

Globalization, ecological consciousness and *curriculum as montage*: A vision for culturally contextualized mathematics education

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Arising from the first author's ongoing doctoral research, this paper enunciates a set of emerging theoretical perspectives in mathematics and science education, such as ecological consciousness, multidimensional nature of mathematics, alternative-inclusive logics and curriculum metaphor in order for overcoming the problem of culturally de-contextualised mathematics education faced by Nepali students due to the hegemonic nature of mathematics *as a body of pure knowledge*. Finally, we propose a vision for curriculum policy that helps promote culturally contextualised mathematics education, an approach that allows us to incorporate local-cultural practices into mathematics curricula of Nepal.

An Introductory Methodological Sketch

This paper arises from the first author's ongoing doctoral research which draws on auto/ethnography as a method of inquiry (Ellis & Bochner, 2000; Song & Taylor, 2005) to (i) illuminate the negative impact on teaching and learning in Nepal of a culturally decontextualised mathematics education and (ii) envision a culturally inclusive model of mathematics education. In recent publications we have excavated Bal's lived experience as a student of mathematical enculturation in a rural village school, a culturally alienated university student of advanced mathematics, and a mathematics teacher educator with a frustrated social conscience in order to richly portray ways in which mathematics education in Nepal unduly privileges a Western Modern Worldview and fails to respect and develop the cultural capital of Nepalese students (Luitel & Taylor, 2006, 2007a, 2007b).

In this paper, which represents the next step of our co-generative process of writing as inquiry (Richardson, 2000; Tobin, Elmskey & Seiler, 2005), we make use of the additional logics of metaphor, poetics and Eastern dialectics, together with theoretical referents of postcolonialism, ecological consciousness and curriculum theory. Our goal is to create a culturally inclusive curriculum space - *curriculum as montage* - in which antagonistic images of mathematics can co-exist, particularly the prevailing image of *mathematics as a body of pure knowledge* and the counter-hegemonic image of *mathematics as cultural activity*.

We begin with Bal's voice, though expressed via a propositional-analytic logic, as an insider of the Nepali mathematics education community reflecting critically on the problem of culturally decontextualised mathematics education. In subsequent sections, we weave together new theoretical perspectives for generating policy implications for curriculum in order to envision a culturally contextualised mathematics education in Nepal. Boxed texts and images throughout the paper are designed to enhance the transferability of the research to other cultural contexts by engaging our readers as co-researchers in being 'pedagogically thoughtful' about the central issues of this inquiry (Manen, 1990; Taylor, Luitel, Desautels, & Tobin, 2007).

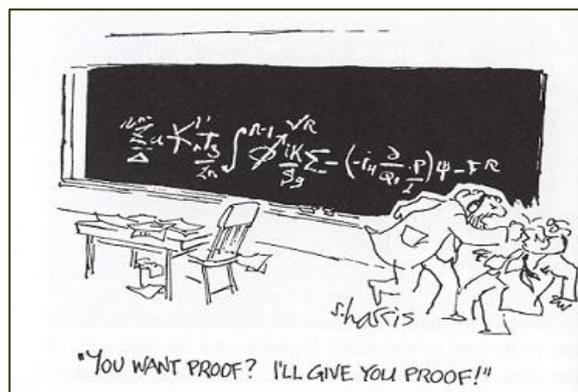
A Self-Culture Dialectics

Growing up as a student, mathematics teacher and teacher educator, I have experienced mathematics education in Nepal being solely guided by the nature of *mathematics as a body of pure knowledge*, a metonymy¹ of mathematics hitherto narrowly equated with *the global*

nature of mathematics emanating from a dualistⁱⁱ perspective which undeniably depicts mathematics as a culture-free knowledge system handed down by properly trained ‘genius minds’, rather than a cultural-social-historical construct. For me, such a metonymy privileges the sole attribute of ‘pure knowledge’ to signify the entirety of mathematics as though this is the only nature of mathematics available to us.

Because of such an un/witting promotion of the a restricted view of the nature of mathematics, via different levels of curricular practices, this view of

mathematics saturates the consciousness of teachers, students and other stakeholders, giving rise to a so-called normal view of mathematics as a ‘course of study’ for intelligent students, thereby harbouring many unhelpfully antagonistic dualisms, such as pure versus impure mathematics, formal versus informal mathematics, official versus street mathematics, and hard versus soft mathematics. Although I refrain from promoting an essentialistⁱⁱⁱ view, the prominent source of these dualisms appears to be the Western Modern Worldview (WMW) which has an interest in promoting a singular view of the nature of mathematics via ontologies of *Platonism*, which regards mathematics as a study of pure and ideal shapes and numbers only accessible to a rational mind, and/or of *Formalism*, which subscribes to the view that mathematics is merely a mechanical process of manipulating symbols through Cartesian logics. By promoting and privileging a Western worldview in this way the minds (and hearts) of many Nepali students are trained to embrace the narrow view of *mathematics as a body of knowledge* which is disassociated from their lifeworlds (Kline, 1980; Taylor & Wallace, 2007).



Although I find most government policy documents in Nepal depicting mathematics as a vehicle for enhancing scientific-technological innovation in the country, recent curriculum reforms in school mathematics have continued adding more content areas with the pretext of producing globally (and regionally) competent high school graduates (Maharjan & Poudel, 1998).

This approach to curriculum reform has reinforced the traditional culturally dislocated mathematics curricula for Nepali schools together with a one-size-fits-all pedagogical approach, adhering to a carefully engineered transmission-based pedagogy of mathematics content *as though* it comprises sacred and indubitable texts. The idea of ‘careful engineering’ is associated with the enactment of

twin myths - cold reason and hard control - which tend to promote the view that the learning of mathematics is possible only through a limited set of asocial and culture-free activities,

*Which is whose voice?
How can ‘i-we’ portray as clearly as possible?
As we co-generate voices and texts
Ownership of voices and texts blurs
In a dialectic of self and other
How does a co-generation take place?
Self and other speak and co-speak
They hear and co-hear
Blurring the role of speaker and hearer
Apparent gives rise to obscure
Obscure makes sense of apparent
Self makes sense of other
By stretching it-self to reach out to other
Other makes sense of self
By combining self, selves and no-self*

such as defining, algorithmic problem solving, theorem proving and rote-memorising, via the strongly endorsed role of *teacher as controller* of unprecedented heresies that otherwise infect the purity of mathematics (Taylor, 1996). While Nepali ‘culture-scapes’ comprise a mosaic of multiple knowledge systems woven into their age-old (probably older than Western European Civilisations) linguistic and cultural practices, Nepali mathematics classrooms (in schools and universities) are busy striving to transmit *pure mathematical knowledge* that has minimal social and cultural relevance for Nepali students. My intention here is not to downplay the social use of pure mathematics; rather I am critical of the metonymy of *pure knowledge* which otherwise separates mathematics from life-worlds. This separation of students’ (and teachers’) life-worlds from mathematics education echoes the British-Indian colonial heritage in which Nepal took refuge for developing its earlier vision of modern education. The colonial legacy of producing docile clerks and confirming learners further strengthened the pre-existing feudal-hierarchical system, leaving minimal room for creative, imaginative and ‘critical cultural’ thinking through education, especially, mathematics education. This *clerk-centric* mathematics education excels at producing mathematics teachers with less than the required vision and skills for making mathematics relevant to the life-worlds of students living in agrarian-village communities, continues to reproduce the widespread view of mathematics as a body of pure knowledge. As this cycle of reproduction continues, a large (really large!) number of primary and secondary students suffer from rampant underachievement in mathematics, as reported by recent national studies (EDSC, 1997, 2003; Koirala & Acharya, 2005; Mathema & Bista, 2006). It is interesting to note that the notion of achievement in these reports has been narrowly conceptualised as ‘measuring out’ students’ possession of certain aspects of mathematical knowledge, strengthening the image of *education as banking* (Freire, 1993) that prevents mathematics education from cultivating multiple and culturally-situated intelligences (Sternberg, 2007). This is a vicious circle created by the celebration of the one-dimensional nature of mathematics and hierarchical-dualistic curricular practices. A large number of students are disadvantaged from gaining better opportunities in their present and future life trajectories.

A Pragmatic-Theoretical Galvanising

Preventing mathematics education from being inclusive of local cultural practices and from being meaningful to learners’ lives casts doubt on the zeitgeist of *education for all*, a pro social justice program targeted at all children of transitional societies (UNESCO, 2003). UNESCO’s emphasis on promoting biocultural diversity prompts us to discuss the notion of globalisation which is in danger of being used as yet another mask for promoting a one-size-fits-all approach, often proposed by donor agencies as a panacea for Nepali education. This is not to deny positive impacts of globalisation, especially through a number of promising intercultural dialogues between different cultural groups around the world. If we are to be fully aware of and respond constructively to problems facing mathematics education in Nepal (and perhaps other countries in similar situations), we need to unpack both positive and negative aspects of globalisation in order to make Nepali mathematics education inclusive of local cultural approaches. In what follows we argue for a reconceptualised notion of curriculum that includes the cultural capital of diverse Nepali society and for a reconceptualised notion of globalisation as a mosaic of multiple, yet dynamic, worldviews via our theoretical perspectives.

Ecological consciousness

The dichotomy of globalisation versus localisation can be addressed well via the longstanding culturally woven view of *ecological consciousness*, often elusive to the Western Modern Worldview. The idea of ecological consciousness promotes post-human thinking by

recognising the relationship between humans and other species, plants and *lands* as neighbours engaged in reciprocal relationships; a view that can characterise a Nepali Cultural Worldview (NCW) which comprises diverse linguistic practices as well as Vedic, Buddhist and other indigenous faith systems being practised in Nepal. Whilst taking the positive image of *globalisation as a platform for dialogue*, the idea of ecological consciousness (Brickhouse & Kittleson, 2006) bolsters the view that the different cultural groups sharing the planet are discursive neighbours. In the context of a Nepali Cultural Worldview, the idea of ecological consciousness is well established from millennia-old cultural and linguistic practices.

*If a language disappears
Trees will die away
Herbs make their way to unknown lands
Birds stop singing melodious song*

*If a language disappears
One loses her/his Wor(l)d
One buries her/his consciousness
One changes her/his colour and texts*

*If a language disappears
The mountain loses its importance
The river is no longer sacred
The land no longer serves a motherly role*

*If a language disappears
Birds and animals go away
Flowers stop blossoming
Festivals become alien*

The perspective of ecological consciousness not only embraces the physical aspect of ecology but also the spiritual well-being of our immediate neighbours. By contrast, the Western description of the human-Nature relationship seems to adopt an anthropocentric perspective which undervalues the role of *Nature as carer, mother and provider* by considering Nature to be separate from human beings and as a ‘thing’ to be manipulated to gain control over our ecological neighbours. The Western Modern Worldview has been developed around this dualistic premise and has governed Mathematics curricula in Nepal, thereby promoting culturally dislocated mathematics education that hinders learners from cultivating their local cultural capital.

We are also aware that all culturally situated knowledge systems do not always qualify for being incorporated into the curriculum practices of mathematics. We hold a *postcolonial cultural view*^{iv} in order to examine diverse traditional knowledge systems and practices for their potential role in inculcating critical citizenry via mathematics education and to avoid a narrowly conceptualised notion of *native(ity) as fixed and unchanging* (Ahluwalia, 2005). Thus we propose a three-fold principle that can help us develop a frame of reference for including diverse local knowledge systems in mathematics education: (1) every potential local knowledge system needs recognition; (2) local knowledge systems which are potentially useful for promoting a justice-oriented, egalitarian and democratic society should be incorporated into curriculum practices (UN, 2000); and (3) meaningfulness (i.e., relevance for and applicability to life-worlds of learners) is yet another



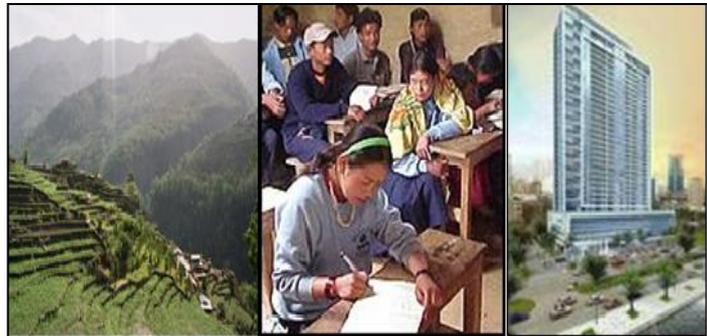
principle with which to re-contextualise local knowledge systems in order for incorporation into school mathematics curricula (Luitel & Taylor, 2007a).

Our three principles open a new vista for creating potentially a hybrid space for a negotiation between WMW and NCW in order to empower students to be able to fully utilise the benefits of differing views for making better sense of their complex world. The image of negotiation as a constant interplay between worldviews gives rise to the view of culture as an ever-changing phenomenon. It is through this hybridity that emerging dialectics between WMW and NCW can develop an holistic-multiplistic perspective in order to soften the unhelpfully rigid cultural borders created by many unhelpful dualisms. By this process, we can shift from the age old dualistic goal of mathematics education as delivering *coming-from-nowhere-content* to a mathematics education that is ecologically responsible, holistic and accountable to local cultural practices.

Multidimensional nature of mathematics

In order to fully conceptualise an holistic-multiplistic mathematics education we need to account for the multidimensional nature of mathematics so as to respond to different aspects of knowing, being and valuing (Taylor, 1998). In this process, we need to recognise first the hegemonic metonymy of *mathematics as a body of pure knowledge* which privileges the 'pure' dimension of mathematics. Indeed the notion of pure cannot stand alone from the opposing notion of impure, and *vice-versa*. Thus, we do not advocate for a total replacement of the existing one dimensional nature of *mathematics as a body of pure knowledge* by an alternative equally privileged image that will celebrate only the cultural dimension of mathematics. Rather our emphasis is on promoting a multi-dimensional *im/pure* mathematics in order to provide students with enhanced social and cultural opportunities. Thus, we are not interested in yet another restrictive metonymy of mathematics; rather we look for a multidimensional representation of mathematics which is inclusiveness of different forms of mathematics that can serve the varying interests of all learners.

But we will not be able to fully escape from the grip of dualism until and unless we develop an inclusive-alternative view of



mathematics education via a multidimensional concept of *mathematics as im/pure knowledge* that can allow learners to cross multiple borders created by different images of mathematics, such as *mathematics as cultural activity*, *mathematics as an evolving tree of knowledge*, *mathematics as a multi-semiotic endeavour* and *mathematics as embodied knowledge*. Having experienced different images of mathematics, students can expand their opportunities in their present and future lives by permuting different aspects of mathematical knowing manifested in an ever-developing multidimensional image of the nature of mathematics.

We also realise that a sea of pedagogical potentials is nested within an holistic-multiplistic vision of mathematics education. Permutations of differing pedagogical approaches which arise from diverse images of mathematics allow teachers and students to play varying roles as a learning community. On some occasions learning activities can align with the image of *mathematics as a cultural activity* while on other occasions mathematics can be taught *as though* it is a transcultural knowledge system (i.e., a body of pure knowledge), considering it a special case of the multidimensional nature of mathematics,

similar to the notion that the Newtonian worldview is a special case of a Relativistic worldview. We envisage that a simplistic pedagogical prescription will be as harmful as the embrace of a unidimensional image of the nature of mathematics. The only pedagogical principle we hold thus far is the empowerment of *learner as agency*.

Alternative-inclusive logics

We will not fully realise the use of ecological consciousness and the multidimensional nature of mathematics as major referents for improving mathematics education unless we embrace appropriate logics that are capable of explaining the complex and mutual relationship between Nature and humans. The propositional-rationalistic logic arising from Cartesian *cogito* (I think therefore I am) cannot explain fully the complex nature of the reciprocal relationship between Nature and human beings. Thus, we employ additional logics, especially dialectical, metaphoric and poetic logics.

Although there are different forms of dialectics, the main purpose of dialectical thinking is to minimise contradictions imbued in 'either or' dualistic logics. For instance, while embracing *mathematics as a body of knowledge* we ignore the so-called opposing dimension without which *mathematics as a body of knowledge* does not make the fullest possible sense, just as the concept of light does not make sense without the concept of darkness. Our recent exploration of culturally ingrained dialectics helps us to realise the power of dialectical thinking more than we had envisioned initially. While synthetic and dialectic views embedded in early Vedic traditions indicate the possibility of amalgamations of opposites so as to generate an holistic perspective of the world (Sri Aurobindo, 1998), negative dialectics (the logic of *neither nor*) (Raju, 2001; Raju, 1954) embedded in the Advaita Vedanta tradition of Hinduism and the Madhyamika tradition of Buddhism can allow us to move beyond two opposing views of the nature of mathematics.



Viewed from an Advaita-Vedantic perspective, neither mathematics as a body of knowledge nor its negation constitute the true nature of mathematics; rather there is something beyond these two which can help realise the comprehensive-holistic nature of mathematics. Contextualising Nagarjuna's negative dialectic also helps us to realise that every concept is co-arisen by its opposite, thus leading to an emptiness. Nagarjuna's view is quite powerful for critiquing the dualistic-essentialist view of anything including views of the nature of mathematics it-self, for the notion of self is understood in terms of other (non-self) and *vice versa*, leading to both of these concepts presupposing each other and neither having a permanent essence.

Metaphorical thinking promotes open and embodied inquiry for exploring multiple facets of knowledge and knowing. Metaphors provide us with a great deal of richness for understanding a phenomenon, especially when a simplistic definition is not able to capture the complexity associated with it. It is this approach that transcends narrow literalism by making use of images and imageries (Willison & Taylor, 2006). In our attempts to develop a vision for culturally contextualised mathematics education, we have used metaphors for representing different views of the nature of mathematics through different images, such as *body of knowledge, activity, embodiment, knowledge system* and *container* (Luitel & Taylor, 2006; Luitel & Taylor, 2007a, 2007b). While metaphorical thinking allows us to operate beyond the propositional logic frame, it also provides us with a platform for thinking and acting through many ‘as-thoughts’ in order to minimise the extreme essentialism imposed upon various aspects of mathematics education by a dualist-modernist perspective.

Let's encourage me as a mathematics teacher

To speak from my heart
 To tell the truth of who I am
 To allow them to explore their identity
 To link between the word and the world

Let's encourage me as a mathematics teacher

To know what I don't know
 To admit what I don't admit
 To share what I don't share
 To realise what I *can* and *cannot* know

Let's encourage me as a mathematics teacher

To treat my students as human beings
 To regard my students as self-ful persons
 To fulfil a yearning for knowing, being and valuing
 To see hopes and possibilities in every student

Drawing from mytho-poetic traditions (Fleener, 2002), poetic logic helps reach toward the unreachable (or ineffable) via a normal academic-language structure. Bringing this logic into mathematics education requires us to unpack the prevailing academic language games that promote propositional-analytical logic which prefers clean (not messy), linear (not nonlinear) and unequivocal texts via the interlocking system of academic training, research and productivity. We can see many culturally woven views being potentially useful for generating an empowering vision for us to embrace in a culturally contextualised mathematics education. Epistemologically, this form of logic can be useful for introducing nonlinearity, silence, emergence, melody and meter, all of which are useful for developing an holistic understanding of the world around us.

Curriculum metaphor

Utilising these alternative ways of thinking, we argue that the widespread, yet strategically hegemonic, view of *mathematics as a culture-free discipline* continues to supersede other viable images of mathematics, especially *mathematics as cultural activity* and *mathematics as multi-semiotic endeavour*. We then develop a multi-perspectival image of *curriculum as montage* which can potentially emancipate learners from the one dimensional view of *mathematics as a body of pure knowledge*. The term ‘montage’ derives from



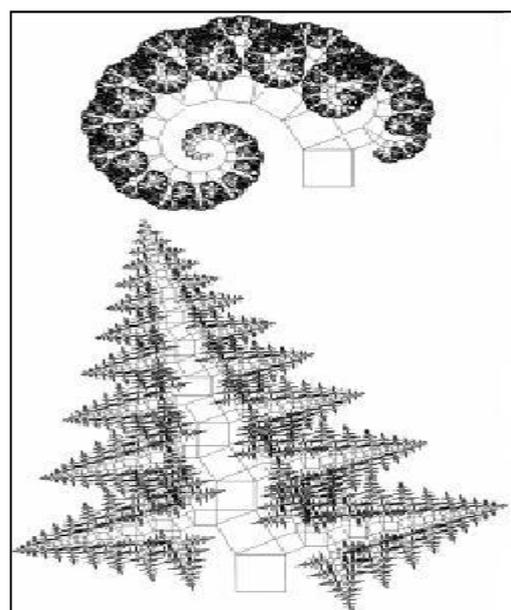
cinematography where it means to embody an unconventional approach to editing images (Reid, 2005). The idea of montage is famous for disrupting the longstanding realist and formalist approach to creating pictorial representations of the social and political world by juxtaposing unrelated shots and images, thereby generating layered visual understandings of the world. We develop an image of *curriculum as montage* so as to create legitimate space for a contextualised mathematics education that takes into account cultural and spiritual multiplicities. The montage image offers a great deal of potential for incorporating multiple knowledge systems arising from the diverse cultural and spiritual traditions. It involves a dynamic adaptation of multiplicities, as a complex and cosmological act, for nurturing learners' layered and multifaceted personalities (Doll & Gough, 2002; Pinar, 2004; Sri Aurobindo, 1998).

Our involvement in an ongoing UNESCO-funded Project (Kathmandu University, 2006b) has provided us with the basis for envisioning the image of *curriculum as montage*. In the project we have employed observational ethnography (Wolcott, 1999) with a range of methods, including photography and video recording of major cultural activities of local people, in order to understand cultural practices of two villages nearby Kathmandu Valley (Kathmandu University, 2006a). We then processed the data in such a way that they could be helpful for writing curriculum materials for teachers and students. Inspired by this and other similar projects for contextualising mathematics education, we see the possibility of adapting the process of preparing contextualised curriculum materials so that it is inclusive of social, cultural-spiritual and cosmological dimensions of human life. It is this approach that draws us close to learners' life-worlds in order to search for a multidimensional image of the nature of mathematics, which can be represented truly via the image of *curriculum as montage*.

Implications for Curriculum Policy

The image of *curriculum as montage* involves the activity theory dialectic of structure and agency (Sewell, 1999). The aspect of structure is represented well by Schubert's (1986) traditional metaphoric images of *curriculum as subject matter, planned activities, learning outcomes, and discrete tasks and concepts*. These images describe ways in which to structure mathematics curricula. Other contemporary images, such as *curriculum as currere, experience, cultural reconstruction and cultural reproduction*, represent the agency aspect of curriculum. The notion of agency accounts for the dynamic roles of learners in the process of curriculum enactment. For instance, the idea of *currere* is to help learners explore their individual/cultural life-world experiences as a basis for developing visionary thinking about their present and future learning (Pinar, 2004).

The idea of agency-structure dialectic gives rise to a unique view of curriculum development and implementation. We believe that the agency of learners (and teachers) cannot be enhanced and facilitated well without a structure that is self-organising, auto-adaptive and self-reflective, and that the enhancement of this type of structure, in turn, requires a strong sense of agency vested in teachers and learners. Thus, our argument for an emphasis on the agency-structure



dialectic as an underlying logic serves the purpose of providing learners and teachers with opportunities to incorporate their imaginings into the curriculum process. The empowering idea of ‘flexible control’ embedded in the image of *curriculum as montage* helps learners and teachers to co-generate their curriculum as a frame of reference as well as an emergent social-cultural-cosmological *coursing*, an approach to viewing curriculum as an individual path-making journey. We argue, therefore, that in order to develop a culturally inclusive and contextualised mathematics education attention needs to be paid to the structure-agency dialectic; reconceptualising *curriculum as montage* promises a more inclusive and dynamic mathematics education. Once this curriculum framework is in place then research can focus on development of eco-pedagogies (Afonso, 2007) that foster learners’ cultural capital (Cupane, 2008) and critical (scientific and mathematics) literacies (Brown, Revels & Kelly, 2005), which appear to be the primary focus of mathematics education for a transitional countries like Nepal.

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ⁱ Metonym is a metaphor in which part of a concept is taken to represent the whole concept. In the case of mathematics, which is a multidimensional concept (comprising body of knowledge, social activity, discourse, etc.), often only one of its dimensions (body of knowledge) is taken to represent the whole concept (Lakoff & Johnson, 1980)

ⁱⁱ Dualism promotes binary thinking (yes or no, but not both) in order for justifying the notion that reality consists of two separable parts, such as perception versus object, subjective versus objective and self versus other (Schwandt, 2001). Recently, dualistic perspectives have been criticised for being unable to account for non-Western worldviews in order to develop a justifiable mathematics and science education programs in postcolonial countries in Africa, Asia and Latin America.

ⁱⁱⁱ Essentialism is a metaphysical doctrine that holds the view that objects have essences. This notion has become a major ideological tool (somewhat invisible) for justifying the superiority of European coloniser over the non-European colonised. It is this view that gives rise to unhelpful labels of places and people, such as Dark Africa, Exotic India and Oriental China (Ashcroft, Griffiths & Tiffin, 2000). This doctrine has also been used for promoting a narrow view (essentialised view) of science and mathematics education as to promote the Western Modern Worldview unquestioningly.

^{iv} A postcolonial cultural view is described by the notion of culture as emerging activities that produce meanings as opposed to culture as fixed and unchanging entity (Schech & Haggis, 2000). Such a view of culture is believed to be empowering because of its holistic view of self, other and society, and has a potential for being used as a referent for culturally contextualised mathematics and science education for postcolonial-transitional societies.