underlined by Berk (2009) who writes that, "according to Piaget human infants do not start out as cognitive beings. Instead, out of their perceptual and motor activities, they build and refine psychological structures – *organised ways of making sense of experience that permit them to adapt more effectively to the environment*. Children develop these structures actively; using current structures to select and interpret experiences, then modify those structures to take into account more subtle aspects of reality" (p. 224). Furthermore, cognition is fundamentally predicated on interplay between several factors. These elements include; heredity of the child, maturation of the nervous and endocrine systems, action-oriented experience, regular social interaction and sharing of knowledge and the internal regulatory mechanism (Woolfolk, 2010; Muthivhi & Broom, 2009; Louw, van Ede & Louw, 1998; Webb, 1980). In addition to the preceding factors, Piaget (1952) argues that human actions are precipitated by the "two most general biological functions: organization and adaptation" (p. 5). As I try to demonstrate in this discussion, adaptation and organisation are inseparable. The same applies to related processes of assimilation and accommodation.

Piaget (1952) conceives adaptation as a reciprocal process wherein the organism, in the context of this discussion a cognizing child, and the environment have a mutual influence on each other. Hence, according to him; "there is adaptation when the organism is transformed by the environment" (ibid.) and this transformation leads to more interaction between the organism and the environment, culminating in auspicious preservation of the latter. Furthermore, Piaget (1952) argues that the transactions between the organism and the environment are centred on two interconnected processes: assimilation and accommodation. There are numerous examples that could be presented to highlight how adaptation might occur in a developing preschool child. However, in the interest of this discussion a single illustration should suffice.



Suppose a preschool girl who has in her cognitive structure the concept of a horse sees, for the first time, a zebra. “Mama! Mama! Look...a horse!” she shouts excitedly. In this regard, the girl taps into the information in her cognitive structure to make sense of what she sees in her environment. The process in which a person uses the information that already exists in the cognitive structure in order to adapt to the environment is called assimilation (Gordon & Browne, 2011; Woolfolk, 2010). According to Piaget (1952) in assimilation, the subject “brings the new into the known” (p. 6). Hence, viewed from equilibration point of view, assimilation leads to cognitive equilibrium in the organism that is interacting with the environment at a given point.

However, in the above example, as soon as the mother decides to assist the child to ‘eliminate’ the dissonance between reality and what the child seems to conceive, cognitive disequilibrium would occur. The mother might say, “No my daughter, that is a zebra and not a horse”. This ‘intervention’ by the mother would set the process of accommodation in motion. She could do this by, for example, providing the child with basic distinctions and similarities between the two organisms. In essence, Bongekile’s cognitive schemes would be expanded to create space for and, thus, accommodate new information (Gordon & Browne, 2011; Berk, 2009). Subsequently, equilibrium or “a sense of balance” (Gordon & Browne, 2011, p. 117) would occur in the cognitive structure of the child as soon as she has obtained clarity on what sets the zebra apart from the horse.

Therefore, for adaptation to occur there has to be toing and froing between cognitive equilibrium and disequilibrium as the subject moves from assimilation to accommodation, and back to assimilation while trying to make sense of the surrounding world. Throughout this process, the cognitive schemes are restructured to facilitate adaptation. Hence, as Piaget (1952) points out, intimately linked to adaptation is organisation. Organisation refers to an on-going process in which the child restructures information in order to make sense of the environment (Woolfolk, 2010; Berk, 2009).

It needs to be emphasised that the onset of cognitive development does not necessarily occur promptly from birth. Thus, inherent in Piaget’s theory is the notion that cognitive development is contingent upon chronological age. On the basis of this claim, Piaget (1952) believes that cognitive development in human beings is gradual and goes through different stages. As a result, he distinguishes between four stages of cognitive development, namely; sensori–motor (0 to 2 yrs.), pre–operational (2 to 7 yrs.), concrete–operational (7 to 11yrs.) and formal operational (11 yrs. to adulthood). However, as stated in the introduction of this paper, I focus only on the first two stages.

Sensori-motor stage (0 - 2yrs)

Berk (2009) asserts that, the name sensori–motor “reflects Piaget’s belief that infants and toddlers ‘*think*’ with their eyes, ears, hands and other sensori–motor equipment. They cannot yet carry out many activities mentally” (p. 226). According to Piaget (1952) the initial phase of this stage, i.e. from 0 to about 8 months, is characterised by elementary sensory adaptations wherein the child uses senses and reflexes to explore the surroundings. At this stage, the activities entail, *inter alia*: “Sucking thumb or tongue, following with the eyes moving objects, searching for where sounds come from, grasping solid objects to suck or look at them” (Piaget, 1952, p. 122).

During the latter part of the stage, from about 8 months to 24 months, the behaviour becomes more intentional rather than reflexive; hence Piaget (1952) refers to the behaviour associated with this phase as sensori–motor adaptations. According to Piaget (1952) behaviour at this stage involves awareness because it is “determined by consciousness of desire, or of the direction of the act” (p. 148). It is, therefore, at this goal–oriented level, at around 18 months, that the child develops behavioural patterns demonstrative of object permanence and symbolic thought (Piaget, 1952).

Indeed, the manifestations of cognitive development associated with sensori–motor are not limited to the above–mentioned behaviours but also include, *inter alia*, the imitation of other people, the development of memory and thought, and attempts to remove toys from a container (Woolfolk, 2010; Louw, van Ede & Louw, 1998). In concluding this discussion on sensori–motor, it is worth noting that the developmental processes associated with this stage contribute to the child’s ability to traverse subsequent stages of cognitive development. Additionally, certain behavioural patterns straddle the stages of cognitive development; therefore, “all aspects of cognition change in an integrated fashion” (Berk, 2009, p. 224). The next point of discussion focuses on the pre–operational stage.

Pre-operational stage (2 to 7 yrs)

Woolfolk (2010) contends that the concept of “operations” entails the process wherein a child executes actions by thinking them through prior to acting them out reflexively. Therefore, viewed from this angle, Piaget’s pre–operational stage is a period of cognitive development in which children use operations, i.e. internalized cognitive patterns, for thinking, *albeit*, at a less–advanced stage (Woolfolk, 2010; Louw, van Ede & Louw, 1998). However, at the beginning of pre–operational stage, from 2 to 4 yrs, children find it difficult to represent reality through images or reconstruction (Louw, van Ede & Louw, 1998). Piaget and Inhelder (1969) accentuate the limitation faced by young children in respect of applying operations by writing that, “the first obstacle to operations, then is the problem of mentally representing what has already been observed on the level of action” (p. 94).

Notwithstanding the deficiencies of young children in relation to operations, as mentioned above, tangible cognitive developments do occur at pre–operational stage. These changes can be attributed to on–going adaptation and the concomitant modification and expansion of cognitive schemes. These notable developments include; “an extraordinary increase in mental representations” (Berk, 2009, p. 236) or “representational intelligence” (Heo, Han, Koch & Aydin, 2011, p. 734) along with “an increase in language ability” (Ojose, 2008, p. 27). Accordingly, it can be argued that even though Piaget does not attach much significance to language as a key factor in enabling cognitive development, he does acknowledge its role in aiding mental representations. At this stage of cognitive transformation, language development is very rapid and facilitates symbolic and semiotic functions. Therefore, it is due to language improvement and the onset of representational intelligence that preschool children are able to, for example, use the picture of a dog to talk about a dog or use a broom stick to represent a horse in make–believe play. Additionally, having referred to make–believe play, it is in the interest of this discussion to



also mention that play is important in developing intelligence in pre-schoolers because it involves various cognitive schemes and reduces self-centeredness in young children (Berk, 2009).

In addition to the above-mentioned occurrences, there are numerous other changes, which are also attributed to adaptation, that characterise the pre-operational stage. Some of the changes are conceived as positive while others are not, these include: socialisation, moral development, emotional functioning, egocentrism and unique illogical perspectives (Heo *et al.*, 2011; Simatwa, 2010; Ojose, 2008; Fleming, 2005). However, irrespective of how these factors are conceived, they are inherently inseparable. To amplify this point, Piaget and Inhelder (1969) write that: “the affective and social development of the child follows the same general process, since the affective, social, and cognitive aspects of behaviours are in fact inseparable” (p. 114). The two authors seem to suggest that the assimilation dichotomies associated with the pre-operational period are integral elements of this stage “which constitutes an obstacle to, as well as a preparation for, operatory assimilation” (*ibid.*) that occurs in the concrete-operational stage.

It is in activities such as play that aspects such as socialisation, moral development and emotional functioning are developed. In the playground, just like in various aspects of a pre-schooler, language fulfils a fundamental function in facilitating the learning of social rules, which children “make up as they go along” (Fleming, 2005, p. 3). It is also when they engage in play activities that children learn to express themselves, *albeit* at a less-formalised level, about the concept of morality, i.e. what is morally acceptable or not (Fleming, 2005). This self-expression would include the communication of emotions such as sadness, happiness, anger, frustration, etc. Apart from elements like socialisation, moral development and emotional functioning, Piaget also refers to egocentrism as a key component of the pre-operational stage.

Piaget uses the concept of *cognitive egocentrism* in reference to the tendency of children at pre-operational stage to use illogical and unidirectional reasoning (Woolfolk, 2010; Simatwa, 2010). Children at pre-operational stage are inclined to view things from their own perspective and expect others to do the same. Piaget also uses the concept *egocentrism* in reference to children’s private speech; a phenomenon he deems insignificant (Louw, van Ede & Louw 1998). Egocentrism, which diminishes due to interaction between peers at pre-operational stage, is one of the obstacles to logical thought (Heo *et al.*, 2011). In addition to egocentrism, Piaget also identifies the problem of de-centering, the inability to focus on more than one dimension of an object at a given time (Woolfolk, 2010; Louw, van Ede & Louw, 1998), as another shortcoming associated with children at pre-operational stage. These are just some of the deficiencies related to pre-operational stage as postulated by Piaget, all of which would be addressed in subsequent stages of cognitive development.

In concluding the discussion on Piaget, it is important to mention that despite its unquestionable contribution to our understanding of cognitive development in children, Piaget’s theory has not been immune from criticism. For example, Piaget has been criticised for, purportedly, suggesting that all children in a particular age-group reach the same level of cognitive development simultaneously (Bennett, 1981). There is also an assertion that Piaget gives

more prominence to biological influences while neglecting the impact of the environment on cognitive development (Shelley, 2012). However, the major criticism is around the notion that the developments Piaget refers to in his cognitive stages occur much earlier than he suggests they do (Shaffer & Kipp, 2014; Russell, Jarvis & Gorman, 2004). In the next section I discuss Vygotsky's Socio-cultural Perspective.

Vygotsky's Socio-cultural Perspective

Lev Vygotsky's socio-cultural perspective focuses on the whole child (Gordon & Browne, 2011). According to Vygotsky, the society in which the child develops plays a central role in the holistic growth of the child, notably, cognitive development. To amplify this point, Berk (2009) writes that, Vygotsky "believed that many cognitive processes and skills are socially transferred from more knowledgeable members of society" (p. 25) to the child. Some of the more knowledgeable members of society who contribute meaningfully towards the development of a child include; experienced family members, knowledgeable peers and teachers (Donald, Lazarus & Lolwana, 2010; Woolfolk, 2010). Therefore, conceived from Vygotsky's perspective, cognitive development is a social process that is mediated through continuous interaction between the developing child and competent others; these knowledgeable people can be *significant others* who are closely related to the child or distant individuals (Simatwa, 2010; Muthivhi & Broom, 2009; Jones & Brader-Araje, 2002).

The interaction between the developing child and other members of the society helps to facilitate the learning process. Therefore, it is through social interaction that the child learns the values, skills, customs and beliefs of the cultural community that forms part of the child's daily life (Gordon & Browne, 2011). Throughout the learning process, the child is not a passive recipient of information but plays an active role in the acquisition and information processing. Hence, Gordon & Browne (2011) assert that in Vygotsky's perspective "learning is active and constructed" (p.123). The learning process gradually leads to higher cognitive development and it occurs at two levels, initially at social level and thereafter at individual level. Vygotsky (1981) underscores this point by writing that, "Any function in the child's cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological plane. First it appears between people as an interpsychological category, and then within the child as an intrapsychological category" (p. 163). There are various functions, tools, activities, etcetera that aid both cultural and intellectual development in children. Language is one of the principal tools worth reflecting upon in this respect.

Language as Cultural Tool for Development

The learning process is made possible by various cultural tools that form part of the daily settings of the developing child. Vygotsky highlights language as the major tool used to facilitate cognitive development in human beings. Jones & Brader-Araje (2002) underline this point:

Language forms the foundation of an individual's conceptual ecology as well as the means of conceptual growth. Furthermore, Vygotsky's argument that language serves to mediate higher order thinking (Vygotsky, 1978; Wertsch,



1979) has challenged educators to reconsider the critical role of language in the teaching–learning process. According to Vygotsky, language serves as a psychological tool that causes a fundamental change in mental functions (p. 4).

Undoubtedly, the preceding point tersely amplifies Vygotsky’s view on language as one of the drivers of cognitive development. Of significance is the link that exists between language and thought. According to Vygotsky (1986) there is “the fusion of thought and speech in adults as well as in children” (p. 89). It is primarily through language that the child learns about and, subsequently, appropriates social skills, values, rules, beliefs and so on, that ultimately define him/her as an important role player in society. Vygotsky highlights socialised speech and private speech as key elements of human language that contribute towards cognitive development.

Earlier in this discussion, I referred to the on–going interaction between the child and other members of the community in which the child develops. It is through this interaction, which “involves collaboration with competent others as mediators” (Denhere, Chinyoka & Mambue, 2013, p. 374), that the child gets to use language to learn and talk about events, actions and processes in society. This is made possible through socialised speech. Therefore, the language used in society (i.e. socialised speech) is a tool that fulfils two significant functions; it helps children talk about their actions and it also promotes active learning (Jones & Brader–Araje, 2002). Besides socialised speech, Vygotsky (1986) also talks about the importance of what he terms “private speech”. Private speech, also referred to as egocentric speech (Gordon & Browne, 2011), is a ‘product’ of socialised speech. This point is discernible from the assertion by Vygotsky (1986) who argues that:

Essentially, the development of inner speech depends on outside factors; the development of logic in the child...is a direct function of socialised speech. The child’s intellectual growth is contingent on his mastering of the social means of thought, that is, language (p. 94).

Furthermore, it is important to note that both socialised speech and private speech are invaluable in cognitive development. For example, it is through socialised speech that the child is introduced to social rules, beliefs, values and so forth. Equally, the process of internalisation, i.e. an individual’s reflection and assigning of meaning to the social rules, beliefs, etcetera, and the appropriation of these elements (Woolfolk, 2010; Berk, 2009) to guide one’s behaviour, is facilitated by private speech. Hence, Gordon & Browne (2011) assert, “Vygotsky contended that children speak to themselves for self–guidance and self–direction and that this private speech helps children think about their behaviour and plan of action” (p. 124). Accordingly, just like socialised speech, private speech is important in cognitive development. Apart from language, Vygotsky assigns a lot of significance to what he terms the zone of proximal development. Consequently, a discussion of this concept and its concomitants; mediation and scaffolding, is appropriate at this point.

The Zone of Proximal Development, Mediation and Scaffolding

As already mentioned in this discussion, Vygotsky posits that learning is actively constructed and mediated through continuous interaction between the developing child and other people within the socio–cultural setting of the child

(Gordon & Browne, 2011; Woolfolk, 2010). Vygotsky also suggests that, generally, children are able to learn without assistance. However, for learning to be meaningful, learners have to be often presented with challenging work; the work that is “slightly more difficult than what they do alone” (Shabani, Khatib & Ebadi, 2010, p. 238) and, thus, requires guidance, assistance and collaboration with more competent others. This approach helps in enhancing intellectual advancement and puts the learner on the trajectory towards more pronounced independent learning. Therefore, in order to differentiate between instances where guided learning is required and those in which it is not, “Vygotsky developed concepts of cognitive learning zones” (Blake & Pope, 2008, p. 60).

In discussing the cognitive learning zones; “Vygotsky drew a distinction between two levels of development, namely the ‘actual development level’ and the ‘potential’ or ‘zone of proximal development’ (ZPD)” (Mkhize, 2004, p. 5). In the ‘actual development level,’ the learner can accomplish successful completion of tasks independently and, thus, has nothing new to learn in this zone (Blake & Pope, 2008; Mkhize, 2004) while the ZPD refers to the critical space between what the learner already knows (the actual level of development) and the next level of development that the learner could accomplish. The attainment of this level of development is facilitated through mediated learning which involves collaboration between ‘more knowledgeable people’ and various tools available within the socio-cultural setting of the learner (Gordon & Browne, 2011; Donald, Lazarus & Lolwana, 2010).

Hamachek (1995) clarifies the essence of the ZPD by writing that, “at any given point in children’s intellectual growth there are certain problems that they are close to being able to handle. At such times, children need to be encouraged, perhaps by clues, reminders, gentle prodding, more instructions, or whatever it takes to bring them to the edge of new knowledge” (p. 163). The encouragement, clues, gentle prodding, etcetera used to facilitate the negotiation of the ZPD embody mediated learning (Donald, Lazarus & Lolwana, 2010; Hean, Craddock & O’Halloran, 2009); mediated learning is also referred to as scaffolding (Berk, 2009). Successful scaffolding is predicated on skilful identification and use of ‘appropriate’ socio-cultural resources, such as language and other social tools, to help the learner navigate the ZPD (Woolfolk, 2010). Additionally, for it to be effective, scaffolding should not be made a permanent feature of the learning-teaching process. Hean, Craddock & O’Halloran (2009) amplify this point by asserting that, scaffolding empowers learners “to build on their own existing knowledge and internalise new information. Scaffolds, by their nature are temporary support structures and will be slowly removed as students master the concepts in question and become independent learners” (p. 78).

In addition to scaffolding, Vygotsky (1976) argues that play activity is “the leading source of development in preschool years” (p. 537) and that there is a link between holistic development and the role of play-based activities in early childhood. According to Vygotsky, play is a development vehicle used by the preschool child for socialisation and appropriation of his/her socio-cultural world (Nicolopoulou, 1993). Appropriation includes the learning of; *inter alia*, the language, rules, games and skills that form part of the learner’s socio-cultural world (Nicolopoulou, 1993; Vygotsky, 1976). Hence, as Berk (2009) points out, Vygotsky views play as an influential zone of proximal development wherein



children advance their intelligence by trying a variety of new and challenging skills.

In concluding this discussion on Vygotsky, it is important to highlight that the ZPD has some implications for pedagogical processes. Vygotsky attaches a lot of significance to teaching and learning, particularly, mediation and guidance (Donald, Lazarus & Lolwana, 2010). For Vygotsky, learning can be facilitated through well-planned teaching and learning activities. This view is discernible from the assertion that, “to create the zone of proximal development, that is to engender a series of processes of internal development, we need the correctly constructed processes of school teaching” (Vygotsky, 1978, p. 134 cited in Donald, Lazarus & Lolwana, 2010, p. 56). This suggests that for learners to efficaciously traverse the ZPD, “correctly constructed processes of school teaching” (Vygotsky, 1978, p. 134 in Donald, Lazarus & Lolwana, 2010, p. 56) are necessary, i.e. teachers must plan and present meaningful pedagogical activities. In the next section, I try to demonstrate how Piaget and Vygotsky’s respective theories could be applied in the integration of EE in Grade R teaching.

The Application of Piaget and Vygotsky in the Integration of Environmental Education in Grade R

The South African public school curriculum advocates for the integration of EE in Grade R (DBE, 2011a; DBE, 2011b; DBE, 2011c). More importantly, a closer analysis of the Curriculum and Assessment Policy Statements (CAPS) used to aid curriculum implementation across all Grade R subjects suggests that the integration of EE in each of the subjects is feasible (Hebe, 2015). However, for the purposes of this discussion I have chosen the topic; “numbers, operations and relations” (DBE, 2011a, pp. 19 – 22) within the subject of mathematics, to demonstrate how EE could be integrated in Grade R. According to the CAPS document (DBE, 2011b), in the presentation of the chosen theme, teachers are required to focus on issues such as teaching and enabling Grade R learners to, among other things; count concrete objects, estimate and count at least ten everyday objects, count forwards and backwards, and solve word problems (story sums) in context. Additionally, teachers are required to utilise various pedagogical approaches including “number rhymes and songs, and say and use familiar number names in familiar contexts” (DBE, 2011b, pp. 19 – 20).

There are various ways in which the respective theories of Piaget and Vygotsky could be, complementary, applied in the presentation of the chosen theme to enable EE integration in a Grade R classroom. However, in my opinion, careful planning is required on the part of the teacher to accommodate, at least to some degree, both Piaget and Vygotsky’s perspectives. Therefore, the design and implementation of pedagogical activities should cater for various cognition processes, e.g. assimilation and accommodation. Likewise, planning for the navigation of the ZPD through, for example, mediation is also essential. Additionally, the respective roles of individual learners and their peers, the teacher and language should also be considered because, as highlighted in the discussion of the respective theories, they are all cardinal in facilitating knowledge construction. More importantly, because young children learn best through play-based activities (Cutter-Mackenzie, Edwards, Moore & Boyd,

2014; DBE, 2011a), due consideration should also be given to the role of play in classroom presentation.

In presenting a forward and backward counting lesson, involving numbers 1 to 10, that seeks to integrate EE through the use of Piaget and Vygotsky; the teacher as mediator of learning would have to plan a lesson that is characterised by a series of learner-centred activities (DBE, 2011a). Equally, an integrated approach to learning and teaching characterised by, *inter alia*, stimulating, play-based activities where learners actively interact with their environment should guide the pedagogical actions of the facilitator (McMonagle, 2012; DBE, 2011a). Hence, I would suggest that the lesson on the chosen theme, like any other Grade R lesson, should involve playing/singing activities, as ice-breakers and sources of fun. The teacher, as the facilitator of learning (DBE, 2011b), could use the following handclapping rhyme as part of the lesson (perhaps at the beginning of the lesson) to facilitate the learning of forward counting in a fun way.

Figure 1: A Nursery Rhyme that could be used for teaching forward Counting

<p style="text-align: center;">One Potato, Two Potato (Handclapping Rhyme)</p> <p style="text-align: center;"><i>Submitted by: Jill</i></p> <p style="text-align: center;">One potato, two potato, three potato, four, five potato, six potato, seven potato more. Icha bacha, soda cracker, Icha bacha boo. Icha bacha, soda cracker, out goes Y-O-U!</p> <p style="text-align: center;">Source: https://www.scrapbook.com/poems/doc/2948.html</p>
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The above rhyme or any other relevant rhyme that caters for forward counting from 1 to 10 would serve as an ice-breaker and a source of fun in the classroom. There are numerous other rhymes that could be used for ice-breaking and counting purposes. For example, a rhyme entitled; *The Singing Walrus: Counting from 1 to 10!* (<http://thesingingwalrus.com>) would be relevant in this lesson. This rhyme accommodates both forward and backward counting. The other rhyme that could also be relevant in this lesson is the backward counting rhyme; *Ten in a Bed* (<https://www.kididdles.com/lyrics/t003.html>). Excitement is one of the essential ingredients in a foundation phase classroom because it has the potential to sustain the interest and enthusiasm of young children. Therefore, the teacher has to do the best to instil and maintain enthusiasm among young learners. The singing of a rhyme would also provide the learners with opportunities to draw mental pictures that link each number, for example; the number “one,” to a tangible object such as “one potato” or any other object found in their surroundings.



It could, therefore, be argued that mental pictures derived from the use of a rhyme such as the one in figure 1, above, have the potential to promote the process of internalization which, according to Vygotsky, is a constituent of cognitive development (Muthivhi & Broom, 2009). Likewise, the role of language (in this case the language used by the teacher and the learners in the rhyme), and the linking of the abstract (the numbers) to the concrete (real objects) accentuates Vygotsky's views on the importance of both the language and the socio-cultural setting in the learning process (Jones & Brader-Araje, 2002). The language as a socio-cultural tool helps the child to learn at interpsychological level, *externally*, by interacting with others and at intrapsychological level by internalizing, at an individual and personal level; transforming the abstract into meaningful information.

After the singing of the rhyme, the teacher may give the learners various opportunities to count familiar objects, first inside the classroom and, later, outside the classroom. However, it is necessary to note that although, generally, young children are able to mention number names; most of them do not fully understand the concepts denoted by the number names (Bobis, 2008). Thus, it is to be expected that even if some of the Grade R learners might be *familiar* with the number names from "one" through "ten", the reality is that the majority of these learners cannot draw a link between the number names and the concomitant numerical symbols, i.e. 1 to 10, and what they signify. To most young children the number names are empty words because they have no meaning (Vygotsky, 1986). Hence, in the presentation of backward and forward counting, from 1 to 10, the teacher would have to strive to assist the learners to "make connections so that they develop insight and feel for numbers" (Anghileri, 2006, p. 2). This is necessary because as Vygotsky (1981) writes:

.....a word must have sense, i.e. a relation to an object. There must be an objective bond between the word and what it signifies. If this does not exist, further development of the word is impossible....this objective bond between the word and the object must be used functionally by the adult as a means of social interaction with the child: only then does the word acquire significance for the child (p. 162).

Therefore, for meaningful learning to occur, the teacher has to practically amplify the link between the abstract words (number names and the concomitant symbols, 1 to 10) and real life objects found in the socio-cultural world of the child and what the link signifies. Ordinarily, the Grade R classroom setting should have numerous objects that could be used for mediation purposes by the teacher. Such objects could be useful in facilitating the conceptual knowledge and understanding of the number names already referred to and the associated symbols. These objects would have been brought to class by learners or designed by the teacher as Learning and Teaching Support Materials (LTSM). The teacher would have to use some of those objects as scaffolds to expedite the learning process and to *concretize* the mathematical ideas associated with the concepts facilitated by the teacher. For example, the teacher could use wooden blocks, an abacus and so forth to facilitate learning. The following are some of the resources that could also be used to help the learners make sense of the numbers 1 to 10:

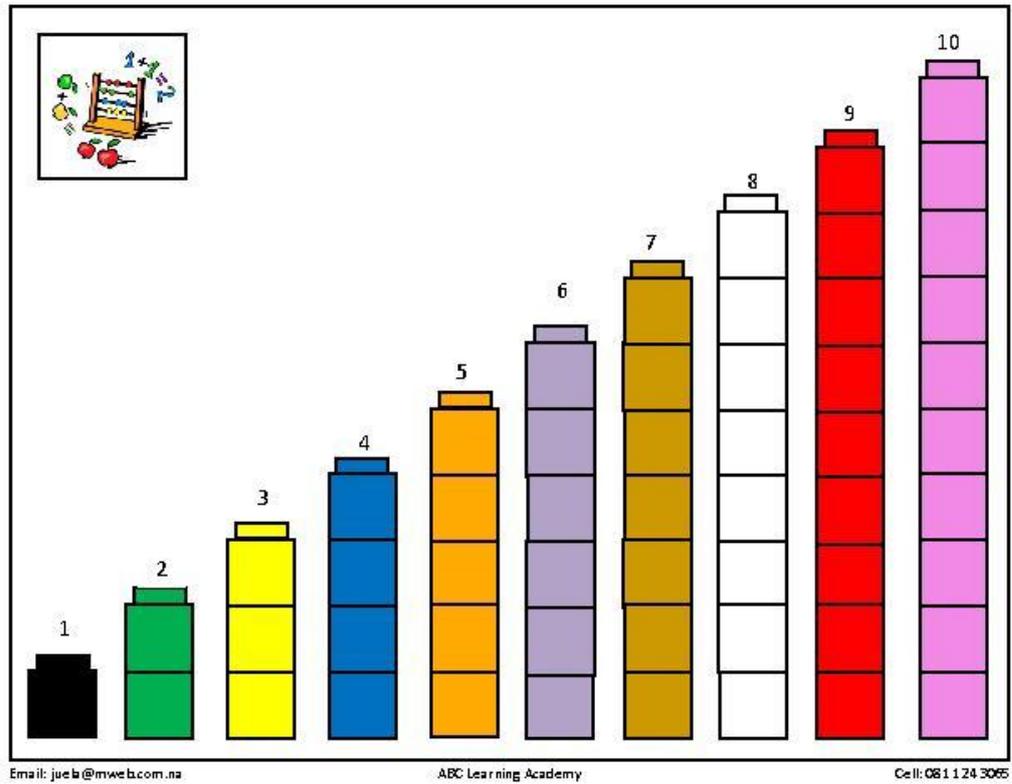


Figure 2: Unifixes 1 – 10

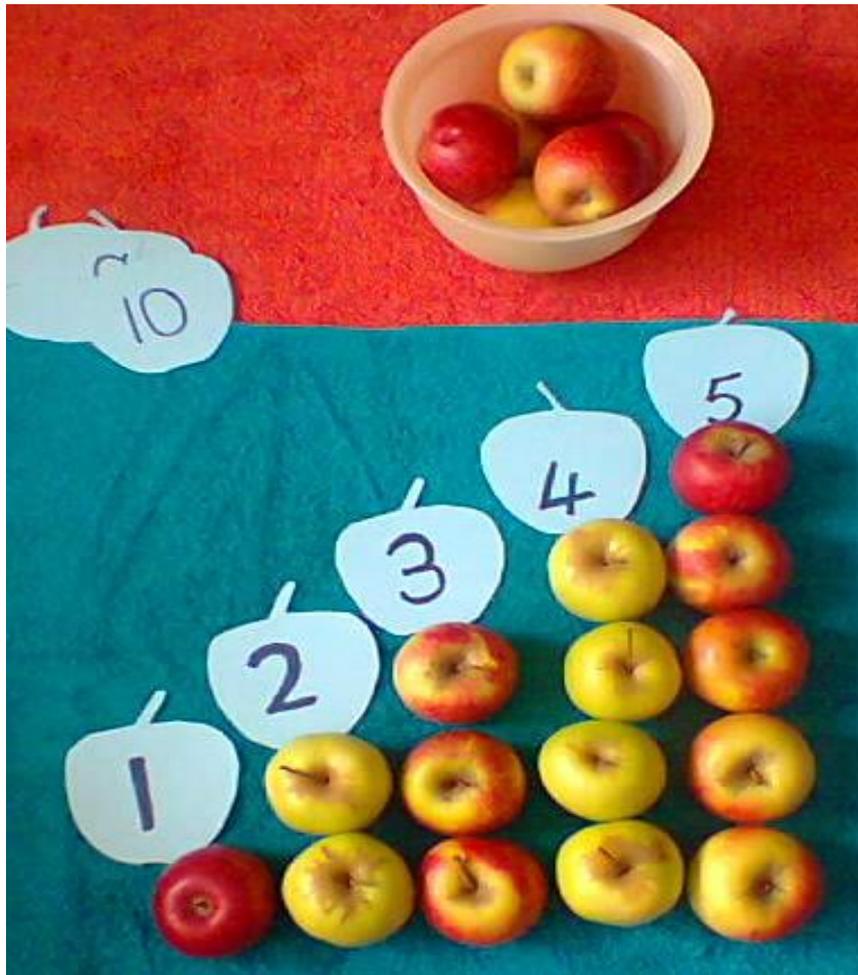


Figure 3: Apples 1 – 10

The use of objects such as the ones in figures 2 and 3 to mediate the learning of backward and forward counting can take numerous forms. For example, the unifixes provide each learner with an opportunity to, *inter alia*, internalize the numbers 1 to 10 while also aiding the processes of forward and backward counting through the manipulation of tangible objects available in the immediate surroundings of the learner. However, the teacher could find it even more useful to help the learner see the link between the number names, the numerical symbols and the objects. The objects in figure 3 provide the learners with this linking opportunity. This could be done by placing the small cards with numerical symbols (i.e. 1 to 10) alongside some objects; for example the apples, as illustrated in figure 3 above. Thereafter, to help the learners draw an association between the numbers and objects; the teacher would have to use verbal statements, e.g. “one apple”, “two apples,” etcetera, while pointing at the cards and objects. The teacher would also have to allow the learners (collectively and individually) to demonstrate that they can also link the numbers to objects. This would have to be done for both forward and backward counting.

Undoubtedly, the process would not be easy; therefore, a lot of toing and froing between assimilation and accommodation is to be expected. To ease the challenge, the teacher would have to, *inter alia*; use the language of the socio-cultural setting of the learner. Likewise, it would be helpful to allow the learners to learn from one another. Once the teacher is convinced that the learners have a conceptual understanding of the numbers 1 to 10, which would take more than one lesson and a lot of effort, the learning process would have to be taken outside of the four walls of classroom.

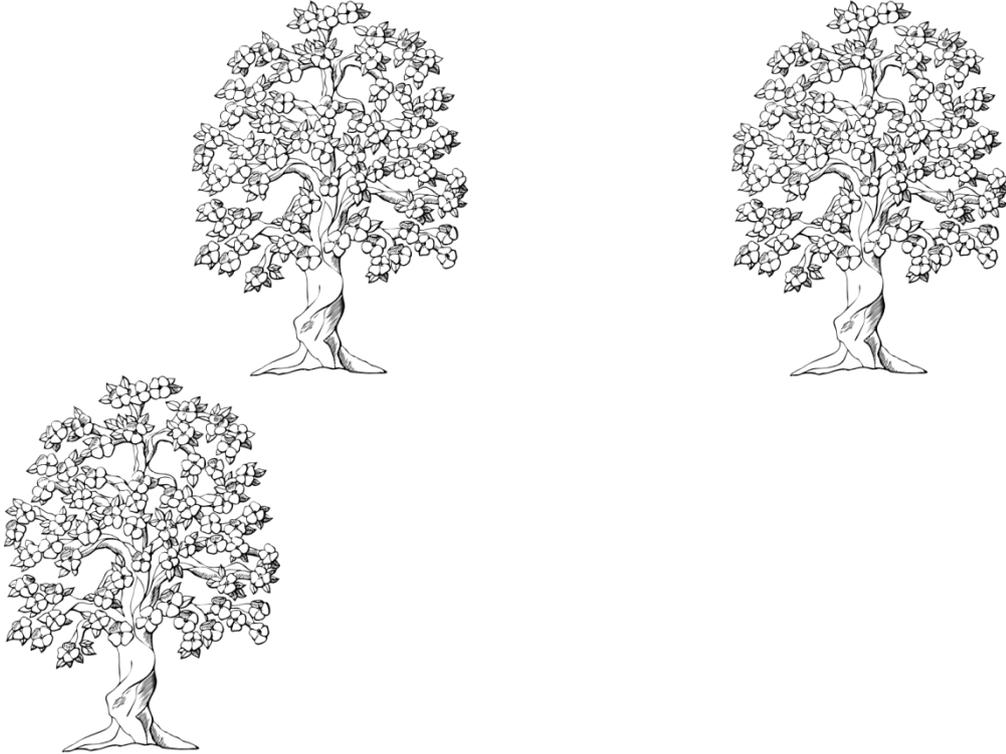
Outside the classroom, the teacher could guide the learners through the process of physically counting some objects that are visible through the naked eye. The learners may, for example, count various trees found in the school yard. The teacher may ask the learners to mention, while counting the trees, the fruit borne by each tree, e.g. “there are one, two, three, peach trees in our school garden”. The learners should also be given a chance to touch the trees – e.g. the barks, the leaves and fruit. Throughout the process, the teacher should assist and guide the learners. The learners should, as they identify each one of them, also be asked to state the importance of the trees found in the school yard. Additionally, since preschool children are at the onset of ethical development, to aid both cognitive and moral advancement; the teacher may highlight that all the trees in the learners’ surroundings and beyond are important and, that there is a need for their preservation. To facilitate active learner participation and, indeed, intellectual development; the teacher would also have to ask the learners to talk about the actions that could be undertaken to protect the trees from any possible forms of harm. Learners may also be given opportunities to talk about the trees and other flora found in their homes and how they look after it.

As soon as the teacher is convinced that the learners have, somewhat, *grasped* the notion of backwards and forwards counting, then the concept of a problem sum can be introduced. The following example or its variation could be used:



Figure 4: An Example of a Problem Sum that could be used in a Grade R Classroom

There are three peach trees in our school garden. How many more peach trees must be planted to have ten peach trees?



+

= 10

Answer: _____

In order to amplify the value of trees and, indeed, other forms of vegetation, the sum lesson could be followed by a *class project*. Therefore, the teacher may bring a tree or two and work, collaboratively, with the Grade R learners in planting the tree(s). The tree-planting project, just like the other activities that precede it in the backward and forward counting lesson, would contribute to the expansion of cognitive schemes in most of the participating Grade R learners. This would be attributed to the equilibration process, the toing and froing between assimilation and accommodation, in which learners (with the help of the facilitator) move from the known to the unknown as they

endeavour to assign meaning to new information. In concluding this discussion, I reflect on how environmental education is integrated in the already discussed lesson specimen.

Illumination: Locating Environmental Education within the Lesson Specimen

In his seminal work entitled, *Environment and Environmental Education: Conceptual Issues and Curriculum Implications*, Lucas (1972) posits that Environmental Education adopts the following three-dimensional approach; ‘education *about* the environment,’ ‘education *in* the environment’ and ‘education *for* the environment’. Education *about* the environment focuses on learning ‘factual’ information about the systems that exist in the environment, how they are linked and interact and, the influence of human beings on environmental systems. Education *in* the environment centres on the acquisition of awareness, values, skills and the development of attitudes about the environment by actively engaging learners in activities that occur in the environment; outside the four walls of the classroom. On the other hand, education *for* the environment is more about problem-solving. Some of its key elements include environmental activism and social transformation through individual and collective action. According to Rosenberg (2009), typically, education *for* the environment is socially critical and persuades teachers to present learners with opportunities tilted towards environmental action; the acquisitions of skills, values and attitudes that empower learners to contribute towards addressing environmental challenges.

Over the years, flowing from the emergence of this three-dimensional approach to EE, the notion of ‘education *about*, *in* and *for* the environment’ gained widespread acknowledgement. In the eyes of many advocates of environmentally-inclined pedagogy, this notion has virtually become the summation of what EE is all about. Undoubtedly, this “three-fold structure” (Palmer, 1998, p. 136) has had an influence on how EE is conceived. Accordingly, as Robottom (2007) writes, “it is possible (and completely acceptable) for EE practitioners to employ the label of EE to describe their practice in any (or all) of these approaches” (p. 92). It is due to its pervasive appeal that I employ this three-dimensional approach to illustrate how EE could be integrated through the use of Piaget and Vygotsky’s respective theories in Grade R. The following points seek to highlight how the preceding lesson example accommodates the three-dimensional approach to EE.

There are numerous examples that point to the application of the three-dimensional approach to EE in the lesson specimen, above. For example, education *about* the environment would be discernible from the activity that involves talking about and counting familiar objects that form part of the daily setting of the Grade R learner. In the lesson example, reference is made to phenomena such as potatoes, unifixes and apples. Ordinarily, all these aspects should form part of the learner’s surroundings and each one of them has a *niche* in the environment of the developing child.

Likewise, by taking the learners outside the four walls of the classroom and enabling them to count, touch and talk about flora found in the courtyard of their learning centre; the teacher would be engaging them, simultaneously, in education *about* and *in* the environment. By allowing the learners to touch the



vegetation, the teacher would be providing them with opportunities to explore and aesthetically appreciate nature. The exploration of nature is an essential element of EE in the realm of ECE (Laird, McFarland–Piazza & Allen, 2014) and, thus, it needs to be encouraged. Additionally, the activity of talking about the necessity to protect and preserve plants and the focus on how to go about doing it should contribute towards the inculcation of positive values and attitudes needed to assist learners develop environmental awareness.

To conclude, a decision to undertake a tree–planting class project would amount to education *for* the environment. In my view, this action–oriented activity should contribute towards enabling the learners to see the need to appreciate and value the beauty of nature. More importantly, through this activity, the facilitator would also contribute towards helping learners, from early in their lives, “to acquire, through *active participation* and meaningful practical experiences, the *skills* and *knowledge* that should help them to, ultimately, develop a pro–environment *attitude* characterised by caring and protection towards the environment” (Hebe, 2015, p. 20). Hence, as some authors (e.g. Kopelke, 2012; Robottom, 2007) also point out; education *for* the environment is, indeed, the essence of EE.

Conclusion

Undeniably, human actions pursued in a quest to satisfy needs and insatiable wants persist to negatively impact the environment. Accordingly, literature argues for the introduction of young children, from as early as Early Childhood Education level, to Environmental Education (Davis, 2009; Hägglund & Pramling Samuelsson, 2009). This is conceivably one of the measures that need to be undertaken to, ultimately, offset the impact of human actions on the environment. Concomitantly, the value and practicable application of various pedagogical approaches, including theory–driven strategies, in the integration of EE at ECE level have been highlighted (Hebe, 2015). However, as this paper argues, there seems to be paucity of literature that focuses on the application of theory–driven pedagogy in the integration of EE at ECE level.

Accordingly, in this paper, I tried to demonstrate how Piaget and Vygotsky’s respective theories could be applied in the integration of EE in ECE. I used a theme drawn from the South African public school curriculum to make my point. In order to substantiate the applicability of these two perspectives, I commenced by highlighting that since they have been applied in various spheres of education; these theories can also be applied in the integration of EE in Grade R classes in the South African public school system.

My view is that in light of ceaseless challenges facing our environment; every effort is needed to equip young people with skills, knowledge and values that would enable them to contribute towards addressing the growing environmental challenges facing the planet. Certainly, the use of theory–driven pedagogy that seeks to infuse EE at ECE level could be one of the approaches that are explored further. Hence, since there is an indication that there is very little, if anything, that has been written about paradigm–driven pedagogy in the integration of EE at ECE level; more research is needed in this area.

Disclosure statement

The Authors reported that no competing financial interest.

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