THE INDIGENOUS KNOWLEDGE DEBATE IN LIFE SCIENCES: WHAT ABOUT INDIAN INDIGENOUS KNOWLEDGE?

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ABSTRACT– In the recent uproar in South Africa about 'decolonisation of the Life Sciences curriculum' and the integration of indigenous knowledge into the curriculum, it is important to not only consider indigenous knowledge from an African perspective. South Africa also has a large Indian population, with their own rich indigenous knowledge system, notably that of Ayurveda, an aspect not previously considered as warranting integration into the South African Life Sciences curriculum. In this paper, which is primarily conceptual in nature, the authors focus on the five basic tenets of Ayurveda as an indigenous knowledge system, and how it can be infused into the South African Life Sciences Curriculum and Assessment Policy Statement. Ayurveda aims to achieve positive health and wellbeing by suggesting precise yet practical ways in which humans should conduct their daily and seasonal activities to avoid pain, disease and ultimately suffering. Ayurveda has survived through the ages by having the ability to evolve through time while remaining true to its core principles. These principles are the *Panchamahabhuta; tridoshas; Agni; dhatus* and *malas*. The authors show how these basic principles could be infused in the CAPS curriculum in order to better contextualize Life Sciences for Indian learners. Ayurvedic principles can also then offer learners a practical alternative to achieve better health in the fast-paced, polluted, environment they live. Since the indigenous knowledge of a cultural group is being studied, Embodied Situated and Distributed Cognition is used as a theoretical lens to justify this incorporation of Ayurveda philosophy into the Life Sciences curriculum. The empirical section of the paper will reflect on a planned intervention in which Life Sciences teachers' pedagogical content knowledge is scaffolded for infusing Ayurveda into their lessons. The overarching research question that guided this design- based research is: How can Indian indigenous knowledge be infused into the Life Sciences curriculum?

Keywords: Life Sciences curriculum; Ayurveda; Indigenous knowledge systems; Tridosha theory; Embodied, situated and distributed cognition.

1. INTRODUCTION

Since 2015 South African tertiary education has been fraught with violent student protests demanding that fees must fall and that university curricula be decolonised. There are many evils of colonisation most especially on indigenous people who are forced to follow the belief systems imposed on them by colonialists. Of particular significance is the effect of colonialization on the education of indigenous people. Ogunniyi (2004, p. 289) regards it as having introduced "the erosion of certain cultural values and practices of African people" and that western science is "an instrument of exploitation, cultural subjugation and denigration of indigenous peoples through the mediating agents of trade, education and administration." The notion of decolonising the curriculum is not unique to South Africa. Tuhiwai-Smith, a researcher in New Zealand shares the belief that "Western stories and "regimes of truth" are situated within a particular cultural, social system that needs to be decolonised" (Wilson, 2001).

The marginalising effect of western science on indigenous knowledge shows that a key factor in decolonising the curriculum would be to then include indigenous knowledge into it. Post-1994, South African education has seen many changes in the school curriculum with the most recent being the Curriculum and Assessment Policy Statement (CAPS). One of the guiding principles of CAPS for Life Sciences is to value indigenous knowledge systems by "acknowledging the rich history and heritage of this country" (DoE, 2011, p.5) and incorporating this into Specific Aim 3, a broad subject specific aim that includes "…the relationship between indigenous knowledge and science" (DoE,

2011, p.13). The South African Life Sciences curriculum makes intermittent reference to indigenous knowledge, with an overwhelming focus on African Indigenous knowledge. South Africa, often touted as a rainbow nation has a large Indian population (almost 1.3 million according to the 2011 national census) with their own rich indigenous knowledge, such as Ayurveda that should also be integrated into the curriculum.

This paper aims to show how Indian indigenous knowledge may be infused into the Life Sciences curriculum. Since the indigenous knowledge of a particular cultural group is the focus of this paper, the theoretical lens that will be used to support the inclusion of Ayurveda philosophy into the curriculum is that of Embodied situated and distributed cognition (ESDC).

2. THEORETICAL LENS – EMBODIED SITUATED AND DISTRIBUTED COGNITION (ESDC)

Several researchers have shown that children can learn science successfully if their indigenous knowledge, social context of learning and their socio-cultural background is acknowledged (in Ramnarain, nd, p.5-6). Murphy (2003, p. 2) stated that "intellectual abilities are socially and culturally developed" thereby emphasising the role played by children's culture and their society in enabling meaningful learning.

One of the reasons for poor performance in science is that learners experience a conflict between their "everyday socio-cultural worldview" and the "science worldview" that they encounter for the first time in school. This in turn forces learners to adjust their existing worldview so that they can develop "a new scientific way of viewing the world" that favours rote-learning instead of meaningful cognition (Ramnarain, nd, p.6), using a type of learning called assimilation. According to Piaget (1964, p.13) assimilation is "the integration of any sort of reality into a structure." In order for the new (science) knowledge to be understood it must then be integrated into the existing structure of their daily socio-cultural worldview. However, this integration does not occur smoothly, since very often, their socio-cultural perspectives are not considered in the classroom showing an urgent need for this dynamic of science teaching to change so that learners' everyday socio-cultural experiences are considered. The integration of indigenous knowledge into the school Life Sciences curriculum then lends itself to supporting this.

The notion of ESDC considers various aspects of a person to enable learning: embodied refers to the socio-cultural environment in which a person lives such that this becomes an extension of the person; situated looks at the deep cultural history that frames learning; distributed takes into account that learning first occurs socially and then it is internalised allowing indigenous knowledge to be transmitted in this way to others in the community; cognition refers to the conceptual change that occurs when physical neural connections are made in the brain to develop understanding resulting in meaningful learning. ESDC is therefore a suitable theoretical lens with which to view this paper on indigenous knowledge being infused into the curriculum, since one of the definitions of indigenous knowledge states that it is "embedded in the cultural milieu of all people" (Maila & Loubsher, 2003 – cited in Ramnarain, nd, p.3).

3. CONCEPTUAL FRAMEWORK

Various intermediate concepts contribute to this study that looks at how Indian indigenous knowledge can be infused into the Life Sciences curriculum.

3.1. Indians in South Africa

The abolishment of slavery in the British Empire in 1833 heralded a new form of human suffering, in the form of the indentured emigration system, introduced to meet the growing demand for labour in British colonies around the world. Indentured Indian labourers were bound by a contract that stipulated amongst a myriad of terms, the period of indenture after which they were allowed a free return trip

back to India (Lal, 1998, p. 216). Between 1860 and 1911, more than 152 000 indentured Indians were shipped to Natal were they toiled arduously performing back-breaking labour under inhumane conditions. Upon intervention by the Indian government, conditions gradually improved resulting in many Indians deciding not to return to India after their indenture period. This marked the establishment of the Indian community in South Africa (Lal, 1998; Bradlow, 1991) that presently constitutes 2.48% of the South African population (as at the national census of 2011).

Contrary to the colonialists' perception that Indians were heathens, the early indentured Indians brought with them their rich traditions and culture that they persevered to conserve albeit under difficult conditions (Lal, 1998). Indians also attached immense value to education, going to great lengths to educate their children. Nowadays, the Indian diaspora in South Africa continues to prioritise practising their culture and educating their children.

3.2. Indian Indigenous Knowledge – Ayurveda

There are several definitions of indigenous knowledge in academic circles and for the purposes of our study we borrow the definition cited by Vhurumuku and Mokeleche (2009, p.98) that indigenous knowledge reflects "the dynamic way in which people living within a given geographical locality" are able to successfully use the plants, animals, cultural beliefs and history of that area to improve their lives. Ayurveda is a Sanskrit term meaning the knowledge or science of life. It is a holistic, traditional healing system existing for almost 5000 years in India that aims to keep an individual in a state of good health to avoid disease (Palep, 2004, p.1). Unlike allopathic medicine, Ayurveda emphasises prevention of illness and the cause rather than symptoms are treated. It must be mentioned, however, that "Ayurveda does not claim to be able to cure all diseases." Ayurveda and allopathic medicine are both important with their different but complementary strengths that can work together to benefit humanity (Singh, 2005, p.3).

It is relevant in modern times because it is based on five basic principles that have not changed (Vaidyaratnam Foundation, 2017, p.1), viz. Panchamahabhuta; tridoshas; Agni; dhatus; malas:

1. Ayurveda is based on the premise that the five basic elements (*Panchamahabhuta*) – *Akasha, Vayu, Jal, Agni* and *Prithvi*, corresponding to those identified by the ancient Greeks (ether, air, water, fire and earth) occur in different proportions in all materials and living organisms on earth (Vaidyaratnam Foundation, 2017, p.3).
2. These *Panchamahabhuta* occur in the form of the *tridoshas* (three vital humours) where each *dosha* is controlled by two of the five elements viz: *Vatta* (*Akasha + Vayu*)*, Pitta (Agni + Jal), Kapha* (*Jal + Prithvi*), thereby giving each dosha a bilateral quality. For a person to be healthy all three *doshas* must be in a state of balance in the body. The predominant *dosha* also gives a person particular characteristics of the mind and body as shown in Table 1. Each *dosha* also has the tendency to be upset and to upset the other *doshas* – Ayurveda refers to this upsetting of the *doshas* as a **vitiation** – leading to sickness and disease. This information in Ayurveda can be linked to physiology and diseases in the Life Sciences curriculum.

Table 1. Table showing the properties of each Dosha

Dosha	Elements	Function of Dosha in Body	A few characteristics of person with predominant Dosha	Some conditions resulting from vitiation of Dosha
Base in body	Qualities			
Vatta	Ether and Air	Movement – eg. Blood, lymph flow, transmission of nerve impulses, birth of baby, reflexes, activity of sense organs	Thin and small build, poor physical strength; skin, hair and nails are rough and dry in texture. Quick memory but short-lived – poor retention and recall of information; talkative, poor concentration Timid, unfriendly; does not	Constipation; osteoporosis; painful joints
Pelvis (below navel/ umbilicus)	Light, dry, cold, rough, subtle, mobile			
Pitta	Fire and Water	Transformation – eg. Digestion, absorption, vision, hunger, thirst, memory, intellect, softness of body – skin and	Medium build; scanty soft, dry hair with premature greying Perspires easily Easily angered but intelligent Pride, cleanliness	Excessive sweating; infections; fainting; acne, rashes and inflammation
Abdomen (between umbilicus and heart)	Hot, oily, sharp, fleshy smell, fluid			
Kapha	Water and Earth	Protection – eg. Holds cells together to form tissues; maintains immune system; enables stability of	Compact, stable body; slow purposeful movements; low hunger and thirst; strong joints and ligaments Long lasting memory Fortitude, forgiveness, tolerance	Feeling of heaviness of body and weight gain; decreased body temperature; cough; excessive sleep
Thorax (above heart)	Slow, cool, soft, slimy, static, cloudy			

3. The third principle is that of the seven *dhatus* which are the structural units of life, supporting and nourishing the body, and which are the next important part of the body after the *doshas*. These are the *rasa* (lymph); *raktha* (blood); *mamsa* (muscle); *medas* (adipose); *asthi* (bone); *majja* (bone marrow); and *shukra* (reproductive tissues). Ayurveda believes that these tissues develop in the order listed. Each of the seven *dhatus* are directly related to the curriculum as these tissues are taught to Life Science learners in some detail from Grade 10. Each of these *dhatus* is also under the control of a *dosha* as follows: *Pitta* controls *raktha; Vatta* controls *asthi*; and *Kapha* controls all the others. Once again, an imbalance in any of the *doshas* leads to a disease affecting the corresponding *dhatu* (tissue).

4. The fourth principle is that of the *malas* or waste products. The three metabolic wastes (faeces, urine and sweat) must be excreted from the body to maintain good health. An abnormal state (i.e. suppressing the urge to excrete them or over-excretion) can result in disease (Palep, 2004, p.24). In Life Sciences, each of these waste products are dealt with under different topics: digestion, urinary system and thermoregulation.

5. The fifth principle on which Ayurveda is based is that of *Agni* (digestive and metabolic fire/ energy). It is described as being the source of energy for the body and maintains the body temperature at the molecular level (Palep, 2004, p.197) – thus having relevance to the Grade 11 topic, Cellular Respiration. Ayurveda places great importance to food and its digestion and proclaims that most illnesses are as a result of poor or incorrect ingestion and digestion. This is the major cause of vitiation of the *doshas* that ultimately leads to disease (ibid).

Pancha mahabhuta **(Element)**	***Dosha***	***Dhatu*** **(Tissue)**	**Relevance to curriculum**	***Malas*** **(Waste)**	**Relevance to curriculum**	***Agni*** **(Biological fire)**	**Relevance to curriculum**
Akasha – ether	VATTA	Asthi (bone)	Mammalian Tissues (Grade 10) – Blood, muscle, adipose); Lymphatic system (Grade 10) - lymph; Skeletal system (Grade 10) - bone and bone marrow; Human Reproduction (Grade 12) – reproductive tissues	faeces	Digestive system – Grade 11	Digestion	Digestive system – Grade 11
Vayu – air				urine	Excretory System – Grade 11	Metabolism	Energy transformations (Respiration) – Grade 11
Teja – fire	PITTA	Raktha (blood)		sweat	Homeostasis – Grade 12		
Jal – water	KAPHA	Rasa (lymph); mamsa (muscle); medas (adipose); majja (bone marrow); and shukra (reproductive tissues)					
Prithvi – earth							

Table 2. Table showing the Ayurvedic principles with relevance to the Life Sciences curriculum

The World Health Organization (WHO) defines health in its 1948 constitution as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." A completely healthy person is called a *Svastha*, defined in one of the ancient Ayurvedic texts, more than 1200 years ago, as someone with all three doshas in a state of balance having optimal digestive power, correct functioning of all the tissues, optimal waste disposal and clarity of soul, mind and senses (Vaidyaratnam Foundation, 2017, p.2). The WHO definition therefore echoes the Ayurvedic definition for what constitutes good health, thereby giving credence to the relevance of Ayurveda in modern times.

4. METHOD

This paper uses design-based research and reports on a planned short course intervention with Life Sciences teachers. It is part of a larger study looking at the integration of indigenous knowledge into the curriculum. Similar short courses have already been done in Limpopo and the North-West province in 2016 with Life Sciences teachers there. The results and experiences amassed at these two interventions will be used to design the planned short course that includes Indian indigenous knowledge. Both courses were based on the nature of indigenous knowledge (Cronje, 2015) and empirical data collection and revealed a few recurring challenges facing teachers such as their lack of laboratory skills and their limited or uninformed view of the tenets of the nature of science and indigenous knowledge.

The planned course will therefore be designed using several design principles that emerged from these two interventions in an attempt to address these concerns. One of the activities that will be included in the course is that of the Kirby-Bauer technique investigating the anti-microbial action of certain plants used in Ayurvedic treatments e.g. garlic and turmeric. There will therefore be a substantive as well as a syntactic angle to the course. Another design principle will be that ofincluding classroom action research (CAR) where the teachers attending are encouraged to become researchers themselves by reflecting on their own teaching. Our aim is for teachers to critically reflect on their pedagogical content knowledge while also performing mini-investigations into their teaching practice in the classroom. This design principle is based on the results of the previous interventions that required teachers to submit portfolios. It was distressing to note that only 34 teachers submitted out of 71 teachers attending and only 20 of these 34 passed with 50%. This showed that most teachers did not include their reflections or they do not reflect critically on their teaching. In addition, follow up visits

to the school showed that very little inquiry learning takes place in the classroom. The planned short course will include an activity for teachers to conduct CAR by setting out a project for their learners involving a survey of the community's knowledge of Indian medicinal plants, thus making the activity an ethnobotanical survey with research skills. The teachers' role would be to monitor their learners research and guide them to produce a report for a science expo or similar contest.

The poor rate of portfolio submission shows that the short learning courses are not optimally effective and that the professional development of teachers is best achieved within communities of practice. For the planned course, it may be more productive for the participating teachers to become part of an online and face to face community of practice where they are able to meet from time to time to share their experiences and resources. An online platform that can be used here is that of the E-Fundi online portal for teachers. Instead of submitting a paper portfolio, teachers at the planned short course can rather submit a portfolio in stages on an online platform where they receive badges for each submission – similar to the notion of "gamification" used in computer games nowadays to earn points.

One of the ways in which Ayurveda prevents an imbalance of *doshas* is with a very detailed and careful daily and seasonal regimen that list precise ways in which a person should perform their daily rituals including the time they get up, the way in which they cleanse their body and the foods to be eaten. This aspect of Ayurveda can be infused into the curriculum so that learners can contextualise it to their daily lives, thereby making indigenous knowledge relevant to them. Some learners may already practice some of the rituals or they may have seen people in their community doing so. In this way the theoretical lens of ESDC is being brought to light: embodied and situated because these practices are part of the child's culture; distributed because it is in their community and cognition because they are learning about the reasons for these rituals and making sense of them.

One of the challenges highlighted by teachers during the previous short courses was the lack of resources in their schools hindering them from being effective teachers. The planned short course will therefore provide several resources that teachers can use such as a DVD with relevant videos and pictures; books and mini HIV kits. Teachers will also be made to realise that they are the biggest resource in the classroom with their ability to improvise with items from their environment. They can be taught how to design their own herbarium for their class with pressed plants to use during lessons. They can also conduct ethnobotanical research in their community by using local plants to make skin and hair tonics e.g. in Ayurveda, hibiscus flowers are ground into a paste and applied to the hair as a shampoo resulting in soft shiny hair, freshly squeezed lemon juice rubbed into scalp before washing to treat dandruff (Vaidyaratnam Foundation, 2017); chewing cloves for sore throat and mouth infections (Singh, 2005, p. 91).

Another design for the planned short course is that a "one size fits all" approach does not work for teachers attending. Some teachers may know practical skills and content while others may many not. It will therefore be prudent to do a baseline assessment on teachers before the course starts to ascertain the shortcomings and adapt the course around that information. This will ensure that the participants don't get bored and lose interest with the course and instead remain motivated to practice the techniques in the classroom. The short courses done in Limpopo and North-West have a strong focus on generic texts on indigenous knowledge systems. However, many indigenous cultures (African, Khoi-san, Indian) share certain traits – their knowledge is holistic and often embedded in the spiritual. They also share the Theory of Signature which is an ancient form that by careful observation one can learn the uses of a plant from some aspect of its form or place of growing (James, n.d.) such as tomatoes which are red with chambers resemble the heart and promotes heart health. This is one of the ways of creating a sense of unity in the planned intervention regardless of which cultural group the participants belonged to.

5. ETHICAL ISSUES

Written permission was obtained from the Gauteng Department of Education via e-mail. Participants were assured of their privacy and confidentiality at all stages of the study. In the written consent to participate in this study, the respondents acknowledged that they were doing so on a purely voluntary basis and that they could withdraw at any time from the research. Appropriate feedback will be given to them on the outcomes of the investigation once it is completed.

6. CONCLUSION

The planned intervention is expected to provide a few nuances into the integration of Indian indigenous knowledge into the Life Sciences curriculum especially with the use of the several design principles described above. The participants' reactions to the planned short course will be communicated in a separate report.

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A LEAP TOO FAR: AN EVALUATION OF LIFE SCIENCES TEACHERS' LEARNING DURING A THREE DAY SHORT LEARNING PROGRAMME IN INDIGENOUS KNOWLEDGE

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ABSTRACT – In this paper the authors reflect on the value of a short learning programme in terms of teacher professional development. Life Sciences teachers (n = 71) who attended a three-day short learning programme on infusing indigenous knowledge into their teaching of curriculum themes, had to submit evidence-based portfolios within three months after attending the course. During the short course the teachers were exposed to teaching and learning strategies such as cooperative learning, problem-based learning and reflective practices. In the portfolios the teachers had to provide lesson plans in which they incorporated these strategies and foci. In this qualitative study data were collected through the analysis of these portfolios, as well as through individual interviews with six teachers, and the analysis of the Views of the Nature of Indigenous Knowledge questionnaire. The findings show that, after the course many teachers were still unable to apply these strategies effectively in their lessons. Although the teachers were more familiar with these strategies, the data showed that many of them did not have nuanced understandings of the principles underpinning such strategies. Teachers, although they were more aware of the affordances of including indigenous knowledge in their lessons, provided very little evidence of mastering such epistemological border-crossing. In this paper recommendations are made on how such interventions could be revised in order to have a bigger impact, amongst others by establishing on-line communities of practice to further support teacher professional development.

Keywords: Teacher professional development; Cooperative learning; Indigenous knowledge; Epistemological border-crossing; Problem based learning; Communities of Practice; Portfolios.

1. INTRODUCTION

The curriculum and assessment policy statement (CAPS) for Life Sciences (DBE, 2011) states that indigenous knowledge systems should be cherished in the classroom, in order to make learners aware of the rich cultural diversity and indigenous knowledge of the people of South Africa. However, the curriculum does not provide definite guidelines on how teachers should incorporate indigenous knowledge into the curriculum (Hewson, 2015). To infuse indigenous knowledge into the classroom teachers must firstly have a good understanding of the tenets of indigenous knowledge (Cronje, De Beer & Ankiewicz, 2015), in order to be able to teach indigenous knowledge in relation to the content of the existing curricula. Teachers should also adapt their teaching strategies accordingly (George, 1999). Ogunniyi (2007), Cronje (2015) and De Beer (2016) state that teachers are still uncertain what is required from them and how to incorporate indigenous knowledge (IK) in their classrooms. Futhermore South Africa has a rich cultural diversity which makes it difficult to decide *which* indigenous knowledge to infuse into the curriculum (George, 1999; Cronje, 2015). The result is that teachers tend to marginalize indigenous knowledge when teaching or ignore it completely (De Beer, 2015).

To address this problem and to empower teachers to include indigenous knowledge in their teaching a short three day learning programme (SLP) was developed by the North-West University. This SLP emphasizes science processes (and emphasizing the tenets of science) and how it

corresponds to the tenets of indigenous knowledge. Literature indicates that to be successful short courses should include both knowledge and pedagogical approaches, and that it should furthermore emphasize critical reflection (VeLure Roholt & Fischer, 2013). The SLP therefore focused on the nature of indigenous knowledge (and the epistemological and ontological similarities and differences between indigenous knowledge and the natural sciences), and on infusing indigenous knowledge into classrooms by using cooperative learning (CL) and problem based learning (PBL) approaches. Although Bernstein (2011) cautions against the use of short courses for teacher professional development (emphasizing that more systemic, longitudinal interventions are needed, and that teacher professional development can best be scaffolded within well-functioning communities of practice), other research indicates that short courses do have merit (Van der Mark,
2013).

The research question that guided this research was: What role does a three-day short learning programme play in assisting Life Sciences teachers in their professional development, specifically in terms of infusing indigenous knowledge in their teaching approaches?

2. THEORETICAL AND CONCEPTUAL FRAMEWORKS

This research was anchored in social constructivism as theoretical framework. The third generation cultural historical activity theory (CHAT) (Engeström, 1987) was used as a lens for this research as it explains learning from a social interaction perspective (Ogawa, Crain, Loomis and Ball, 2008). CHAT has its roots in Vygotsky's (1978) theory which proposes that higher cognitive development and functions can be attained through mediation by using cultural tools, signs and artifacts during the processes of social interaction (Veresov, 2009). Built into the activity theory is Vygotsky's theory of the zone of proximal development (ZPD). In this research we specifically focus on the zone of proximal teacher development (ZPTD) (Warford, 2011), and how teacher learning could be scaffolded during the SLP. The zone of proximal development in the context of this study, refers to the epistemological border-crossing in infusing indigenous knowledge in the teaching of Life Sciences curriculum themes. Figure 1 below conceptualizes how IK can be infused into the school education system.

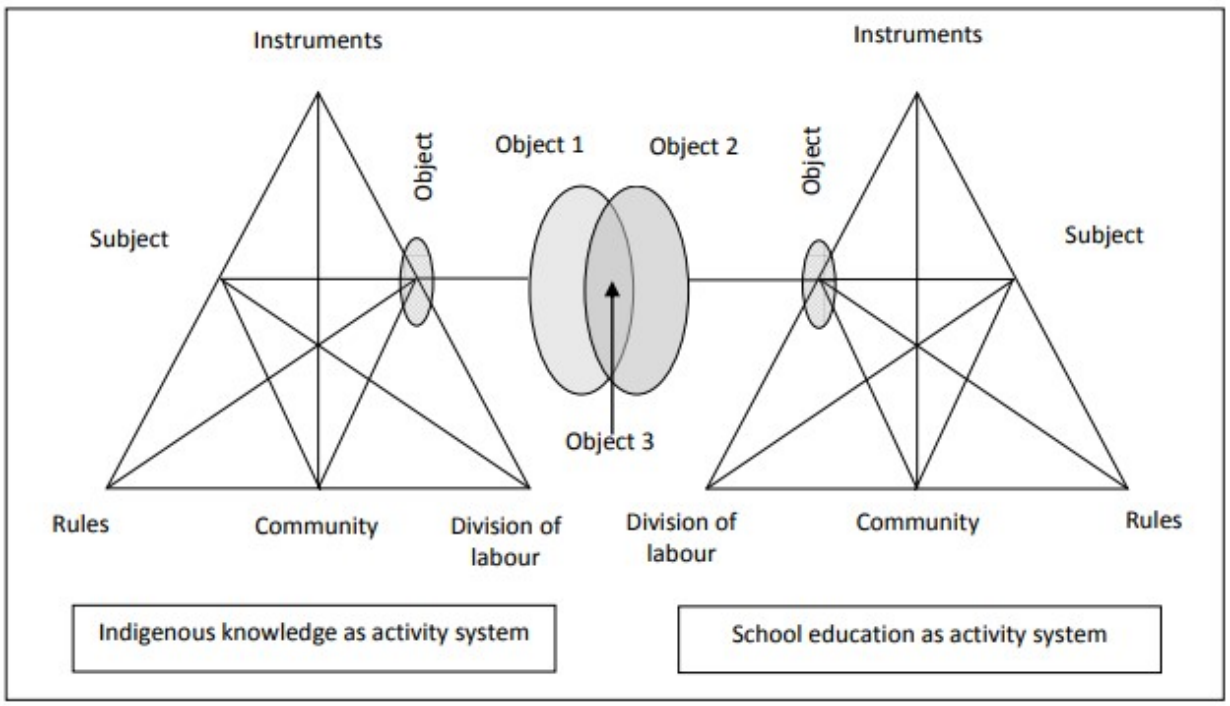

Fig. 1 Indigenous knowledge and school education as two interacting activity systems adapted from Engeström (1987) (based on De Beer & Mentz, 2016)