
School as cultural practice: Piaget and Vygotsky on learning and concept development in post-apartheid South Africa

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Abstract

Contemporary South African schooling, founded on progressive educational ideals such as learner-centeredness, teacher as mediator and respect for cultural diversity, calls for a close examination of the assumptions underlying these concepts and their associated pedagogical approaches.

Piaget and Vygotsky's theories respectively offer an interpretive and conceptual framework suited for elaborating on the nature of curriculum and the ensuing pedagogical practices of the post-apartheid educational setting in South Africa. The paper, informed by Piaget and Vygotsky's framework, examines concept learning and development as simultaneously involving individual, self-regulatory processes on the one hand and the socio-culturally mediated processes on the other hand.

This paper posits that learners manifest, during the experimental task performance, both the structure of the processes of self-regulation (individuality) and other-regulation processes of their society and culture. These pluralist, heterogeneous forms of cognitive development and functioning suggest a unique socio-cultural context of learning and development – with important implications for curriculum organisation and the design of classroom instruction.

Introduction

Piaget and Vygotsky were concerned with a common unit of analysis; namely, the processes of thinking of a subject located in society and culture. They proceeded from a common ontological assumption that knowledge is actively constructed and that it is the product of the actions of an individual rather than an imposition by society and culture (cf. Stetsenko, 2008). Individual activity as a central mechanism that accounts for knowledge was explained by Piaget (1964; 1981) through the concept of *equilibration* while Vygotsky (1978; 1981) used the concept of *internalisation* to account for the same process. Both processes suggest adaptation through transformation of self.

It is in the account of the formal operational processes and their genetic basis that the analytic emphases of the two frameworks diverge. Piaget emphasised the internal structuration of thought while, from Vygotsky's point of view, such structuration has to be considered against the background of how the sociocultural context within which it arises has, in turn, been structured. These differences have been conceived as dividing the two approaches. However, this diversity in analytical emphasis in the respective frameworks should allow them to be brought into some kind of dialogic relationship. The different analytical foci of the two theoretical traditions should motivate for their complimentary application in empirical research to facilitate a more comprehensive interpretation of observations.

The application of this novel interpretive approach to subjects' experimental task performance in the present study renders their complex cognitive performance meaningful in relation to the specific cultural context of its manifestation. The subjects' spontaneous developmental processes and their culturally mediated processes are explainable in terms of a single interpretive framework that takes into account both the *organism* and the *tool* through which action becomes possible. In this way, the human organism changes its culture at the same time that culture is changing it. The subjects' organismic potential is viewed from the perspective of what Shayer (1997, pp.36 and 38) argued is a "genetic programme" supporting the assumption of a "genetic potential for cognitive development". The same organism, making use of culturally mediated tools, elaborates and sometimes transforms itself as it simultaneously transforms its culture.

Schooling as a sociocultural practice is progressively changing in the course of new discoveries positing new social relations, at the same time that learners are expected to learn new knowledge from this institution and transform their existing ways of thinking. Piaget, for example, anticipated a mode of teaching and learning in school that is premised on symmetrical relations with no unequal, authority-based social relations that often result in learners feeling the pressure to adopt the point of view of the adult (cf. Labouvie-Vief, 1996). Contemporary schooling in South Africa seeks to provide learning conditions of equality where the teacher is a 'mediator' and 'life-long learner' rather than the 'source of knowledge' (Department of Education, 1996; Department of Education, 2004).

This approach, on the part of South African teachers, would involve a change of their existing cultural practices to those demanded by their new schooling and curriculum policy. These processes of social relations, necessary from

Piaget's framework to bring about formal operational forms of thinking and problem solving, were anticipated by Vygotsky in the formulation of his theory; as processes of culture and society that are temporally prior to individual activity but not reducible to it (Wertsch, 1995). As a result, South African schooling could be considered from the Sociocultural perspective as providing a cultural context characterised by rapid change from the authoritarian, apartheid schooling to the contemporary, post-apartheid dispensation. This is a unique sociocultural context of learning and development that demands close examination regarding its consequences for learners' learning and development as well as the learners' (and teachers') contribution to changing the cultural-psychological processes of school learning and development.

The present study shows how an understanding of the commonalities and differences between the Piagetian and Vygotskian frameworks can illuminate how the subjects' specific schooling and culture shape their learning and development in the South African context. The theoretical approaches of Piaget and Vygotsky were based on the assumption that to understand a phenomenon is to understand the process through which it has been produced, "its developmental construction" (Duveen, 1997, p.68). Vygotsky (1978) has proposed that the appropriate methodology for the study of human psychological processes involves the reconstruction of the genetic (historical-developmental) basis of the phenomena, its course of development, to its present manifestation. In a similar vein, Piaget (1995, p.278) argued that "human intelligence is subject to the action of social life at all levels of development from the first to the last day of life". A theoretically informed analysis of the subjects' responses to the experimental task questions that considers the genetic basis of such performance from the subjects' context of learning and development in their schooling is carried out with a view of illuminating on the sociocultural structuration of the subjects' task performance.

The experimental task

The task performance of Grade 7 learners (mean age of twelve years) provides an appropriate focus for the analysis. The full report of these experiments was presented in Muthivhi (2008a; 2009). Schooling for learners in Venda was dominated by rote-based transmission modes of teaching and learning, with little critical engagement with knowledge. These are practices that derived,

and had evolved, from the missionary traditions on which Venda schooling was predicated. Within this system of schooling, the authority of the text was venerated and learners were taught to accept the text without question and critique. These modes of classroom practice were later replaced, but not superseded, by the schooling traditions of the repressive apartheid political regime. Under this system of schooling, learners were also encouraged to accept the authority of the text without question and teachers were trained for uncritical reproduction of the apartheid ideology (see Muthivhi, 2008a for a detailed discussion). These were the conditions of schooling and classroom teaching and learning in which the learning and development of the learners in Venda took place and that constituted the cultural-institutional context of formal schooling.

The experimental tasks required the subjects to demonstrate understanding of *possibility* through hypothesising about possible colour values that can be made from the given situations that involved a tinfoil covered half circle and a red uncovered half circle. The tinfoil covered half is assumed to be either red or green and its colour value is presumed not to be knowable in advance. As a result, proceeding from the hypothetical position regarding the covered half, it should be possible to make an (i) all red circle and a (ii) red and green colour circle but it would not be possible to make a green colour circle since the uncovered half was already red. Adding another uncovered green colour half circle into the task (for Situation Two) makes it possible to make (i) an all green circle, (ii) an all red circle and a (iii) red and green circle (see Muthivhi, 2008; 2009).

Although these procedures were explained to the subjects, who participated in the experiment one at a time, and they seemed to understand and agree with the explanation given by the experimenter, the subjects did not stick to the principles agreed to at the demonstration stage during their responses to the task questions. For example, their responses to the task questions revealed that they did not consider the tinfoil covered element as not knowable in advance since they responded to the questions on the basis of an assumption of a definite colour value pertaining to the covered element.

The following were the task questions the subjects responded to:

Table 1.1. Situation 1 questions¹

- (1a). If we remove the foil, will it be possible to make an all-red circle?
 - (1b). If we remove the foil, will it be possible to make an all-green circle?
 - (1c). If we remove the foil, can the full-circle be red-and-green in colour?
 - (1d). If we remove the foil, will the circle be of one, or two, colours?
 - (1e). If the circle that is made out of these two halves is one colour only, what colour does it have to be?
 - (1f). A few minutes ago, another child made a one-coloured circle using the same halves as these in front of you. What colour do you think it was?
 - (1g). What colour can all the circles that can be made out of these halves be?
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Situation 2. questions

- (2a). Can we make a red-and-green colour circle?
 - (2b). Is there another way in which a red-and-green circle can be made from the half circles in front of you?
 - (2c). With these half circles, will it be possible to make an all-red circle?
 - (2d). If the tinfoil is removed, will it be possible to make an all-green circle?
 - (2e). If the foil is removed, can we make a one-coloured circle from these halves in front of you?
 - (2f). If we want to make a one-colour circle, by these halves in front of you, what colour will it be?
 - (2g). If the foil is removed, what are the different-colour circles that can be made from the half circles in front of you?
 - (2h). If the one colour circle that is made from these halves in front of you has to be one colour only, that is: all-red, or all-green, it has to take the colour of one of these three halves. Can you say which one this half circle is and why do you think so?
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Results

The results of the Grade 7 subjects are of particular interest for the present discussion. From a theoretical perspective, twelve year olds have just attained formal operations and are therefore expected to perform competently on the task. The comparative results of Pieraut Le-Bonniec (1980) and Macdonald (1987) have shown that the children were able to solve all the task problems by Grade 5 (ten years of age). In contrast Muthivhi (2008a; 2009) showed that

¹ Tables reproduced from Muthivhi (2009) with permission.

children in disadvantaged, rural and non-industrialised sociocultural settings failed to address all the task problems competently even by twelve years of age.

Grade 7 subjects obtained an average performance of 84 per cent, only 15 per cent more than the Grade 5 subjects who managed 69 per cent. The Grade 7 subjects' performance was not statistically significantly different from that of the concrete operational Grade 5 subjects (See Muthivhi, 2008a; 2009 for details of the statistical analysis of the performance). These results suggest that the performance of the Grade 7 subjects was still dominated by the concrete approach to problem solving. They did not apply the rule regarding the formulation of a hypothesis about the covered element consistently to address all the task questions. The explanation for this dominance of a concrete approach to problem solving can be found in the subjects' dominant modes of learning in their schooling. Their school learning did not emphasise formal, abstract modes of problem orientation and task engagement. Empirical studies of classroom teaching and learning activities confirmed this assertion (cf. Muthivhi, 2008b).

Culturally shaped modes of learning and development are internalised into the dominant problem orientation and task engagement strategy for solving formal problems by the subjects. For example, when addressing situation (1f): "A few minutes ago another child made a one-coloured circle using the same halves as these in front of you. . .", the subjects often interpreted the hypothetical statement in concrete terms, giving it a literal interpretation. The notion of "another child" tended to be interpreted as referring to a real person who had earlier on participated in a similar experiment. For example, Mulalo² responded to question (1f) that the other child could have made a red circle. To the follow up question: "How did she do this?" Mulalo responded: "She could have used a red half from these (pointing at the elements that were placed outside)". To the experimenter's further suggestion that the red colour circle was made using the two elements in the game, Mulalo argued: "This (the covered element) is green and the only one that could have been used by the other child is the one outside as she could see that its colour was red". Mpho responded to the same question with: "It depends on what colour halves the other child has used", while Dakalo said: "I cannot say what colour it was because I did not see what the other child did". While proceeding on the basis of an assumption of a definite colour value for the covered element, the

² Not real name. All names have been changed to protect the identity of the subjects.

subjects interpreted this question as referring to a real event that happened earlier on, and sometimes thought of the participants who had gone before them as “another child” the statement referred to. For example, Livhu retorted after the question was asked her: “Which child? Tshifhiwa?”

This response pattern suggests that the subjects resisted the information provided at the beginning of the experiment and the assertion that this task would involve hypothesising about the colour value of the covered element to think about possible states of affairs. The notion of possibility the subjects emphasised was tied to the concrete materials of the experimental tasks while the scope of the materials to be used for the purpose of task engagement was also extended arbitrarily (against initial agreement) to include the elements that were placed outside the experimental activity. This approach to task problem suggests a mode of problem orientation that is concrete and functional. Solving the task problems for the subjects was not conceived, primarily, as an act of adhering to the rules of engagement that had now become the subject of thought in abstraction but a matter of addressing a real and immediate problem using all available contextual information. This approach to problem solving and problem orientation seems to be embedded in the culture of learning and schooling of the subjects, where tasks are often linked to, and make direct reference to concrete phenomena in the subjects’ immediate surrounding.

In the case of situation (1g), as in questions (2g) and (2h) that required the formulation of a double hypothesis about the covered element, most subjects did not perform competently. This was probably due to the subjects’ tendency to think of ‘the possible’ as also involving ‘the real’. That is, once the subject posited that it was possible to make a red, or red and green circle, he or she ignored the fact that it should ‘simultaneously’ be possible to make an alternative colour circle. For example, Kundi (K) responded to question (1g) posed by the experimenter (Exp):

- Exp:** “What colour can all the circles that can be made out of these halves be?”
K: “Red and green”.
Exp: “Only a red and green circle? What other colour circle could also be made?”
K: “Red and Green”.
Exp: “Will it be possible to also make a red circle, all red circle, from these halves in front of you?”
K: “No”.
Exp: “Wouldn’t it be possible to make a circle that is red all over?”
K: “No”.
Exp: “Why do you think so?”
K: “(After a long pause) This (pointing at the covered element) is red”.

Fhatu (F), in responding to question (2g), only suggested two instead of three possibilities:

- Exp:** “If the foil is removed, what are the different-colour circles that can be made from the half circles in front of you?”
- F:** “We can make a red and green circle (pointing at the relevant uncovered elements) and a red circle if this (pointing at the covered element) is red when it is uncovered”.
- Exp:** “Is it possible to make a green circle, a circle that is all green from the elements in front of you?”
- F:** “No”.
- Exp:** “Why do you think it is not possible to make a green circle form these halves?”
- F:** “Because we will find this (pointing at the covered half) to be red when we uncover it”.
- Exp:** “How do you know this?”
- F:** “I just know”.

Question (2h) seemed to confound the subjects by its content. The subjects did not appear to be used to engaging with long and complex verbal statements. This question had to be repeated for most subjects. The incorrect responses involved pointing at the red uncovered half. Most of these responses were not clearly defended as the subjects often said that they “just knew”, or that “the circle will be red”. Also notable in the subjects’ responses to these questions (and this could also be said of most subjects who provided competent responses) was the inability to provide a justification for the initial responses as the question required. Thus, only the first part of the question: “. . . Can you say which one this half circle is. . .” was addressed while the part involving “. . . why do you think so?” was often ignored and only addressed on the experimenter’s insistence.

The limitations in the subjects’ responses to these questions could be traced to the dominant activities of their classroom teaching and learning, and involved an inability to provide an elaborate account of the processes and procedures involved. That is, explaining how the possible states would result from each of the possible situations, rather than emphasising the answer – usually given as one word or as a pointing gesture. Related to this limitation was the emphasis on ‘what is’ and the perception of what was possible as involving the ‘possible-real’. Thus, classroom teaching and learning in the subjects’ schooling context did not foster considerations and discussions of possible states of affairs and knowledge as a property of the mind or rational enquiry (see Muthivhi, 2008a and 2008b). The subjects’ experience involved the acquisition of factual knowledge in its ready-made form, not open to further

interrogation and modification. Learners responded to teachers' questions in one word or a short phrase and were never asked to explain their answers. Learning did not emphasise a genuine process of thinking and enquiring about the possibilities regarding the objects of knowing. As a result, such modes of engagement, which were dominant in the subjects' formal schooling, were likely to constrain their performance on experimental tasks that required the application of precisely those categories.

Commonalities in Piaget and Vygotsky's theories

The development of more adequate conceptual systems for a better understanding of classroom processes of teaching and learning and their consequences for learner development through a consideration of cognitive functioning and problem solving modes in experimental situations is pertinent for contemporary, post-apartheid South African education, especially as we seek to understand more effective ways of improving learners' performance and learning experience. The Piagetian and the Vygotskian conceptual frameworks respectively offer a possibility for a comprehensive understanding of the processes of concept learning and development as derived simultaneously from pupils' own activity and the activity of their society and culture.

The Vygotskian view of culture relates to the concrete practices of people and may be applied both to spontaneous, everyday contexts and to the formal school context of learning and development. Culture is "the product of social life and human social activity" (Vygotsky, 1981, p.164). It "creates special forms of behaviour, changes the functioning of mind and constructs new stories in the developing system of human behaviour (Vygotsky, 1981, p.29). The formal practices of classroom teaching and learning, for example, can be viewed as constituting a form of cultural practice of their own which differs from those of the every day, spontaneous contexts of learning and development. Therefore, all everyday spontaneous situations of learning and development would manifest common characteristics that make them essentially the same, irrespective of the specific cultural traditions in which they are manifest. This sets the spontaneous, everyday contexts of learning apart from the formal, school-specific contexts of learning and development (Kozulin, 2003, p.1990). On the other hand, school knowledge and learning, according to this view, would also reveal qualities that separate them qualitatively from the forms of learning and development that characterise non-school, everyday situations.

Vygotsky (1978) argued that learning, as it happens during the child's pre-school years, is qualitatively different from the learning that occurs during formal schooling, which is concerned with learning the fundamentals of scientific knowledge. The introduction of the scientific form of knowledge to children, and the associated methods of its acquisition creates, in learners, new zones of proximal development (Vygotsky, 1978). Thus, learning formal knowledge in school changes the course of development and creates new developmental pathways, which might not occur otherwise. By 'scientific concepts' or 'scientific knowledge' Vygotsky does not only mean knowledge of the natural science disciplines but also of the humanities, languages and arts. This form of knowledge is characterised by its systematicity, abstractness and generalisability (Vygotsky, 1978; 1986). This form of knowledge could be defined as constituting the highest form of 'artificial' human thinking, a deliberate creation by man to master his own world through his or her thought processes.

Piaget avoided questions about the social and cultural contexts of learning. He considered that these were at a different analytic level to the genesis of 'true forms' of thought processes that are unencumbered by the 'authoritarian' adult forms of knowledge and social relations (Anne-Nelly Perret-Clermont, 1997). The social forms of the development of knowledge were of interest only where such forms of knowledge pertained to the development of scientific knowledge through symmetrical, peer interaction, which does not include adult-child relations. Therefore, Vygotsky's framework could be viewed as elaborating on the social aspect of knowledge development, to uncover the specific conditions of the asymmetrical adult-child and peer relations (within specific socio-institutional contexts like formal schooling) in which development takes place. This context of development was posited in Piaget's theory mainly where it involved symmetrical peer relations, probably as it was not deemed to be possible in then, early and mid 19th century educational settings (Duveen, 1997).

For Vygotsky, there are always conditions under which developmental processes would be activated. For example, the mediation (and internalisation) of the knowledge of objects does not occur in isolation of the knowledge of their social uses. As Karpov has argued, object-centred activity deals with:

[. . .] children's manipulations of objects in accordance with their social meanings and includes, but is not limited to, children's play with toys. As opposed to physical characteristics of objects, their social meanings are not 'written' [. . .] on objects and, therefore, cannot be discovered by children independently. For example, children could

discover by themselves that banging a spoon on the table will produce a sound, but they would not be able to discover without adult mediation how to use the spoon for eating (Karpov, 2003, p.144).

This example of the social structuration of the knowledge of objects is particularly relevant for elaborating Piaget's concern with the emergence of logico-mathematical form of knowledge as a product of the subject's actions on the world. The importance of considering the subject's discoveries as involving prior activities of society and culture is highlighted by Bryant's (1997) observation about the number concept as a product of prior human social activity. Bryant (1997, p.140) reports on studies that support the importance of cultural structuration of the number system, serving to improve intellectual power and to transform intellectual processes. Bryant argues that the decade structure of the modern number system makes it possible to count generatively, enabling the generation of successive numbers on the basis of the knowledge of the structure of 10s, 20s, 30, 100s, etc. Bryant argues that this decade structure is a cultural invention that cannot be learnt 'spontaneously'; is handed on from generation to generation and therefore serves as a cultural tool. Bryant further reports on Miller and Stigler's (1987) study that found that the Taiwanese children performed better on counting than their American counterparts owing to the cultural-linguistic structuration of their experience of the number system.

While Piaget's apparently inadequate treatment of the socio-cultural factors underlying individual activity would benefit from such an elaboration, Vygotsky's seemingly inadequate treatment of the internal, self-regulatory processes implied by his notion of 'internalisation' would similarly benefit from Piaget's in depth treatment of the internal regulatory processes. For example, Vygotsky's (1978) description of the mechanism through which a reflex, motor movement is transformed through the 'internalisation' of social-relational processes into a socially mediated function for pointing at objects, i.e. the pointing gesture, does not clearly account for the internal regulatory processes that lead to the eventual developmental achievement. There is therefore, from the perspective of the current synthetic approach, a conflict that arises when the internal, individual processes come into contact with the external, contextual and socio-culturally patterned processes. The question becomes how this conflict, from the perspective of the developing subject, is to be overcome. That is, whether it is through the actions of the subject in isolation or whether it is by the joint activity of the individual and society or socially mediated individual actions?

The interpretation of the experimental task performance presented in this paper is informed by these conceptual frameworks, and aims to illustrate the theoretical assumption of the primacy of the individual in the development of knowledge, without reducing the process to *solo* activity by and of the individual. In this way, the contribution of societal and cultural processes in determining, and indeed, co-determining, the subjects' cognitive actions regarding their responses to the experimental task questions becomes explicable. This approach makes possible the assumption about culture and society as never superseding the individual, and the individual as not entirely isolated from his or her sociocultural milieu but not reducible to it. This position informs the view of the concept of 'possibility' as constitutive of both the internal, individual and external, socio-cultural modes. The development of this concept is viewed as proceeding, both from the internal individual self-regulatory processes and from the external, socio-cultural processes characteristic of formal schooling.

'Possibility' as an 'everyday' and as a 'school-formal' concept

The notion of 'possibility' as a psychological category arising out of the formal operational state involving the ability for hypothesising could be related to two distinct developmental 'levels'; the 'spontaneous, everyday, natural, elementary' form, and the formal, abstract-conceptual and theoretical form (Vygotsky, 1986; 1987; Kozulin, 1990; 2003). The former is linked closely to the perceptual processes of the child and arises from the direct relationship the child has with the world, while the later arises from the systematically 'mediated' experience of formal school learning in which the child has no direct relationship with its world of experience. This characterisation of the two distinct forms of conceptual relations is crucial as it sets apart the qualitatively distinct processes of learning and knowledge acquisition pertaining to everyday learning situations on the one hand and to formal school learning situations on the other hand. The formal-abstract aspect of the concept of 'possibility' arises from the sociocultural practices of formal schooling and other related institutional practices of industrialised societies (cf. Tulviste, 1991).

At the level of the everyday, spontaneous learning and developmental context, the notion of what is 'possible' would be closely linked to the 'real', what *can* be done. This notion is qualitatively different from the notion of 'the possible'

as involving an abstract, hypothetical and indeterminate situation or as a category embedded in language-based conceptualisation of the world that formal school knowledge and forms of knowing is primarily concerned with. The possible, as ‘the real’, the ‘can do’ or the ‘possible-real’, that characterises the learning and developmental ‘culture’ of the spontaneous, everyday life is embedded in the concrete manifestation of phenomena to which it refers. In its manifestation in formal school knowledge and forms of learning, the notion of ‘the possible’ is embedded in language rather than in the concrete contexts of its application and proceeds from the conceptualisation of an idea involving ‘either-or’ situations, which is essentially a category of the mind rather than a quality of its referents in the concrete situation of knowledge application.

The notion of the possible that is closely linked to the real and concrete manifestation of objects and experiential world that dominates spontaneous, everyday situations of learning and development is consistent with Piaget’s notion of concrete thought processes. Concrete operational thought is tied to the concrete manifestation of phenomena (Piaget, 1964; 1981). Shayer (1997) reports on an international survey of five- to eleven-year-old children, which found that only the top 20 per cent of the children developed as Piaget’s theory had described. That is, they attained concrete operations by seven to eight years old and formal operations by eleven to twelve years of age:

Children below average have not completed the concrete operations stage by the time they reach adolescence, and complete it only by the end of adolescence. This is part of the basis of the claim that Piaget had correctly described the genetic programme – realized in full only by 10 per cent of the population, and in part by a further 20 per cent – but not the general human condition (Shayer, 1997, p.36).

Shayer’s observation is consistent with the view that formal operational processes that enable thought to proceed exclusively from its formal, context-free basis is a special human achievement mediated, in particular, through the processes of formal schooling.

Therefore, subjects who may fail to manifest formal operational thought in specific task situations may not necessarily lack the underlying capacity, the “genetic potential for cognitive development” (Shayer, 1997, p.38) to think in that particular way. The apparent lack may result from the fact that such modes of thinking and problem solving are not emphasised in the activities that dominate their learning and development and hence not elaborated to constitute the subjects’ consciously available cognitive capacities and problem solving skills. The present study examined the task performance of subjects within a schooling system whose practices of teaching and learning, due to the

specific socio-political conditions of the apartheid schooling in South Africa, has not fully developed formal operational, abstract-theoretical and conceptual modes of task engagement on the part of its learners. As a result, these subjects manifested an apparent lack of confidence and full mastery of the formal operational rule-based, abstract categories that are not reliant on the concrete manifestations of phenomena in their engagement with the experimental task questions.

Conclusion

Piaget's framework emphasises the internal structuration of thought driven by the subject's own activity in the world of her experience (Piaget, 1981; 1964). The subject's activity is motivated by the need to adapt to the external constraints presented by the subject's environment. This results in the internal self-regulatory process of equilibration that produces structural transformation from qualitatively lower to qualitatively higher forms of thinking, with the acquisition of formal operational thought as the pinnacle of development. Development is hierarchical, proceeding from the pre-operational stages where the basic structural foundations are established. The preoperational child (before the age of seven) from the Piagetian perspective is more likely to explain situations on the basis of the characteristics of their configurations rather than on the basis of their transformations or changes leading from one situation to the other. Cognition, at this stage, is still bound up with concrete reality or what events and situations actually look like.

According to Piaget (1964; 1981), concrete operational thought (around 7–11 years-of-age) is characterised by the extension of actual or concrete reality, towards the direction of the potential, or the possible. It is at this stage that the child begins to think in terms of what is possible and proceeds by formulating hypotheses about possible states, instead of thinking exclusively in terms of his perceptions of concrete situations. At about 11 years-of-age, children have developed capacities for formal-operational thinking enabling them to think from what is possible to what is empirically real. Instead of deriving the conclusion about what is possible directly from the empirical data and concrete states, the formal operational child begins with the postulation that certain relations are necessary (Le Bonniec, 1980).

The Vygotskian perspective emphasises the underlying sociocultural context which structures both the social and the natural environment within which the

subject interacts. The activities of society and culture are considered to be prior to that of the individual, although not replacing it. The individual internalises or actively transforms sociocultural processes into personal, intra-psychological processes. This framework has the potential of providing a clearer explication of the social and cultural processes that underlie individual activity in its objective world, and hence of elaborating on the external, sociocultural aspect of the internal, endogenous equilibratory processes Piaget has so exquisitely explicated.

The subjects in the current study manifest the spontaneous developmental achievement of the formal operational thought posited in Piaget's theory while simultaneously manifesting processes that are tied to the concrete manifestation of the task materials and a perception of the possible as the 'possible-real'. The sociocultural structuration of the subjects' developmental learning in their specific tradition of schooling largely accounts for the lack of a consistent application of the formal operational processes in the subjects' responses to the task questions. A tradition of schooling or cultural-institutional context of learning and development that does not foster critical and genuinely inquisitive engagement with knowledge is not likely to generate processes that elaborate on the formal operational thought processes posited by Piaget. This, therefore makes consideration of the sociocultural processes of schooling crucial as constitutive of the mechanisms that generate, and elaborate on, the formal operational thought processes during the subjects' learning and development. The integration of Piagetian and Vygotskian conceptual systems enable a comprehensive understanding of the mechanisms that generate, and elaborate on, development as simultaneously constituted within both the internal, intra-subjective and the external, inter-subjective processes that are not reducible one to the other (cf. Wertsch, 1995; 1993).

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