# Kenya secondary school students' intelligence beliefs-a case study in mathematics.

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Beliefs that students hold towards their intelligence have been shown to affect their orientation towards learning. In situations considered challenging, those with incremental views have been shown to exhibit adaptive motivational patterns whereas those with entity views have been shown to exhibit maladaptive motivational patterns. This qualitative exploratory study focuses on the extent of incremental and entity beliefs amongst a group of 26 Kenya secondary school students. Analogical diagrams by students, written protocols and participant observations were used to provide a contextualized perspective on predominant intelligence beliefs amongst the students as postulated by Dweck's theory of intelligence. This research suggests that most of the students held the theory that their intelligence for mathematics is innate and fixed.

**Keywords: implicit theories of intelligence; motivational patterns; metaphoric diagrams; Kenya secondary school students**

## Theoretical background

The long held assumption by psychologists of a link between implicit belief and human behaviour continue to inform researchers' and educators' interest in exploring the connection between students' intelligence beliefs and their learning (Stump, Husman & Corby, 2014).

One of the widely used models applied in examining students' intelligence beliefs is Dweck's model of implicit theories of intelligence. According to Dweck, most students hold one of two conceptions of intellectual ability; the belief that their intelligence is a fixed trait or an entity they possess or the belief that their intelligence is a malleable, increasable and controllable quality (Grant & Dweck, 2005).

The main postulate of this model is that students who hold an incremental theory of intelligence tend to be oriented towards a mastery approach to learning (Bandura, 2001) while those holding entity beliefs are oriented towards a performance approach to learning (Dupeyrat & Marine, 2004).

Whilst this model is considered to have contributed valuable information in understanding students' success in their course work (Ahmavaara & Houston, 2007), there is a growing concern amongst a number of researchers on the paucity of cross-cultural studies of intelligence beliefs. The concern is hinged on the understanding that students'' beliefs are considerably shaped by underlying cultural beliefs (Braten & Stromso, 2005) implying that considering students' beliefs across different cultures would result in an improved understanding of different aspects of student's learning process. According to Pillay, Purdie & Boulton-Lewis (2000) cross-cultural research would not just help in identifying mono-cultural bias in students' beliefs but also help "in identifying both uniformities and consistencies in learning beliefs and behaviours

while at the same time identifying where there is systematic covariation between cultural and learning variables" (p.66).

While significant efforts have been made to extend the exploration of the students' intelligence beliefs beyond the Western context into the Asian context (see for example: Pillay, Purdie & Boulton-Lewis, 2000) the intelligence beliefs of students learning in the African context still remain largely unexplored. To the best of my knowledge, there have been no studies on the nature of intelligence beliefs (especially in mathematics) amongst indigenous African students.

This presents a gap in knowledge given the situated dimension of learning and the unique aspects of indigenous African culture. As a contribution to filling this gap, this study explored which of the intelligence theories as proposed by Dweck's theory of implicit intelligence is predominant amongst a sample of secondary school students from a secondary school in Kenya. As a pilot case study, the study provided an initial step in exploring the generalizability (to the African context) of existing theoretical frameworks on students' intelligence beliefs (Hofer, 2004).

## The Kenyan Education Context

Kenya has 12 years of compulsory education; 8 years in primary and 4 years in Secondary. There is a tension between belief in effort and ability with the belief in personal ability is being more explicit in mathematics and sciences than in other subjects. Indeed, this predisposition towards ability is best exemplified by a recent policy change that saw the introduction of an alternative mathematics and science curriculum ostensibly to cater for the secondary students who may be 'less able' (Kosgei, 2015).

Due to the competitive nature of the Kenyan education system, a majority of the Kenya mathematics teachers still practice teacher centred teaching (Njoka et al., 2013). This is despite education reforms pushing for student centred teaching and learning in sciences and mathematics.

## Methodological framework

Given the complex nature of implicit beliefs, it was important that different sources of data were used for the study to enable triangulation and ensure construct validity. For this reason case study was chosen as the key methodological framework. The choice was also informed by case study's repute in not just enabling the understanding of complex issues but also testing and building of theories (Dooley, 2002).

The strict use of qualitative methods in this study underscored the fact that the intention of the researcher was to develop an interpretative understanding (Renganathan, 2009) of the extent of incremental and entity beliefs amongst the participating students (Hofer, 2004).

The participants were drawn from a faith based private secondary school in Kenya. A total of 26 students of mixed attainment levels spread across the four levels participated in the study. Of the 26 participants, 12 were female. The researcher is a member of the founding community of the school and was a physics teacher in the school until 2014 when she left to pursue her PhD studies.

The methods chosen for this study were largely activity-based. The choice of the methods was informed not only by the need to de-center power around the researcher but also by a desire to help the students overcome the temptation of giving responses that they thought would be considered suitable by the researcher. As such, while the general design of the research activities would be considered to be primarily

'etic' in its approach the data collection process was designed to be more 'emic' allowing the participants and data to speak to the researcher and for the themes, patterns and concepts to emerge from the data (Renganathan, 2009).

Specifically, data for this study was collected through three main methods. The first the method involved the drawing of metaphorical diagrams by the students to express their epistemological orientations towards mathematics. The specific question to the students was: "draw a picture that best present what mathematics is and what learning mathematics is from your experience of learning mathematics". The interpretation of the question was left fairly open to minimise potential bias (Bagnoli, 2009). The choice of metaphorical diagrams in particular was informed by the fact that the process of drawing analogical/metaphorical diagram is considered to be more reflexive and thoughtful than ordinary diagrams (Risch, 2008). As such, they are known to unleash and reveal deep meaning, multiple perspectives and fluidity of thought - thereby allowing for visual representation of the otherwise invisible (Buckley & Waring, 2013).

The second method of data collection was the use of written protocol analysis - an adapted version of the verbal protocol analysis which is a qualitative research method frequently used in cognitive psychology and education to gain a participant's cognitive thoughts using verbal reports (Branch, 2000). For this study, individual students from form two and three randomly chosen from the study group were assigned mathematical questions at their achievement level and asked to write down their thoughts either as they were doing the mathematics question or immediately after. The thoughts were not to be limited to cognitive or metacognitive processes aspects but were also to include behavioural and affective aspects.

The third method of data collection was participant observation centrally focusing on a section of the participants who had been assigned a problem-based mathematics activity to solve in groups.

Throughout the study the researcher helped create an environment that allowed for 'thick descriptions' (Geertz, 1994) of the participants' experiences during the study activities by adopting an ethic of empathy and friendship (Way, Kanak Zwier & Tracy, 2005).

## Analysis and findings

The analysis was based on the implied connection (Dweck's model) between students' goal orientation and respective intelligence belief; attributes and systematic relations of diagrams (Gentner, 1983), observations made during the group mathematical task and behavioural and affective dimensions of the students thoughts, externalized in their written protocols. These were analysed with a view of establishing which of the goal orientation (mastery or performance) they were indicative of.

### *Findings*

A number of students used diagrams of the head, and brains to represent what learning of mathematics was to them thereby suggesting an innate dimension of intelligence resonating with Dweck's argument that those with entity beliefs, focused on supposed index intelligence like their IQ unlike their counterparts with incremental beliefs who consider exertion of effort as a key means of becoming more intelligent Grant & Dweck, 2005). The inference for an entity belief from the 'head' diagrams was made even stronger by the fact that the head generally had attributes like

'standing' hair and worried faces enabling one to draw a parallel with Stump, Husman & Corby, (2014) observation that when students believe their intellectual ability is innate, they tend to worry about having enough of it.

The students' statements explaining the key meanings behind their diagrams tended to amplify the aspects of performance in comparison to others rather than strategy and effort. According to Dweck, the performance orientation is anchored on a 'having it or not having it' disposition, a reality that was amplified by two drawings; a star(s) and a double edge sword which in the context of the participants' cultural upbringing is associated with separating one from another. Indeed, the two diagrams and the use of words like '*prestigious'* and '*sophisticated'* underscored the elitist view of mathematics as a subject by this set of students finding resonance with the following statement by Povey (2010, p. 2) that…

> the view that 'mathematics is difficult' helps to underpin the belief that mathematics is an elite subject suitable for the most advantaged to study; it also helps to maintain the role of mathematical success as a gatekeeper to privilege

Dweck through her theory argues that the impact of intelligence beliefs on learning is more apparent when a high degree of challenge is present, when a task is personally important, or when the processing of complex material is necessary (Grant & Dweck, 2005). In analysing the data from the diagrams and their accompanying text explanations; both retrospective and concurrent written protocols and the written field notes on the observations made as a group of the students engaged in considerably challenging mathematics problem solving task, it is clear that a majority of the students exhibited or indicated maladaptive motivational achievement behaviour characterised by debilitation or withdrawal when carrying out tasks that they found challenging. These observations are indicative of entity beliefs for according to Dweck (in Otieno, 2015 p.12),

> 'a belief in fixed intelligence raises pupils concerns about how clever they are, creates anxiety about challenges and makes failures into a measure of intelligence that will result in defensive and helpless behaviour that worsens performance….

## Discussion

Results from the study provide evidence that most of the students in the study are holding inherent beliefs that their mathematics intelligence is innate and fixed. This orientation towards entity beliefs of intelligence could be attributed to amongst other things, the fact that the Kenyan education system is intensely competitive and specifically in the case of mathematics tend to emphasize ability and performance (Kosgei, 2015). Indeed, other researchers have linked entity theory of intelligence and competitive approach to learning and teaching (Stump, Husman & Corby, 2014).

The emergence of the data on theories of intelligence from a study primarily designed to investigate the epistemological beliefs is also significant given the argument by some researchers that the two sets of beliefs are inextricably linked to each other (Braten & Stromso, 2005). The fact that the intimate connection was more obvious from the drawings confirms the assertion by some researchers that the evocative nature of diagrams can enable participants to represent concepts in a particularly condensed manner including the emotional dimension that in most cases is out of reach of text based research (Buckley & Waring, 2013).

It is must be noted though, that one of the methods used, that is the written protocols, did not seem appropriate for the male students. Unlike their female counterparts who were open in writing down their thoughts during a mathematical exercise the male students seemed to shy away from revealing their thoughts. This may be attributed to concerns around social desirability and the predominant culture that orients the male child to be less emotionally expressive.

The possible explanations notwithstanding, this observation does add credence to the call for the use of more naturalistic empirical methods in seeking to understand implicit beliefs and related constructs like self-regulated learning (Pulkkinen & Puustinen, 2010).

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